BOOK OF ABSTRACTS

29th Annual Congress of the

EUROPEAN COLLEGE OF SPORT SCIENCE

2 - 5 July 2024, Glasgow - Scotland, UK

Hosted by the University of the West of Scotland

Edited by: Davison, R.C.R., Tsolakidis, E., Thompson, J.L., Ferrauti, A., Piacentini, M.F.

29th Annual Congress of the

EUROPEAN COLLEGE OF SPORT SCIENCE

2 - 5 July 2024

BOOK OF ABSTRACTS

Edited by:

Davison, R.C.R., Tsolakidis, E., Thompson, J.L., Ferrauti, A., Piacentini, M.F.

ISBN 978-3-9818414-7-3

ECSS Platinum Partner since 2012

European College of Sport Science:
Book of Abstracts of the 29th Annual Congress of the
European College of Sport Science, 2 - 5 July 2024
Edited by Davison, R.C.R., Tsolakidis, E., Thompson, J.L., Ferrauti, A., Piacentini, M.F.

ISBN 978-3-9818414-7-3

Conception, DTP: SporTools GmbH – Data management in sports
Corrections: Patera, K., Tsolakidou, A., Tsolakidis, S.

supported by

SPORTOOLS
Data management in sports

Paul-Nießen-Str. 12, 50969 Cologne, Germany
www.SporTools.de

Organisation

CONGRESS PRESIDENT

– Richard Davison (GBR)

ECSS EXECUTIVE BOARD

– Alexander Ferrauti - President (GER)
– Janice L. Thompson - President Elect (GBR)
– Jørn Wulff Helge - Past President (DEN)
– Elke Grimminger-Seidensticker (GER)
– Andrew Jones (GBR)
– Truls Raastad (NOR)

ECSS SCIENTIFIC BOARD

– Maria Francesca Piacentini - Chair (ITA)
– Markus Gruber - Co-Chair (GER)
– Maurizio Bertollo (ITA)
– Jatin Burniston (GBR)
– Tim Cable (GBR)
– Christian Couppé (DEN)
– Anne-Marie Elbe (GER)
– Peter Federolf (AUT)
– José González-Alonso (GBR)
– Amelia Guadalupe Grau (ESP)
– Robert Lamberts (RSA)
– Johannes Van Lieshout (NED)

ECSS SCIENTIFIC COMMITTEE

– Per Aagaard (DEN)
– Ignacio Ara (ESP)
– Leigh Breen (GBR)
– Aaron Coutts (AUS)
– Sally Fenton (GBR)
– Keith George (GBR)
– Andrew Lane (GBR)
– Pierre-Nicolas Lemyre (CAN)
– Uros Marusic (SLO)
– Ryoichi Nagatomi (JPN)
– Fernando Pareja Blanco (ESP)
– Dace Reihmane (LAT)
– Ramona Ritzmann (GER)
– Bart Roelands (BEL)
– Oliver Seynnes (NOR)
– Wolfgang Taube (SUI)
– Lex Verdijk (NED)
– Tobias Vogt (GER)

ECSS REVIEWING PANEL

– Julian Alcazar (ESP)
– Stephen Bailey (GBR)
– Nick Ball (AUS)

– Bill Baltzopoulos (GBR)
– Marco Beato (GBR)
– Gregory Bogdanis (GRE)
– Matteo Bonato (ITA)
– Ulrike Burrmann (GER)
– Neil Cronin (FIN)
– Martino Franchi (ITA)
– Christopher Gaffney (GBR)
– Dominic Gehring (GER)
– Daniel Green (AUS)
– Sidney Grospretre (FRA)
– Mette Hansen (DEN)
– Ilkka Heinonen (FIN)
– Kristin Jonvik (NOR)
– Jaak Jürimäe (EST)
– Pascale Kippelen (GBR)
– Benedikt Lauber (SUI)
– Stefan Josef Lindinger (SWE)
– Jamie McPhee (GBR)
– Fabian Möller (USA)
– David Morales-Álamo (ESP)
– Vassilis Mougios (GRE)
– Hannah Rice (NOR)
– Miriam Seyda (GER)
– Christopher Shaw (AUS)
– Ana Sousa (POR)
– Mike Stembridge (GBR)
– Ian Taylor (GBR)

ECSS ADMINISTRATION

– Thomas Giel - Managing Director (GER)
– Elena Jacobi - Vice Managing Director (GER)
– Elias Tsolakidis - Technical Director (GRE)
– Vinisha Prashant - Communications Manager (IND)
– Pablo García González - Office Manager (ESP)
– Nicolas Puhe - Office Manager (GER)
– Konstantina Patera - Congress Secretariat (GRE)

LOCAL SCIENTIFIC COMMITTEE

– Richard Davison (GBR)
– Ailsa Niven (GBR)
– Vish Unnithan (GBR)
– Chris Easton (GBR)
– Gayle McPherson (GBR)
– Geraint Florida James (GBR)
– Nick Sculthorpe (GBR)
– Hayley McEwan (GBR)
– U (Chris) Ugbolue (GBR)
– Steph Valentin (GBR)

LOCAL ORGANISING COMMITTEE

– Richard Davison - Chair (GBR)
– Laura Graham - Head of Volunteers (GBR)
– David Kyle - Head of Marketing (GBR)
– Alison McIntosh - Head of Events (GBR)
– Marcus Ross - Vice Principal (GBR)
– James Todd - Communications Manager (GBR)
– Iain Harkin - IT Manager (GBR)
– Mia Burleigh - Social Media Lead (GBR)
– Victoria McLaughlin - Administration Coordinator (GBR)
– Annabel Simpson - Bengt Saltin Run Organiser (GBR)

Welcome

We are thrilled and honoured to host this important event from 2-5 July 2024 – the first time the congress has come to Scotland.

Glasgow is the largest city in Scotland and is renowned for its rich cultural heritage, including its contributions to art and architecture, vibrant music and nightlife scenes and its role in the Industrial Revolution. It boasts the largest academic community outside London and world-leading research in life sciences, engineering, science and technology. Cultural attractions include the works of Charles Rennie Mackintosh and many museums and art galleries offering free entry.

Glasgow is internationally recognised as a 'city of sport', having hosted numerous international sporting events, including the Commonwealth Games 2014 and European Championships 2018. In 2023, the city hosted the first-ever unified UCI World Cycling Championships – the largest ever cycling event. Glasgow is also home to two of Scotland's most successful and well-known football teams, Celtic and Rangers. These two clubs have a fierce and longstanding rivalry, known as the 'Old Firm', which has become one of the most iconic rivalries in sport.

The congress will take place in the Scottish Event Campus (SEC) featuring a mix of three different buildings – the SEC Centre, the Armadillo and the OVO Hydro. This multi-award-winning campus has played host to a variety of prestigious global conferences, including the UN Climate Change Conference COP26. Our ECSS Congress will be held within the SEC Centre and the iconic Armadillo building. The venue is surrounded by hotel accommodation and is a short distance from Glasgow's City Centre. The food and drink scene offers something for everyone, from traditional whisky pubs to fine dining, in a variety of lively neighbourhoods including Finnieston (SEC), the City Centre, the West End and Merchant City.

Enhancing Health, Performance and Community Sport is the theme for the ECSS Congress in Glasgow and reflects a broad programme of scientific presentations across all sport and exercise disciplines. We also welcome the opportunity to support innovative pre-congress symposia which bring together sport industry, business and the scientific community.

With such a rich cultural heritage we aim to create a diverse and vibrant social experience at the congress and guide you to the wider cultural opportunities while you visit Glasgow and Scotland. We would also encourage you to extend your stay and sample the great hospitality both in Glasgow and the many great tourist destinations across Scotland.

We invite you to ECSS 2024 in Glasgow and look forward to providing a great event and an unforgettable cultural experience.

Yours in Sport Science,

The ECSS Glasgow 2024 Organising Team

Prof R.C. Richard Davison (Congress President)

The University of the West of Scotland

Table of Contents

Tuesday, 2 July 2024

12:00 - 13:15

Invited Symposium

IS-MH09 Improving health and wellbeing with a minimal dose of high-intensity exercise; can we make it work?

VERY LOW VOLUME SPRINT INTERVAL EXERCISE FOR IMPROVING HEALTH AND FITNESS: WHAT IS THE EVIDENCE?

METCALFE, R.
SWANSEA UNIVERSITY

Over the last ~15 years there has been considerable interest in the effects of high-intensity interval training (HIIT) upon health. Much of this research has focused on sub(maximal) HIIT protocols (e.g., 10 x 1-min efforts with 1 min recovery), as these are perceived to be more applicable for unfit and inactive individuals and/or patient populations. However, the need for multiple high-intensity efforts still makes these protocols demanding to perform, while also reducing the overall time-efficiency that is one of the key proposed benefits of HIIT. At the same time, sprint interval training (SIT) – a specific form of HIIT involving repeated 'all-out' sprint efforts – has been largely dismissed as a viable form of exercise for improving health. Yet, a growing body of evidence demonstrates the efficacy of SIT protocols with fewer (as little as two repetitions) and shorter (10-20 s) sprints for improving important risk factors for chronic disease. These SIT protocols involve extremely low doses of exercise (40 s per session) and a minimal total time commitment (20-30 min per week), making them shorter and easier and removing many common barriers to HIIT and to exercise in general. Nevertheless, there are many common misconceptions about very low volume SIT protocols amongst both academic researchers and practitioners. A common one is that "this cannot possibly be enough exercise to actually be effective!". At face value this is reasonable – that as little as 40 s of exercise could elicit beneficial adaptations is an extraordinary claim. However, when viewed through the critical lens of the physiological and molecular responses to acute sprint exercise, it is a much less surprising, and even expected, finding. The purpose of this talk is to critically discuss the mechanistic basis for physiological and health-related adaptations to occur with minimal doses of sprint interval exercise. The current evidence for the effects of very low volume SIT on health and fitness parameters (e.g., cardiorespiratory fitness, insulin sensitivity, etc) will then be discussed, with avenues for future research highlighted.

EXERCISE AT HIGHER INTENSITIES MAKES PEOPLE FEEL WORSE, BUT DID WE OVERLOOK THE INFLUENCE OF SHORTER EXERCISE DURATION?

VOLLAARD, N.
UNIVERSITY OF STIRLING

An increasing body of evidence supports the lab-based efficacy of interval protocols involving brief repeated bouts of (sub)maximal exercise (high-intensity interval training [HIIT]) or supramaximal exercise (sprint interval training [SIT]) to improve general health and reduce risk of a range of noncommunicable diseases. However, whether HIIT and/or SIT can be used as effective real-world interventions remains a topic of debate. Concerns have been voiced that the high exercise intensities involved with HIIT and SIT will substantially decrease participants' affective valence, reducing exercise enjoyment and self-efficacy, and ultimately leading to poor uptake and adherence. Research solely based on continuous exercise confirms links between exercise intensity and changes in affective valence, as well as between changes in affective valence and future physical activity behaviour. However, HIIT and SIT are not continuous exercise, and HIIT is not SIT: these are distinct exercise interventions encompassing widely divergent protocol parameters (e.g., sprint intensity and duration, number of repetitions, recovery interval duration, training frequency, mode of exercise). Recent evidence supports that modulating sprint duration and number of sprint repetitions can substantially alter in-task affective responses to HIIT and SIT. Moreover, emerging evidence refutes the proposed links between changes in affective valence and exercise enjoyment, as well as between changes in affective valence and future physical activity behaviour. Dr Vollaard will argue that very low volume SIT protocols may represent acceptable interventions for improving health markers in the general public and specific patient populations. This talk is intended to be of relevance to researchers with a general interest in the area of physical activity and health.

IMPROVEMENTS IN GLUCOSE METABOLISM AND INSULIN SENSITIVITY WITH INTERVAL EXERCISE: IS IT A HIIT IN FEMALES?

GILLEN, J.
UNIVERSITY OF TORONTO

High-intensity interval exercise (HIIE) is touted as a time-efficient strategy to improve indices of cardiometabolic health including glycemic control and insulin sensitivity. The benefits of HIIE on glycemic control and insulin sensitivity include improvements observed during and up to 24 hr following a single session of exercise, and those which accrue from repeated sessions of exercise over weeks or months (i.e., following chronic exercise training). While a number of studies have now documented the glycemic benefits of HIIE, there is evidence that females do not achieve the same improvements in this important health outcome as males. It has been suggested that sex differences in skeletal muscle metabolism, including cellular stress and fuel metabolism, may explain the difference in the insulin-sensitizing effects of HIIE in males and females. In this session, an overview of the effects of HIIE on glycemic control and insulin sensitivity will be provided. Dr Gillen will then highlight the evidence demonstrating sex differences in the response, providing both possible mechanisms and confounding factors in study designs that could explain these findings. Dr Gillen will also highlight recent data from her lab demonstrating that manipulating the timing and macronutrient composition of meals around exercise may be a strategy to optimize the glycemic benefits of HIIE in females. Finally, Dr Gillen will identify gaps in knowledge for future research and provide recommendations for best practices in research designs investigating both sex-based differences and women's health in response to exercise. This talk will be of interest to researchers and practitioners with interests in exercise physiology, muscle metabolism, women's health, nutrition, and diabetes.

Invited Symposium

IS-BM01 Energetics and mechanics of human locomotion: insights from a muscle and tendon perspective in determining the mechanical and energetic responses

THE INFLUENCE OF MUSCLE AND TENDON BEHAVIOR IN DETERMINING THE MECHANICAL AND METABOLIC RESPONSES DURING WALKING IN HEALTHY AND PATHOLOGICAL POPULATIONS

MONTE, A.
UNIVERSITY OF VERONA

Over the last decades, human walking has been considered an inverted pendulum where the potential and kinetic energies of the body center of mass are out of phase and continuously exchange, reducing the total mechanical energy oscillations over a stride. On the other side, from an energetic point of view, the metabolic energy expended to cover one-unit distance as a function of speed was empirically described by a quadratic (U-shape) function that shows a minimum at a speed of about 4-5 km.h-1, often called the "optimal walking speed". Thanks to this whole-body approach, it was possible to describe the salient characteristics of human walking in healthy and pathological situations. Therefore, the first aim of this study is to provide a comprehensive description of human walking at the whole-body level. Along this line of reasoning, within the last years, several researchers have tried to explain the changes in metabolic and mechanical demands of walking from muscle and tendon perspectives in order to discover new training strategies and therapies to counteract the loss of function imposed by several conditions. In this regard, using a combination of ultrasound, EMG, kinematic and dynamometric measurements, we observed that changes in muscle fascicle behaviour imposed by an increase in walking speed could partially explain the changes in the metabolic cost as well as the transition between walking and running; while this was not the case for the behaviour of the elastic tissues. Hence, the second aim of this presentation is to report the influences of muscle and tendon behaviour in determining the energetics and mechanics of walking as a function of speed, in order to understand how their modification could affect the biomechanics of walking in pathological situations. Finally, I will report new data from experimental studies, in which the behaviour of plantar flexor muscle fascicles and the Achilles tendon have been investigated during walking at different speeds in people with type 2 diabetes, pre and post ten weeks of stretching training program. Our preliminary data showed that the increases in energy cost of walking, typically observed in people with type 2 diabetes, could be partially counteracted by using a simple stretching training protocol. In this regard, stretching was able to modify the stiffness of the Achilles tendon, leading the muscle fascicles to operate in a more favourable portion of the F-L and F-V curves, finally reducing the energy cost of walking. In the last part of this talk, final remarks and future directions will be provided and discussed.

THE DYNAMIC INTERPLAY OF TRICEPS SURAE MUSCLE AND TENDONS IN OPTIMIZING THE METABOLIC COST OF RUNNING

VANWANSEELE, B.
KU LEUVEN

Over the last decades it has become more and more recognized that running has played a major role in human evolution. Compared to other (quadrupedal) animals, humans are very average sprinters, but we perform surprisingly well at endurance running. Nowadays running is among the most popular physical activities worldwide, primarily because its accessibility and association with health benefits. Watching runners passing by, there are substantial differences in how

individuals run. Despite the large body of running research, research into the underlying mechanisms explaining the variability in running patterns is very limited. A commonly used and widely accepted hypothesis to explain why humans move the way they do is that we optimize performance (e.g. minimize certain neuromuscular cost function while performing the movement). There is scientific evidence that humans seem to be able to self-optimize their running pattern, as they adopt a specific running gait, e.g. stride frequency, stride width, foot strike pattern, associated with minimal energy consumption. Hence, energy minimization is often assumed to be one of the major neuromuscular mechanisms underlying the preferred running pattern. However, why a certain running pattern requires less energy, and is thus more optimal, than another for a specific runner is still an open question. Skeletal muscles are the tissues consuming the majority of energy during running. Hence, explaining the metabolic cost of running from a muscular perspective is an important next step to enhance our insights on the metabolic cost of running. However, the metabolic cost of the muscles during running cannot be measured directly. We therefore need to use a combination of experimental and simulation approaches combining motion capture, EMG, ultrasound with musculoskeletal modelling and muscle metabolic cost models. I will first explain how we modified existing musculoskeletal models to represent better experimental measures. Then, I will present the results from several studies using this approach to investigate how triceps surae muscle-tendon interactions affect whole-body and muscle metabolic rate during preferred and adjusted running patterns. I will present data on the effect of changes of speed, stride frequency and foot strike pattern on triceps surae fascicle length, length changes and simulated metabolic energy. Increasing the running speed increased triceps surae metabolic cost through an increase in muscle forces and changes in muscle-tendon interaction. While changing foot strike pattern had the opposite effect on the muscle forces and muscle fascicle length changes, resulting in no differences in muscle metabolic energy and whole-body metabolic energy. Lastly, I will present the results on how stride frequency influences muscle fascicle behavior and how changes in whole-body metabolic energy consumption can be explained by a combination of muscle fascicle behavior and muscle activation.

SPECIFIC MUSCLE CONTRACTILE CONDITIONS PROMOTE LOCOMOTOR ECONOMY, SPRINT PERFORMANCE AND PERTURBATION-RECOVERY

BOHM, S.
HUMBOLDT-UNIVERSITÄT ZU BERLIN

Human locomotion covers a broad range of speeds and is driven by the generated forces of the lower limb muscles. To sustain submaximal running for a longer period of time, economical muscle force generation and efficient muscle work production may optimize the metabolic cost. However, when increasing speed to the maximum, high mechanical power production is needed at the expense of metabolic energy cost. Moreover, real-world environments rarely allow for stable and constant locomotion. Most often, the locomotor behavior faces unsteadiness and external environmental perturbations that challenge the neuromuscular system to generate compensatory muscle forces for the maintenance of the stability of the body. A muscle's mechanical output is dictated by its operating contractile conditions, particularly the fascicle length and velocity during the movement with respect to the intrinsic force-length, force-velocity, power-velocity and efficiency-velocity relationships. The decoupling of the muscle fascicle length changes from the muscle-tendon unit due to the compliance of the attached tendon and the fascicle rotation (changes in pennation angle) provides regulatory mechanisms of the operating muscle length and velocity. Furthermore, previous in vitro and in situ evidence suggest that the force-length relationship depends on the activation level, i.e. optimal length for force generation shifts towards longer length at decreasing activation levels. This activation dependence reasonably influences the force generation during movements with variable activation pattern. The talk will present current experimental findings on the contractile conditions and activation of the soleus, as the main muscle for propulsion, during steady and perturbed locomotion. We found that during submaximal running, the soleus fascicles shorten close to optimal length and at a velocity close to the efficiency-maximum, two contractile conditions for economical work production. At high and maximum running speeds, the fascicles still operate near optimum length, yet the fascicle shortening velocity increase and shift towards the optimum for mechanical power production with a simultaneous increase in muscle activation, indicating three cumulative mechanisms to enhance mechanical power production. Furthermore, our preliminary results show how the contractile conditions and activation of the soleus muscle contribute to compensatory muscle force generation in response to a walking perturbation induced by an unpredictable drop in surface height. Particular attention will be given to the regulatory effect of the fascicle decoupling by tendon compliance and fascicle rotation as well as to the influence of the activation dependence of optimal length on the soleus muscle contractile conditions during the different running speeds and stability recovery response.

Oral Presentations

OP-AP07 Training and Testing/Power and Strength I

THE EFFECTS OF THREE CONTRAST TRAINING SESSIONS IN A WEEK ON POST-ACTIVATION PERFORMANCE ENHANCEMENT IN HIGH STRENGTH MALE

CHEN, C.M.1, CHENG, K.2, LI, T.1

1NATIONAL TAIWAN SPORT UNIVERSITY; 2NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Previous studies indicated that the primary contributor of contrast training improving explosive performance might be the post-activation performance enhancement (PAPE) and further emphasizing to conduct plyometric training at the optimal PAPE time. However, its applicability in practical training is not yet clarified since the PAPE appeared to be influenced susceptibly by relative strength level, training protocol, fatigue, and etc. Thus, the purposes of this study were to: 1) examine the effects of three contrast training sessions in a week on individual and group's PAPE and the optimal PAPE timepoint. 2) assess the intrasession reliability of the optimal PAPE timepoints.

METHODS: Eighteen trained male (age, 23.2 ± 3.3 years; body mass, 73.5 ± 8.9 kg; parallel back squat 1-repetition maximum [1-RM], 154.7 ± 22.9 kg and relative parallel squat 1-RM, 2.11 ± 0.21 kg·kg-1) performed three contrast training sessions, which consists of three sets of three repetitions of parallel squats at 90% 1-RM in a week. Alongside this, countermovement jump (CMJ) tests were conducted before the first set of squats and at 1, 3, 5, 7, 9, and 11 minutes after each squat set, with the kinematic parameters of the parallel squats also being collected. Data analyzed using Cochrans Q test, repeated measures one-way ANOVA with post hoc Bonferroni, and coefficient of variation (CV). Statistical significance was set at $\alpha = .05$.

RESULTS: Sixteen participants experienced individual PAPE whose data was adopted in statistics. The occurrence percentage of individual PAPE at nine sets of contrast training was significant difference (12/16, 5/16, 1/16, 10/16, 9/16, 8/16, 7/16, 2/16 and 4/16; Cochrans Q test, $p < .001$). The intrasession CVs of the optimal PAPE timepoints in three contrast training sessions were 60.9%, 59.4% and 39.6%, respectively. No group' PAPE was found at any sets of the three contrast training sessions. Concentric mean velocity of squat decreased at the second and third set compared with the first set in every contrast training session ($P < .05$), whereas the velocity loss of squat decreased at the second and third set compared to the first set only in the first and second training session ($P < .05$).

CONCLUSION: The findings of this study indicated that the reliability of the optimal PAPE timepoints was inconsistent and varied with the numbers of set and training session, even absent. It was also suggested that the arrangement of plyometric training based on the PAPE during contrast training might not be practicality.

THE INFLUENCE OF BACK SQUATS IN COMBINATION WITH REACTIVE STRENGTH TRAINING OR STRENGTH TRAINING OF THE PLANTAR FLEXORS ON SPEED AND JUMP PERFORMANCE IN YOUTH ELITE SOCCER PLAYERS

KADLUBOWSKI, B., KEINER, M., WIRTH, K., CSAPO, R.

UNIVERSITY VIENNA

INTRODUCTION: Soccer, characterized by dynamic movements like sprinting, jumping, and directional changes, heavily relies on explosive actions for scoring goals [1]. One crucial factor in facilitating rapid force development during these actions is the stretch-shortening cycle [2]. Despite numerous studies investigating training interventions to enhance speed and jumping ability in soccer players, there is still a gap in our under-standing regarding the effectiveness of isolated plantarflexor muscle strength training [3]. This study aimed to compare the effects of combined training interventions incorporating back squats with either calf raises or plyometric training, on the linear sprint and jump performance of youth soccer players.

METHODS: A longitudinal six-month training study was conducted with male youth soccer players (n = 89) from two elite youth training centers in Germany. Participants were divided into two intervention groups (PLY-BS, plyometric exercises + back squat; CR-BS, back squat + calf raises), and a control group (CG), which per-formed the conventional soccer-specific training only. Outcome measures included back squat and calf raise one-repetition maxima (1-RM), linear sprint times (5m, 10m, 30m) as well as the performance in countermovement jumps (CMJ) and drop jumps (DJ) from heights of 15cm, 30cm, 45cm, and 60cm.

RESULTS: A mixed factorial ANOVA showed that 5m LS times were affected by time ($p<0.001$), with 1.8% reduction post-training. Group and time × group interaction effects were non-significant. For 10mLS, the effect of time ($p=0.01$) was significant. A statistical time × group interaction effect ($F(2,78)=8.599, p<0.001, \eta p2=0.181$) showed that training-induced improvements were larger in CR-BS and PLY-BS than in CG Similarly, CMJ performance improved over time ($p<0.005$) and differed between groups ($p<0.05$). The significant time × group interaction ($p<0.005$) demonstrated that the improvements over time were greater in CR-BS and PLY-BS than in CG.

CONCLUSION: Our findings indicate that implementing combined training interventions, which involve combining back squats with either calf raises or plyometric exercises, can significantly enhance sprint and jump perfor-mance among youth soccer players. This underscores the pivotal role of targeted strength and condition-ing measures in soccer training

programs. Notably, for improving drop-jump performance, it appears that calf raises yield superior outcomes compared to plyometric training.

References

1. Christou et al., (2006). Effects of resistance traning on the physical capacities of adolescent soccer players. J Strength Cond Res, 20(4), S. 783-791.

2. De Ste Croix et al., (2017). Leg stiffness in female soccer players: Intersession reliability and the fatiguing effects of soccer-specific exercise. J Strength Cond Res, 31, S. 3052-3058.

3. Stolen et al., (2005). Physiology of soccer: An update. Journal of sports medicine, 35, S. 501-536.

DIFFERENCES IN MUSCLE STRENGTH AND JUMPING PERFORMANCE ADAPTATIONS BETWEEN HIGH-LOAD AND LOW-LOAD FLYWHEEL SQUAT RESISTANCE TRAINING INTERVENTIONS

SPUDIC, D., PRIMOŽ, P., VOJKO, S., NEJC, Š., IGOR, Š.

UNIVERSITY OF LJUBLJANA

INTRODUCTION: Quantification of load magnitude is a limitation in flywheel (FW) resistance training protocols. Adaptation mechanisms for muscle strength and jumping performance improvement are velocity-specific [1]. However, it is unknown whether this specificity extends to the FW modality. Force-velocity-power (FvP) profiling has been proposed to assess neuromuscular characteristics of lower extremities in FW squats [2,3]. This method could also be utilized to individually allocate the magnitude of FW load [4]. This study aimed to evaluate the differences in adaptations of leg strength and jumping performance after FW squat resistance training performed under low and high loading conditions.

METHODS: Physical education students were randomly assigned to two training groups and a control group. The training groups engaged in eight weeks of FW squat resistance training, 2-3 times per week, with low and high inertial loads. Individual load determination was based on FvP profile characteristics obtained during FW squats. The low-load group (n = 16) performed squats with the FW load that maximized power output, and the high-load group (n = 18) used a load corresponding to 70% of maximal theoretical power. The control group (n = 13) received no intervention. Various tests were conducted, including isometric knee extension strength and rate of force development (RFD), squat jump (SJ), countermovement jump (CMJ), FvP profiling in FW squats and CMJs. Mechanical and electromyography (EMG) variables were measured, along with an ultrasound assessment of vastus lateralis (vl) muscle thickness, pennation angle, and fascicle length. A mixed model analysis of variance with factors time (pre, post) and group (C, low-load, high-load) was performed to reveal differences in adaptations between groups over time.

RESULTS: FW squat training induced improvements (all $p < 0.05$) in: knee extension strength; SJ RFD, force and power; CMJ height, force and power in concentric and eccentric phases; FW FvP profile outcomes in the concentric phase and the maximal theoretical force in the eccentric phase; CMJ FvP profile maximal theoretical velocity and power; vl muscle thickness and pennation angle. No significant differences were found in the adaptations between the two training groups ($p > 0.05$).

CONCLUSION: FW squat resistance training emerged as an effective modality for enhancing the strength, power, and jumping abilities of athlete students. Interestingly, the magnitude of the FW load did not show a statistically significant influence on the observed adaptations. There was a trend toward higher changes in mechanical variables and muscle architecture in the high-load group. The improvements in mechanical variables were more strongly associated with the adjustment in vl muscle thickness than with neural activation enhancement, irrespective of the motor test performed.

REFERENCES:

1) Behm & Sale, Sport. Med. 1993

2) Spudić et al., J. Biomech. 2020

3) Spudić et al., PLoS One 2020

4) Spudić et al., Kinesiol. Slov. 2023

HIGH COGNITIVE EFFORT PRIOR TO VELOCITY-BASED TRAINING SESSIONS INHIBITS RATE OF FORCE DEVELOPMENT, BUT NOT MAXIMUM STRENGTH GAINS IN UNTRAINED ADULTS

ALVES ARAUJO DE LIMA JUNIOR, D.R., BOULLOSA, D., ROELANDS, B., FERREIRA, M., FORTES, L.

UNIVERSITY OF BOLOGNA

INTRODUCTION: The objective of this study was to analize the repeated effect of high cognitive effort immediately prior resistance training sessions on neuromuscular performance in untrained adults.

METHODS: We therefore employed a mixed experimental design, with the group as the between-participant factor and time as the within-participant factor. The thirty- four participants were randomly assigned to two parallel groups: high cognitive effort (n = 17) and control (n = 17). The control group maintained seated during 30 min before resistance exercise sessions while the high cognitive effort group made incongruent trials of the Stroop task until subjective mental fatigue was present immediately prior start resistace exercise sessions. Participants attended 45 sessions over fifteen weeks, consisting of three familiarizations, three baseline evaluations, 36 resistance training sessions, and three post-experiment evaluation sessions. Rate of force development (RFD) for isometric mid-thigh pull, half-back squart 1-RM, and countermovement jump (CMJ) was measured before and after the 12-week intervention.

RESULTS: A significant group x time interaction effect was found for the average RFD 0-250 ms ($p<0.05$), with greater improvements for the control group than for the high cognitive effort group. There was no effect of group x time interaction for half-back squat 1-RM ($p>0.05$). Also, there was no effect of group x time interaction for CMJ ($p>0.05$).

CONCLUSION: In conclusion, repeated high cognitive effort immediately prior to resistance training sessions impaired the improvements in RFD, although this did not inhibit the increased performance for half- back squat 1-RM and CMJ in male untrained adults.

Oral Presentations

OP-AP05 Football Statistics

SUPER SIZE SOCCER – ALTERATIONS OF PITCH DIMENSIONS REVEAL HYSTERESIS IN TEAMS' COLLECTIVE BEHAVIOR

DEUKER, A., BASSEK, M., WITTKUGEL, J., BRAUNSTEIN, B., REIN, R., RAABE, D., VOGT, T.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Sports teams are frequently interpreted as (dynamical) systems to examine their collective behaviors, (CB; i.e., states) under stable environmental conditions (1). However, it is unknown whether the states of such a system are time-dependent, i.e., sensitive to previous environmental conditions (2). One particularly suitable system to study this dependency is soccer teams, where variations in pitch dimensions across contexts, e.g., from training to competition, are pervasive. The present study examines time-dependency by investigating hysteresis effects in the spatial organization of soccer teams responding to systematic changes in pitch dimensions.

METHODS: Twenty-two male soccer players (6th division or higher) participated in a 11-vs-11 crossover, controlled, trial-based approach (3). They were instructed to perform an organized attack in 4-4-2 formation. Following six warm-up trials on an official-sized pitch (105x68 m; 7,140 m²), twelve experimental trials were conducted across four pitch size conditions (50%, 100%, 150%, 200%). To observe time-dependent adaptations in CB, each team performed three experimental trials per condition, scaling UP from 50% pitch size to 100%, 150%, and 200%. After a short break, this procedure was reversed, scaling DOWN from 200% back to 50%, totaling 54 trials. Player positions were tracked using GPS (10Hz) and verified with video footage. For each trial, effective playing space (EPS), team spread, stretch index, and relative field usage were calculated as parameters of CB. Multiple linear regression was employed to assess the influence of pitch size (50%, 100%, 150%, 200%), scaling direction (UP, DOWN), and their interaction on the CB.

RESULTS: Linear regression analysis resulted in significant main effects for pitch size across all calculated CB parameters (EPS, team spread, stretch index, relative field usage; $p<.0001$). Interaction effects between pitch size and scaling direction were significant for EPS ($p=.04$), team spread ($p=.05$), relative field usage ($p=.03$), and a trend towards significance in the stretch index ($p=.06$). Hysteresis was particularly present at 50% pitch size, with average differences between UP- and DOWN-scaling as follows: Stretch index delta of 1.07 m, relative field usage of 3.5%, EPS of 127 m², and team spread of 14.5 m. These findings indicate time-dependency of changes in CB.

CONCLUSION: The discovered hysteresis effects provide empirical evidence for a time-dependency of soccer teams states on historical environmental conditions. This result demonstrates how a (dynamical) systems perspective on soccer teams may lead to important insights, showing that soccer teams CB is highly sensitive and adaptable to previous stimuli. Better understanding the dynamics of team system configuration in sports contexts is a fertile ground for future research.

1. Duarte et al. (2012). 10.2165/11632450-000000000-00000

2. Couzin et al. (2002). 10.1006/yjtbi.3065

3. Low et al. (2021). 10.1080/02640414.2021.1925424

GAZE STRATEGY AND ANTICIPATION OF DEFENSIVE SITUATIONS IN YOUTH PERFORMANCE SOCCER – AN EYE-TRACKING PILOT STUDY

HERDEN, M., ADAMI, T., EHSANI, B., SCHUMACHER, N.
UNIVERSITY OF HAMBURG

INTRODUCTION: In fast-paced team sports like soccer, defenders anticipation skills are crucial in decisions-making, often determining success or failure [1]. Studies show that expert athletes use more effective visual search strategies and focus on more relevant areas than less experienced athletes, implying that gaze behaviour such as saccades and fixations may be relevant for anticipation and successful decisions in soccer [2]. The aim of this pilot study was thus to investigate differences in gaze behaviour with correct or incorrect decisions in young elite soccer players.

METHODS: The study enrolled 10 young elite soccer players, including six defenders and four offensive players aged 16-18 years, (16.7 ± 0.68) with an average of 11.2 years of soccer experience. Participants viewed standardized videos of 48 defensive 1:1 game situations which were occluded at -150, -300, and -450ms before the critical last ball contact. Study participants were instructed to decide within 10 seconds after occlusion whether the opponent player depicted in the video was about to run to the left or right. Gaze behaviour was registered with an Eye Tracking System (Tobii Pro Glasses 3) measuring total saccades and fixations. Fixations were analysed with respect to regions of interest defined by Krzepota et

al [3]. Differences between correct and incorrect decisions with regard to total saccades and fixations were calculated using the Mann-Whitney-U Test. The alpha-level was set at 0.05.

RESULTS: Significant differences were observed for total saccades (p = 0.026), fixations at the "zone-in front of-of the-ball/ foot" (p = 0.008), and the "zone beyond the player and ball" (p = 0.020) at -300ms while correct decisions showed more total saccades, shorter fixation duration at the "zone in front of the ball" and longer fixation duration at the "zone beyond the player and ball". Video sequences at occlusion timestamps of -150ms and -450ms revealed no significant differences between correct or incorrect decisions.

CONCLUSION: The differences in gaze behaviour (saccades and fixations) underline their importance in correct decision-making. Young soccer players may make better decisions with respect to anticipated opponents' movement when they exhibit more saccades and shorter fixation duration at the "zone in front of the ball". Future research should explore integrating gaze strategies into training and further investigate the relationship between saccades, player position, and decision accuracy.

References:

1. Williams & Ford (2008) 2. Savelsbergh et al. (2002) 3. Nagano et al. (2004) 4. Krzepota et al. (2016)

MATCH DIFFERENCES BETWEEN DIFFERENT THRESHOLDS OF ACCELERATIONS AND DECELERATIONS IN ACADEMY SOCCER PLAYERS

VAMPOLA, J., ŠTASTNÝ, P., VARJAN, M., MALÝ, T., MUSÁLEK, M., CASTELLANO, J., KOKŠTEJN, J.

CHARLES UNIVERSITY

INTRODUCTION: According to previous studies on the neuromuscular demands (Harper et al., 2019), professional football is more decelerative than accelerative. However, it is not known whether this is respected in terms of intensity ranges. The aim of the study is to compare whether this trend in favor of deceleration is maintained in the different intensity ranges.

METHODS: External load from official competitions in three age categories (2nd team, 20.8 ± 4.4 yrs; U19, 17.0 ± 0.7 yrs; and U17, 15.8 ± 0.6 yrs) of elite football academy were measured by 10 Hz GPS technology during two consecutive seasons, 2021/22 and 2022/23. 2nd team played in third and second professional Czech leagues, both youth teams played the highest youth competitions. Various thresholds were used for examining the number of accelerations (ACC) and decelerations (DEC): ACC12 (from 1 to 2 ms-2), ACC23 (2-3 ms-2), ACC34 (3-4 ms-2), ACC45 (4-5 ms-2), ACC5 (>5 ms-2), with negative sign for decelerations (from DEC12 to DEC5), respectively. From official matches with 4-3-3 formation in which the players participated for the entire duration (>90 minutes), were calculated averages for every player/season. Repeated measures ANOVA with Bonferroni's post-hoc test, Student t pair test and Wilcoxon signed-rank test were used (JASP, Version 0.18.3). Cohen´s d values were employed to assess effect sizes. Effect magnitude was interpreted according to power analysis (G*power, version 31.9.7).

RESULTS: ANOVA revealed a significant influence of category on the results. Significant differences were found in all parameters only between the 2nd team and U17, although with small effect sizes according to power analysis ($p<0.05$, d= 0.47-0.60). There were found, in all categories, greater number of ACC than DEC in thresholds of 2-3 ms-2 (ACC23>DEC23) and 3-4 ms-2 (ACC34>DEC34). In all other thresholds more decelerations were found (ACC12 < DEC12, ACC45 < DEC45, and ACC5 < DEC5). In the lowest level ACC12 and DEC12, there were found statistically significant differences only in U17 ($p< 0.01$, d= 0.38) and U19 ($p< 0.01$, d= 0.53) categories with low and high effect size, respectively. For all other thresholds statistically very significant differences were found for all the categories ($p<0.01$). Magnitude of effect size exceed the counted thresholds by power analysis in all other thresholds except for U17 ACC34 versus DCC34 (d= 0.49) and ACC45 versus DCC45 (d=0.51).

CONCLUSION: The results confirm that more DEC than ACC occur in football matches when higher thresholds are considered. On the contrary, the opposite is true in lower speed changes. Additionally, the team category significantly impacts the results, with U17 showing significantly lower number of ACC and DEC compared to the 2nd team in all thresholds. In addition, one of the main findings for practice is, that integrating accelerations and decelerations into one variable (i.e. mean value) is not recommended for greater thresholds (>4 ms-2), where the difference between ACC a DEC is greater.

MULTIVARIATE ANALYSIS OF SET PIECES AT WOMEN AND MEN 2021-22 UEFA CHAMPIONS LEAGUE

TREJO, A., CORREA, R., TRUJILLO-BAAMEIRO, D.

UDELAR-ISEF; IUACJ

INTRODUCTION: Set pieces (SP) are widely regarded as significant technical-tactical indicators of sport performance in football (Ugalde and Rodríguez, 2021), with studies indicating they contribute significantly, up to 40%, to the overall tally of goals scored (Mitrotasios et al., 2021). While there has been a rise in research focusing on these critical moments in women´s football matches, there remains a noticeable gender disparity in the analysis of performance indicators in team sports (Adán et al., 2020). Therefore, the aim of the present study was to analyze and compare women´s and men´s offensive performance during direct and indirect free kicks (DFK; IFK) and corner kicks (CK) in the 2021-22 UEFA Champions League

METHODS: The sample was composed of 1945 CK and free kick (FK) sanctioned at female and male 2021-22 UEFA Champions League (n=61 female matches and n=61 male matches). Observational methodology procedures were followed for

collecting data. the binary regression and classification tree (Exhaustive CHAID) multivariate models were used to identify the best predictor variables for women and men.

RESULTS: Results showed that 15,8 ± 3,9 SP were registered at the women´s tournament (6,0 ± 2,8 FK; 9,8 ± 3,1 CK) and 16,1 ± 4,8 SP at the men´s tournament (7,0 ± 3,2 FK; 9,2 ± 3,3 CK) having CK a significant relationship ($p < 0.05$) with women and FK ($p<0.05$) with men. Women teams presented a significant tendency to end CK with shots on goal ($p<0.05$) reaching a 4.2% efficacy, while men saw more incomplete plays and ball possession losses ($p<0.05$) presenting an efficacy of 3.0%. Similarly, in FK situations, women tended to aim for goal and take shots outside the goal ($p<0.05$), whereas men tended to initiate organized attacks ($p<0.01$). The CHAID results identified women teams taking CK when match status is winning, and executing them with opposite foot (having an in swing trajectory). Moreover, not winning male teams registered SP while winning and executed CK with natural kick or short corner. Male teams tended to continue playing an organized attack when having a CK and match status was draw or losing.

CONCLUSION: While presenting similar frequencies of SP sanctioned women teams seemed to be more efficient than men. Men showed a tendency to use short corner and out swinger trajectory in CK.

REFERENCES

Adán, L., García-Angulo, A., Gómez-Ruano, M., Sainz de Baranda, P., y Ortega-Toro, E. (2020). Análisis bibliométrico de la producción científica en el fútbol femenino. Journal of Sport and Health Research, 12 (3), 302-317.

Mitrotasios, M., Casal, C., Armatas, V., Losada J., & Maneiro, M. (2021). Analysis of Corner Kick Success in LaLiga Santander 2019/2020. European Journal Of Human Movement, (10), 8-22.

Ugalde-Ramírez, J., & Rodríguez-Porras, L. (2021). Indicadores técnicos que influyeron sobre el rendimiento deportivo de los equipos en el mundial femenino 2019. RYCIDE, 10(2), 112-125.

HOW IS THE TEAMS RUNNING PERFORMANCE WHILE SCORING AND CONCEDING GOALS IN UEFA CHAMPIONS LEAGUE: ANALYSIS OF 5 MINUTES TIME-INTERVALS

CHMURA, P., MODRIC, T., DROZDZOWSKI, A.

WROCLAW UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: Performance analysis can provide the coach with a range of relevant information and support more informed decision-making [1]. The objective of the research was to determine the running performance (RP) according to scored and conceded goals in the UEFA Champions League (UCL) within each 5-minute time interval.

METHODS: The matches from the 2020/2021 season in the UEFA Champions League were analyzed, and relevant data were retrieved using the semi-automatic video system InStat Fitness. One-way analysis of variance (ANOVA) was used in the statistical analysis, and the effect size was determined by calculating the partial eta square ($\eta 2$). The teams performance was determined by obtaining a significant difference in total distance covered (TD) and high intensity running (HIR) under the following conditions: the team scored a goal, the team conceded a goal, and the score did not change.

RESULTS: Our main results indicate that, when teams scoring goals, the significant differenced occurred in 3 out of the 20 five-minute time intervals for the TD parameter and in 4 out of the 20 or the HIR. In the other hand, when teams conceded goals, showed significant differences 8 out of 20 tested intervals for TD and 3 out of 20 for HIR, respectively.

CONCLUSION: Currently, it is observed that the level of running performance is steadily increasing, the physical demands for teams are getting higher and higher, hence a need has arisen to update this information in different context of analysis, like changing the score line [2]. In conclusion, teams that significantly reduced their running performance in consequence conceded goals in all 5-minutes indicated intervals. A detailed match analysis in a 5-minute time interval with running performance is a valid indicator in relation to scored and conceded goals. From a practical point of view, coaches should be aware, especially in the context of the pace strategy used, that the teams running performance directly affects the score line and consequently also indirectly on the match outcome.

References:

1. Errekagorri et al. (2023)

2. Redwood-Brown et al. (2018)

12:00 – 13:15

Oral Presentations

GSSI Award

THE EFFECT OF 24 H ENERGY AVAILABILITY MANIPULATIONS BY DIET OR EXERCISE ON SUBSTRATE UTILISATION, METABOLISM, AND PERFORMANCE IN CYCLISTS

SMITH, E., KUIKMAN, M., WEAKLEY, J., TEE, N., MCCORMICK, R., ACKERMAN, K., ELLIOTT-SALE, K., STELLINGWERFF, T., HARRIS, R., MCKAY, A., BURKE, L.

AUSTRALIAN CATHOLIC UNIVERSITY

INTRODUCTION: Athletes often implement acute, adaptable, periods of low energy availability (EA) to facilitate performance goals, such as reducing body mass to meet weigh-in targets, altering body composition for competition, or intensified training blocks with increased exercise energy expenditure (EEE). Prolonged low EA is problematic, as it is associated with negative health and performance outcomes. Yet the time course for maladaptations to occur once adequate EA "thresholds" are consistently unmet remains unclear. The method of reducing EA (i.e., dietary restriction or increased EEE) may also influence physiological outcomes. This is relevant in tailoring athlete training/nutritional protocols to alter body composition whilst minimising negative consequences. Additionally, there is some evidence that women may be more sensitive to the physiological effects of acute low EA than men. However, studies examining sex differences are scarce, particularly among trained athletes. We therefore examined how 24 h EA manipulations, induced by diet or exercise, influenced next day substrate oxidation, postprandial metabolism, and performance among trained women and men.

METHODS: In a Latin Square design, 20 endurance athletes (10 females using monophasic oral contraceptives and 10 males) undertook five trials, each comprising three consecutive days. Day one was a standardised period of high EA; EA was manipulated on day two; and post-intervention testing occurred on day three. EA on day two was low/high/higher EA (LEA/HEA/GEA) at 15/45/75 kcal·kg·FFM·day-1, respectively. Participants received prescribed food and drink prepackaged and weighed before each trial. Conditions of LEA/HEA were separately achieved by manipulations of EEE/energy intake (LEA/HEA[REST/EX]). On day three, fasted peak fat oxidation during cycling and two-hour postprandial metabolism (high carbohydrate/energy meal) were assessed, alongside performance tests: Wingate, countermovement jump (CMJ), squat jump (SJ), isometric mid-thigh pull (IMTP), and the Stroop Colour and Word Test.

RESULTS: Highest peak fat oxidation occurred under LEA induced by exercise ($p<0.01$), with no difference between sexes. Postprandial glucose ($p<0.01$) and insulin ($p<0.05$) responses were highest across both sexes when LEA was induced by diet. Relative peak/mean power throughout the Wingate and CMJ/SJ jump height was greater in males than females ($p<0.01$), but there was no difference between EA conditions for the Wingate/CMJ ($p>0.05$). During the SJ, jump height was lower under GEA than LEAREST ($p=0.045$) and HEAEX ($p=0.023$) across both sexes. IMTP peak force and the Stroop effect did not change with altered EA.

CONCLUSION: Acute (24 h) exercise-induced manipulations in EA influence fasted substrate oxidation more than LEA induced by diet alone, while 24 hours of LEA appeared not to impair strength/power, sprint capacity, or cognitive performance, at least when measured post-prandially. Finally, the responses to EA manipulations did not differ between sexes.

POST-EXERCISE MYOFIBRILLAR PROTEIN SYNTHESIS RATES ARE EQUIVALENT FOLLOWING INGESTION OF GRADED DOSES OF LEUCINE AND ACROSS DIFFERENT MENSTRUAL CYCLE PHASES IN YOUNG FEMALES

APICELLA, M., JAMESON, T., ABDELRAHMAN, D., MURTON, A., ALAMDARI, N., DIRKS, M., WALL, B., STEPHENS, F.

UNIVERSITY OF EXETER

INTRODUCTION: Optimal adaptation to resistance exercise likely requires a maximal rate of myofibrillar protein synthesis (MyoPS), which is thought to be achieved by the post exercise consumption of >20g of protein or ~2g of the essential amino acid (EAA) leucine. Recent work has challenged this centrality of leucine and suggested that such responses may also vary in females due to typically lower body mass and differing hormonal profiles. However, limited data is available on the role of naturally fluctuating oestrogen (O) concentrations during the menstrual cycle (MC) in regulating postprandial post-exercise MyoPS. This study aims to investigate the effect of post-exercise ingestion of low and moderate compared to an optimal dose of leucine on MyoPS, and determine if post-exercise MyoPS and expression of 46 genes involved in the regulation of muscle mass are different during the early follicular (EF, low O) and late follicular (LF, high O) phases of the MC, when progesterone (Pg) is low.

METHODS: Twenty-eight healthy, eumenorrheic females (age: 27±8 y; BMI: 24±3 kg/m2) completed one of three parallel experimental trials in a randomised double-blind manner during EF (4±1d following menses; O 183±78 pmol/l, Pg 1.1±0.7 nmol/l). A subset of 17 participants completed a second trial during LF (2±2 d before luteinising hormone surge; O 855±571 pmol/l, Pg 4.0±5.1 nmol/l), in a randomised order. On each visit, participants received a primed continuous infusion of L-[ring-2H5]phenylalanine for 7.5h. Following a bout of resistance exercise, participants ingested one of three drinks containing 1.5g EAA (n=10) or 15g (n=10) and 20g (n=8) whey protein, equating to 0.6, 1.5, and 2.0g leucine, respectively. Muscle biopsies were collected before and during the 4h post-exercise postprandial period to assess MyoPS and

gene expression. Two-way ANOVAs were performed to detect changes across drinks and MC phases. Data are expressed as means±SD.

RESULTS: Post-exercise drink ingestion increased MyoPS above postabsorptive values after 2h by 0.058±0.038, 0.035±0.050 and 0.064±0.036%·h-1 (P<0.0001) and after 2-4h by 0.050±0.035, 0.011±0.040, and 0.031±0.063%·h-1 (P=0.009) for 0.6g, 1.5g, and 2.0g drinks, respectively, with no interactions observed. MyoPS increased by 0.050±0.056 and 0.048±0.081%·h-1 after 2h (P<0.001), but not 2-4h (P=0.522) for EF and LF, respectively, with no differences between MC phase at either timepoint. Muscle mRNA expression of several genes involved in oestrogen signalling, protein synthesis, and inflammation were increased in LF vs EF, and to a greater extent 4h post-exercise, whereas protein breakdown genes were decreased.

CONCLUSION: Ingestion of 0.6g (1.5g EAA) or 1.5g leucine (15g protein) increases post-exercise MyoPS to a comparable extent as 2g leucine (20g protein) in females. This increase in MyoPS does not appear to be affected by increased O during the LF phase of the MC, despite a gene expression profile in LF consistent with muscle growth.

EFFECT OF PRE-SLEEP ALPHA-LACTALBUMIN SUPPLEMENTATION IN AN ATHLETICALLY TRAINED POPULATION WITH SLEEP DIFFICULTIES

BARNARD, J., ROBERTS, S., LASTELLA, M., CALLAHAN, D., AISBETT, B., CONDO, D.

DEAKIN UNIVERSITY

INTRODUCTION: Sleep is vital for optimal recovery and sporting performance (1). Recently, protein has been identified as a dietary factor influencing the sleep of athletically trained populations (2), whereby the type and timing of protein appears crucial in the protein-sleep relationship (3). Evening consumption of a whey protein rich in the amino acid tryptophan (TRP), alpha-lactalbumin (ALAC), has previously shown to benefit sleep - particularly among poor sleepers (4). Given trained populations often experience sleep difficulty (5), this study sought to investigate whether acute evening supplementation of ALAC would influence sleep outcomes, and next-day cognitive performance within a trained population with sleep difficulties.

METHODS: Nineteen trained males (n=8) and females (n=11) with sleep difficulties aged 18-40 completed this double-blinded, counterbalanced, randomised, cross-over trial. 40 g ALAC (1.9 g TRP) or an isocaloric placebo (collagen) were supplemented two hours prior to individualised bedtime for three consecutive nights in a controlled environment, with sleep measured using portable electroencephalography (DREEM 3). Diet was standardised to 1.2 g/kg body weight protein throughout the day, with a low-protein dinner provided two hours prior to the supplement to limit confounding effects on TRP levels. On the first night of each intervention period, blood samples were taken across five evening timepoints (0, 30, 60, 90, 120 min post-supplement) prior to bedtime. A tablet-based testing battery (Joggle Research) assessing multiple cognitive domains was completed next day, thirty minutes after waking. Mixed models were used to assess the effect of treatment on sleep variables and cognition, with time added as a fixed effect to determine the treatment and time interaction for plasma TRP concentrations.

RESULTS: During the ALAC condition, participants had an increased NREM stage 2 sleep duration (PLA 205.9 ± 33.3, ALAC 216.5 ± 33.1 min); improved reaction time in cognitive tests involving sensory motor speed, spatial orientation, and vigilant attention ($p<0.05$); and raised plasma TRP across all timepoints compared to 0 min ($p<0.01$). No other sleep or cognitive outcomes were affected by ALAC supplementation.

CONCLUSION: Pre-sleep ALAC supplementation increased NREM stage 2 sleep, improved morning cognition, and augmented plasma TRP levels compared to placebo. With NREM stage 2 sleep being important for brain plasticity and motor learning (6, 7), acute supplementation of ALAC may prove beneficial to trained individuals with sleep difficulties looking to assist next-day performance. Future research should investigate the impact of chronic ALAC supplementation on sleep and next-day sporting performance within a trained population with sleep difficulties.

REFERENCES:

(1) Lastella et al. 2015, (2) Barnard et al. 2022, (3) Falkenberg et al. 2021, (4) Barnard et al. 2024, (5) Roberts et al. 2018, (6) Boutin & Doyon 2020, (7) Walker et al 2003

EXERCISE-INDUCED HYPOHYDRATION IMPAIRS ENDURANCE RUNNING PERFORMANCE IN THE HEAT IN FEMALE, BUT NOT MALE, RUNNERS: EVIDENCE OF A SEX-HYDRATION INTERACTION

CABLE, T., FUNNELL, M., PEDEN, D., REYNOLDS, K., TAYLOR, L., MEARS, S., JAMES, L.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Exercise-induced hypohydration impairs endurance performance in the heat, but most data is in cycling, with less known about running. Furthermore, the impact of biological sex on physiological and performance responses to hypohydration is unclear. Females have a smaller relative total body water (TBW) compared to males, and thus symptoms of hypohydration may be exacerbated in females. Therefore, this study assessed the impact of exercise-induced hypohydration on running performance in the heat in male and female runners.

METHODS: 11 male (M; age 37 ± 3 y; VO2peak 61 ± 3 mL/kg/min) and 8 female (F; age 34 ± 4 y; VO2peak 54 ± 4 mL/kg/min) trained runners completed a familiarisation (ad-libitum water intake) and two experimental trials, involving a preload (PL; 7 x 10 min at 60% VO2peak, 1 min rest) and a 3 km time-trial (TT) on a treadmill in the heat (32°C, 50% RH). Water to replace sweat loss (EU) or a total of 80 mL water (HH) was provided during the PL to manipulate hydration, aim-

ing for ~3% reduction in TBW in HH. TBW was estimated by bioelectrical impedance and used to compare relative TBW loss between sexes. Venous blood was collected, and nude body mass measured at baseline, post-PL and post-TT, with gastrointestinal (GI)/skin temperature, heart rate, perceptual responses and oxygen uptake measured throughout trials. 3 km TT performance was the primary outcome.

RESULTS: Post-PL relative TBW loss in EU (M -0.6 ± 0.2%; F -0.7 ± 0.3%) and HH (M -3.5 ± 0.6%; F -3.1 ± 0.4%) was not different between sexes (P≥0.109). Hypohydration increased heart rate, GI temperature and thirst, and decreased body mass and plasma volume (P≤0.041), but did not alter skin temperature, oxygen uptake, RPE, GI comfort or thermal sensation (P≥0.380). However, there were no trial*time*sex interactions for any physiological or perceptual variable (P≥0.108). There was a trial*sex interaction for 3 km TT performance (P=0.034), with females 5% slower in HH (EU 970 ± 286 s; HH 1020 ± 316 s; P=0.037), with no significant difference between trials in males (EU 715 ± 52 s; HH 722 ± 55 s; P=0.405). During familiarisation, ad-libitum water intake in PL replaced more of the sweat loss in females (M 47 ± 26%; F 67 ± 28%; P<0.001), meaning relative TBW loss was less in females (M 3.3 ± 1.3%; F 2.4 ± 1.4%; P<0.001).

CONCLUSION: These data demonstrate that hypohydration impairs endurance performance in female, but not male, runners, but sex did not significantly alter any physiological or perceptual variables. Interestingly, during familiarisation, ad-libitum water intake replaced a greater proportion of sweat losses in females, producing a lower relative TBW deficit. This indicates some sex-based differences in hydration behaviour that might explain some of the observed performance effects of hypohydration. These results suggest that where high sweat rates are likely during running, females might need to pay more attention to hydration strategies than males.

GLYCEROL-AND SODIUM-INDUCED HYPERHYDRATION DOES NOT IMPROVE HALF-MARATHON TIME-TRIAL PERFORMANCE IN TRAINED RUNNERS IN WARM CONDITIONS.

JARDINE, W., CONDO, D.1, AISBETT, B.1, ROSS, M.L.2, BURKE, L.M.2, DURKALEC-MICHALSKI, K.3, PÉRIARD, J.D.4, CARR, A.J.1

1 DEAKIN UNIVERSITY, AUSTRALIA; 2 AUSTRALIAN CATHOLIC UNIVERSITY, AUSTRALIA; 3 POZNAN UNIVERSITY OF PHYSICAL EDUCATION, POLAND; 4 UNIVERSITY OF CANBERRA, AUSTRALIA

INTRODUCTION: Hyperhydration aims to offset fluid loss during endurance exercise in hot conditions and is achieved by ingesting large volumes of fluid with an osmolyte (i.e., glycerol or sodium) to enhance fluid retention. The aim of this study was to investigate the effect of combined glycerol- and sodium-induced hyperhydration (HYP), compared to a control (CON), on 1) half-marathon time-trial performance and 2) hydration measures (fluid retention, plasma volume; PV), core temperature (Tcore) and heart rate (HR) in the field.

METHODS: Endurance-trained athletes (n = 13, 1 F, age: 33 ± 7 yr, height: 1.78 ± 0.07 m, weight: 72 ± 10 kg, VO2max: 60.07 ± 8.39 mL/kg/min) completed two half-marathon time-trials in outdoor conditions (wet-bulb globe temperature: HYP: 23.5 ± 1.8°C, CON: 23.7 ± 2.7°C). Before each time-trial, participants completed either a 180-min HYP (25 mL/kg BM of fluid with 1.2 g/kg BM of glycerol and 7.5 g/L of sodium chloride in four equal aliquots, finishing 120 min pre-exercise) or CON (volume-matched beverage ingested at the same time points). Urine volume (UVol) was recorded every 20 min pre-exercise and fluid retention was calculated as fluid ingested minus UVol. Capillary blood samples were taken at baseline and every 60 min pre-exercise for haematocrit and haemoglobin to assess for changes in PV. During each time-trial, Tcore and HR were recorded. Linear mixed modelling was used to determine interaction effects between conditions for fluid retention, changes in PV, Tcore, HR and exercise performance. Results are reported as mean differences and 95% confidence intervals (lower bound, upper bound).

RESULTS: There were no differences between conditions for exercise performance (HYP: 101.51 ± 18.45 min, CON: 101.74 ± 16.97 min; p = 0.960). There was greater fluid retention in HYP compared to CON at 80 min (234 mL (32, 436); p = 0.024), 100 min (470 mL (268, 672); p < 0.001), 120 min (769 mL (567, 971); p < 0.001), 140 min (870 mL (668, 1072); p < 0.001), 160 min (996 mL (794, 1198); p < 0.001) and 180 min (1189 mL (987, 1391); p < 0.001). Changes in PV were greater in HYP, than CON, at 60 min (9.1% (4.8, 13.4); p = 0.014), 120 min (11.6% (7.3, 15.9); p = <0.001) and 180 min post-ingestion (11.7%, (7.4, 15.9); p = 0.001) and post-exercise (6.9% (2.6, 11.1); p < 0.001). There were no differences in mean Tcore (p = 0.44), peak Tcore (p = 0.88) or mean HR (p = 0.55).

CONCLUSION: The findings from this study indicate that the combined ingestion of glycerol and sodium significantly enhanced fluid retention and PV compared to a matched fluid volume. However, these differences in hydration status did not provide a thermal-, cardiovascular- or performance-benefit to trained runners during a simulated half-marathon time-trial in the field, potentially due to the relatively low environmental stimulus used in this study. Future work may consider a stronger environmental stimulus when assessing differences in exercise performance.

12:00 - 13:15

Oral Presentations

OP-MH06 Exercise and cancer I

THE INCLUSION OF CHILDREN WITH CANCER IN AN ADAPTED FOOTBALL TRAINING PROGRAMME IN HOSPITAL

GUARESCHI, S., REDAELLI, R., CALDARA, E., MORIGGI, T., VILLA, E., ZARDO, W., CORTI, E., PELI, L., CORTI, M., JANKOVICH, M., BALDUZZI, A., MORATTI, C., LANFRANCONI, F.
INTER CAMPUS MILANO

INTRODUCTION: Cancer is the leading cause of death among children over the age of one in Europe, and more than 15,000 children and adolescents are diagnosed with cancer each year in Europe. Up to 80% of them can be cured with standard multidisciplinary care. Children, adolescents and young adults with cancer (CAYA-c) suffer from acute and chronic disabilities. Precision-based exercise programmes and sports are a new therapeutic option to counteract the side effects of cancer treatment in hospital. Inter Campus uses the values of football as an educational tool and contributes to the development of local communities by supporting educational, social and health programmes and promotes social integration between different ethnic groups and cultures. The aim of this study was to test the effectiveness of implementing the Inter Campus method in a complex clinical setting.

METHODS: CAYA-c participating in a precision training research programme from 1 September to 31 December 2023 were enrolled. They were referred to the programme by their oncologists. Both sexes, aged between 3 and 21 years, with a diagnosis of blood cancer in the previous 8 weeks were eligible. Between the 3 weekly sessions of combined training (cardiorespiratory, resistance, flexibility and balance), 1 session of football was provided by Inter Campus. The methodology is based on a global approach to football training that includes performance, but also cognitive, emotional-affective and social areas of the childrens and adolescents personalities. Each child received exercises tailored to their own resources and vulnerabilities. Football sessions have been offered on the wards, including the bone marrow transplant center. When followed up in the outpatient clinic, they were trained in small groups (3 to 9 CAYA-c) in the gym, including an outdoor area, in the hospital. The frailest were trained with other CAYA-c to emphasize the inclusion part of the project.

RESULTS: A total of 31 consecutive CAYA-c were enrolled and 29 were trained. The average age was 11.3 ± 5.9 years (range 4-20), 44.8% were female. The diagnoses were acute lymphoblastic and myeloid leukemias (60% and 16%), lymphoma (24%). Adherence to training (number of sessions/expected sessions) was 33% (range 7-80%). CAYA-c satisfaction with the intervention was 9.2 out of 10 in general and 8.8 for Inter Campus activities; parents reported 9.8 and 9.1, respectively. There were no major events related to football activities.

CONCLUSION: Close consultation between pediatricians and exercise professionals, including football coaches with a pedagogical profile, is essential when introducing sport in hospitals. The use of football could be safe even in complex clinical settings. Adherence to training can be low for the most medically fragile children, although their willingness to participate in sports activities remains throughout their care. The satisfaction of the families and of CAYA-c is high and the resulting impact on their inclusion could be enormous.

NEAR INFRARED SPECTROSCOPY IN SKELETAL MUSCLE OXIDATIVE EVALUATION IN CHILDREN WITH BLOOD CANCER IN HOSPITAL.

ZARDO, W., MORIGGI, T., VILLA, E., CORTI, E., PELI, L., BALDUZZI, A., LANFRANCONI, F.
FONDAZIONE MONZA E BRIANZA PER IL BAMBINO E LA SUA MAMMA

INTRODUCTION: Cancer is the leading cause of death from non-communicable diseases in children, adolescents and young adults with cancer (CAYA-C) in Europe. Reduced exercise capacity in CAYA-C may reflect both bed rest and drug-induced side effects such as cardiopulmonary dysfunction and/or reduced skeletal muscle oxidative metabolism due to myopathy and peripheral nervous system impairment. The individuals reduced exercise capacity in complex clinical situations, i.e. during the intensive phases of CAYA-C treatment, can be assessed by cardiopulmonary exercise testing (CPET). During CPET, near-infrared spectroscopy (NIRS) measures muscle oxidative capacity in vivo at the vastus lateralis and physiological calibration using an ischaemic leg cuff manoeuvre is required to compare different individuals. The leg cuff maneuver is not an option in CAYA-C with cancer due to severe thrombocythemia. The aim of this pilot study was to test whether adapted NIRS physiological calibrations obtained by quadriceps isometric and isotonic exercise manoeuvres can be performed in CAYA-C instead of the classical leg-cuff ischaemia.

METHODS: After CPET on a cyclergometer, ischaemia of the quadriceps was performed on 3 CAYA-C with blood cancer (age 16.0±3.0 years) by means of isometric and isotonic exercises on a leg extension machine (80% of 1 maximum repetition). Each manoeuvre was separated by 2 minutes of rest and the difference between the values at rest and at the end of the manoeuvres was calculated, until a plateau of deoxygenated hemoglobin values was reached (D[HHb], A.U.). In 3 healthy young adults (HEAL) the 2 methods were compared with a 300 mmHg leg cuff tourniquet and the D[HHb] kinetic time (τ, sec) was measured. The D[HHb] values obtained during CPET were expressed as a percentage of the different ischaemias (D[HHb]/D[HHb]isch).

RESULTS: None of the CAYA-C patients complained of pain during the manoeuvres, although the HEAL patients experienced discomfort during the leg-cuff. The 3 CAYA-C showed D[HHb] 19.1±2.8 and 16.8±2.7 in relation to isometric and isotonic conditions respectively, without any statistical difference. The D[HHb]/D[HHb]isch were 0.38±0.08 and 0.34±0.07 in relation to isometric and isotonic conditions, respectively. The 3 HEAL showed D[HHb] 10,1±6,5, 9,3±9,8 and 11,7±9,0 in relation to isometric, isotonic and leg cuff conditions respectively without any statistical difference. The τ of the 3 procedures were 36,8±21,0, 23,1±22,9 and 249,8±133,7 respectively with a significant statistical difference (p<0,006)

CONCLUSION: The adapted physiological NIRS calibrations were well tolerated in both CAYA-C and HEAL. Reduced oxidative metabolism was observed in CAYA-C and comparable D[HHb] values were found between isometric and isotonic manoeuvres. HEAL showed that the kinetics of the leg cuff is slower than other manoeuvres and give reasons for the pain experienced during the manoeuvres, adding concern in performing the manoeuvre in CAYA-C.

CHANGES IN PEAK OXYGEN CONSUMPTION ELICITED BY PREHABILITATION PRIOR TO ONCOLOGIC RESECTION

LAZA CAGIGAS, R., RAMPAL, T., LARUMBE-ZABALA, E., SEIJO, M., NACLERIO, F.
UNIVERSITY OF GREENWICH

INTRODUCTION: Cardiopulmonary exercise testing is frequently utilised in the United Kingdom to assess patients' functional capacity prior to elective surgery. Both peak oxygen (VO2Peak) and the amount of oxygen consumed at the 1st ventilatory threshold have been used as markers of functional capacity with low values linked to morbidity and mortality in the postoperative period. Surgical prehabilitation (PREHAB) is an intervention including one or more lifestyle components (e.g., exercise) implemented to enhance functional capacity in patients awaiting surgery.

We aimed to systematically summarize the effects of PREHAB on VO2Peak in patients awaiting oncologic resection.

METHODS: This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) checklist and registered with the International Prospective Register of Systematic Reviews, PROSPERO (CRD42023428676). The search of the literature was conducted using Cochrane Library, EBSCOhost, Google Scholar, MEDLINE PubMed, and Web of Science from March 2023 to October 2023. Inclusion criteria were randomized controlled trials (RCT), including adult patients (≥18 years old), diagnosed with any type of cancer, who could be undergoing or not neo-adjuvant chemotherapy, implementing any type of PREHAB modality (i.e., unimodal or multimodal), delivered at any venue (i.e., home, hospital or in the community), by any means (i.e., telehealth or face-to-face) and including at least an intervention group (PREHAB) and one control group (standard care). Continuous data on VO2Peak as a marker of functional capacity were pooled using a random-effects model. The Comprehensive Meta-Analysis Software, v. 4.0.000 (Biostat Inc., Englewood, New York, USA) was used for the analysis.

RESULTS: Seven RCTs reporting VO2Peak met the inclusion criteria. The overall quality of the included studies was high, with a low risk of bias, scoring from 2 to 5 points in the Cochrane collaboration tool. All the studies included an exercise component. Two studies implemented multimodal prehabilitation and five implemented unimodal exercise-based prehabilitation. The mean effect size (Hedges' g) of PREHAB vs. standard care on VO2Peak was medium (n = 7, g= 0.615, 95% CI 0.243 to 0.987), and statistically significant (Z = 3.240, p = 0.001). The prediction interval was calculated from -0.562 to 1.793 (95% CI). The sensitivity analysis showed that none of the studies contributed disproportionately to the results of the meta-analysis and no outliers were identified amongst the analysed studies.

CONCLUSION: Considering the overall findings and the estimated prediction interval from the seven meta-analysed RCTs, we are unable to support the claim that PREHAB improves VO2Peak.

THE PECTORALIS MAJOR STRETCH RESPONSE IN WOMEN AFTER RADIOTHERAPY FOR BREAST CANCER

WOLFRAM, S., LIPPS, D.B.
UNIVERSITY OF MICHIGAN

INTRODUCTION: Radiotherapy (RT) for breast cancer has been associated with shoulder co-morbidities like reduced strength and range of motion (ROM) (1). These impairments may be related to stiffening of shoulder muscles, like the pectoralis major, after RT (2). Increased pectoralis major muscle stiffness likely causes difficulties with shoulder abduction. However, it is unknown how this muscle responds to stretch during this movement. The purpose of this study was to examine the passive stretch response of the pectoralis major during shoulder abduction after RT for breast cancer.

METHODS: The sternocostal region of the pectoralis major was examined in 18 breast cancer survivors 12-60 months after completing RT (mean ± SD age 57.4 years, height 163.6 ± 7.1 cm, 77.3 ± 10.2 kg) and 18 age-matched cancer-free controls (age 59.3 ± 9.1, height 163.4 ± 6.0 cm, 60.7 ± 10.4 kg). Ultrasound shear wave elastography images were obtained in increments of 5° shoulder abduction as participants remained relaxed. Shear wave velocities (SWV) were extracted from these images as a measure of muscle stiffness. Slack angle, SWV at slack (SWV0) and elasticity coefficient were determined from a piece-wise exponential model fitted to the SWV-joint angle curve (3). Differences between the groups for these parameters were examined with an independent two-sided t-test. Joint angles were normalised to 100%ROM, starting at the slack angle. SWVs were extracted for joint angles at intervals of 10%ROM using non-linear interpolation. A repeated-measures ANOVA tested if SWVs differed between the two groups (between-subjects factor) and joint angles (within-subjects factor).

RESULTS: Slack angle was similar (p = 0.84) between groups (breast cancer group: 49.4 ± 16.0°; control group: 50.7± 20.5°). SWV0 was significantly greater (p = 0.016) for the breast cancer group (2.41 ± 0.46 m/s) than the control group (2.1 ± 0.26 m/s). There was no difference (p = 0.36) in the elasticity coefficient between the breast cancer (0.0073 ± 0.0026)

and the control group (0.0065 ± 0.002). SWVs increased significantly with an increase in joint angle from slack angle onwards for both groups ($p < 0.001$), with greater SWVs for the breast cancer group than the control group ($p = 0.02$).

CONCLUSION: Higher SWVs in the breast cancer group throughout the examined abduction ROM indicate increased stiffness of the pectoralis major after RT for breast cancer, which is likely due to radiation-induced muscle fibrosis. However, slack angle and elasticity coefficient did not differ between groups suggesting that the stretch response of the pectoralis major is not altered. Therefore, higher pectoralis major muscle stiffness after RT may not contribute to limitations in abduction ROM commonly observed in breast cancer survivors.

References

(1) Johansen et al. Acta Oncol, 2014.

(2) Lipps et al. Sci Rep, 2019.

(3) Wolfram & Lipps. J Biomech, 2023.

Oral Presentations

OP-PN15 Hypoxia I

NEAR-INFRARED SPECTROSCOPY MUSCLE REOXYGENATION KINETICS ARE SLOWED WITH INCREASING EXERCISE INTENSITY IN AN INCREMENTAL CYCLING TEST: COMPARISON BETWEEN MUSCLE SITES

JEM, A., YOGEV, A., NELSON, H., KOEHLE, M.S.

UNIVERSITY OF BRITISH COLUMBIA

INTRODUCTION: Near-infrared spectroscopy (NIRS) is used to indicate the balance of local oxygen (O2) delivery and O2 uptake in exercising muscle. Muscle oxygen saturation (SmO2) generally decreases proportionally to exercise intensity and duration, and increases during recovery. Reoxygenation represents a relative excess in O2 delivery during recovery while O2 uptake declines as the local metabolic milieu is restored. Reoxygenation is typically evaluated in a single working muscle, where SmO2 will reach peak values above resting baseline (hyperaemia) within 1-3 minutes after maximal exercise. We sought to compare reoxygenation kinetics between working and accessory muscles during an incremental cycling exercise step test (IET) as a function of increasing intensity. We hypothesised that reoxygenation would be faster in working muscle, slower in accessory muscle, and slower overall with increasing intensity.

METHODS: Twenty-one trained cyclists (10 F, 11 M) performed two IET trials at 1.0+0.5 W·kg-1 per 5-min stage, with 1 min rest between stages, to maximal tolerance. Moxy NIRS sensors (Fortiori Design LLC, Hutchinson, MN, USA) were placed on vastus lateralis (VL), rectus femoris (RF), erector spinae (ES), and deltoid (DL) muscles. Reoxygenation kinetics were evaluated during rest intervals as the time to recover half the SmO2 amplitude from the end of work to the peak SmO2 value (half recovery time, HRT in seconds). A linear mixed effects model was used to analyse HRT with fixed effects for trial, relative intensity (% peak workload), and muscle site, with random effects of slope and intercept by participant. Post hoc estimated marginal means were contrasted across intensity at 50%, 75%, and 100%, and between muscle sites.

RESULTS: Reoxygenation kinetics were generally slower (HRT was greater) with increasing exercise intensity beyond 50% in the VL, RF, and ES muscles (each $p<0.01$), but not DL ($p>0.05$). VL had the lowest between- and within-participant variation and recovered faster than other sites (HRT model estimates [95% CI]: VL=9 [6, 11], 12 [9, 14], 17 [13, 21] sec at 50, 75, 100% intensity, respectively). RF, ES, and DL were progressively slower at all intensities ($p<0.001$), except for ES and DL at 100% (ES=38 [34, 42] vs DL=40 [36, 45] sec; contrast=3 [-3, 9] sec, $p=0.68$).

CONCLUSION: In a cycling IET, reoxygenation kinetics are faster in working muscle than accessory muscle, and generally slower overall as systemic metabolic demands increase with intensity. The VL is the primary working muscle in cycling and is consistently prioritised for recovery, as might be expected where motor recruitment and metabolic demand are highest. Slower recovery and higher variability in other muscle sites hint at heterogeneities in accessory muscle recruitment strategies and systemic competition for cardiac output. Integrating NIRS responses across working and accessory muscles may help to reveal more about local contributions and limitations to performance.

MAXIMUM END-EXPIRATORY BREATH-HOLDS DURING REPEATED SPRINT TRAINING: IS IT EFFECTIVE?

RABERIN, A., CARLETTA, M., FRANCHI, N., CITHERLET, T., MANFERDELLI, G., MILLET, G.P.

UNIVERSITÉ DE LAUSANNE: UNIVERSITE DE LAUSANNE

INTRODUCTION: Repeated sprint training in hypoxia (RSH) was shown as an effective method for enhancing repeated sprint ability. Since the required hypoxic device is not always available throughout a season or for each athlete, an alternative method called repeated sprint training with hypoventilation at low lung volume (RSH-VHL) was developed to induce a hypoxic stress. However, it also generates acidosis and hypercapnia. Recently, the concept of exercising with bouts of end-expiratory breath-hold until the voluntary breaking point (UBP) has been proposed, offering an even more hypoxemic and hypercapnic stimulus during high-intensity interval training, although this has not been applied specifically to repeated-sprints training.

Therefore, the objective of this study was to compare the physiological responses of repeated sprint training in normoxia (RSN), RSH-VHL, and repeated sprint training during end-expiratory breath-hold until the breaking point (RSH-UBP). Due to putative higher hypoxic and hypercapnic stress, we hypothesized a greater amplitude in stroke volume changes and muscle deoxygenation/reoxygenation (i.e., Tissue Saturation Index, TSI) during RSH-UBP compared to RSH.

METHODS: Ten healthy active men performed 3 sessions of sprint training (2 sets of 8 sprints with 5 min of rest between sets; exercise:rest ratio of 1:2) in a randomized order. Sprint duration was 10 s for RSN and RSH-VHL conditions, while it depended on the apnea duration for RSH-UBP. Pulse oxygen saturation (SpO2), gas exchange, cardiac hemodynamics, muscle oxygenation, and total work were continuously recorded during the sessions.

RESULTS: The time spent <96% of SpO2 (all $p<0.010$) and mean end tidal carbon dioxide pressure (all $p<0.001$) during the exercise bouts were higher in both RSH-VHL (81±65 s and 33.6±4.2 mmHg) and RSH-UBP (74±57 s and 32.9±3.5 mmHg) than in RSN (11±14 s and 27.8±4.2 mmHg). The pH similarly decreased from pre- to post-session between sprint modalities ($p=0.137$). Total work was lower ($p<0.001$) during RSH-UBP (33.1±5.8 kJ) compared to RSH-VHL (46.5±5.7 kJ) or RSN (47.4±6.0 kJ). Stroke volume and cardiac output did not differ between sprint modalities (all $p>0.4$). Amplitude in TSI changes was smaller ($p<0.050$) during RSH-UBP (7.0±4.3%) compared to RSH-VHL (10.3±6.0%) but not compared to RSN (10.3±7.1%).

CONCLUSION: While RSH-UBP induced a greater hypoxic and hypercapnic stress than RSN, no difference was observed when compared to RSH-VHL. The reduction in total work during RSH-UBP was attributed to participants inability to maintain long-enough apnea, leading to a decrease in sprint duration. Consequently, the muscle deoxygenation level during RSH-UBP appeared blunted.

In conclusion, acutely, RSH-VHL appeared as a more effective condition than RSH-UBP. Further interventional training studies comparing the two strategies are required to assess if RSH-VLH can better preserve training load and elicit consistent physiological adaptations.

ACUTE MOUNTAIN SICKNESS PREDICTION USING NOCTURNAL OXYGEN SATURATION-RELATED METRICS IN PREMATURELY-BORN HEALTHY ADULTS

NARANG, B., MANFERDELLI, G., MILLET, G., DEBEVEC, T.

JOŽEF STEFAN INSTITUTE

INTRODUCTION: Specific responses to hypoxia at rest and during exercise have been observed in healthy adults born preterm [1]. Nocturnal pulse oxygen saturation (SpO2) recordings, together with acute mountain sickness (AMS) assessment, could offer insights into the aetiology of prematurity-related altitude (in)tolerance.

METHODS: In this study, 12 pre-term (Mean±SD; age: 21±3 yr, BMI: 23±3 kg/m^2, gestational age: 29±2 wk) and 12 term-born (22±3 yr, 23±2 kg/m^2, 40±1 wk) male adults underwent an overnight normobaric hypoxic exposure equivalent to 4200 m. AMS was assessed using the Lake Louise scale 6 h after hypoxic room entry (9pm), and the following morning 1 h after waking (7am). Participants were classified as AMS+ if their total symptom score was ≥3, with a headache score ≥1 [2]. SpO2 was recorded continuously at 3 Hz at the fingertip. Data from 11pm to 5am were extracted, and mean SpO2 and proportion of the 6 h with SpO2<80% (TST80) were calculated. Desaturations were defined by rate (>0.1%/s), magnitude (≥2%), and total duration until re-saturation (≥10 s & ≤60 s) [2]. The cumulative desaturation areas above the curve, relative to each respective onset value, indicated the hypoxic burden (%min/h). Groups were compared using independent t-tests and Mann-Whitney U tests, and are reported as Mean±SD and Median[IQR], respectively. Receiver operating characteristic (ROC) analysis was used to indicate the predictive potential of SpO2 metrics for morning AMS incidence. The area under the ROC curve (AUC) is reported, representing the balance between true- and false-positive AMS classifications.

RESULTS: Before sleep, 9 term-born and 7 pre-term participants were AMS+. Upon waking, 5 term-born and 6 pre-term participants were AMS+. Nocturnal mean SpO2 was similar between the pre-term and term-born groups (77±3 vs 77±4%; $p=0.661$), as was TST80 (72±29 vs 70±27%; $p=0.879$). However, mean SpO2 and TST80 predicted morning AMS considerably better in the pre-term (AUC=0.889 and 0.944, respectively) than in term-born (AUC=0.457 and 0.571, respectively) participants. Pre-term adults experienced more desaturations (413[291] vs 122[209]; $p=0.008$), albeit shorter in average duration (17±2 vs 21±2 s; $p<0.001$). Pre-term participants also experienced a significantly greater hypoxic burden (32[26] vs. 7[25] %min/h; $p=0.039$). However, desaturation-related metrics did not predict morning AMS incidence accurately in the two groups separately or combined (all AUC<0.743).

CONCLUSION: These data indicate high predictive potential of composite nocturnal SpO2 metrics for AMS incidence in healthy adults born pre-term. However, while desaturations were more frequent in pre-term adults, inducing a greater hypoxic burden, they were neither predictive of AMS-related outcomes in pre-term participants, nor in their term-born counterparts.

References

[1] Narang et al (2022) Eur J Appl Physiol. 122(9), 1991-2003.

[2] Roach et al (2018) High Alt Med Biol. 19(1), 4-6.

[3] Taha et al (1997) Sleep. 20(11), 991-1001.

CONTROLLED MODERATE HYPOXIA ACUTELY PREVENTS PHYSICAL INACTIVITY-INDUCED PERIPHERAL BDNF DECLINE

DUDERSTADT, Y., SCHREIBER, S., BURTSCHER, J., SCHEGA, L., MUELLER, N.G., BRIGADSKI, T., BRAUN-DULLAEUS, R., LESSMAN, V., MUELLER, P.
UNIVERSITY HOSPITAL MAGDEBURG

INTRODUCTION: Brain-derived neurotrophic factor [BDNF] is a crucial mediator of cognitive abilities, like long-term memory. Previous investigations indicate that different factors (e.g., physical activity, nutrition, psychosocial stress, hypoxia) can influence blood BDNF levels in humans. Currently, there is inconsistency in the reported results concerning the effects of controlled and moderate normobaric hypoxia [NH] on BDNF. Therefore, we investigated the impact of passive exposure to NH on BDNF levels in blood serum and plasma, alongside its effects on cognitive functions.

METHODS: In a controlled crossover study 25 healthy adults (25.8±3.3yrs., 15 female) were randomly exposed to normoxia [NOR] and NH (80-85 % peripheral oxygen saturation [SpO2]). The experiment started with a passive 30-min supine rest under normoxic conditions followed by a 90 min continuation of passive NOR or NH. Serum and plasma blood samples were collected every 15 min for the entire exposure length of 120 min via peripheral venous catheter except for the final sample, which was taken simultaneously from the contralateral arm via butterfly needle. Heart rate and SpO2 were continuously measured. Before and after each exposure, cognitive tests of short-term memory, working memory and attention were performed.

RESULTS: The 30 min of passive rest under NOR reduced the blood serum ($p<.001$) and plasma ($p<.001$) BDNF levels significantly. An extension of passive NOR have resulted in a continued decline in blood serum BDNF levels after an additional 45 min ($p=0.18$). Likewise, plasma BDNF levels exhibited further reductions after 30 min ($p=.040$) and 90 min ($p=.005$). Under NH BDNF levels remained stable. The two methods of blood collection (peripheral venous catheter vs. butterfly needle) did not differ. Furthermore, no effects on short-term memory or working memory functions were observed following NOR or NH. However, significant improvements in attention were observed after both conditions.

CONCLUSION: As expected, exposure to a passive NOR leads to a reduction in BDNF levels in serum and plasma. However, 90 minutes of NH exposure has no such negative effect. There is also no acute negative effect on short-term memory, working memory or attention. These results can therefore serve as an initial basis for counteracting the decline in BDNF caused by physical inactivity with the help of controlled hypoxia. This study also shows the need for a standardized protocol for future studies determining BDNF levels determinations in blood.

Oral Presentations

OP-PN06 Molecular Biology and Biochemistry II

METHYLATION STATUS OF ACTN3 GENE: THE IMPACT ON INJURY RISK AND TIME-LOSS IN YOUNG BASKETBALL PLAYERS

JÒDAR-PORTAS, A., FORT-VANMEERHAEGHE, A.2, SACOT, A.1, FONT-LLADÓ, R.3, LÓPEZ-ROS, V.3, BARRETINA, J.4, ESTELLER, M.5, PRATS-PUIG, A.1, PLANS-SALAS, E.1
1.UNIVERSITY SCHOOL OF HEALTH AND SPORT , 2.RAMÓN LLULL UNIVERSITY; 3.UNIVERSITY OF GIRONA; 4.INSTITUTE FOR HEALTH SCIENCE RESEARCH GERMANS TRIAS I PUJOL; 5.JOSEP CARRERAS LEUKAEMIA RESEARCH

INTRODUCTION: The higher demands of the basketball game expose the athletes to some high injury risk situations. Gene variation is known to predispose athletes to injury, but also the epigenetic role has only recently been discovered. ACTN3 gene alteration has been related with deficiency in functional α-actinin-3, a key component of the skeletal muscle fast-twitch fibers. Although no single study has investigated the relationship between DNA methylation on ACTN3 gene with injury risk in basketball. The aims of the present study were (1) to compare the percentage of methylation of each ACTN3 CpG site between injured and non-injured players and (2) to investigate the relationship between the ACTN3 methylation and time-loss due to sport injuries.

METHODS: The sample included 57 young basketball players from 12 to 18 years old. The players were recruited from the youth teams of Bàsquet Girona club and performed three ninety-minute training sessions and a game per week. The experimental design of the DNA methylation study included a pre-test and a post-test assessment of salivary samples. The Illumina Methylation Epic Array v2.0 (Illumina) was used to analyse methylation status of 25 CpG sites within the ACTN3 gene. Injuries occurring throughout this period were recorded following the protocol outlined in the International Olympic Committee consensus and the OSICS classification system.

An independent sample t-test was used to compare the percentage of methylation of each ACTN3 CpG site between the injured and non-injured players. In the case of a not normal distribution, a Mann-Whitney test was used. The significance level was set at $p < 0.05$ and Cohens d was used to evaluate the effect size (values for d of ≤0.2, ≤0.5, and ≥0.8 are considered as small, medium, and large, respectively). Finally, Spearman's Rho correlation analysis was used to assess the relationship between methylation levels and time-loss. The protocol was approved by the ethics committee.

RESULTS: Significant differences in the percentage of DNA methylation levels between non-injured and injured basketball players were found at three CpG probes within the ACTN3 gene. Before the injury, the injured group showed hypomethylation on the cg20608119 probe ($p = 0.004$, $d = -0.912$, large differences) while after the injury, hypomethylation on the

cg10523820 (p = 0.004, d = -0.923, large differences) and hypermethylation on the cg18257026 (p = 0.042, d = 0.362, medium differences) probes were seen.

No significant relationship between pre-test methylation levels and time-loss were found. In contrast, at the post-test assessment a significant negative relationship between methylation levels and time-loss was found in cg10523820 (r = -0.416, p = 0.001).

CONCLUSION: Our preliminary data suggests that DNA methylation levels in ACTN3 differs between injured and non-injured young basketball players. Those epigenetic alterations seem to indicate that hypomethylation in ACTN3 could be related with more time-loss.

THE INFLUENCE OF SEX ON EXERCISE-INDUCED NUCLEAR FACTOR ERYTHROID 2-RELATED FACTOR 2 AND DOWNSTREAM TARGETS

THORLEY, J., ALHEBSHI, A., MARTIN, N.R.W., BISHOP, N.C., BAILEY, S.J., CLIFFORD, T.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Nuclear factor erythroid 2-related factor 2 (NRF2) is a transcription factor that regulates cellular resistance against oxidative distress and inflammation by coordinating the expression of key antioxidant and anti-inflammatory proteins. Moderate-to-high intensity exercise has been reported to increase NRF2 activity via oxidative cysteine modification of kelch-like ECH-associated protein 1, leading to redox-specific training adaptations. It is unknown, however, whether changes in exercise induced NRF2 and its downstream targets can vary depending on sex. Previous research has postulated that NRF2 activity is sensitive to oestrogen, which is greater in females vs. males. Thus, the aim of the study was to investigate whether NRF2 responses to an eccentric-heavy, plyometric-type exercise protocol. known to increase NRF2 activity, differed between males and females. It was hypothesised that exercise would increase NRF2 activity to a greater extent in females than in males.

METHODS: 22 males and females (mean [SD]: age: 25 [6] years, height: 171.3 [10.4] cm, weight: 69.6 [12.3] kg), who identified as recreationally active, performed 100 drop jumps from a 0.6 m box, followed by 50 squat jumps. NRF2/antioxidant response element (ARE) binding in peripheral blood mononuclear cells, and antioxidant and inflammatory markers influenced by NRF2 (glutathione peroxidase [GPX], interleukin-6 [IL-6], tumour necrosis factor-α [TNF-α], matrix metalloproteinase-9 [MMP-9], vascular cell adhesion molecule-1 [VCAM-1], total leukocytes, neutrophils, monocytes) were measured pre-, post-, and 1 h post-exercise. A 2 (sex) x 3 (time) linear mixed model was performed to detect time, group, and interaction effects. A statistical level of $p < 0.05$ was accepted.

RESULTS: NRF2/ARE binding did not significantly alter following exercise (p=0.59) and there were no sex differences at rest (MALES: 0.047±0.027; FEMALES: 0.045±0.018), post- (MALES: 0.047±0.028; FEMALES: 0.035±0.012), and 1 h post-exercise (MALES: 0.042±0.021; FEMALES: 0.037±0.020) (p=0.17). Regarding NRF2 gene targets, GPX activity did not change post-exercise (p=0.74) and did not differ between sexes (p=0.61). IL-6 and TNF-α did not increase post-exercise (p>0.05 for both) but were lower in females vs. males (p<0.01 for both). MMP-9 increased post-exercise (p=0.02), but no differences between sexes were found (p=0.27). VCAM-1 was unchanged after exercise (p=0.38) and did not differ between sexes (p=0.11). Total leukocytes, neutrophil, and monocytes all increased post-exercise (p<0.01 for all); neutrophils were lower (p<0.01), and monocytes higher (p=0.03) in females vs. males.

CONCLUSION: There were no sex differences in exercise-induced NRF2 activity, however, several inflammatory markers displayed sex-specific differences, independent to NRF2. This highlights the possibility of differential immune responses following exercise in males and females, which could impart variability in exercise recovery and training adaptations.

INDIVIDUAL MUSCLE HYPERTROPHY RESPONSES TO OVERLOAD PROGRESSION MODELS ARE NOT EXPLAINED BY CHRONIC CHANGES IN MYONUCLEI, SATELLITE CELLS, PROTEOLYSIS AND EXTRACELLULAR MATRIX REMODELING MARKERS

SCARPELLI, M., BERGAMASCO, J.1, CHAVES, T.1, GODWIN, J.2, MESQUITA, P.2, SILVA, D.1, DIAS, N.1, BITTENCOURT, D.1, UGRINOWITSCH, C.3,4, ROBERTS, M.2, LIBARDI, C.1

1 FEDERAL UNIVERSITY OF SAO CARLOS, BRAZIL, 2 AUBURN UNIVERSITY, USA, 3 UNIVERSITY OF SAO PAULO, BRAZIL, 4 UNIVERSITY OF TAMPA, USA

INTRODUCTION: The progression of overload in resistance training (RT) programs is traditionally performed by adjusting the load to a repetition maximum zone (LOAD). Yet, using a within-subject design, our group has shown that the progression of overload through increases in repetitions (REPS) promotes similar muscle hypertrophy compared to LOAD (1). Interestingly, despite group means results, some individuals showed greater gains in response to REPS. It is possible that this protocol may be differentially impacting mechanisms associated with muscle hypertrophy compared to LOAD. Our aim was to investigate if a higher responsiveness to REPS can be associated with changes in myonuclei and satellite cell content, proteolysis-related biomarkers and extracellular matrix (ECM) remodeling factors.

METHODS: Thirty-seven previously untrained young men (19) and women (18) had their legs randomized to one of two protocols: increasing load (LOAD) or repetitions (REPS). Participants underwent 10 weeks of RT. Vastus lateralis muscle cross-sectional area (CSA) ultrasound assessments and muscle biopsies were performed pre- and post-training period. Based upon the CSA responsiveness criteria we identified and analyzed a subcluster of 12 participants who were high-responders to REPS, i.e. between-legs difference in muscle hypertrophy was greater than twice the coefficient of variation calculated from the typical error (5.67%). We used immunohistochemical analyses to assess myonuclei and satellite cell

content; luminescence assays for measures of enzymatic activity; and western blotting for assessing protein contents of proteolysis and ECM remodeling biomarkers.

RESULTS: As per design, REPS promoted greater increases in CSA than LOAD (P = 0.004), with no differences in volume load (P = 0.93). Whilst controlling for pre values, the analysis of covariance showed no differences between REPS and LOAD for the relative change in: the content of myonuclei (P = 0.33) and satellite cells (P = 0.93); enzymatic activity of calpain (P = 0.47), proteasome (0.68) and MMP (P = 0.71); and protein content of calpain 1 (P = 0.92), calpain 2 (P = 0.71), 20S proteasome (P = 0.47), polyubiquitinated proteins (P = 0.87), P62 (P = 0.21), MMP9 (P = 0.58), MMP14 (P = 0.96) and TIMP2 (P = 0.07). There was a difference in the relative change of protein content of TIMP1 (P = 0.029), which was greater for LOAD compared to REPS.

CONCLUSION: Our results highlight that some individuals showed greater muscle hypertrophy gains after REPS, regardless of accumulating similar volume load in both protocols. This suggests individual manipulation of overload may improve responsiveness to training. However, different overload progression models do not differentially affect the chronic response of myonuclei, satellite cells, proteolysis-related biomarkers and ECM remodeling factors to RT.

REFERENCE:

1. Chaves et al. Effects of resistance training overload progression protocols on strength and muscle mass. Int J Sports Med. 2024.

Oral Presentations

OP-AP10 Talent Transfer

SUCCESSFUL TALENT TRANSFER OF GERMAN ELITE ATHLETES: REASONS AND MECHANISMS – AN INTERVIEW STUDY

SIENER, M., SCHMID, L., VOGT, T.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: In competitive sports, nations have an increased interest in identifying and developing talented athletes. However, only a handful of these gifted individuals make it to the top. This situation poses a challenge, especially for smaller countries with a potentially limited pool of promising athletes or budget. A talent transfer—meaning the transfer of already (semi)successful athletes to another sport—can be an opportunity to convert the support already made, ideally into a medal. However, clubs and associations often hesitate to release their athletes, having invested significant time and resources in them, which is not always in the interests of the athletes. Therefore, this study aims to identify motives and circumstances with a positive influence for a successful talent transfer.

METHODS: A total of seven German athletes (25±2 years; n♀=4) who had changed sports during their career were asked about their talent transfer using a guided interview. All participants are currently professional athletes, part of their national teams, and regularly compete internationally. The interviews focused on reasons for the switch, the transfer process, encountered challenges, differences between the original and new sports, and available support. The transcribed interviews were then analyzed using MAXQDA.

RESULTS: Interviewed athletes from the sports of gymnastics, athletics, volleyball, and swimming transitioned to pole vaulting, bobsledding, triathlon, rowing, or ski freestyle aerials at an average age of 19. Common reasons for switching included lack of motivation, enjoyment, or prospects for international success in their original sport. The athletes emphasized an importance of family support and noted similar physiological demands in the switched-to sport being helpful. Technical challenges were mitigated through gentle introduction with less pressure. The athletes supported a talent transfer but expressed concerns about the absence of organized programs in Central Europe and pointed in particular to the lack of support from clubs and associations for athletes switching sports.

CONCLUSION: Overall, there are a variety of possible reasons for a positive talent transfer. However, according to the athletes interviewed, similar physical abilities and a basic understanding of the fundamentals of the target sport appear to be crucial for a successful talent transition. Other studies show, such alignment can lead to rapid performance improvements, further endorsing successful talent transfers (Cury et al., 2022, doi: 10.1080/23750472.2022.2033638). In addition, there are already confirmed motivational and psychological effects that can ultimately be the cause of making a talent transfer (MacNamara, & Collins, 2015, doi: 10.1080/02640414.2014.908324). Although there are already promising talent development programs in Australia and Canada, the extent to which these can also be established in Germany and prevail against internal club interests remains to be investigated.

THE EFFECTS OF 10 WEEKS POLARIZED TRAINING ON THE CAPABILITY OF SHORT-DISTANCE SPRINT SKIING OF ELITE MALE TALENT-TRANSFERRING CROSS-COUNTRY SKIERS

CAI, X., MAO, L.2, CHEN, X.3

1 NANJING NORMAL UNIVERSITY; 2 SHANGHAI UNIVERSITY OF SPORT; 3 CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Polarized training model could improve endurance performance of elite endurance athletes, and being used widely on modern cross-country (XC) skiing training [1,2]. In XC skiing competition, the short distance skiing competi-

tion demanding athletes need be both strong physiologically and tactically [3]. Aiming for XC skiing success at the Winter Olympic Games (WOG), China has developed a talent transfer program in which athletes from various summer sports by utilizing world class coaching and training methods [4]. However, the effects of long period polarized training on the capability of short-distance sprint skiing of elite male talent-transferring XC skiers are not clear.

METHODS: 10 elite male talent-transferring XC skiers [Age: (19.9±1.4) years old; Height: (178.5±4.3) cm; Weight: (70.0±5.6) kg; VO2peak: (78.8±6.1) ml·min-1·kg-1] of Chinese national XC skiing team took part in 10 weeks polarized training. 3 times XC short-distance sprint competition (the 1st, 6th and 10th week) and 3 times skiing-ergometer & watt-bike testing [the 1st (Week 3), 2nd (Week 4) and 3rd (Week 8) test] were organized during the 10 weeks training period. Training time and intensity were calculated on basis of recordings from heart rate (HR) monitors (Garmin 255, Garmin Ltd., USA) during 10 weeks training. Repeated-measures ANOVA test was used to compare athletes themselves between tests or competitions (the 1st test / Week 1 competitions, the 2nd test / Week 6 competitions, the 3rd test / Week 10 competitions). Significance was set at $P<0.05$.

RESULTS: Compared with the 1st test, the athletes' 5 groups average power output per kilogram of the 1.5 min and 1 min skiing-ergometer test were increased significantly (3.4%, 6.0% respectively; $P<0.05$) in the 3rd test. Compared with the competition results of the free technique and classic technique of the 1st week, the athletes' average time of qualification and quarter final were decreased significantly both in the Week 6 and Week 10 (Week 6, free 3.7%\3.9%, classic 1.0%\1.4%; Week 10, free 4.8%\3.8%. classic 1.8%/1.4%; $P<0.05$).

CONCLUSION: After 10 weeks polarized training, the athletes' capability of XC skiing-specific power output and competition performance of short-distance sprint skiing were increased significantly. In the future training, it is suggested that Chinese elite talent transferring XC skiers should add the running formed high intensity training (HIT) into training schedule, and insistent systematical XC skiing specific strength training and skiing-ergometer formed HIT sessions, to improve the capability of maximal oxygen uptake, continuously power output under high intensity, XC skiing specific strength and XC skiing specific power output.

1. Billat et al. (2001) 2. Sandbakk et al. (2017) 3. Sandbakk & Holmberg (2011) 4. Cai et al. (2021)

NORDIC HAMSTRING EXERCISE: PEAK FORCE, ASYMMETRY AND THEIR DISTRIBUTION IN TOP-CLASS ADULT AND YOUNG FEMALE SOCCER PLAYERS

FRANCINI, L., RIBOLI, A., MAURELLO, F., SALVADOR, S., BOLDRINI, L., MAZZONI, S.

AC MILAN S.P.A.

INTRODUCTION: Several studies (1) suggested eccentric peak force (PF) and inter-limb asymmetry during Nordic hamstring exercise (NH) as factors possibly affecting hamstring injury risk (2). However, the information about PF and asymmetry during NH in top-class women soccer players are still lacking. Therefore, the current study aims to describe the PF and asymmetry during NH in adult and young female soccer players.

METHODS: One hundred and thirty-two female soccer players were involved (n=24 PRO, n=38 U19, n=33 U17, n=37 U15). After a standardized warm-up, NH were performed using a dedicated dynamometer (NordBord VALD, Australia). The injured players were excluded from data collection for at least 1 month after their return to team training; players with a severe hamstring injury during the previous 2 seasons were excluded. A total of 515 NH with ~7 (range: 5 to 19) NH for each player were collected. The PF was measured for each leg and for determining the weaker and the stronger leg. The inter-limbs asymmetry was calculated for both absolute (Newton, N) and relative (percentage, %) values using the following formula [absolute asymmetry = (strong leg - weak leg)] and [relative asymmetry = ((strong leg - weak leg) / (strong leg + weak leg)) * 100], as suggested in previous studies (3). The PF and asymmetry distributions are presented in terms of centiles (i.e. which describe the typical variation in the population). In a Gaussian distribution, some centiles correspond to the standard deviations of the sample (4). Therefore, the 50th (median), 84.13th (+1 SD), 97.72nd (+2 SD), 99.87th (+3 SD) percentiles were calculated (4). A t-test was used for comparisons between PF in weak vs strong leg; statistical significance was set at $P < 0.05$.

RESULTS: The 50th, 84.13th, 97.72nd and 99.87th percentiles for PF and asymmetries were calculated. The 50th percentile for PF and asymmetries were ~287 to ~312 N with 17.1 N (~2.8%) asymmetry in PRO, ~266 to ~281 N with 15.5 N (~2.9 %) asymmetry in U19, ~241 to ~364 N with 17.5 N (~3.5%) asymmetry in U17, ~204 to ~219 N with 13.7 N (~3.3 %) asymmetry in U15. The average PF was higher in strong than weak leg ($P<0.001$) in PRO (320±76 vs 295±70 N for strong vs weak leg, respectively), in U19 (283±41 vs 264±40 N), in U17 (260±36 vs 240±35 N) and in U15 (218±36 vs 203±35 N).

CONCLUSION: The present study describes the PF and asymmetry during NH in PRO, U19, U17 and U15 female soccer players. This information may help coaches and performance scientists for NH players' profiling and hamstring exercise prescription during training routine. The current results might be considered as a descriptive analysis of PF and asymmetries during NH exercises in elite women soccer population across different age-categories. The current results may open to further investigation about the association between PF and asymmetry during NH and hamstring injury risk in women's soccer.

1.Rudisill, et al (2003) 2. Ekstrand, et al (2023) 3. Parkinson, et al (2021) 4. Brook, et al (1982)

PERFORMANCE CHANGES OVER TWO YEARS IN ELITE AEROBIC GYMNASTS TRANSITIONING FROM JUNIOR TO SENIOR CATEGORY

KYSELOVICOVÁ, O., KOTYROVÁ ŠTEFÁNIKOVÁ, G., ZEMKOVÁ, E.
COMENIUS UNIVERSITY IN BRATISLAVA

INTRODUCTION: Our preliminary case study revealed that an elite aerobic gymnast improved in the ability to maintain balance in dynamic conditions and repeated rebounds over two years of training. We were interested in whether and to what extent these changes in the key abilities of an aerobic competition routine would be reflected in a group of athletes. This study compares two-year changes in dynamic balance, explosive power and muscular endurance of lower limbs, isokinetic leg muscle strength, and anaerobic performance in elite aerobic gymnasts during their transitions from junior to senior category.

METHODS: A group of 8 aerobic gymnasts (age 16.2±2.5 y; height 164.1±2.7 cm; body mass 56.0±2.7 kg) performed a postural coordination test, Y-Balance test, countermovement jumps, 60 s test of repeated jumps, an isokinetic leg muscle strength test, and the Wingate test. Performance changes over two years of training were evaluated using a t-test with the significance level set at $p \leq 0.05$. The magnitude of the effect size was evaluated using Cohen's d.

RESULTS: Postural coordination improved by 31.3% (d=1.8) after two years of aerobic gymnastics training. Overall postural strategy index also increased from an average value of 7.2 to an excellent value of 8.1 (d=1.2). Distance reached in the Y-Balance test by the dominant leg increased in anterior (6.3%, d=0.5) and posteromedial (5.5%, d=0.7) directions, and by the non-dominant leg in anterior (by 6.6%, d=0.9) and posteromedial (3.5%, d=0.7) directions. The composite score of both the dominant and non-dominant leg also increased (6.0%, d=0.9, and 4.0%, d=0.7 respectively). Furthermore, the fatigue index in the 60 s test of repeated jumps decreased (from 37.0% to 28.9%, d=0.2). In addition, total work increased during dominant and non-dominant leg extension (12.2%, d=1.2, and 12.5%, d=1.3 respectively) as well as leg flexion at 300°/s (9.4%, d=0.6, and 4.2%, d=0.5 respectively). Similarly, mean power increased during dominant and non-dominant leg extension (15.5%, d=1.2, and 14.5%, d=1.2 respectively) as well as leg flexion at 300°/s (11.7%, d=0.5, and 12.0%, d=0.6 respectively). Peak torque/body weight ratio increased during dominant leg extension at 60°/s (15.3%, d=0.5) and dominant leg flexion at 300°/s (6.0%, d=0.7). However, two years of training failed to show any significant improvements in the explosive power of lower limbs and anaerobic performance.

CONCLUSION: These findings indicate that general aerobic gymnastic training without any specific inputs leads to performance improvements, namely in abilities closely related to competition routines such as dynamic balance, flexibility, and strength endurance of lower limbs.

Acknowledgment: This work was supported by the Scientific Grant Agency of the Ministry of Education, Research, Development and Youth of the Slovak Republic and the Slovak Academy of Sciences (No. 1/0725/23 and No. 1/712/24).

ANTHROPOMETRIC AND PHYSICAL PERFORMANCE DETERMINANTS OF YOUNG TENNIS PLAYERS PROGRESSING THROUGH A TALENT IDENTIFICATION AND DEVELOPMENT PROGRAMME

CHAPELLE, L., DHONDT, J., DHONDT, E., CLARYS, P.
VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: Talent identification and development (TID) programs attempt to discover and develop young athletes with the potential to become successful (professional) athletes. This study examined the influence of both anthropometric and physical performance determinants on the likelihood to be selected to progress through a TID programme in youth tennis.

METHODS: Data were collected in 538 young tennis players (323 males and 215 females) from six age categories (U8-U13). A principal component analysis was used to generate 1 anthropometric determinant (based on body height, body weight and maturity offset) and 4 physical performance determinants: speed and agility (based on 5 m sprint, 20 m sprint and 505 change of direction test); jumping power (based on standing broad jump and standing broad jump in series); motor coordination (based on balancing backwards and jumping sideways) and tennis ball control (based on a throw and catch test and hold tennis ball up test). For all determinants, tertiles were generated for every age category and both sexes separately. Univariate binary logistic regressions were performed to examine the influence of each determinant on the chances to be selected to progress in the TID programme.

RESULTS: Significant odds ratios were found for all included anthropometric and physical performance determinants ($p<0.05$), ranging from 0.26 to 7.50 in the male young tennis players and from 0.18 to 6.87 in the female young tennis players. The included determinants influenced selection chances mostly in the early age categories (U8-U10) as opposed to the later age categories (U11-U13).

CONCLUSION: Future research should examine the influence of additional determinants (such as tennis (match-play) performance) on the selection chances to progress through a TID programme.

Oral Presentations

OP-MH04 Physical activity for individuals with disabilities

CHANGING BEHAVIOUR TOWARDS AEROBIC AND STRENGTH EXERCISE: RESULTS OF A RANDOMISED, PHASE I STUDY DETERMINING THE SAFETY, FEASIBILITY, AND CONSUMER-EVALUATION OF AN ONLINE EXERCISE PROGRAM IN PERSONS W

LEARMONTH, Y., KAUR, I., BAYNTON, S., WHITE-KIELLY, A., WALL, B., PAUL, L., FAIRCHILD, T.

MURDOCH UNIVERSITY; MURDOCH UNIVERSITY; MURDOCH UNIVERSITY; MURDOCH UNIVERSITY; GLASGOW CALEDONIAN UNIVERSITY; MURDOCH UNIVERSITY

INTRODUCTION: Many people with MS do not meet the recommended exercise guidelines to elicit health benefits. Programmes combining exercise prescription and behaviour change coaching lead to optimal outcomes. This study aimed to determine the feasibility, safety and participant evaluation of an exercise intervention, based on recent exercise guidelines and principles of behaviour change, delivered online to persons with MS.

METHODS: Seventy-two participants (age: 43.3 ± 13.3 years; mean ± SD) with mild to moderate MS were stratified according to previous exercise behaviour, and block-randomised into one of three groups: Control (CON; n=24), General Exerciser, (GE; n=24), and Advanced Exercisers, (AE; n=24). GE and AE received a four-month online-supervised exercise program including aerobic, resistance, balance, and flexibility training based on behaviour change theory. Participants completed questionnaires at baseline, four months, five months and eleven month. Process (e.g., recruitment), resources (e.g., monetary cost), management (e.g., staff time), and scientific (i.e., safety, outcomes, and participant evaluation) feasibility were assessed.

RESULTS: Of 198 potential participants, 143 met the eligibility criteria (72%) and 72 participants were randomised. Fifty-three participants completed the intervention (74% immediate retention), and 44 participants were retained at the six-month follow-up (61%). Personnel time was 369 hours, and the total per participant cost for the study is AUD $1036.20, including personnel costs. Adherence rate was 60% (GE), and 83% (AE) and self-reported online compliance was 73% (GE) and 38% (AE) of the prescribed exercise sessions. When considering safety (e.g., number of participants experiencing a change in MS symptoms) there were no differences in safety outcomes when comparing GE (n=9), AE (n=10) and control (n=10) participants.

CONCLUSION: We conclude that it is feasible, safe, and efficacious to deliver a remote exercise program with updated exercise guidelines and embedded with behaviour intervention to persons with mild-to-moderate MS. Future research should focus on determining the feasibility and acceptability of exercise prescription combined with behaviour changes to meet the recent guidelines at a wider scale across other MS populations, and to consider the feasibility of similar exercise programme delivery across neurological populations.

HEALTH-RELATED QUALITY OF LIFE ASSOCIATED WITH FATIGUE, PHYSICAL ACTIVITY AND PACING IN ADULTS WITH CHRONIC CONDITIONS

BARAKOU, I., SEVES, S., ABONIE, U., FINCH, T., HACKETT, K., HETTINGA, F.

NORTHUMBRIA UNIVERSITY

INTRODUCTION: Fatigue and inactivity are linked to decreased health-related quality of life (HRQoL) in adults with chronic conditions. A multidimensional approach to activity pacing targeting physical, psychological, and social factors holds promise for improving HRQoL through promoting physical activity engagement and alleviating fatigue. A transdiagnostic approach to fatigue in adults with chronic conditions is crucial, especially when underlying causes are unknown. Such approaches offer a comprehensive understanding of fatigues multidimensionality, valuable for researchers and clinicians. This study aimed to examine (1) associations between HRQoL and indices of fatigue and pacing in adults with chronic conditions, including perceived fatigue, engagement in pacing, perceived risk of overactivity, physical activity (self-reported & device-based), self-regulation of physical activity, and (2) if these associations are different for the subscales physical, social, emotional, and functional well-being.

METHODS: Survey and ActiGraph (7 days) data of 66 adults with chronic conditions, experiencing fatigue, were collected. Multivariable linear mixed model analyses were performed. First, HRQoL was the dependent variable, and one of the six indices of fatigue and pacing factors was the independent variable together with confounders: pacing groups, gender, age, body mass index (BMI), duration of condition, and years of fatigue management advice. Second, interaction effects with the HRQoL domains (physical, social, functional, and emotional well-being) were added to the models.

RESULTS: HRQoL was significantly associated with fatigue(B=-7.82; p=<.001), engagement in pacing(B=-.23; p=.006), self-regulation of physical activity(B=0.11; p=.013), and self-reported physical activity(B=1.32; p=.046), when corrected for confounders. Significant interaction effects were found in the models with fatigue, engagement in pacing, perceived risk of overactivity, and self-reported and device-based physical activity.

CONCLUSION: Reduced fatigue is associated with enhanced HRQoL, while corrected for confounders, stressing the significance of effective fatigue management. Higher levels of self-regulatory behaviour in physical activity, corrected for confounders, and increased physical activity are linked to enhanced HRQoL, emphasising the benefits of appropriate physical activity behaviours. Lower levels of fatigue, more engagement in pacing and higher levels of physical activity have a

greater impact on the physical subscale of HRQoL compared to the other subscales. Higher levels of perceived risk of overactivity and physical activity have a greater impact on the social subscale of HRQoL. The overall findings provide insights into the relationships between fatigue, pacing, self-regulation, physical activity, and their associations with HRQoL and well-being aspects underscoring the importance of a multidimensional approach to fatigue management.

EFFECTS OF A MULTICOMPONENT EXERCISE INTERVENTION ON CARDIOMETABOLIC RISK FACTORS IN CHILDREN AND YOUNG ADULTS WITH CP: A CROSS-OVER TRIAL

SAVIKANGAS, T., VALADÃO, P.F.1, HAAPALA, E.A.2, JUUTINEN FINNI, T.1
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Adults with cerebral palsy (CP) have a higher risk of cardiometabolic diseases compared to the general population, but it is unknown whether this risk is elevated already in childhood and young adulthood. In addition, the evidence on the effects of exercise on cardiometabolic risk in young people with CP is limited. Therefore, we investigated the effects of a multicomponent exercise intervention on cardiometabolic risk factors in children and young adults with CP and compared this risk to typically developing (TD) controls.

METHODS: The EXECP study included 13 males and 5 females, aged 9–22, with CP and 17 age- and sex-matched TD controls. The participants in the CP group were measured at baseline, after a 3-month control period and after the 3-month EXECP intervention. TD participants were measured twice during the control period, without participating in the intervention. The intervention consisted of supervised, progressive, and individualized strength, walking, and flexibility training 2–3 times/week, along with treadmill walking at home for 10 min/day with a focus on stepping. Body weight, whole-body fat percentage, and skeletal muscle mass index (kg/m2) were measured using bioimpedance. Systolic and diastolic blood pressure and pulse wave velocity were measured in a supine position from the left arm with an oscillometric device. Plasma LDL and HDL cholesterol, triglyceride, and glucose levels were assessed from fasting blood samples. Between-group differences in the first measurement were analyzed with independent samples t-tests and Mann-Whitney U tests. Within-group changes in cardiometabolic risk factors were analyzed using age- and sex-adjusted linear mixed-effects models, in which the participant was included as a random effect.

RESULTS: Participants with CP had 1.0 kg/m2 lower skeletal muscle mass index ($p=0.040$) and tended to have 0.4 m/s higher pulse wave velocity ($p=0.062$) compared to TD controls. During the control period, body weight increased by 1.9 and 0.9 kg in the CP and TD groups, respectively ($p\leq0.05$). In addition, pulse wave velocity decreased ($\beta=-0.44$, $SE=0.16$), and whole-body fat percentage ($\beta=1.22$, $SE=0.72$), skeletal muscle mass index ($\beta=0.13$, $SE=0.07$), and blood glucose ($\beta=0.18$, $SE=0.10$) tended to increase in the CP group. During the intervention, no statistically significant changes were observed in any cardiometabolic risk factor in the CP group.

CONCLUSION: Children and young adults with CP did not differ from their TD peers for most cardiometabolic risk factors. Still, lower skeletal muscle mass index may predispose them to functional limitations and higher pulse wave velocity to elevated cardiovascular disease risk. The three-month exercise intervention focusing on strength training and gait quality was not successful in lowering cardiometabolic risk in children and young adults with CP. Longer duration and greater volume and intensity of aerobic exercise may be needed.

RELIABILITY OF THE BROCKPORT PHYSICAL FITNESS TEST IN COLOMBIAN BOYS, GIRLS AND ADOLESCENTS WITH INTELLECTUAL DISABILITIES AGED 10 TO 17 YEARS

CAMARGO ROJAS, D.A., ROJAS CANO, L., HERNANDEZ ALVAREZ, H., MEDINA ARIAS, C., MEDINA GARZÓN, P.M.
UNIVERSIDAD NACIONAL DE COLOMBIA

INTRODUCTION: The Brockport Physical Fitness Test Battery (BPFT) is an assessment tool designed for children and adolescents with intellectual disabilities (1), which has been used nationally (2) and internationally (3) to determine the level of physical fitness. The instrument lacks reliability values for the Spanish-speaking population, hindering the development of intervention programs with health benefits (4) and public policies aimed at promoting physical activity and exercise. This research aimed to determine the reliability of the Brockport Physical Fitness Test Battery in children and adolescents aged 10 to 17 years with intellectual disabilities.

METHODS: An assessment of the BPFT was conducted, including tests for body fat percentage, the sum of triceps and calf skinfolds, grip strength, push-ups, modified sit-ups, trunk lift, backsaver sit-and-reach, shoulder stretch, and PACER, on 56 children and adolescents with intellectual disabilities, aged 10 to 17 years, belonging to 2 educational institutions in the city of Bogotá, Colombia. The assessment was carried out by 4 expert evaluators at 3 different times; internal consistency analysis was performed using Cronbachs Alpha coefficient, test-retest analysis established the Intraclass Correlation Coefficient (ICC) and Spearman coefficient, as well as intra-evaluator reproducibility. Lastly, Cohens Kappa coefficient and ICC were calculated for inter-evaluator reproducibility analysis.

RESULTS: Acceptable levels of reliability were observed for the BPFT. Internal consistency obtained a Cronbachs Alpha >0.6 with the elimination of the PACER and modified sit-up items, ICC values >0.8, Spearman coefficient and ICC >0.9, and Cohens Kappa 1.0 corresponding to test-retest reliability, intra-evaluator reliability, and inter-evaluator reliability for each of the items composing the instrument.

CONCLUSION: The BPFT is a reliable and reproducible instrument for children and adolescents with intellectual disabilities in Colombia. It is recommended to review the selection of the modified sit-up item due to the risk of injury and its contribution to the construct of physical fitness for health. Also, it was observed from this research that certain elements of the test

do not contribute to the internal consistency of the instrument or to the construct of physical fitness for health in the population. Among them are the Modified Curl-up and the PACER, which have already been described by some authors as tests that have no validity or require familiarization by the participants.

EFFECTS OF PHYSICAL ACTIVITY HABITS IN CARDIOMETABOLIC HEALTH IN ADULTS WITH ACHONDROPLASIA

ALVES, I., CASTRO, M.A., TAVARES, S., ALVES, E., FERNANDES, O.
ÉVORA UNIVERSITY, PORTUGAL

INTRODUCTION: Achondroplasia (ACH) is a rare skeletal dysplasia characterised by short disproportionate stature, increased cardiovascular disease and tendency to obesity [1]. Reduced physical fitness, muscle strength and lung capacity have been reported in adults with achondroplasia (AwACH) [2]. The cardiorespiratory functional capacity is influenced by body size, physical activity level (PAL), and genetics [3]. We hypothesise that higher levels of regular physical activity are associated with better physical fitness, lower adiposity, and cardiometabolic optimization in AwACH.

METHODS: Participants performed a maximal treadmill exercise test to measure metabolic parameters: VO2max, peak VO2 (pVO2), peak ventilation (pV), maximum heart rate (maxHR), anaerobic threshold (AT), and functional Capacity (FC). Anthropometrics were collected and body composition parameters as fat mass (FM%), lean mass (LM%) and water (BW%) percentages, were estimated by bioimpedance. Physical fitness, with the 6 minutes walking test (6MWT) and strength test by handgrip strength (HGS) were performed. The International Physical Activity questionnaire (IPAQ) was self-administered to obtain a PA score (PAS) and PAL.

RESULTS: Seven AwACH, 4 women, mean age 37.3±11.9 years, body weight 53.7±15.2kg and height 129.0±13.9cm. Based on PAS (723±768 MET-min/week), two groups were identified: PAL1 (n=5) and PAL2 (n=2), inactive and minimally active, respectively. Multivariate analyses revealed PAL2 significantly outperformed PAL1 across functional exercise capacity and cardiovascular fitness indicators. Significant differences ($p<0.05$) existed between groups in favour of PAL2 on FC (3.924), pVO2 (2.847), VO2max (4.055), AT (2.564), 6MWT (3.03), PAS (3.176) and height (3.752). PAL2 participants showed lesser 15.52% FM% and 2.7bpm maxHR. Strong correlations ($p<0.001$) existed between HGS and pV (0.955), VO2max and PAS (0.967) and FM% (-0.842), indicating lower cardiometabolic risk, favouring PAL2. Other correlations ($p<0.01$) were found between pVO2 and HGS (0.939), bW (0.928) and LM with AT (0.873). VO2max predictors were identified: FM ($R2=0.709$) and 6MWT ($R2=0.699$), $p<0.01$.

CONCLUSION: These preliminary results show that increased PA is associated with cardiorespiratory function in AwACH, which can improve cardiometabolic health. Higher PAL showed association with lower FM% mass and maxHR. The 6MWT and HGS may represent surrogate markers of fitness and are promising clinical proxies for exercise tolerance in AwACH. Results provide insights in developing strategies to increase PA among AwACH for cardiometabolic optimization.

References

1.Hoover-Fong J, et al., Lifetime impact of achondroplasia. Bone. 2021 May; 146:115872.

2. de Vries O, et al., Physical fitness and activity level in Norwegian adults with achondroplasia. AmJMedGenet, 2021 Apr;185(4):1023-1032.

3.Mezzani A et al., Standards for the use of cardiopulmonary exercise testing for the functional evaluation. EJCardiov Prev Rehabil. 2009 Jun;16(3):249-67

Oral Presentations

OP-PN28 Exercise for postmenopausal women

ACUTE METABOLIC RESPONSES TO RESISTANCE TRAINING SESSIONS DIFFERING IN SET CONFIGURATION IN POSTMENOPAUSAL WOMEN.

NINE, I., RIAL-VÁZQUEZ, J.1, FARIÑAS, J.1, RÚA-ALONSO, M.1, REVUELTA-LERA, B.1, RIVERA-MEJÍA, S.L.1, CLAVEL, I.1, MÁRQUEZ, G.2, IGLESIAS-SOLER, E.1
UNIVERSITY OF A CORUNA / Q6550005J

INTRODUCTION: Postmenopausal women are more susceptible to encountering diverse metabolic disorders, often with changes in body composition, energy metabolism, muscle mass and strength reduction (1). Manipulation of set configuration modulates acute responses to resistance exercise (2) modifying the intensity of effort, by the redistributing of the repetitions and rest periods (3). This study aimed to compare acute metabolic responses to training sessions differing in set configuration in a sample of postmenopausal women.

METHODS: 50 physically active postmenopausal women participated in this study funded by the Spanish Ministry of Science and Innovation (PID2021-124277OB). Three resistance training (4 exercises) and a control session (CON) were randomized. The exercises were performed using a 12RM load, differing in set configuration while maintaining the same volume (36 repetitions): 9 sets of 4 reps (4S), 6 sets of 6 reps (6S), and 4 sets of 9 reps (9S). Inter-set rest intervals were 45, 72 and 120 seconds, respectively, ensuring an equivalent work-to-rest ratio.

Oxygen uptake (VO2), carbon dioxide production (VCO2) and respiratory exchange ratio (RER) were recorded before (PRE: 15min) and after (POST: 60min) each session and averaged over 10min intervals. Blood lactate concentration (La) was sampled before and 1min after session. A 4x7 ANOVA analyzed set configuration effects on energy expenditure responses over time (PRE: 5-10min; and POST: 0-10, 10-20, 20-30, 30-40, 40-50, 50-60min), and a 3x2 ANOVA assessed lactate levels (PRE and POST).

RESULTS: The analysis showed a main effect of session, moment and session×moment interaction (p=0.005) for VO2, RER and La.

Greater VO2 values were observed in 9S and 6S compared with CON (p=0.006), with a tendency of 4S to be higher than CON (p=0.059). Higher VO2 was recorded in the first 10min POST compared to PRE and subsequent intervals (p=0.002). VO2 was only increased after 9S (POST 0-10) compared with PRE (p<0.001). Compared to CON, VO2 POST remained higher in 9S until 40-50min of recovery (p=0.039); in 6S until 30-40min (p=0.014) and in 4S only for the first 10min (p=0.002).

Baseline RER values were similar across all sessions, with PRE > POST (p<0.001). Overall, CON showed higher values (p=0.036) than experimental sessions, with 9S recording the lowest values (p=0.037). La POST was significantly higher than PRE in all sessions, with greater values in 9S compared to 6S and 4S (9S>6S>4S) (p<0.001). For VCO2 only a time effect (p<0.001) was detected (POST 0-10 > the rest of periods).

CONCLUSION: By maintaining the same volume and work-to-rest ratio, no differences in total energy expenditure were found, however only long set configuration (9S) promoted VO2 increase immediately after exercise. Set configuration may modulate the metabolic response after strength exercise, with shorter sets promoting lower La compared with longer sets.

1) Ko et al., Nutrients, 2021

2) Kraemer et al., Curr Sports Med Rep, 2002

3) Iglesias-Soler et al., J Sports Sci

CARDIAC AUTONOMIC MODULATION AND BAROREFLEX SENSITIVITY IN POSTMENOPAUSAL WOMEN: ACUTE RESPONSES TO RESISTANCE TRAINING SESSIONS DIFFERING IN SET CONFIGURATION.

VAZQUEZ, J.R., RÚA-ALONSO, M., NINE, I., FARIÑAS, J., REVUELTA-LERA, B., RIVERA-MEJÍA, S.L., IGLESIAS-SOLER, E.
UNIVERSITY OF A CORUNA

INTRODUCTION: Hormonal changes of menopause impact on womens health (1). Resistance training is recommended on reducing the risk of cardiovascular disease (2), but manipulation of set configuration has been found to influence the acute decrease in cardiac parasympathetic modulation (3). The aim of this study was to explore cardiac autonomic modulation and baroreflex sensitivity after resistance training sessions differing in set configuration.

METHODS: 50 physically active postmenopausal women (37 normotensive-13 hypertensive) participated in this study funded by the Spanish Ministry of Science and Innovation (PID2021-124277OB). After a medical exam and familiarization, women completed in a randomized order one control (CON) and 3 experimental sessions (4 exercises): 9 sets of 4 repetitions with 45s of inter-set rest (9S); 6 sets of 6 repetitions with 72s of rest (6S) and 4 sets of 9 repetitions with 120s of rest (4S). Before and after each session, cardiac autonomic modulation [root mean square of differences between adjacent pulse interval (RMSSD), heart rate (HR), high frequency power (HF) and sample entropy (SampEn)], baroreflex sensitivity (BRS) and its effectiveness (BEI) was evaluated at rest.

4x10ANOVA was used to analyze the effects of set configuration across time for cardiac autonomic modulation (Baseline and post-sessions: 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-45, 45-50min). 4x5ANOVA was used to analyze baroreflex sensitivity (Baseline and post: 5-15, 15-25, 30-40, 40-50min).

RESULTS: No differences between normo- and hypertensive women were observed. CON values for all parameters were greater after sessions compared to experimental sessions (regardless HR, which was lower).

ANOVA detected a main effect of session, time, and session×time interaction (p<0.05) for RMSSD, HF, HR, BRS and BEI. The decrease of RMSSD and HF after 6S and 9S was greater compared to 4S (p<0.05). Compared to baseline, RMSSD was attenuated until 15min, 25min and 30min after 4S, 6S and 9S respectively (p=0.033). HF was decreased up to 20min, 25min and 30min after 4S, 6S after 9S respectively (p=0.016). Overall, FC was greater after 9S and 6S compared to 4S, being increased until 25min after 4S and 6S and up to 35min after 9S (p<0.05). Similar values of SampEn were observed between experimental sessions, being greater in CON. BRS was attenuated until 10min after 4S, and up to 25min after 6S and 9S and BEI was decreased until 15min only after 9S (p>0.05).

CONCLUSION: Experimental sessions produced a reduction of cardiac parasympathetic modulation and cardiac baroreflex activity, being longer sets which produced a greater drop in comparison with short sets. Results agree with previous findings in healthy young subjects (3). Short set configurations should be recommended for post-menopausal women.

REFERENCES:

1) Hulteen, et al., Int. J. Sports Med, 2023.

2) Momma, et al. Br. J. Sports Med, 2022.

3) Rúa-Alonso, et al. Eur. J. Appl. Physiol, 2020.

EVALUATING CARDIAC GEOMETRY AND FUNCTION IN EARLY POST-MENOPAUSAL ATHLETES: AN ECHOCARDIOGRAPHIC STUDY

HENLEY-MARTIN, S., BRADE, C., COLLIS, J., NAYLOR, L., SPENCE, A.
CURTIN UNIVERSITY

INTRODUCTION: Menopause is a critical phase in female reproductive ageing and is characterised by a rapid decline in oestrogen. Due to its cardioprotective effects, cardiac health is particularly affected. Exercise exerts protective effects on cardiovascular health to mitigate the age-related decline, preserving function and maximal aerobic capacity. While studies in men offer insight, female-specific responses regarding the impact of exercise on cardiac function in postmenopausal (PM) women is limited. This study assessed cardiac geometry and function in early PM women who identified as athletes (AT) compared to recreationally active healthy controls (CO).

METHODS: Twenty women (age 56.9±3.9 y), classified as Stage +1c using the STRAW staging system (4.5±2.2 y post-final menstrual period) participated. Cyclists/triathletes (AT, n=10) and CO (n=10) were matched for age and hormone replacement therapy use (pooled n=8). Resting transthoracic echocardiography was used to assess diastolic function (medial e' cm/s; lateral e' cm/s; E/e' ratio; indexed left atrial volume LA ESVi mL.m-2), stroke volume (SV mL), ejection fraction (EF %). Left ventricular mass (LVMi g/kg) and end-diastolic volume (EDVi mL/kg) were both indexed to lean mass (kg) while speckle-tracking echocardiography assessed LV global longitudinal strain (GLS%). Resting heart rate (HR bpm), resting mean arterial pressure (MAP, mmHg), peak oxygen consumption (VO2peak mL.kg.min-1), DXA-derived body composition (lean mass kg; body fat %) and physical activity (PA mins/wk) were also assessed. Student's t-test was used to assess significance between groups (p<.05).

RESULTS: VO2peak (41.7±5.4 v 33.2±3.3 mL.kg.min-1 p<.001) and PA (1000.0±202.3 v 200.0±77.6 mins/wk p<.001) were significantly higher in AT compared to CO, while resting HR (47±5 v 55±6 BPM p<.005) and MAP (82±8 v 92±9 mmHg p<.05) were significantly lower in AT. Lean mass did not differ between groups (45.2±3.8 v 48.8±5.0 kg p=0.085) but body fat % was significantly lower in AT compared to CO (27.4±2.4 v 32.1±4.3% p<.05). No significant difference was found for cardiac geometry (LVMi 3.1±0.4 v 3.0±0.4 g/kg p=0.512; EDVi 2.2±0.3 v 1.9±0.3 mL/kg p=0.077), systolic (SV 65.4±8.9 v 63.3±11.1 mL p=0.639; EF 66.9±7.1 v 67.0±4.2% p=0.951) or diastolic function (medial e' 7.7±2.1 v 7.2±1.7cm/s p=0.600; lateral e' 11.0±2.5 v 10.5±2.3cm/s p=0.629; E/e' 9.0±2.6 v 9.5±1.9 p=0.620; LA ESVi 36.6±9.6 v 35.3±11.5mL/m2 p=0.790). No significant difference was observed for GLS (-23.0±1.3 v -22.0±1.8% p=0.177).

CONCLUSION: Despite significantly lower resting HR, lower MAP and improved VO2peak in PM athletes, we observed no cardiac geometrical or functional differences between PM athletes and recreationally active controls, when studied at rest. The greater aerobic capacity in PM athletes may therefore be due to improved cardiac functional reserve as well as peripherally-mediated mechanisms such as enhanced oxygen extraction efficiency and thus warrants further investigation.

SYNDECAN-1: A MARKER OF ENDOTHELIAL GLYCOCALYX DEGRADATION IN POST-MENOPAUSAL WOMEN

AYYALASOMAYAJULA, M., DELGADO, J., DAMANI, J., PROCTOR, D.N.
PENNSYLVANIA STATE UNIVERSITY

INTRODUCTION: The endothelial glycocalyx (eGC) forms a critical protective barrier made of glycoconjugates, which include carbohydrates linked to various molecules such as amino acids, proteins, and lipids [1, 2]. In aging and cardiovascular disease (CVD), the eGCs integrity is compromised, possibly preceding conventional markers of age-related vascular dysfunction, like impaired endothelium-dependent dilation and increased arterial stiffness [3]. Syndecan-1, a heparan sulfate proteoglycan expressed in endothelial cells, serves as a key biomarker of endothelial function and glycocalyx degradation [4]. Previous research has demonstrated that in endothelial cells (ECs), the glycocalyx plays a critical role in mediating nitric oxide (NO) production. Degradation of the endothelial glycocalyx layer (eGC) significantly diminishes ECs ability to produce NO in response to fluid shear stress. Estradiol is known to protect the endothelial glycocalyx (eGC) from shedding. Consequently, the reduction in estrogen levels around menopause may lead to symptoms that impact womens well-being and health, coinciding with eGC shedding [2, 5]. Therefore, we aimed to investigate the impact of menopause on glycocalyx degradation by comparing plasma concentration of Syndecan-1 in the early-postmenopausal and late-post menopausal women. We hypothesized that late-menopausal women would exhibit higher Syndecan-1 concentrations compared to early-menopausal women, indicating increased eGC degradation.

METHODS: Plasma samples were collected from early and late postmenopausal women and analyzed using enzyme-linked immunosorbent assay (ELISA) to measure Syndecan-1 concentrations. Independent sample T-tests were employed to assess differences between early and late postmenopausal groups. Alpha was set to 0.05.

RESULTS: Early post-menopausal women (n=12) were significantly younger with fewer years since menopause (Age: 56 ± 4 yrs; Years since menopause: 4 ± 2) compared to late postmenopausal women (n = 13) (Age: 63 ± 4 yrs; Years since menopause: 14 ± 5). All postmenopausal women were normotensive and healthy. Early postmenopausal women exhibited significantly lower plasma concentrations of Syndecan-1 compared to late postmenopausal women (Early: 29.65 ± 7.26 ng/ml; Late: 41.93 ± 15.03 ng/ml; p = 0.017).

CONCLUSION: Late-postmenopausal women demonstrate higher circulating Syndecan-1 concentrations, indicative of increased glycocalyx degradation compared to early-menopausal women. These findings underscore the potential implications of menopause for vascular health and highlight the need for further research and targeted interventions to mitigate glycocalyx degradation and potentially enhance endothelial function in menopausal women.

References:

1. Francekovic (2023) 2. Potje(2023) 3. Machin (2019) 4. Zhang(2021) 5. Bartosch (2017)

EFFECT OF DIFFERENT SET CONFIGURATION ON MECHANICAL PERFORMANCE OF POSTMENOPAUSAL WOMEN DURING BENCH PRESS EXERCISE.

LENS-VALES, A., FARIÑAS, J., OVIES-GUTIÉRREZ, F., RÚA-ALONSO, M., NINE, I., RIAL-VÁZQUEZ, J., REVUELTA-LERA, B., GIRÁLDEZ-GARCÍA, M.A., IGLESIAS-SOLER, E.

UNIVERSITY OF A CORUÑA

INTRODUCTION: In order to counteract the negative effects of hormonal changes, resistance training is strongly recommended for postmenopausal women (1). Furthermore, different organizations recommend different levels of resistance training according to age. The strength training prescription may be designed manipulating training parameters, and it has been shown that set configuration can modulate velocity and power losses, resulting in different levels of fatigue (2), but this has primarily been investigated in healthy and young individuals. The aim of this study was to compare the effects of different set configurations on mechanical performance of postmenopausal women during a bench press exercise.

METHODS: 50 physically active postmenopausal women took part in this study, funded by the Spanish Ministry of Science and Innovation (PID2021-124277OB). After a medical examination, each woman completed three experimental sessions in a randomised order. Each experimental session consisted of 36 repetitions of 4 exercises at 12RM (leg press, bench press, prone leg curl and lat pull-down), which differed in set configuration: 9 sets of 4 repetitions with 45 seconds rest between sets; 6 sets of 6 repetitions with 72 seconds rest between sets and 4 sets of 9 repetitions with 120 seconds rest between sets. Rest periods between exercises were 4 minutes. Throughout the exercise sessions, mechanical data were collected in bench press exercise (BP) (i.e. velocity (VL) and power (PL) loss). Explosive performance was also calculated before and after each session by performing 2 repetitions at maximum intended velocity at 70% of 12RM in bench press exercise.

RESULTS: Main effect of session ($p<0.001$) was found with significant lower reductions regarding VL in 4S (mean = 28.52%) compared with 6S (mean = 38.56%) and 9S (mean = 50.64%) and 6S compared with 9S. Similarly, to VL, a main effect of session ($p<0.001$) was detected for PL with lower in 4S (mean = 28.52 %) in comparison with both 6S (mean = 38.56 %) and 9S (mean = 50.64 %). For neuromuscular test, we found main effect for time ($p<0.001$), although we did not find main effect of session ($p=0.374$) nor moment x session interaction ($p=0.967$). Mean velocity in neuromuscular test was higher in the pretest (mean=0.638 m·s-1)) than in the posttest (mean=0.609 m·s-1).

CONCLUSION: Set configuration influences on mechanical performance of postmenopausal women in the bench press exercise. The 4S configuration allows to blunt velocity and power loss during BP exercise.

1. Hulteen RM, Marlatt KL, Allerton TD, Lovre D. Detrimental Changes in Health during Menopause: The Role of Physical Activity. Int J Sports Med [Internet]. 2023 Jun 17;44(06):389–96. Available from: http://www.thieme-connect.de/DOI/DOI?10.1055/a-2003-9406

2. Iglesias-Soler E, Carballeira E, Sánchez-Otero T, Mayo X, Jiménez A, Chapman ML. Acute effects of distribution of rest between repetitions. Int J Sports Med. 2012;33(5):351–8.

Oral Presentations

OP-MH20 Sports Medicine and Orthopaedics I

HEAD IMPACT ACCELERATIONS AND PUNCH ACCUMULATION OF FEMALE ELITE AMATEUR

CALLAN, J., WATCHORN, J.

SHEFFIELD HALLAM UNIVERSITY

INTRODUCTION: Repeated head impact accumulation may provide a marker of athlete welfare and training prescription in combat and contact sports. Instrumented mouthguards (IMGs) may provide insightful and detailed information to inform sparring, training and athlete monitoring. IMG data from elite boxing competition is currently limited. This case study presents the head impact data from an elite amateur female boxer.

METHODS: One elite female boxer (age = 26 years; mass = 70kg; stature = 173cm) took part in an international amateur boxing tournament (3 bouts = 3 x 2 mins:1 min recovery) whilst equipped with a Protecht IMG (OPRO+ smart mouthguard, UK) during each bout. The participant won all three bouts. Variables measured were linear head acceleration (g), angular head acceleration (rad·s), and number of head impacts. One-way ANOVAs ($p\leq0.05$) with omega squared ($\omega2$) effect size using JASP 0.18.1 were used to compare the following between bouts: mean g; mean rad·s; mean g split by 50th%, 75th% and 90th%; mean rad·s split by 50th%, 75th% and 90th%.

RESULTS: Bout 1: total impacts = 117; linear acceleration = 15.7±10.6g; angular acceleration = 3,802±3,272rad·s. Bout 2: total impacts = 58; linear acceleration = 14.6±9.1g; angular acceleration = 3,585±3,863rad·s; Bout 3: total impacts = 57; linear acceleration = 13.1±6.8g; angular acceleration = 3,251±2,244rad·s. There were no significant differences in mean g or rad·s between bouts. There were differences in mean g in the 75th% ($p = 0.04$, $\omega2 = 0.07$; bout 1 = 29.9±12.1g .v. bout 3

= 22.1±6.2g, post hoc p = 0.03) and in the 90th% (p = 0.2, ω2 = 0.23; bout 1 = 41.5±10.5g .v. bout 3 = 29.1±4.2g, post hoc p = 0.02) between bouts. There were no differences in mean rad·s between bouts split by %.

CONCLUSION: This participant experienced head accelerations lower than those reported from male combat sport and American football athletes [1]. The frequency of head impacts and the magnitude of linear accelerations reduced over the course of the three bouts, with no change in angular acceleration. These data provide novel information regarding head impacts in elite amateur female boxers. Future cohort studies for both sexes are required to better understand the effects of boxing competition.

References

1. Tiernan et al., (2021), Finite element simulation of head impacts in mixed martial arts, Computer Methods in Biomechanics and Biomedical Engineering 24:3

THE HIGH ROTATION TEST COMPARED TO THE CKCUEST – THE ABILITY TO DIFFERENTIATE OVERHEAD ATHLETES WITH AND WITHOUT SHOULDER PAIN

SCHUHBECK, M., TAUBE, W., KEINER, M., BEINERT, K.

GERMAN UNIVERSITY FOR HEALTH AND SPORT

INTRODUCTION: Chronic shoulder pain is prevalent among overhead athletes (OA), from baseball pitchers to handball players, with pitchers reaching angular velocities over 7000°/sec for internal rotations (Fleisig et al 1999). Common physical performance tests, such as the closed kinetic chain upper extremity stability test (CKCUEST) cannot differentiate athletes with and without pain (Torabi 2024), probably because they do not test the rotational aspects of overhead motion. In addition, CKCUEST provides only one sinlge outcome measure, the "number of touches". This study introduces the High Rotation Test (HRT), performed in 90° abduction, addressing speed and rotation. The aim of the study was to compare the performance of patients with shoulder pain (Experimental Group, EG) and healthy controls (Control Group, CG) on HRT and the CKCUEST. Further, we also assessed joint position sense (JPS) and pain.

METHODS: In the study, 54 participants took part (EG, n=35, 38.3 ± 13.8 yrs.; 19 males; CG, n=19, 27.7 ± 7.2 yrs.; 9 males). Kinematic variables such as velocity (v), acceleration (a) and range of motion (ROM) were recorded for both HRT and CKCUEST, utilizing inertial motion units (IMU) (Captiv Motion System, TEA, France). IMU's were also used to assess joint position sense (JPS). Differences between groups were analysed with student´s t-test. Effect sizes were reported with Cohen´s d and correlations between the kinematic variables and pain were calculated with Pearson correlation coefficient.

RESULTS: Average pain intensity was 6.1 on a NRS for the EG and 0 for the CG. Significant differences in HRT performance were found between the EG and CG for repetitions [t(52) = 2.63, p = 0.011, d = 0.75] and velocity [t(52) = 2.68, p = 0.006, d = 0.82]. Further, the number of repetitions was significantly correlated to acceleration (r = .41, p = 0.002) and velocity (r = .43, p = 0.001). Regarding the CKCUEST, significant differences between EG and CG were found for repetitions [t(51) = 2.53, p = 0.015, d = 0.72] but not for velocity. Further, the number of repetitions was significantly correlated to acceleration (r = .64, p < 0.001) and velocity (r = .43, p < 0.001). Significant differences were also found for shoulder JPS [t(52) = -4.75, p < 0.001, d = 1.35]. Pain correlated with JPS (r = .39, p = 0.003) but not with velocity or acceleration.

CONCLUSION: Both tests show differences in repetitions between EG and CG. This is of clinical importance because repetitions are easily assessed in daily routine. Differences in peak velocity were identified with the HRT, but not in the CKCUEST. This might be an important parameter for determining the return to sports, as most OA rely on very fast rotational movements. Complementary to the functional tests, the limitation of shoulder patients in the JPS test may indicate the impaired sensory component of pain. Thus, it is recommended to use the HRT in combination with the JPS test in order to test for motor and sensory impairments in OA with shoulder problems.

CHANGES IN PUPILLARY LIGHT REFLEX FOLLOWING COMPETITIVE RUGBY UNION

BARNES, A., KIRK, C., HILL, R., BOWDEN, B., MERCER, J.

SHEFFIELD HALLAM UNIVERSITY

INTRODUCTION: Automated pupil light reflex (PLR) is a valid indicator of dysfunctional autonomic brainfunction following traumatic brain injury and may be a useful tool to triage patients [1]. Rugby union is characterised by repeated head accelerations, with high head acceleration events occurring more frequently in elite men's forwards than backs [2]. PLR may offer a more sensitive and objective means of detecting signs of brain dysfunction resulting from head accelerations without diagnosed concussion and may reduce the need for clinical judgments to inform player management. This study aimed to examine the impact of a competitive match on PLR variables.

METHODS: Twenty-nine adult male rugby players (16 Forwards, 13 Backs) playing level 4 rugby in the English league structure took part in the study. PLR of both eyes were measured pre and post a competitive match using a Neuroptic NPi-200. Pupillometry values including the Neurological Pupil Index (NPi), mean constriction velocity (CV), max constriction velocity (MCV), and dilation velocity (DV) were obtained. Differences between left and right eye were analysed pre- and post-match using a paired t-test. The averages of both eyes together were compared pre- and post-match, and between forwards and backs using a two-way mixed ANOVA.

RESULTS: The difference in DV between the left and right eye increased post-match (0.3± 0.1824 mm· s-1)compared to pre-match (0.14± 0.1324 mm·s-1, p=0.05). There was a significant main effect of match on both NPi (pre= 3.8 ±0.4 AU vs

post=3.5 ±0.4 AU, p=0.005) and DV (pre=1.25 ±0.24 mm·s-1 vs post=1.12± 0.18 mm·s-1, p=0.02). No main effect of position was seen for any variables, nor were there any observed interaction effects.

CONCLUSION: PLR was altered following participation in competitive rugby union. The lower NPi and DV values post-match suggest a change in autonomic brain function, in keeping with studies where concussions were clinically diagnosed [1]. Anisocoria also increased pre-post, reflecting previous data from mixed martial arts sparring without incidence of diagnosed concussion [3]. PLR offers a rapid and objective measure of autonomic brain function and could be a promising tool for player assessment, but further research is needed to establish the relationship of PLR to the number and severity of head impacts and the decay of these changes.

1. Traylor, I, et al., Quantitative pupillometry in patients with traumatic brain injury and loss of consciousness: A prospective pilot study. Neurosci J, 2021.

2. Tooby, J, et al., Instrumented mouthguards in elite-level men's and women's rugby union: The incidence and propensity of head acceleration events in matches. Sports Med, 2023.

3. Kirk, C., Childs, C., Combat sports as a model for measuring the effects of repeated head impacts on autonomic brain function: A brief report of pilot data, Vision, 2023.

THE EFFECT OF COVID-19 ON AUTONOMIC NERVOUS SYSTEM FUNCTION IN AMERICAN FOOTBALL ATHLETES

RIFAT, S., MILLER, B., CHUNG, E., JOHNSON, P., SARNA, K.

CLEVELAND CLINIC

INTRODUCTION: SARS CoV-2, the respiratory virus causing COVID-19, is known to affect many organs and systems. Although most healthy, immune competent athletes fully recover, some continue to experience long term symptoms. Little is known about the causative mechanism of this phenomenon, however emerging evidence suggests that cardiovascular autonomic dysfunction may play a role. Autonomic dysfunction can manifest in many ways including disturbances in blood pressure, resting heart rate (RHR) and Heart Rate Variability (HRV). These parameters can be easily measured with popular wearable devices. To our knowledge this is the first study to prospectively investigate the effect of COVID-19 on cardiac autonomic function in American football players by using a commercially available wearable device.

METHODS: Forty American football players from the same team were enrolled in this prospective matched cohort study. Twenty who recovered from COVID-19 who were cleared to play after normal physical examination and normal cardiac testing (hs-troponin, echocardiography and cardiac MRI), and a matched cohort of 20 who were antigen negative at baseline and never tested positive for COVID-19 throughout the study period. All participants underwent 6-times per week COVID-19 testing throughout the study period. The control group was matched based on position including the following three groups; Linemen (L), Large Skill (LS) and Small Skill (SS). All participants wore a multi-sensor wrist device (WHOOP Inc., Boston, MA) that measured RHR, HRV, respiratory rate (RR) and hours sleep (HS) per night throughout a 6-week period during their competitive season. Statistical analyses were performed to evaluate the association between each individual categorical characteristic variable and COVID-19 history. Difference scores from last and baseline values for the entire study duration were calculated. General linear model analysis was done considering COVID-19 infection status and player position.

RESULTS: Twenty-nine players completed the study. Eleven were removed, 8 from the COVID-19 cohort and 3 controls because they did not wear the wrist band long enough to acquire a baseline. There was no statistically significant difference between the groups apart from the LS subgroup with a higher body mass index for the COVID-19 group (p=0.0460). Throughout the study period there was a statistically significant difference (p=0.0434) between RHR mean for the SS group with a higher mean of the mean in the COVID-19 cohort compared to the control group. There was no statistically significant difference between player position groups for any other variables.

CONCLUSION: COVID-19 does not appear to have significant long-term effects on HRV, RR and HS in American football players who fully recovered from COVID-19. Although the study group size was small, elevated RHR in the Small Skill group may indicate prolonged autonomic dysfunction after COVID-19 in these lean, highly conditioned athletes.

EFFECT OF HIGH-INTENSITY INTERVAL TRAINING ON CARDIOPROTECTION AGAINST RENAL ISCHEMIA-REPERFUSION INJURY IN RATS

TANG, C.Y., LAI, C., FU, S., TSAO, P., TSENG, K.

UNIVERSITY OF TAIPEI

INTRODUCTION: In recent years, High-Intensity Interval Training (HIIT) has gained popularity among athletes due to its ability to save exercise time, promote more efficient fat loss, and assist in improving disease prognosis. The results of this study will clarify whether HIIT can reduce myocardial damage caused by renal ischemia-reperfusion, with the aim of serving as a reference for exercise prescriptions in health promotion in the future.

METHODS: 30 male Sprague Dawley rats were divided into three groups: Sham (SHAM), Non-High-Intensity Interval Training (Non-HIIT), and High-Intensity Interval Training (HIIT). The SHAM group had no further intervention after abdominal opening, while the other two underwent 60 minutes of renal artery occlusion and 24 hours of reperfusion before being sacrificed. Blood samples were taken to assess Troponin-I and CPK levels, and ELISA measured serum TNF-α for apoptosis and inflammation. Heart tissues were also collected for HE and TUNEL staining to evaluate cardiac damage and myocardial apoptosis.

RESULTS: Blood test results revealed significant differences among the groups. Troponin I levels were markedly different between SHAM, CAO, and HIIT groups: 0.68 ± 0.47 vs. 298.08 ± 173.09 vs. 41.56 ± 10.44 ($p < 0.01$). Similarly, CPK levels showed substantial variations: 577.50 ± 19.40 vs. 8531.33 ± 591.00 vs. 3918.17 ± 1761.22 ($p < 0.001$). In the Elisa assay, TNF-α concentrations differed significantly among the groups: SHAM vs. CAO vs. HIIT: 39.12 ± 5.59 vs. 104.408 ± 6.62 vs. 62.31 ± 6.57 ($p < 0.001$). Additionally, HE staining indicated notable differences in myocardial damage quantification: SHAM vs. CAO vs. HIIT: 0.20 ± 0.08 vs. 3.65 ± 0.44 vs. 1.28 ± 0.32 ($p < 0.001$). Finally, TUNEL analysis showed significant variations in myocardial cell apoptosis rates: SHAM vs. CAO vs. HIIT: 2.3 ± 0.7 vs. 34.3 ± 5.5 vs. 19.7 ± 1.2 ($p < 0.01$).

CONCLUSION: Studies have shown that HIIT can significantly reduce plasma mRNA expression related to inflammation. It also helps lower Agt mRNA expression associated with the Renin-Angiotensin-Aldosterone System (RAAS), thus aiding in blood pressure reduction, and decreases Fan1 mRNA expression related to apoptosis, thereby preventing cell damage (1,2). Additionally, HIIT intervention has been found to reduce kidney weight and the ratio of kidney weight to body weight, indicating that this exercise modality can improve renal interstitial fibrosis, reduce kidney damage, and consequently mitigate myocardial damage (3). Our results demonstrate that four weeks of consecutive HIIT intervention before renal artery occlusion significantly reduces cardiac damage. From the perspective of primary and secondary disease prevention and treatment strategies, improving physical function through exercise represents one of the simplest and most cost-effective ways to enhance human health.

Reference:

1. Tucker, et al., Free Radic Biol Med., 2015

2. Tucker, et al., Sports Med Open., 2016

3. Keller, et.al., New England Journal of Medicine, 2003

Oral Presentations

OP-SH16 Psychology of Team Sports

IDENTIFYING RISK PROFILES: INSIGHTS INTO INJURY SUSCEPTIBILITY AMONG YOUTH FLOORBALL PLAYERS

LEVIN, S., TERVO, T., IVARSSON, A., HÄGGLUND, M., STENLING, A.

UMEÅ UNIVERSITY

Introduction

Sport injuries are common in most sports, at elite level as well as among youth athletes. To reduce the occurrence of sport injuries, understanding the risk factors associated with injuries is essential. During the last decade, there have been calls in the literature for more holistic approaches to understand how combinations of factors affect injury risk. The aim of the present study was to employ a person-centered approach to identify combinations of psychological and physical factors that influence the risk of injury among youth floorball players.

Methods

In the beginning of the floorball season 222 youth athletes (age:15-19, female: n=97) underwent physical field tests and completed a baseline survey, which included demographic information and assessments of psychological well-being (i.e., depression and anxiety symptoms). At the end of the season, participants were asked to report any traumatic or overuse injuries experienced during the season. Latent profile analysis (LPA) was used to identify potential risk profiles among the athletes. We then conducted a covariate analysis with sex, age, height, weight, previous injury history and injury status at baseline as predictors of profile belonging. Finally, we compared injury risk between the identified profiles.

Results

The LPA resulted in a three-profile solution where profile 1 (n=101) reported above average psychological well-being and higher results on physical field test than the other profiles, whereas profile 2 (n=49) had lower psychological well-being than the other profiles, and profile 3 (n=72) performed the worst on physical field tests. Covariate analysis showed that athletes who were injured at baseline were more likely to belong to profile 2 when compared to profile 1, no other significant differences were observed. A total of 113 athletes (50.9%) reported an injury at the end of the season. The analysis of distal outcomes (traumatic or overuse injury) showed that profile 1 had a higher risk of any injury compared to profile 2 (risk difference RD=16.5%, 95% CI [-0.3-33.4]) and profile 3 (RD=15.0%, 95% CI [0.0-29.9]). Additionally, profile 1 exhibited a higher risk of acute injury compared to profile 3 (RD=16.6%, 95% CI [3.8-29.4]).

Discussion

Surprisingly, our findings revealed that the athletes with high physical ability and low levels of depression and anxiety had the highest risk of injury. One potential explanation could be that athletes in this profile engage in more practices and competitive games (compared to athletes in the other two profiles), which exposes them to more risk situations, higher physical load, and insufficient recovery. These findings have practical implications for seasonal planning and highlight the coaches role as key figures in assisting youth athletes to balance the demands of training intensity with adequate recovery.

NORWEGIAN ELITE HANDBALL AND FOOTBALL REFEREES' SELF-REPORTED INTENTION TO QUIT OFFICIATING: THE ROLE OF THE DUALISTIC MODEL OF PASSION.

JOHANSEN, B.T., ERIKSTAD, M.K., HAUGEN, T.
UNIVERSITY OF AGDER

Introduction

Researchers have raised concerns about sport referee attrition and its potential negative impact on the games quality [1]. Previous studies have highlighted that passionmay prevent dropout from sport activities [2,3], still empirical evidence from the context of sport refereeing is requiring. Hence, the aim of the present study was to investigate the predictive value of passion on intentions to quit among Norwegian elite sport referees.

Methods

The participants were 224 Norwegian elite referees of handball (n = 111, m age = 35.3 years, 13.5% females) and football (113, m age = 30.8 years, 8% females) who had been referees for an average of 14.4 years (sd = 7.77 years; min: 4, max: 37) and a referee at the present level for 6.8 years (sd = 6.20 years, min: 1, max: 32). In a section of the web-based survey was a question constructed based on the work of Van Yperen [4] assessing participants' intentions to quit as an elite referee (e.g., ˜Do you sometimes think about quitting as elite referee?'). The referees could choose between three alternative answers: 1. I never think about quitting, 2. I sometimes think about quitting, and 3. I often think about quitting. The 12-item Passion Scale [2,3] was used to assess the referees' type of passion that characterized their officiating.

Results

The number of complete cases for the present study was N = 184. Overall, 50.5 % (n = 93) of the referees had an intention to quit refereeing. A logistic regression was performed to assess the predictive value of harmonious passion and obsessive passion on the likelihood of intention to quit officiating. The logistic regression model was statistically significant, $\chi2(1,181) = 33.319$, $p < .001$. The model explained 22% (Nagelkerke R2) of the variance in intention to quit. The odds ratio for harmonious passion was 0.397, meaning that one unit increase on the harmonious passion scale (1-7) was associated with a decrease of 60 % in the odds of having an intention to quit officiating. Additionally, no statistically significant effect was found for obsessive passion on intention to quit officiating.

Conclusion

The present findings revealed that harmonious passion significantly decreased the likelihood of intending to quit officiating, emphasizing the importance of nurturing a positive and balanced passion in sports refereeing. The study offers insights that could help address concerns raised by researchers regarding elite sport referee attrition and its potential impact on game quality.

References

1. Livingston et al. (2017). Curr Iss Sport Scien, 2, 011.

2. Vallerand et al. (2003). J Pers Soc Psychol, 85(4), 756-767.

3. Vallerand et al. (2006). J Sport Exer Psychol, 28(4), 454–478.

4. Van Yperen, N. (1998). Sport Psychol, 12, 427-439

DEVELOPING RESILIENCE THROUGH COMMUNITY FOOTBALL; A FEASIBILITY STUDY.

MOLLOY, L., BEATTIE, S., CALLOW, N., HARDY, J., TUDOR-EDWARDS, R., ONG, C.W.
BANGOR UNIVERSITY

Introduction

Resilience has historically been viewed as an outcome or trait, with individuals who achieve better-than-expected outcomes despite dealing with adversity being considered resilient. More contemporary research suggests resilience may be a process, with both proactive and reactive elements. However, there has been little investigation as to how this more contemporary concept of a resilient as a process can be incorporated into specific interventions to develop resilience. In an established community football programme, we set out to explore ways that resilience may be developed as part of engagement in the programme, and the feasibility of conducting a specific resilience intervention.

Methods

The Resilience Process Scale – RPS (a 13-item scale assessing 4 stages of resilience: anticipate, minimise, manage and mend), CD-RISC 10 (10 item version of the Connor Davidson Resilience Scale), wellbeing (SWEMWBS) and physical activity levels using questions from the IPAQ were administered to 16 individuals partaking in a school-holiday based community sport programme at pre and post intervals following 4 coach-led and co-developed resilience sessions. Post-intervention qualitative analysis was conducted with participants via focus groups and coaches via 1-1 interviews to understand what aspects of the intervention were successful and where it can be improved.

Results

Quantitative analysis revealed improvements in the Manage aspect of the RPS, SWEMWBS Score and levels of physical activity approaching significance. Further investigations through thematic analysis of the focus groups and interviews revealed several key themes: coach relationship, social interaction and football as the 'hook' were revealed to be positive influences on session enjoyment and engagement.

Discussion

The findings suggest that, while improvements in resilience were statistically non-significant, participants felt they had learned some useful skills and had engaged well with the programme. This was echoed by coaches who enjoyed the opportunity to intertwine resilience theory with their coaching and had freedom to structure the sessions as they wished. This has several implications for practitioners and coaches looking to develop resilience interventions. Firstly, using a 'hook' or basing the intervention around an activity that participants would actively engage in will improve interest. Second, ensuring coaches are familiar and have a good relationship with participants will further increase engagement. Finally, giving coaches more freedom on how to implement the intervention content into the sessions will improve eagerness and motivation to engage in the process.

EXPLORING THE EXPERIENCES OF A CHINESE ATHLETE IN FACILITATING CAREER TRANSITION THROUGHOUT A PSYCHOLOGICAL SKILLS TRAINING PROGRAM: A NARRATIVE ANALYSIS

ZHANG, X., LUO, P.2, WANG, H.N.3, ZHANG, K.Y.4, LI, Y.5, AN, Q.5

1 UNIVERSITY OF CALGARY, 2 BEIJING SPORT UNIVERSITY, 3 WEST CHINA HOSPITAL OF SICHUAN UNIVERSITY, 4, SOUTHEAST UNIVERSITY, 5 CAPITAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS

Psychological skills training programs have been consistently reported as an important part of preparation for optimal performance in high-performance settings (Weinberg & Gould, 2015), as well as for career transition and life skills development (Zhang et al., 2017; Zhu et al., 2023). Additionally, it has been noted that the specific sport context should be taken into consideration when delivering such a program (Si et al., 2015; Zhu et al., 2023). The Chinese sport system is characterized as a semi-closed environment in which Chinese athletes are able to focus on training but often have limited access to formal education and other people for connecting and networking , which subsequently leads to challenges when preparing for retirement at the end of their sport careers (Zhang et al., 2019).

The purpose of this paper was to explore the experiences of a Chinese volleyball player in facilitating career transition throughout a three-year psychological skills training program. An instrumental case study methodology with a narrative analysis approach was employed to illustrate the evolving application of psychological skills and the athlete's experiences.

The athlete spoke of the benefits derived from the psychological skills training program, and three patterns emerged: stories of how a player learned to plan for training and competitions; how she became reflective to prepare for career transition; and how she began to utilize the skills in life after sport.

This study provides insight into a psychological skills training program delivered within the Chinese sport system that facilitated the career transition of a Chinese volleyball player to be used in both sport and life out of sport.

Si, G., Duan, Y., Li, H.-Y., Zhang, C.-Q., & Su, N. (2015). The influence of the Chinese sport system and Chinese cultural characteristics on Olympic sport psychology services. Psychology of sport and exercise, 17, 56-67. https://doi.org/10.1016/j.psychsport.2014.08.008

Weinberg, R. S., & Gould, D. (2015). Foundations of sport and exercise psychology (Sixth edition. ed.). Human Kinetics.

Zhang, C.-Q., Si, G., Chung, P.-K., & Bu, D. (2017). A three-stage adversity coping model for Chinese athletes. Journal of sport psychology in action, 8(2), 87-95. https://doi.org/10.1080/21520704.2017.1287143

Zhang, Y., Chin, J. W., & Reekie, S. H. M. (2019). Education in the Chinese national sport system: experiences of professional wushu athletes. Sport in society, 22(8), 1466-1480. https://doi.org/10.1080/17430437.2018.1529168

Zhu, Q., Pynn, S. R., Holt, N. L., Huang, Z., & Jørgensen, H. (2023). Life skills development and learning contexts among members of China womens national soccer teams. International journal of sport and exercise psychology, 21(1), 15-32. https://doi.org/10.1080/1612197x.2021.2025137

PSYCHOLOGICAL FACTORS IN BASKETBALL TALENT IDENTIFICATION: A SYSTEMATIC REVIEW AND META-ANALYSIS

HAN, M., LORENZO-CALVO, J.

UNIVERSIDAD POLITÉCNICA DE MADRID

Introduction

Identifying athletic talent involves assessing physical, motor, and psychological factors. Cognitive perceptual skills are crucial in basketball because they allow for quick decision-making and efficient movement [1]. Expert players use visual search strategies to predict outcomes, while novices struggle with effective gaze patterns. Although many studies have explored visual interventions with adult athletes, few studies have investigated the impact of visual perception, particularly in the selection of young athletes. This study conducted a systematic review and meta-analysis to identify psychological factors in basketball talent (1) to find out whether visual perception affects talent identification in youth players and (2) whether visual search behaviour training applies to youth players of all ages.

Methods

The search was carried out using the most relevant databases, such as Web of Science, PubMed, SPORTDiscus, and Scopus, according to the PRISMA (2020) guideline. Keywords such as 'basketball', 'talent identification,selection', 'psychological', 'perceptual cognitive', 'decision making', basketball, and 'visual' were used for the search in English, following the PICOS question model. Meta-analyses were performed using Cochrane Collaborations Collaboration Review Manager

5.4.1, an open-source programme. A total of 33 articles were evaluated for overall methodological quality using critical review forms.

Results

The findings highlight the complexity of the interactions between psychological factors, training interventions, and motor skills for identification in basketball talent. Visual perception affects their response time, shooting accuracy, and movement time during the game. Players visual behaviour and their reactions to opponents are influenced by factors such as peripheral vision. Expert players performed better in terms of visual behaviour. The role of reaction time, gender, age, and peripheral perception in predicting the role of vision and visual attention in improving performance is also stressed, as is the importance of focusing on the direction of the pass to mitigate the effects of high frequency.

Conclusion

The results demonstrated the importance of these psychological and perceptual factors in maximising the performance and success of the court. It also revealed the complex relationship between basketball players visual behaviour and performance, which indicated the viability of visual and motor performance assessment for coaches and scouts looking for talent.

References

1. Kusdinar, Y., Abdullah, A., Ma'Mun, A., & RUSDIANA, A. (2021). Revisiting sports talent identification: A meta-analysis. Journal of Engineering Science and Technology, 16(2), 1258-1272.

Oral Presentations

OP-SH03 History

MEDIA TRANSITION AND SPORTS CELEBRITIES: THE INFLUENCES OF CHINESE SPORTS BROADCASTERS AND THE HISTORY OF CHINESE POPULAR CULTURE

LI, X., HUANG, L., BI, X.
BEIJING SPORT UNIVERSITY

Introduction: As one of the perspectives in cultural studies, celebrity studies has gradually become a hot topic in the intersection of sports and other disciplines [1]. However, sports media practitioners, who similarly possess celebrity attributes, have consistently been overlooked [2], perhaps attributable to the marginalized position of media studies within the tradition of sports research [3]. Indeed, in the progressive development of modern sport, the relationship between sport, media and social culture has become indivisible [4]. Taking the perspective of intergenerational changes in sports broadcasting brought about by media transitions, this study analyzes the characteristics of popular culture in the Chinese sports broadcasting industry during the modern development of sports. It identifies the interactive relationship between media transitions in China, sports broadcasting activities, and sports popular culture.

Methods : Through literature review and case analysis, this study examines the historical context and representative broadcast celebrities in the development of sports broadcasting in China. It explores the characteristics of sports broadcasting in different eras and uncovers the underlying popular cultural influences.

Results: In the more than 60 years since the development of sports commentary in China, media technology has made three significant changes to the way sports texts are presented, and sports broadcasters have thus demonstrated the temporal characteristics of "idols", "experts" and "micro-celebrities". They have thus participated in the production of sports popular culture characterized by "nationalized", "grouped", and "stratified".

Conclusion: The late popularization of television technology has led to a scarcity of professional sports broadcast resources in China. State-dominated sports events have made sports broadcasters play the role of transmitting national emotions, becoming "idol-style" leaders of popular culture, and shaping a "nationalized" popular culture through the expression of national identity emotions.

The rise of internet technology in the early 21st century has brought a surge of modern sports broadcast resources into China. Sports broadcasters have evolved into star figures as "experts" in a particular sport. Chinese sports audiences have been further categorized on this basis, with the emergence of a significant "grouped" of online community culture.

With the proliferation of social media, the decentralization of discourse in the online space has led to an influx of non-professionals into the sports broadcasting industry. These individuals, adopting non-traditional forms of discourse, have become "micro-celebrities" further fragmenting the sports audience "grouped" into "stratified" and resulting in a more polarized and divisive popular culture content.

REFERENCES:

1.Andrews (2001)

2.Weathers et al. (2014)

3.Wenner (2021)

4.Rowe (2011)

THE HISTORY OF CHILDREN'S PLAY FROM AN EVOLUTIONARY PERSPECTIVE: A NARRATIVE REVIEW

LANGFORD, A., SHEEHAN, D., HANLON, M., FRANCIS, P.
SOUTH EAST TECHNOLOGICAL UNIVERSITY CARLOW

Introduction

Children's most common form of physical activity (PA) is play[1]. Play is something that children partake in voluntarily and is imaginary[2]. Evolutionary biologists argue that play is risky and metabolically expensive, and the energy could be better used for survival activities like scavenging and hunting[3]. However, play is seen throughout history and therefore must be essential in childhood. Play contributes to social and emotional skill development, and physical skills like strength and speed. The aim of the review is to understand children's play from an evolutionary lens and subsequently, design a PA intervention more in tune with human evolution.

Methodology

A search was conducted across four databases, including PubMed, ERIC, EBSCOhost, and Scopus. The search terms were "play" OR "physical activity" AND "prehistory" OR "modern history" OR "ancient history" OR "ancient Greece" OR "ancient Rome" OR "medieval history" OR "evolution" AND "children" OR "child". The inclusion criteria were that the article is in English and must discuss children's play. This search yielded 2122 results, and after applying the inclusion criteria, deduplication, screening of titles and bibliographies, 156 articles were included in the review.

Results

Prior to written history (3 million BCE-3000BCE), evidence for play comes from toys and artefacts made from clay and wood with children's fingerprints. By observing modern day hunter-gatherer tribes, rough and tumble games like chasing, gathering natural resources, and playing with spears equip children with life skills as adults. In Ancient Greece (6000BCE-650CE), philosophers like Plato promoted play as a learning tool. Paintings and sculptures on clay artefacts show games like tug-of-war and hopscotch played by Greek children. In Medieval history (650CE-1500CE), an era characterised by disease, children continued to play. The painting 'Children's Games' by Pieter Breughel (1560) shows over 200 children playing over 80 different games. Since the industrial revolution, professional and academic demands have increased. Urbanisation has resulted in the loss of natural environments. This means less time and space for children to play. Consequently, research now focuses on ways to get children active.

Conclusion

From an evolutionary perspective, children's play has persevered throughout history, enduring extreme conditions like war, famine, drought, and disease. Therefore, the advantages of play during childhood must outweigh the metabolic cost. Play is beneficial during childhood to imitate, practice, and develop skills for adulthood. This review understands children's play from an evolutionary perspective and has informed the design of a games-based intervention to promote PA in a fun environment.

References

1. Mackett, R. L., & Paskins, J. (2008). Children & Society

2. LaFreniere, P. (2011). American Journal of Play

3. Rubin, K. H., Fein, G. G., & Vandenberg, B. (1983). Handbook of child psychology

PHYSICAL ACTIVITY DURING MENSTRUATION: ANALYSING HISTORICAL PERSPECTIVES

PAYNE, K.
UNIVERISTY OF GLASGOW

Introduction

Physical activity (PA) can be maintained during menstruation, yet a significant number of individuals avoid it, contributing to a wider issue of inadequate PA levels amongst women globally, with notable public health implications. Attitudes towards PA during menstruation are shaped by various factors, with the persistence of outdated historical beliefs likely to be a contributing factor. Understanding the origin of these assumptions is important for dispelling myths and offering inclusive PA guidance.

Methods

To investigate historical attitudes towards PA during menstruation, a research strategy was implemented that involved searching scientific databases as well as local (Scotland) library and archival sources. Relevant academic and non-academic historical texts related to women's health, PA and menstruation from 1849 to 1960 were identified. Thematic coding identified narrative themes, guiding the critical analysis.

Results

A total of 39 texts were identified. Four overarching themes were identified which gave insights into historical perspectives. The first explored historical attitudes to exercise during menstruation, while the second highlighted the conflation of exercise and study as activities deemed detrimental to women's health. The third examined recommendations of specific exercises for dysmenorrhoea and the final theme considered intergenerational propagation of menstrual taboos.

Discussion

Of 25 sources that gave specific advice on PA during menstruation, 18 encouraged its continuation, while 7 recommended complete rest. There was no discernible trend in these attitudes over the covered time period. Historical texts repeatedly linked both PA and intellectual pursuits as detrimental to women's reproductive health, discouraging engagement in such activities during menstruation. These erroneous assertions are rooted in sociocultural biases relating to women's roles and abilities, persist into the mid-twentieth century and may more subtly manifest in contemporary attitudes. Also highlighted was advice suggesting prescribed exercise routines to be undertaken before and during menstruation, aiming to alleviate dysmenorrhea. Despite being poorly researched, these routines persist in informal contemporary practices disseminated via the internet and wider media. Furthermore, historical texts repeatedly acknowledge that girls primarily receive menstrual health advice from their mothers, a route which is particularly vulnerable to misinformation and bias. This intergenerational channel of information sharing remains a prominent source of menstrual health information today so recognising and addressing the associated risks of misinformation should be given greater consideration.

This study, by revealing enduring historical attitudes impacting womens engagement in PA during menstruation, has the potential to inform public health communications and initiatives, facilitating increased adherence to current PA guidelines.

KOREAN SPORTS MEDICINE FROM THE 1980S TO THE 2020S: EXERCISE PRESCRIPTION AND HEALTHCARE MANAGEMENT IN GREY AREAS

JIN, H.

ZHEJIANG NORMAL UNIVERSITY

Introduction

The first sports medicine book written in English, Sports Medicine, was published in 1962[1]. The emergence of a new type of human, the trained athlete, enables the development of a new academic discipline. Initially targeting professional athletes, sports medicine expanded to the general population with the popularization of sports and the development of prevention and rehabilitation medicine. However, in Korea, the progress of sports medicine has been slow, despite the widespread recognition that 'exercise is medicine' and the need for rehabilitation. To comprehend the current state of therapeutic exercise and its popularization, it is important to understand the historical progression of sports medicine in society.

Method

This study traced the academic history of sports medicine based on the literature review, focusing on The Korean Journal of Sports Medicine as the primary source of analysis. Established in 1983, The Korean Journal of Sports Medicine has been a key platform for the field of sports medicine. Additional secondary sources, including academic materials, policy documents, and press releases were also utilized to provide a thick historical narrative.

Results

There were two overarching trends: Academic and institutional change. Sports medicine has emerged as a field that intersects with two disciplines: medicine and sport science. Initially, sports medicine within the realm of sport science was considered a part of the medical field, but as the field developed, most of it moved away from its roots in the medical field. Since 1995, therapeutic exercise specialists who have been trained and supported by the government have faced challenges in their expertise. They have been referred to as healthcare managers rather than sports medicine/therapeutic exercise professionals since 2015.

Discussion

Progress in sports medicine research has led to the emergence of new majors in higher education, such as exercise prescription. Despite this academic growth, therapeutic exercise professionals have faced challenges in the medical domain due to the implementation of the National Sports Promotion Act of 2014, which abolished the profession of exercise prescription. Consequently, a considerable number of certified therapeutic exercise specialists have transitioned from working in hospitals to local fitness clubs, while physiotherapists have expanded their involvement in rehabilitation interventions. Many aspects of sports medicine knowledge have been disseminated to the general public within the framework of healthcare management. This study demonstrates that sports medicine in Korea is not confined to a specific specialty but rather exists in a grey area where medicine and sports science intersect.

References:

1. Carter, N. Medicine, Sport and the Body: A Historical Perspective. Bloomsbury, London: UK.

THE ANTECEDENT INFLUENCING FACTORS OF MEGA-EVENT ON NATIONAL IDENTITY OF HONG KONG RESIDENTS: A STUDY BASED ON THE PRE-EVENT OF THE 15 NATIONAL GAMES OF CHINA

CHEN, X., LI, S., ZHOU, L.

GUANGZHOU SPORT UNIVERSITY

Purpose – Hong Kong is a highly prosperous international metropolis and a free port, one of the worlds three major financial centers, and a significant hub for international trade and innovative technology. It is a blending place of eastern and western cultures. Studying the national identity of Hong Kong residents holds significant practical importance.Take the 15th National Games of china that the State Councils approval of Guangdong, Hong Kong and Macao to co-host as an example, this study explored the antecedent Influencing factors affecting national identity of Hong Kong residents before the 15th National Games of china.

Methods – Based on the overall framework of "Stimulus→Organism→Response" of S-O-R theory, focused on Hong Kong residents, takes social exchange theory and social identity theory as theoretical perspectives. 383 valid questionnaires were collected from Hong Kong residents by convenient sampling method. Amos 26.0 software was used to build the structural equation model, estimate (standardize), and compare the path coefficient, significance and fitting index. Hypothesis based on the research model: (a)H1: The Perception of positive outcome (POP) formed by Hong Kong residents before the 15th National Games of china will positively influence the event support (ES). (b)H2: The Perception of negative outcome (NOP) formed by Hong Kong residents before the 15th National Games of china will negatively influence ES. (c)H3: POP will positively influence national identity (NI). (d)H4: NOP will negatively influence NI. (e)H5: ES will positively influence NI.

Results and Findings – The results support all hypotheses, with POP and ES (=0.324, $p<0.001$), being positively correlated, and POP having a positive effect on NI (=0.461, $p<0.001$), supporting H1, H3, respectively. NOP on ES (=-0.239, $p<0.001$) and NOP on NI (=-0.267, $p<0.001$) both were negatively correlated, supporting H2, H4, respectively. ES on NI (=0.134, $p<0.05$), being positively correlated, supporting H5. Perception of positive outcome had positive effects on event support and national identity; Perception of negative outcome had negative effects on event support and national identity; event support had positive effects on national identity. Among them, event support are direct influences on national identity, while Perception of positive and negative outcome indirectly influences national identity through event support.

Discussion – The results revealed the relationship between Perception of positive outcome, Perception of negative outcome, event support and national identity. The findings indicate that POP significantly boost residents ES and NI, highlighting the crucial role of mega-event in enhancing national consciousness and ethnic pride. NOP have a detrimental effect on ES and NI, reflecting the impact of mega-event and social issues on NI. Additionally, there is a positive relationship between ES and NI, suggesting that ES may translate into NI. Taken together, the findings of this study highlight the significant potential of major sporting events to enhance national identity. These findings not only provide a novel perspective for the academic community, but also provide practical guidance for policy makers, sporting event organizers, and administrators on how to use sporting events as a means to promote social harmony and national identity.

13:30 - 14:45

Invited Symposium

IS-PN01 Physiological resilience, the 'new' determinant of endurance exercise performance: mechanisms and potential intervention

PHYSIOLOGICAL RESILIENCE: THE 'OTHER' FACTOR INFLUENCING ENDURANCE PERFORMANCE

JONES, A.

EXETER UNIVERSITY

This talk will introduce the concept of physiological resilience or durability, and highlight its importance as an independent determinant of endurance exercise performance. This can be illustrated through studies on truly elite athletes. For example, in Nike's 'Breaking 2' marathon project, measurements of VO2max, fractional utilization of VO2max and running economy in a fresh condition provided reasonably accurate predictions of performance and were used to identify which elite athletes were best equipped physiologically to attempt to break the 2-hour marathon barrier. Of the athletes selected, however, only Eliud Kipchoge has achieved this feat and his performances are exceptional compared to his peers. This suggests that he has superior resilience (i.e., is better able to resist the deterioration of his 'start-line physiology' during a marathon) compared to his rivals. Recent studies indicate that not only do physiological variables such as exercise efficiency and critical power deteriorate during prolonged, fatiguing exercise, but the extent of this deterioration is highly variable between individuals (for example, 1-32% for critical power). Moreover, in the field, the degree of uncoupling between heart rate and speed during endurance exercise has been shown to be an important metric of performance. The basis for these differences in neuromuscular fatigability and metabolic stability (including glycogen depletion, metabolite accumulation, and changes in muscle fibre recruitment) will be discussed with comparisons drawn between elite East African runners and their Caucasian counterparts.

THE MUSCLE-TENDON UNIT IN RUNNING, A MODEL OF ECONOMY/EFFICACY AND RESILIENCE

NICOL, C.

AIX-MARSEILLE UNIVERSITÉ

Endurance running is usually defined as a stretch-shortening cycle (SSC) type exercise in which most of the lower limb extensor muscles are optimally pre-activated prior to ground impact and then fully activated during the braking phase to actively resist to their stretch before shortening with rather low muscle activity. The muscle-tendon units of the lower limbs are impressive for their efficient use of the SSC to store and recoil elastic energy, but also for their resilience to the thousands of ground impacts encountered during running, with limited structural and functional defects specifically in SSC-type muscle actions. Over the last 20 years, ultrasound technology has provided new insights into both the efficient and

protective role of the tendon and the architectural gear ratio, as well as the lack of stretching of biarticular muscles. Each of these factors can be seen as contributing to the rather limited structural and functional deficits in SSC performance found after a running race. Using this technique, our Japanese colleagues have highlighted the potential role of genetic endowment in the specificity of the muscle-tendon and foot architecture of Kenyan runners. As previous physiological studies have shown no marked specificity in any of the basic physiological parameters of elite East African endurance runners, it was concluded that their particular triceps surae muscle-tendon structure may contribute to their unique muscle activation and economical running pattern, which differs from the classical SSC concept. In recent years, female participation has increased considerably in endurance running. Despite sex differences in muscle-tendon characteristics and running biomechanics, males and females do not differ in terms of running economy, suggesting that both sexes optimise their running patterns to suit their characteristics. An indirect way to study sex differences in resilience is to follow the structural and functional recovery pattern after a race. In recreational runners, females showed more structural deficits in the hamstring muscle group than males, but sex-specific intermuscular compensations occur during SSC tasks that would mask residual dysfunction of some muscles.

STRATEGIES TO IMPROVE PHYSIOLOGICAL DURABILITY AND PERFORMANCE IN ENDURANCE ATHLETES

ZANINI, M.
LOUGHBOROUGH UNIVERSITY

This talk will discuss effective interventions to enhance physiological resilience (or durability), and compare athletes with different characteristics to explore other potential mediators of this phenomenon. The current evidence on training interventions to influence resilience in trained athletes is limited, with strength training and repeated sprints proven to be effective. Specifically, adding strength training to the program of endurance athletes can improve performance at the end of prolonged exercise (by between 4 and 40%), as demonstrated in cycling, running, and cross country skiing. Together with this, a reduced deterioration of running economy or cycling efficiency often occurs. Including short sprints during prolonged exercise may be another strategy to improve performance in a fatigued state, although evidence is limited to a few cycling studies. Longitudinal and cross-sectional studies with trained and elite athletes also suggest that performance level, age, and training background can influence resilience, with higher calibre athletes, who are used to longer endurance sessions, and somewhat older athletes being able to produce superior performance after prolonged exercise, and displaying less pronounced physiological drifts. Dietary interventions can also improve durability, with carbohydrate intake allowing athletes to maintain their fresh critical power (CP) after prolonged cycling compared to placebo. Finally, resilience may be dependent on sex, with female runners demonstrating a lower deterioration of economy during prolonged runs, which may help explain differences in marathon pacing (i.e., typically more even) compared to men. Other interventions such as long runs/rides, due to their specificity, may also be effective. More studies are required to improve our understanding of adaptations leading to improvements in durability in endurance athletes.

Oral Presentations

OP-AP08 Training and Testing/Power and Strength II

NEUROMUSCULAR RESPONSES DURING TRADITIONAL AND AUTO-REGULATED RESISTANCE TRAINING

RATTALINO, L., VIEIRA, T.M., DELLO IACONO, A.
POLYTECHNIC UNIVERSITY OF TURIN

INTRODUCTION: The Autoregulation Rest Redistribution Training (ARRT) is a cluster-set resistance training method in which the resistance training structure is personalised according to an individual autoregulation target. Specifically, the number of clusters, repetitions per cluster and between-cluster rest intervals are dynamically adjusted to mitigate the within-session fatigue causing a decay of resistance training performance. While emerging evidence points to the superior performance effects of the ARRT method compared to traditional (TRA) resistance training methods, the underpinning neuromuscular fatigue mechanisms remain unexplored. Therefore, the aim of this study was to compare the effects of TRA and ARRT approaches on mechanical outputs and electromyographic responses during isokinetic contraction tasks.

METHODS: Eighteen male subjects performed two experimental sessions in a randomized order. Both sessions consisted of 24 isokinetic single-leg extension repetitions, executed in concentric mode at a speed of 60 degrees · s-1 and performed according to two training configurations; traditional (TRA): 3 sets of 8 repetitions with 120s interset rest, ARRT: a personalized combination of clusters, repetitions per cluster, and between-cluster rest regulated upon a 20% peak torque loss threshold from the first repetition. Work outputs were recorded repetition-by-repetition. Surface electromyograms (EMG) were recorded from the Vastus Medialis (VM), Rectus Femoris (RF) and Vastus Lateralis (VL) muscles, at both the proximal and distal portions. For each movement cycle, the mean frequency (MNF) of the EMG spectrum was computed according to the Choi-Williams time-frequency analysis. Then, changes in MNF across repetitions were considered to assess how prone the muscles were to fatigue: the myoelectric manifestation of muscle fatigue. The effects of TRA and ARRT on work outputs and EMG responses were investigated using linear mixed-effect and spline mixed-effects models, respectively.

RESULTS: A significant interaction between protocol and repetition was found on work loss (0.41J × repetition, $p<0.001$) indicating that TRA induced greater work loss per repetition compared to ARRT. Overall, no significant effects of training protocol were found on changes in MNF ($p=0.059$). However, a main effect of muscle was found indicating greater MNF changes in the RF compared to both VM and VL (both $p<0.001$). Finally, similar MNF responses were observed between the proximal and distal portions of the muscles ($p=0.956$).

CONCLUSION: The ARRT approach resulted in a similar myoelectric manifestation of fatigue as the TRA, indicating a comparable peripheral metabolic stress induced by TRA and ARRT. It is therefore possible the distinct mechanical outputs between the two training methods may have stemmed from neural and motivational factors.

PSYCHOPHYSIOLOGICAL EFFECTS OF MUSIC ON THE BENCH PRESS EXERCISE: ANALYSIS OF MUSCLE POWER IN A GROUP OF YOUNG ATHLETES

BOZZATO, M., RIZZATO, A., DI SILVESTRE, A., PAOLI, A., MARCOLIN, G.

UNIVERSITY OF PADUA

INTRODUCTION: Listening to music could be an encouraging way to increase adherence and enjoyment in physical activity practice. The effects of music on physical activity have been comprehensively studied (1) and showed that music could be an ergogenic aid in improving psychological and psychophysical states, besides exercise performance (2). However, previous research focused on exercises that are hardly found in everyday sport practice (e.g. handgrip tests, and isometric strength tests) (3,4). Thus, this study aimed to investigate the effects of self-selected music (SSM) and motivational music (MM) on bench press power training.

METHODS: Twenty healthy young men with at least two years of experience in resistance training participated in the study. In the first session, subjects were familiarized with the experimental settings and performed the 1-repetition maximum (1-RM) test. Then, they underwent three bench press sessions in a randomized order: with SSM, MM, and no music (NM) as a control condition. A 48-hour recovery occurred between sessions. In each session, subjects performed three sets of eight repetitions at 75% of 1-RM. We calculated the mean power (PAVG) and peak power (PPEAK) for every completed repetition. Subjects were administered the Borg scale CR-10 (RPE), the Feeling Scale (FS), and the Felt Arousal Scale (FAS) within each session. A two-way analysis of Variance (ANOVA) for repeated measures investigated the main effect of music (i.e., SSM, MM, and NM) and fatigue (i.e., first, second, and third set) or the interaction between them on the bench press power outputs (i.e., PAVG and PPEAK). Moreover, a one-way ANOVA was performed to investigate the effect of music on FAS, FS, and RPE. The level of significance was set to $p<0.05$. Bonferroni post hoc analysis was performed where appropriate.

RESULTS: A significant main effect of music ($p<0.01$) and fatigue ($p<0.01$) was found for PAVG and PPEAK. The post hoc analysis outlined higher power values only in SSM compared to NM ($p<0.05$). Moreover, PAVG and PPEAK values decreased from the first to the third set ($p<0.001$). However, when comparing the third set, SSM highlighted higher power values than NM ($p<0.01$). SSM and MM positively affected FS ($p=0.030$) and FAS ($p<0.001$) scores. Interestingly, FAS scores resulted higher in SSM with respect to MM and NM ($p<0.05$). No changes in perceived exertion were detected.

CONCLUSION: Our data highlighted improved performance during the bench press exercise when subjects listened to music. Notably, self-selected music seemed to be as effective as motivational music independently from the beats per minute (BPM). Moreover, SSM led to a higher psychophysical activation than MM. Our findings thus encourage the use of self-selected music during resistance training.

REFERENCES:

1) Terry et al., Psychol. Bull., 2020

2) Karageorghis & Priest, Int. Rev. Sport Exerc. Psychol., 2012

3) Ballmann et al., J. Strength Cond. Res., 2021

4) Bartolomei et al., Percept. Mot. Skills, 2015

EFFECT OF TRAINING BACKGROUND AND LOAD LEVEL ON ACUTE NEUROMUSCULAR AND HORMONAL RESPONSES AND RECOVERY DURING POWER LOADINGS

KOTIKANGAS, J.1,2, WALKER, S.1,2, HÄKKINEN, K.1,2, PELTONEN, H.3,1,2

1> FACULTY OF SPORT AND HEALTH SCIENCES, UNIVERSITY OF JYVÄSKYLÄ; 2> NEUROMUSCULAR RESEARCH CENTER; 3> SPORT BUSINESS MANAGEMENT, SCHOOL OF BUSINESS, JAMK UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Various power resistance training loadings are used to improve rapid force production during high-velocity dynamic movements [1,2]. In addition to the loading protocol, previous training background seems to affect acute responses and recovery to resistance loadings [3]. Thus, we compared the effect of two power loadings with different load levels on neuromuscular and hormonal responses and recovery in power-trained athletes (PA) and nonathletes (NA).

METHODS: PA (n=6) and NA (n=8) performed two power loadings consisting of 7 sets of 6 repetitions with 3 minutes between-set rest in Smith-machine back squat. The intensity, i.e. barbell load, was either 50% (PL50) or 75% (PL75) of the participant's one repetition maximum (1-RM). Maximal bilateral isometric force (MIVC) and rate of force development with 5-millisecond sampling window (RFD) during isometric leg press, dynamic average velocity (VEL) during back squat, and rest twitch force (RT) during isometric knee extension were measured before (PRE), during (MID) and after loadings (POST),

and after recovery of 1 (POST1), 2 (POST2), and 24 hours (POST24). Serum concentrations of growth hormone, cortisol, creatine kinase (CK), and blood lactate (BL) were measured at PRE, MID, POST and POST1.

RESULTS: Total work was significantly higher during PL75, and PA performed significantly more work than NA during both loadings (p=0.001). There were significant differences between groups in BL during PL50 (F=9.862, p=0.009, ηp2=0.473) and PL75 (F=12.535, p=0.005, ηp2=0.533) with greater increases in BL at MID (p=0.016 and p=0.003, respectively) and POST (p=0.009 and p=0.005, respectively) in PA. A trend for larger increases in CK at POST24 from PL75 was found in PA (p=0.060). Total work correlated positively with both BL and CK (r>0.830, p<0.001). A trend for between-subject effect was found for VEL during PL50 (F=4.592, p=0.057, ηp2=0.292) indicating that PA had a greater decrease in VEL at POST (p=0.045). Significant loading × time interactions were found for all measured variables (F>3.671, p<0.05, ηp2>0.220), indicating that significantly greater decreases in neuromuscular variables and increases in blood variables were observed during PL75 versus PL50 (p<0.05). All neuromuscular variables were recovered at POST24, except RFD after PL50 and RT after both loadings, which already recovered at POST2.

CONCLUSION: Training background seemed to affect mainly blood variables, whereas higher load level led to greater neuromuscular and hormonal responses. These findings may be explained by differences in absolute total work performed between groups and loadings. Load level should be selected based on the individual's training goals, as acute responses may be linked to long-term training adaptations. Moreover, recovery rates of maximal force and rapid force production should be considered in periodization, especially when selecting same-day exercise sessions.

1. Brandon et al. (2015), 2. Howatson et al. (2016), 3. Ahtiainen et al. (2009)

EFFECTS OF COMBINING FREE WEIGHT WITH ELASTIC BANDS DURING UNILATERAL LEG PRESS ON MECHANICAL PERFORMANCE.

REVUELTA-LERA, B., RIAL-VAZQUEZ, J.1, NINE, I.1, FARIÑAS, J.1, RÚA-ALONSO, M.1, MARQUEZ, G.2, IGLESIAS-SOLER, E.1

1: UNIVERSITY OF A CORUÑA / Q6550005J; 2: UNIVERSITY OF A CORUÑA

INTRODUCTION: During exercises such as leg press there is an imbalance between the torque demanded by the external load and the torque-generating capacity of the muscle, resulting in a stimulus that may be suboptimal. The combined use of elastic band with free weight is a possible solution to this problem (1,2). The aim of this study was to compare 4 different bands and free weight configurations regardingmuscle performance.

METHODS: 22 healthy subjects (16 men and 6 women) with at least 6 months of continuous strength training were recruited. Each subject completed 4 sessions with different bands and free weight combination: only free weight (FW), 10%, 20% and 30% of the load provided by elastic tension.

All sessions consisted of 3 sets of deep unilateral leg press to task failure with a 12RM load and 4 minutes of rest between sets. Total number of repetitions completed (TREPS), mean and peak velocity (MV, PV) were recorded during the entire session. Percentage of velocity loss (VL) and the % of range of movement (%ROM) at which peak velocity was achieved were also calculated. Neuromuscular fatigue was assessed by the twitch interpolation technique.

To explore the effect of condition, one way ANOVA was performed. Additionally, 4x3 ANOVA was used to analyzed condition across sets.

RESULTS: A main effect of condition was detected for TREPS, PV, MV and %ROM (p≤0.034). Greater number of repetitions were completed in the 30% condition compared to 10% (p=0.015) and a tendency was observed for 30% > FW (p=0.053). PV was higher in FW compared to the other conditions and MV was greater in 30% in comparison with 10% (p=0.019). No differences between conditions were observed for VL (p=0.145).

Only a significant interaction between condition×set was observed for VM (p=0.023). VM was greater in SET2 for 30% compared to 10%. VM was higher in SET3 for 30% in comparison with FW.

CONCLUSION: Combining elastic bands with free weight seems to be an effective way to achieve a higher number of repetitions whereas replacing 30% of free weight by elastic tension allows maintaining a higher MV. These results show that elastic bands are useful for inducing changes in mechanical stimulus of resistance training (1).

REFERENCES

1. Andersen et al., J Strength Cond Res, 2015.

2. Walker et al., Eur J Appl Physiol, 2013.

Oral Presentations

OP-BM06 Motor Learning

"IN-VIVO HISTOLOGY" OF MOTOR SKILL LEARNING-INDUCED WHITE MATTER PLASTICITY IN THE HUMAN BRAIN

LEHMANN, N., AYE, N., KAUFMANN, J., HEINZE, H.J., DÜZEL, E., ZIEGLER, G., TAUBERT, M.
OTTO VON GUERICKE UNIVERSITY MAGDEBURG

INTRODUCTION: The mechanisms subserving motor learning in the intact human brain are not fully understood. We recently reported that learning a dynamic balancing task (DBT) over a 4-week period in young healthy adults (n = 24) leads to a behaviorally relevant increase in the complexity of cortical neurite orientation in motor brain areas [1], consistent with the idea of synaptic remodeling [2]. However, since a comprehensive understanding of motor learning can only be achieved by studying the interaction of distributed cortical and subcortical areas [2], we will focus here on learning-induced changes of the microstructural composition of the fiber tracts that interconnect hub regions of the motor network.

METHODS: We used a powerful within-subjects design with a 4-week life-as-usual control period immediately followed by an equally long period of DBT learning, as described in [1]. A unique set of quantitative MRI (qMRI) contrasts weighted towards diffusion, relaxation times and magnetization transfer were measured at baseline as well as before and after the learning period. Advanced biophysical models of tissue microstructure were fitted to these data, resulting in parameter maps sensitive to features such as tissue density, neurite orientation and density, myelin and iron [3,4]. White matter fiber tracts were virtually dissected using tractography and neural network-based bundle recognition [5], and qMRI parameter maps were projected onto these bundles. Finally, along-tract statistics of latent microstructural changes over time [6] were performed.

RESULTS: Non-overlapping 95% bootstrap CIs [6] of factor scores over time suggest significant learning-induced plasticity in major association (anterior thalamic radiation, superior longitudinal fascicle), commissural (corpus callosum) and projection tracts (corticospinal tract, thalamocortical and corticostriatal fibers). Importantly, based on factor loadings on the trajectory of latent change over time, we were able to infer three main drivers of neuroplastic change: process 1 is dominated by myelin-sensitive metrics, process 2 is dominated by neurite density and dispersion-sensitive metrics, process 3 is dominated by iron-sensitive metrics.

CONCLUSION: Here we have characterized the multifaceted microstructural changes in white matter in response to motor learning with unprecedented biological specificity. Consistent with theoretical predictions based on animal studies [2], we demonstrate the presence of neuronal, extra-neuronal and myelin-related changes also in the human brain. In perspective, we anticipate our study to be a starting point towards a more comprehensive understanding of the mechanisms subserving motor learning in physiological and pathological aging or in movement disorders.

[1] Lehmann et al., J Neurosci, 2023

[2] Zatorre et al., Nat Neurosci, 2012

[3] Zhang et al., Neuroimage, 2012

[4] Weiskopf et al., Front Neurosci, 2013

[5] Wasserthal et al., Med Image Anal, 2019

[6] Madssen et al., PLoS Comput Biol, 2021

IMPACT OF MASTICATORY MUSCLE MOBILIZATION AND CHEWING EXERCISES ON MUSCULAR TONE AND SOLEUS H-REFLEX RESPONSES

KALC, M., MAGDIC, M., MURKS, N., KRAMBERGER, M., HOLOBAR, A.
SCIENCE AND RESEARCH CENTRE KOPER

INTRODUCTION: The interconnected nature of human musculature and the neural system suggests that localised activities in the neck and masticatory systems could significantly impact spinal excitability throughout the body. For example, teeth occlusion, occurring voluntarily or non-voluntarily during sports activities, has an immediate facilitatory effect (1). However, the effect of stretching and relaxation of masticatory muscles is not well studied. This study aims to investigate the effects of neck and masticatory musculature mobilisation exercises, as well as specific chewing exercises, on masticatory muscle stiffness and the soleus (SOL) H reflex.

METHODS: Ten participants (age 27.2 ± 6.8 years, 4 females) engaged in two interventions: relaxing exercises for the neck and masticatory musculature (EX) and heavy chewing (CW). These interventions were separated by a 30-minute washout period. Masseter muscle tone and stiffness, as well as SOL H-reflex and D1 presynaptic inhibition, were assessed before and after each intervention using a handheld myotonometric device and a 64-channel matrix electrode (GR08MM1305, OT Bioelettronica, Italy). A bipolar version of the signal was computed to extract peak-to-peak amplitudes of electrically elicited responses (Global EMG). Additionally, signals were decomposed to analyse contributions from single motor units (2). A total of 8400 firings from 376 distinct MUs were categorised based on low, medium, and high firing thresholds. Data were analysed using repeated measures nested linear mixed-effect models.

RESULTS: The H-reflex amplitude decreased post-EX intervention, in contrast to the CW intervention, where it remained unchanged, resulting in a significant interaction effect ($p < 0.001$). No statistically significant changes were observed in D1 presynaptic inhibition ($p = 0.2$). Analysis at the single MU level reflected results consistent with the global EMG, but interventions did not selectively affect MUs of different threshold categories. Masseter muscle stiffness and tone increased post-EX and decreased post-CW, showing a significant interaction effect ($p < 0.001$).

CONCLUSION: Neck and masticatory muscle stretching and mobility exercises significantly reduced SOL H-reflex amplitude, indicating a potential global reduction in spinal excitability and enhanced relaxation. This effect does not appear to be mediated by D1 presynaptic inhibition mechanisms and could involve other spinal ionotropic and neuromodulatory mechanisms (3). In contrast, an increase in muscle tone and stiffness was observed during EX, possibly due to increased blood flow in the active muscles, while the decrease post-CW might be attributed to fatigue-induced mechanisms.

REFERENCES:

1. Yamada et al., Health Science Reports, 2023

2. Kalc et al., IEEE TNSRE, 2023

3. Mesquita et al., J Physiol, 2022

EFFECTS OF RESPONSE-OPTIMISED TRAINING ON MOTOR SKILL LEARNING AND TRANSFER

PRABHU, N.M., MATKE, M., LEHMANN, N., AYE, N., ZIEGLER, G., TAUBERT, M.

OTTO-VON-GUERICKE UNIVERSITÄT MAGDEBURG

INTRODUCTION: Positive effects of exercise on cognition are thought to be especially strong at either ends of the life span spectrum [1]. Particularly in case of older adults approaching physical and cognitive decline, optimisation of exercise induced benefits is necessary [2]. One proposed approach is to match the difficulty level of the task being trained to the individual's abilities and applying this optimised ratio during training [3]. Therefore, we hypothesized that optimal training conditions would induce higher learning gains and enhance transfer effects onto untrained motor and cognitive tasks.

METHODS: We conducted a randomized, single-blinded, 6-week dynamic balance training (DBT) intervention [4] optimised to the participants individual balance ability [3] (n=30, age range 60-80 yrs). Balance ability was assessed using 6-different levels of task difficulties ranging from level 0 (highest) to level 5 (lowest). Training was formulated to emulate either overload, underload or optimal load conditions. Cognitive (memory and executive) and near-far motor transfer (untrained variations of DBT and Wii) were investigated half-way through training duration (mid) and post training (post). Statistical analyses were conducted using repeated measures ANOVA with simultaneous component analysis (RM-ASCA+), a method combining linear mixed models with PCA [5]. Using the optimal group as the reference condition, group differences were inferred from non-overlapping 95% bootstrap intervals of the factor scores [5].

RESULTS: RM-ASCA+ revealed higher learning gains after the first training session in the optimal training group (95% CI [0.17, 1.44]) compared to both overload (95%CI [-2.46, -0.07]) and underload conditions (95%CI [-2.08, 0.03]). Similarly, higher learning gains after second (optimal vs underload: 95%CI [-1.76, 0.089]) and fifth training sessions (optimal vs overload: 95%CI [-1.83, 0.22]) were detected. This advantage of optimal training load was more pronounced at higher task difficulty levels as group differences were driven by higher factor loadings at level 1, 2 and 5. Furthermore, optimal load (95%CI [0.34, 1.01]) induced higher transfer effects mid- (underload: 95%CI [-1.29, 0.47], overload: 95%CI [-1.64, -0.3]) and post-intervention (underload: 95%CI [-1.46, -0.04], overload: 95%CI [-2.01, -0.34]). These differences were driven by higher factor loadings for motor transfer and executive tasks.

CONCLUSION: Our results show that benefits of optimising practice conditions in old age are not just limited to greater learning gains on the trained task, but are also reflected as performance improvements in transfer tasks. These findings further highlight the underlying neural mechanisms involved that enable transfer across domains.

[1] Tomporowski & Pesce, Psychol Bull., 2019

[2] Ludyga et al., Nat Hum Behav., 2020

[3] Guadagnoli & Lee, J Mot Behav., 2004

[4] Taubert et al., J Neurosci., 2010

[5] Jarmund et al., Front Mol Biosci., 2022

MOTOR IMAGERY ABILITY RELATES TO IMPROVEMENTS IN FORCE CONTROL IN OLDER FEMALES

CALKINS, C., KRAEUTNER, S., JAKOBI, J.

UNIVERSITY OF BRITISH COLUMBIA OKANAGAN

INTRODUCTION: Mentally rehearsing a task with no overt movements is defined as motor imagery training (MIT), and its application can improve task performance. With increased age the ability to maintain steady force output (force steadiness) declines, and females are also less steady than males. The purpose of this study was to understand if a single session of MIT would improve force steadiness of isometric elbow flexion contractions of older and young females. It was hypothesized that MIT would improve force steadiness and increase corticospinal excitability during isometric elbow flexion contractions in older and young females. It was also hypothesized that older females would improve to a greater extent compared to young females.

METHODS: Twenty-two young (aged 19-35) and thirteen older (aged 65-90) female participants were randomly assigned to a MIT group or control group. Both groups were tested in a block order. Blocks 1,3, and 5 involved participants performing isometric elbow flexion contractions at 10% of their maximal voluntary contraction. Blocks 2 and 4 involved participants performing MIT (training group) or viewing a documentary (control group). Motor evoked potentials (MEPs) were elicited within the last 5 seconds of each submaximal contraction in blocks 1,3 and 5.

RESULTS: The MIT group were less steady than the control group in block one ($p=0.02$), and force steadiness improved in the older group with MIT in block three ($p=0.008$). There were no significant findings for MEPs ($p>0.05$). For visual ($p=0.05$) and global ($p=0.04$) motor imagery ratings from the MIT blocks, young had higher motor imagery ratings than older females. There was a significant negative relationship in older females between global ($r=-0.715$, $p=0.035$) and visual ($r=-0.773$, $p=0.021$) motor imagery ratings from block 2 and force steadiness in block 3, suggesting a higher global and visual motor imagery score was associated with increased ability to produce steady contraction in older females.

CONCLUSION: This study demonstrated that motor imagery ability is maintained with aging and MIT can improve (or preserve) force steadiness in older females.

VARIATIONS IN CORTICAL FOLDING ARE ASSOCIATED WITH ADULT BALANCE LEARNING

TAUBERT, M., ZIEGLER, G., LEHMANN, N.

UNIVERSITÄT MAGDEBURG

INTRODUCTION: Differences in genetics and environment influence motor learning. Research indicates that variations in brain anatomy are related to balance learning (Lehmann et al., 2019). We have recently shown that higher levels of cortical folding in the left premotor cortex (rostral PMd) predict steeper learning rates in a challenging balance task (Taubert et al., 2023). However, it is unclear whether this brain-behavior relationship is moderated by person-specific factors. Here we tested for moderation effects by relatively stable biological factors (body size, gender, age) or environmental variation (initial performance, regular physical activity level).

METHODS: Brain imaging (cortical curvature estimated from T1-weighted MRI images) and balance learning data (N=84) were used from Taubert et al. (2023). Learning rate and initial performance were estimated using power function (slope, intercept) fitted to individual motor performance data. Multiple regression analyses tested if binarized (median split) variables (age, body size, gender, physical activity level, initial balance performance) moderate the link between cortical folding and balance learning rate. Significance was determined using non-parametric statistics with 5000 permutations and family-wise error-corrected threshold of $p < 0.05$.

RESULTS: A significant moderation effect was found for initial performance only. Here, the positive correlation between cortical folding in right PMd and learning rate was significantly larger in participants with lower as compared to higher initial performance levels. Simple slopes showed significant correlations in the right PMd only in participants with lower initial performances, whereas folding in the left PMd was correlated in participants with both low and high initial performances.

CONCLUSION: These results support previous findings on the role of individual folding differences in balance learning (Taubert et al., 2023) and suggest early developmental influences on adult balance learning. In accordance with longitudinal studies (Taubert et al., 2010; Lehmann et al., 2023), it appears that right PMd affects stabilometer learning only at lower baseline levels, while left PMd has an impact regardless of baseline level.

Taubert, Ziegler & Lehmann. Better long-term learning ability is predicted by higher surface folding of the human premotor cortex. bioRxiv

Lehmann, Aye, Kaufmann, Heinze, Düzel, Ziegler & Taubert (2023). Changes in Cortical Microstructure of the Human Brain Resulting from Long-Term Motor Learning. J Neurosci, 43(50), 8637–8648.

Lehmann, Tolentino-Castro, Kaminski, Ragert, Villringer & Taubert (2019). Interindividual differences in gray and white matter properties are associated with early complex motor skill acquisition. Hum Brain Mapp, 40(15), 4316–4330.

Taubert, Draganski, Anwander, Müller, Horstmann, Villringer, Ragert (2010) Dynamic properties of human brain structure: learning-related changes in cortical areas and associated fiber connections. J Neurosci 30:11670-11677.

Invited Symposium

IS-SH01 A critical appraisal of the potential legacy effects of Cycling World Championships on transport and recreational cycling

AN UNHOLY ALLIANCE – CYCLING'S RELATIONSHIP TO SPORT

ODDY, N.

GLASGOW SCHOOL OF ART

The relationship of cycling to sport and competition is long and binding. Cycle sport was established in the brief ascendency of the velocipede bicycle in the late 1860s and was to become almost the defining feature of cycling in the 1870s and 80s. This was the period of the high (or 'ordinary') bicycle, a machine gendered male and conceptualised around increas-

ing speed over all other considerations. In the UK of the early 1890s cycle competition on the public road had become so toxic to other road users that its own legislative bodies moved to ban it, establishing the more discreet, but equally competitive 'time trialing'. This paper is in the form of a historical overview of the relationship of cycling to competition of sport during seismic changes to the nature of the activity on the public road in the UK during the 20th century, as it went progressively down market while becoming a genuine form of utility transport, its subsequent eclipse by automobilism and its resurgence in the 21st. This paper considers the legacy of what it argues is an unholy alliance between cycling and competitive sport framed up in the gender conventions and social class structures of the 19th century which inadvertently contrived, and continues to contrive against cycling in the UK (at least) as a near universal day to day form of utility transport. It takes, as a case study in the present day, the hosting of the UCI World Cycling Championships in Glasgow in 2023 and the 'Festival of Cycling' that was created around it, as an exemplar of the current (mis)understanding of cycling that is a direct inheritance of the way cycling was conceived some 160 years earlier. Nicholas Oddy is Head of Design History & Theory at Glasgow School of Art. He is Chair of the Cycling History and Education Trust, which is responsible for the National Cycle Archive housed at the Modern Records Centre in Warwick University, UK. He has been involved with academic cycling history since giving a positioning paper on Kirkpatrick MacMillan at the First International Cycling History Conference in 1990. He was also active in founding the Cycling & Society symposia a decade later. During the 1990s and 2000s he was consultant to Phillips and Bonhams for their annual Cycling and Cycling Memorabilia sales. His most recent publication is the 'The Visual Culture of Cycling', part 7 in The Routledge Companion to Cycling (2022).

CAN HOSTING THE WORLD ROAD CYCLING CHAMPIONSHIP INSPIRE MORE PEOPLE TO PICK UP THE BIKE? EVIDENCE FROM BERGEN 2017

SOLBERG, H.A.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Cities planning to host major sport events often expect to generate economic, infrastructural, social, and health benefits. The prospect of positive payoffs is often emphasised in applications for financial funding for the events from the public sector. A much-debated issue is to what degree such events are capable of increasing participation in sport and physical activities in the population. Organisers contend that major international sport events are catalysts for sport participation and physical activity. This research investigates the existence of such effects related to the 2017 World Road Cycling Championship that was hosted in the city of Bergen, Norway (population approx. 280,000). In the years leading up to the Championship, representatives of Bergen municipality emphasised impacts that had the character of externalities. In the application for governmental funding from the Ministry of Culture, it was argued: "The Championship will be used to stimulate and inspire more people to choose an active life-style, so that it creates several long term impacts, and in many ways…strengthen the use of cycling as a transportation mode, and hence contribute to reduce pollution." To achieve these objectives, the Championship was surrounded by campaigns and programmes to stimulate residents' motivations and attitudes toward cycling as a means of transportation and exercising. These included a: • Bicycle education programme for children (2015–2017) • Public health programme called Cycle to the World Championship (2017) • Cycling World Championship for older people (2017) • Teaching plans for schools (2016–2017). Pre- and post-event residential surveys show that the Championship had limited impact on local resident's motivation to exercise. Although some 10% of the sample reported higher cycling frequencies in the year following the Championship, this was a temporary effect that could not be traced back to the event. Neither did bicycle traffic data indicate increased cycling activities. We found that cycling frequencies were higher in the years ahead of the Championship. Also, data from National Travel Surveys for the period 2014 to 2022 shows that the modal share of cycling for daily mobility in Bergen remained stable at 3% throughout the period. This is lower than what is observed for other major cities in Norway, and, also below the national average. Taken together, the Championship was considered a big success with respect to spectator numbers and, as we reported, creating a festival atmosphere in the city but that was not enough to initiate a modification of behaviour.

EXPLORATION OF THE POTENTIAL LEGACY EFFECTS OF THE GLASGOW 2023 CYCLING WORLD CHAMPIONSHIPS USING BEHAVIOUR CHANGE THEORY

HARRINGTON, D.

UNIVERSITY OF STRATHCLYDE

Behaviour change towards cycling for transportation or recreation is complex and requires actions on multiple levels. In this symposium the author will use an auto-ethnographic approach by putting her own cycling story at the centre of her argument. She herself is a legacy product of a large cycling event – when the infamous 1998 Tour de France Grad Départ visited Ireland. The effect of seeing this spectacle in person laid latent for many years until a constellation of different actions happened to and around her. She will map her journey from rural Ireland (where she was told bicycles were dangerous) into recreational, competitive and commuter cycling onto the socio-ecological model (individual, interpersonal, community, policy). She will demonstrate the need for a systems-approach to be in place to supplement big sporting events. Actions within the system would also fit with popular behaviour change theory including those represented in the COM-B (capability, opportunity, motivation – behaviour) model. The author will then identify the campaigns and programmes that happened in Glasgow in preparation for the 2023 World Championships that may indeed set the stage for a legacy effect, but also what might be missing. Deirdre Harrington is a Senior Lecturer in Physical Activity and Health at the University of Strathclyde, Glasgow. She has over 17 years of academic research experience under her belt in Ireland, the US, England and now Scotland. During this time she has developed and evaluated studies that use physical activity in

the prevention of obesity and type 2 diabetes. She is the lead of Strathclyde's inter-disciplinary research and practice Active Mobility Hub.

Oral Presentations

OP-PN01 Nutrition I

CARBOHYDRATE FEEDING REPLENISHES LIVER GLYCOGEN CONTENT WELL WITHIN 6 HOURS OF POST-EXERCISE RECOVERY IN WELL-TRAINED CYCLISTS.

FUCHS, C., VEERAIAH, P., HERMANS, W.J.H., BRAUWERS, B., VONCKEN, R., PETRICK, H.L., HENDRIKS, F.K., BELS, J.L.M., VAN DEN HURK, J., WEBER, J., SENDEN, J.M., THELWALL, P.E., PROMPERS, J.J., VAN LOON, L.J.C.

MAASTRICHT UNIVERSITY

INTRODUCTION: Both liver and muscle glycogen contribute substantially to energy requirements during prolonged moderate- to high-intensity exercise. Carbohydrate intake after exercise is essential to replenish both liver and muscle glycogen stores. Consuming ample carbohydrates has shown to replenish muscle glycogen concentrations within 24 h following exhaustive cycling. Yet, the time required to replenish liver glycogen after exercise in vivo in humans remains to be determined.

METHODS: Twelve well-trained male cyclists (age: 25±5 y; VO2peak: 67±5 mL/kg/min; Wmax: 5.8±0.7 W/kg) completed two test days in a randomized cross-over fashion. On both test days, liver and muscle glycogen values were assessed before and immediately after a glycogen depleting exercise session on a cycle ergometer. This was followed by a 12-h recovery period where participants remained fasted (CON) or consumed 10 g carbohydrates per kg body mass (BM) in the form of sucrose containing beverages and carbohydrate-rich meals (CHO). Liver and muscle glycogen levels were measured again at 6 and 12 hours into recovery. We applied 13C-Magnetic Resonance Spectroscopy (13C-MRS) to quantify liver and muscle glycogen concentrations and Magnetic Resonance Imaging to measure liver and muscle volume. In addition, muscle biopsies were collected to determine muscle glycogen concentrations. A two-factor (time*treatment) repeated-measures ANOVA was performed, with significant findings being further investigated through Bonferroni post hoc tests. Muscle and liver glycogen data are expressed as percentage signal intensity from 13C-MRS, with pre-exercise values set as 100% with the other values being expressed as relative changes from pre-exercise values. Data are expressed as means ± SD.

RESULTS: Exercise significantly reduced liver glycogen to 60±12% in CON and 64±16% in CHO, and muscle glycogen to 35±8% of pre-exercise values in both CON and CHO (all $P<0.001$), with no significant differences between the CON and CHO day (liver: $P=0.488$ and muscle: $P=0.803$). Without carbohydrate intake (CON), liver glycogen levels further declined (12 h: 46±11% of pre-exercise values; $P=0.002$), while muscle glycogen levels remained unchanged (12 h: 38±9% of pre-exercise values) compared to post-exercise values ($P=0.596$). Following carbohydrate intake (CHO), liver glycogen levels increased beyond pre-exercise values well within 6 h (145±24% of pre-exercise values; $P<0.001$) with no further increase at 12 h (160±29% of pre-exercise values; $P=0.111$). Despite ample carbohydrate intake, muscle glycogen levels remained below pre-exercise values after 12 hours of post-exercise recovery (71±12% of pre-exercise values; $P<0.001$).

CONCLUSION: Carbohydrate ingestion (1.2 g/kg BM/h) during recovery from exhaustive exercise rapidly replenishes liver glycogen content well within 6 hours. Ingesting 10 g of carbohydrate per kg BM does not fully replenish muscle glycogen stores to pre-exercise values within a 12-hour recovery period.

HYDROLYSED COLLAGEN SUPPLEMENTATION AUGMENTS PATELLAR TENDON HYPERTROPHY AND RATE OF FORCE DEVELOPMENT FOLLOWING EIGHT WEEKS' RESISTANCE TRAINING IN FEMALE MASTERS FIELD HOCKEY ATHLETES

NULTY, C.1, ERSKINE, R.M.1,3

1. LIVERPOOL JOHN MOORES UNIVERSITY; 2. SOUTH EAST TECHNOLOGICAL UNIVERSITY 3. UNIVERSITY COLLEGE LONDON

INTRODUCTION: Despite a high prevalence of lower-limb soft tissue injuries in female Masters field hockey athletes [1], effective exercise and nutrition strategies to mitigate injury risk and enhance performance in this population are unknown. In young female athletes, however, body weight resistance exercise (RE) training with 30g hydrolysed collagen (HC) supplementation enhances patellar tendon (PT) stiffness (which may reduce injury risk and increase performance), although PT cross-sectional area (CSA) remained unaffected [2]. Higher intensity, eccentric RE may cause tendon hypertrophy, thus enabling a greater efficiency of force transfer from muscle to bone, thereby increasing peak rate of force development (pRFD) and athletic performance. The aim of this study was therefore to investigate the effect of HC supplementation combined with high-intensity, eccentric RE on PT CSA, muscle size, strength, power, speed and pRFD in female Masters athletes.

METHODS: Twenty-two international female premenopausal Masters field hockey athletes were randomly assigned to collagen (COL, n=10, 40±4 years, 69±5 kg) and placebo (PLA, n=12, 38±3 years, 69±9 kg) cohorts in a double-blind design, and completed a weekly supervised high-intensity flywheel squat RE session and two home-based lower-limb eccentric bodyweight RE sessions for eight weeks. Prior to each RE session, participants ingested either 30g HC (COL) or 30g maltodextrin (PLA), together with 500mg Vitamin C. Before and after the intervention, maximum voluntary force (MVF) and pRFD were assessed during an isometric mid-thigh pull using force plates. Vastus lateralis (VL) muscle thickness (MT) and

PT CSA were measured with ultrasonography. Countermovement jump (CMJ) height and 20 m sprint speed were evaluated using force plates and timing gates, respectively.

RESULTS: MVF increased from 892±366 to 1,011±420 N (P=0.020), VL MT from 21±3 to 22±3 mm (P=0.015), and sprint speed from 5.7±0.4 to 5.8±0.4 m·s-1 (P=0.011), with no group×time interactions (P>0.05), while CMJ height did not change (P=0.238). PT CSA increased in both groups (P<0.001) but COL (116±12 to 121±13 mm2) increased more than PLA (109±22 to 111±22 mm2, P=0.014). Similarly, pRFD increased post-training (P=0.002) but to a greater extent in COL (7.9±1.3 to 10.1±2.4 kN·s-1) than in PLA (8.5±3.4 to 9.1±3.4 kN·s-1, P=0.039).

CONCLUSION: Eight weeks' eccentric RE with 30g HC supplementation augments the gains in PT CSA and pRFD in international female Masters field hockey athletes. The greater PT hypertrophy in COL may have influenced the larger increase in pRFD in COL by augmenting RE-induced gains in PT stiffness.

REFERENCES:

1. Croteau K. et al. 2022. Injuries in Masters Field Hockey Players Competing in the 2018 World Cup: Comparisons of Prevalence, Location, and Type by Age, Sex, and Field Hockey Experience. Int J Athl Ther Train.27(4):188-192.

2. Lee J. et al. 2023. Collagen supplementation augments changes in patellar tendon properties in female soccer players. Front Physiol.14:60.

ACUTE EFFECTS OF VARIOUS DOSES OF NITRATE-RICH BEETROOT JUICE ON HIGH-INTENSITY INTERVAL CYCLING RESPONSES IN WOMEN: A RANDOMIZED, DOUBLE-BLINDED, PLACEBO-CONTROLLED, CROSSOVER TRIAL

ZHANG, J., DAI, Z., POON, E.T., WONG, S.H.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: Nitric oxide (NO) plays a critical role in improving mitochondrial efficiency and muscle contractile efficiency during exercise and can be exogenously increased via nitrate supplementation. While numerous studies have investigated the effects of nitrate supplementation on exercise performance, most literature has focused on endurance-based exercise protocols. Meanwhile, the optimal dose of nitrate supplementation to maximize performance benefits during high-intensity interval exercise remains unclear, as previous studies have utilized a wide range of nitrate doses and predominantly recruited male participants, overlooking potential sex differences in responses to nitrate supplementation. Therefore, this study aimed to investigate the acute effects of various doses of nitrate-rich beetroot juice on the responses to high-intensity interval cycling in women.

METHODS: A double-blinded, randomized, placebo-controlled, crossover trial was conducted with 13 recreationally active young women (age = 23 ± 2 years). All participants performed interval exercise (8 × 1-min bouts of cycling at 85 % of peak power output [PPO] interspersed with 1-min active recovery at 20% of PPO) 2.5 h after consumption of the randomly assigned beetroot juice containing 0 mmol (placebo control group [PLA]), 6.45 mmol (single-dose group [SIN]), or 12.9 mmol (double-dose group [DOU]) nitrates. The heart rate (HR), blood pressure, blood lactate, blood glucose, oxygen saturation, rating of perceived exertion (RPE), and emotional arousal were assessed. All data collected during the interval exercises were analyzed using a two-way (treatment × time) repeated-measures ANOVA to explore the effect of interventions (PLA, SIN, and DOU) over time on the magnitude of each dependent variable. Statistical significance was set at $p < 0.05$.

RESULTS: Nitrate supplementation significantly altered the HR and RPE responses across the three trials. The mean HR was lower in the SIN and DOU groups than in the PLA group during both work intervals ($F[1.90, 195.78] = 7.06$, $p = .001$, $\eta_p^2 = .064$) and recovery periods ($F[2, 180] = 9.89$, $p < .001$, $\eta_p^2 = .099$), as well as across the overall protocol ($F[1.93, 374.47] = 16.90$, $p < .001$, $\eta_p^2 = .080$). The mean RPE was lower in the SIN and DOU groups than in the PLA group during recovery periods ($F[2, 180] = 10.39$, $p < .001$, $\eta_p^2 = .104$) and across the overall protocol ($F[2, 388] = 11.96$, $p < .001$, $\eta_p^2 = .058$). However, there was no significant difference in either HR or RPE between SIN and DOU on any endpoint.

CONCLUSION: Acute nitrate ingestion led to significant decreases in the mean HR and RPE during high-intensity interval cycling, but no additional benefit was observed with higher nitrate content. These findings may assist practitioners in implementing more effective nitrate supplementation strategies to enhance performance and adaptation during interval exercise.

PROLONGED FASTING ON PEAK FAT OXIDATION – DOES AGE MATTER?

TARRY, E.K.1,2, MIKKELSEN, S.S.1, D'AMBROSIO, M.3, TRANBERG, C.1, FALS, E.B.1, LUNDBY, S.M.1, DELA, F.1, SHAW, C.S.2, LARSEN, S.1,4, HELGE, J.W.1

1UNIVERSITY OF COPENHAGEN, 2DEAKIN UNIVERSITY, 3UNIVERSITY OF PISA, 4UNIVERSITY OF BIALYSTOK

INTRODUCTION: Prolonged fasting is an underutilised method to assess the mechanistic limitations of peak fat oxidation (PFO) during exercise, given it induces considerable energy deficit, reduced glucose and glycogen availability and thus subsequent adaptations facilitating fat handling. This study examined the fasting-induced changes in substrate availability and resultant alterations in fat oxidation. It was hypothesised that PFO rates would be substantially increased after a prolonged 3.5 day fast in healthy young and older individuals.

METHODS: 22 healthy, moderately trained men were recruited into two groups: young (n = 12) (26 ± 4 yrs, BMI 24.1 ± 1.9, VO2peak 53.6 ± 4.8 ml/kg/min) and older (n = 10) (63 ± 2 yrs, BMI 24.2 ± 1.2, VO2peak 42.9 ± 6.5 ml/kg/min) (mean ± SD)) and underwent 3.5 days of water-only fasting. Fasting blood samples and an incremental exercise test to determine

PFO and maximal oxygen uptake were conducted before and at the conclusion of the fasting period. Two-way, repeated measures-ANOVA were used to assess differences between groups over time.

RESULTS: Whole-body PFO increased from (0.45 ± 0.09 to 0.87 ± 0.14 g/min) and (0.41 ± 0.12 to 0.73 ± 0.15 g/min) in the young and older groups respectively, with PFO rates significantly higher after prolonged fasting in the young compared to older subjects (post-hoc: $p < 0.05$). No significant time by age interaction was observed when PFO was expressed relative to fat free mass. Rates of weight loss were similar in the young (84 ± 9 to 81 ± 9 kg) and older groups (76 ± 6 to 73 ± 6 kg). VO2peak values were significantly reduced after fasting, regardless of age (main effect; time: $p < 0.001$). As expected, older subjects had significantly lower VO2peak (main effect; age: $p < 0.001$). Similarly, RER values captured at maximal exercise capacity were significantly reduced following fasting, regardless of age (main effect; time: $p < 0.001$), and older subjects had significantly lower RER values regardless of time (main effect; age: $p < 0.01$).

CONCLUSION: Despite observed age attenuation in PFO and diminished anaerobic metabolism at maximal exercise output, prolonged fasting persists as a potent enhancer of peak fat oxidation. Further analyses of sampled blood and muscle are targeted towards elucidating the mechanisms underlying the fasting-induced adaptations associated with improved fat utilisation.

EFFECTS OF PROTEIN SUPPLEMENTATION DURING PILATES TRAINING ON BODY COMPOSITION, CORE MUSCLE ENDURANCE, AND JOINT FLEXIBILITY IN TRAINED WOMEN

KARPOUZI, C., KYPRAIOU, A., PETRIDOU, A., MOUGIOS, V.

ARISTOTLE UNIVERSITY OF THESSALONIKI

INTRODUCTION: Pilates is a popular type of exercise thanks to its comprehensive approach to physical fitness. Research has shown that Pilates training improves body composition, muscle endurance, and joint flexibility.1 Adequate protein intake is a key factor in supporting the adaptive response of skeletal muscle to exercise training.2 However, whether protein supplementation augments the adaptations to Pilates training remains unknown. Thus, the aim of this study was to investigate the effects of protein supplementation during Pilates training on body composition, core muscle endurance, and joint flexibility in trained women.

METHODS: Nineteen Pilates-trained women (31 ± 9 y) performed 10 weeks of Pilates training, with at least 2 sessions per week. Participants were randomly allocated to either a placebo (n = 10) or protein supplementation group (n = 9) in a quadruple-blinded (participants, intervention providers, investigators, and outcome assessors) design. Participants received 0.6 g of maltodextrin or whey protein/kg body weight/day, respectively. Habitual dietary intake was monitored throughout the study. Before and after the intervention, anthropometric measures (body weight, body mass index, and circumferences), body composition [through multifrequency bioelectrical impedance analysis (BIA) and full-scan dual-energy X-ray absorptiometry (DXA)], core muscle endurance (through the McGill's torso muscular endurance test battery), and joint flexibility (through the sit-and-reach test) were assessed. Data were analyzed by 2-way ANOVA (supplement x time) with repeated measures on time. Common BIA and DXA parameters (lean body mass, fat mass and their percentages) were further analyzed by Pearson's correlation analysis and paired Student's t test. Statistical significance was declared at $p < 0.05$.

RESULTS: Participants received 1.3 ± 0.3 (mean ± SD) protein/kg body weight/day from their habitual diet, with no significant difference between groups ($p = 0.551$). After 10 weeks of Pilates training, hip circumference decreased, body fat mass and percentage (by BIA) decreased, and total lean mass and percentage (by BIA) increased (all $p < 0.05$), regardless of supplementation. Trunk bone mineral content and arm lean mass (by DXA) increased with training ($p < 0.05$). The common BIA and DXA parameters were correlated (all $r > 0.8$, $p < 0.001$), although they differed significantly (all $p < 0.001$). BIA underestimated fat mass by an average 1.4 kg compared to DXA. Core muscle endurance increased by 23–48%, and joint flexibility increased by 57% (both $p < 0.05$), regardless of supplementation.

CONCLUSION: The novel finding of the present study is that, although short-term Pilates training improved body composition and performance parameters in trained women, protein supplementation that increased daily protein intake from 1.3 to 1.9 g/kg body weight did not have any effect on the measured parameters.

1. Kloubec. J Strength Cond Res 2010, 24:661

2. Nunes et al. J Cachexia Sarcopenia Muscle 2022, 13:795

Oral Presentations

OP-MH10 Obesity/Weight loss

IMPACT OF A SUPERVISED EXERCISE PROGRAM AFTER BARIATRIC SURGERY ON BODY COMPOSITION, FITNESS, CARDIOMETABOLIC AND METABOLOMIC PROFILE: INSIGHTS FROM THE EFIBAR STUDY

MARTÍNEZ-ROSALES, E., LÓPEZ-SÁNCHEZ, L., HERNÁNDEZ-MARTÍNEZ, A., FERRER-MÁRQUEZ, M., VILLA-GONZÁLEZ, E., BARRANCO-RUIZ, Y., MARTÍNEZ-FORTE, S., GÓMEZ-NAVARRO, C., ACEITUNO-CUBERO, J., REYES-PADILLA, R., APARICIO-GÓMEZ, J.A., FERNÁNDEZ-ALONSO, A.M., TRISTÁN, A.I., SALMERÓN-LÓPEZ, A.M., ABREU, A.C., RODRÍGUEZ-PÉREZ, M., FERNÁNDEZ DE LAS NIEVES, I., MARTÍNEZ-TÉLLEZ, B., SORIANO-MALDONADO, A., ARTERO, E.G.

UNIVERSITY OF ALMERÍA

INTRODUCTION: Obesity is linked to various health issues, including type 2 diabetes and cardiovascular diseases. Bariatric surgery has been proposed as an effective weight reduction method. This study aimed to determine the impact of a 16-week concurrent exercise program on body composition, fitness, cardiometabolic, and metabolomic profile in participants undergoing bariatric surgery.

METHODS: Eighty individuals with severe obesity (body mass index ≥35 kg/m2) were randomized to an exercise group (n=40) or a control group (n=40) following bariatric surgery. Baseline, week 16-and 12-months post-surgery assessments included measurements of body composition (i.e., fat-free mass) using a bioimpedance device (Inbody 270). Cardiometabolic parameters, such as glucose and lipid metabolism (i.e., insulin, triglycerides...), inflammatory cytokines (i.e., TNF- α), and liver function (i.e., glomerular filtration rate), were obtained through blood serum. Nuclear magnetic resonance (NMR) spectroscopy was used to assess metabolite concentrations. Health-related fitness parameters, including cardiorespiratory fitness (VO2max), handgrip strength, 30-second chair stand, and back-scratch tests, were also measured at the specified time points. The exercise program consisted of 48 sessions (three times per week over 16 weeks) of 60-min sessions that include (1) warm up at 50–65% of HR reserve (HRR), (2) compensatory training (i.e., core stability and stabilizer muscle exercises), (3) strength training (whole-body exercises progressing from 1 to 3 sets, from 12 to 6 repetitions per set, from 24 to 10 repetitions maximum (RM) (≈50 to 75% of 1RM), (4) aerobic training (on a treadmill, progressing from 15 to 25 min, from 65 to 85% of HRR), and (5) cool down. Analyses were conducted using a per-protocol approach, with statistical significance set at $p < 0.05$, and R software (v. 4.2).

RESULTS: Both groups improved body composition and fitness parameters at week 16 and 12 months. However, no significant between-group differences were observed. Related to liver function, the variable glomerular filtration rate (mL/min) showed a significant between-group difference at 12 months (-4.7 mL/min, (95% Confidence Interval [CI]) 95%CI [-8.7 to -0.7], $p < 0.05$) but not at 16 weeks. We observed that 38% of the metabolites exhibited a significant reduction, but non-significant group or group x time interactions were reported. Results were consistent across sensitivity analyses.

CONCLUSION: Our study provides insights into the impact of a 16-week concurrent exercise program on individuals undergoing bariatric surgery for severe obesity. However, the complex interplay of exercise, surgery, and metabolic responses warrants ongoing investigation for a more comprehensive understanding and optimization of health outcomes in individuals with severe obesity.

THE EFFECT OF EXERCISE TRAINING REGIMENS ON BODY COMPOSITION AND CARDIOMETABOLIC HEALTH AFTER METABOLIC BARIATRIC SURGERY: THE POWER BARIATRIC RANDOMIZED CONTROLLED TRIAL.

GOLDENSHLUGER, A., SAKRAN, N., FRIDMAN, L., DICKER, D., RAZIEL, O., KAIS, H., TURJEMAN, T., YAVETZ, R., GOITEIN, D., DUVNOV-RAZ, G., MHALER, I., YUNGSTER, Y., BEN ARI, A., KEIDAR, A., GEPNER, Y.

TEL AVIV UNIVERSITY

INTRODUCTION: Metabolic bariatric surgery (MBS) is the most effective treatment for morbid obesity, yet the impact of exercise training regimens on body composition and cardiometabolic changes post-MBS remains largely unexplored.

METHODS: A six-month randomized controlled trial was conducted with participants randomly allocated to exercise training intervention groups: aerobic (n=13), strength (n=11) or combined (n=10) exercise, and a control group (n=11) receiving routine care. The supervised exercise intervention gradually increased to 3 sessions/week for six months after MBS. Pre- and post-intervention participants were assessed for changes in body composition using Dual-x-ray absorptiometry (DEXA), abdominal adipose tissue distribution by 3-Tesla magnetic resonance imaging (MRI), cardiometabolic blood markers and body function and strength through handgrip, six-minute walk test, sit to stand and one repetition maximum test (1RM).

RESULTS: In our preliminary results among 45 participants (aged 39.2+9.4y, 75.6% females, BMI 42.3+4.2kg/m2) mean weight loss was 31.7+8.8 kg, and 67.8+16.6% of excess weight loss percentage. Fat mass decreased by -10.6+4.6% ($p>0.001$) and fat-free mass (FFM) by 6.2+2.8 Kg ($p<0.001$). Following six months of intervention, the combined and the aerobic groups achieved greater preservation of FFM compared to the control group (-4.6+1.8, -4.59+1.67 vs. -8.67+2.3kg, respectively; $p<0.05$). Additionally, no significant differences were observed between the combined and strength groups regarding FFM preservation. There was a trend for a higher reduction in deep subcutaneous adipose tissue (DSAT) in the aerobic group compared to the control group (relative percentage change -35.8+15.4% vs. -16.3+12.8%, $p=0.061$). Additionally, the aerobic group showed a higher decrease in alanine aminotransferase levels com-

pared to the control group (-39.1 +25.6% vs. 4.7+33.6% respectively, p<0.05). The physical activity regime was independently associated with the change in blood glucose levels after controlling for FFM loss (β=0.426, p=0.046). Physical function improved across all groups with the most notable enhancement in the aerobic and combined groups.

CONCLUSION: This study underscores the beneficial impact of exercise interventions after MBS on muscle mass preservation, adipose tissue distribution and metabolic markers, emphasizing the importance of exercise in comprehensive obesity management.

THE EFFECT OF EXERCISE TRAINING ON RESTING METABOLIC RATE AND BODY COMPOSITION FOLLOWING BARIATRIC SURGERY; SIX-MONTH RANDOMIZED CLINICAL TRIAL

FRIEDMAN, L., GOLDENSHLUGER, A., TURJEMAN, T., SAKRAN, N., DICKER, D., KAIS, H., GOITEIN, D., KEIDAR, A., DUVNOV-RAZ, G., MHALER, I., APTERMAN, A., ISRAEL, I., GEPNER, Y.

TEL AVIV UNIVERSITY

INTRODUCTION: Approximately 50% of individuals experience weight regain within five years following bariatric surgery (BS). This is primarily attributed to decreased resting metabolic rate (RMR), driven by fat-free mass (FFM) loss post-BS. This study aimed to investigate the impact of exercise training on RMR and examine the association between changes in RMR and body composition after BS.

METHODS: Sixty candidates (39.2±10.7y, 114.3±17.5kg, 41.7±4.4kg/m2) for BS were enrolled in a six-month open-label randomized controlled clinical trial. Participants were randomly assigned to one of four groups: control group (receiving standard care), aerobic, resistance, or combined online supervised training. Training sessions gradually increase to 60 minutes/session, 3 times/week. Pre- and post-intervention RMR measured by indirect calorimetry and body composition (FFM and fat mass) measured by dual-energy X-ray.

RESULTS: The 38 participants (aerobic; n=11, strength; n=10, combined; n=11, control; n=6) that completed the study by February 2024, demonstrated a significant (p<0.01) decrease in body weight (-31.1±8.7 kg), FFM (-6.61± 2.6 kg), fat mass (-24.4±7.4 kg), and absolute-RMR (-397± 264kcal/day). Yet, all study groups demonstrated similar and significant (p<0.01) increase in RMR adjusted to body weight (2.09±2.58 kcal/kg/day). The aerobic group displayed a significant correlation between FFM loss and absolute RMR six months post-surgery (r=0.646, p<0.05). In the combined group, RMR changes were associated with both weight loss (r=0.698, p=0.01) and fat mass loss (r=0.751, p=0.01).

CONCLUSION: Relative to body weight, RMR increased following BS with or without exercise training. Despite the notable loss of FFM, the decline in absolute RMR values following BS may not necessarily signify future weight regain.

EFFECT OF FATMAX COMBINED WITH KAATSU TRAINING ON BODY COMPOSITION AND LIPID METABOLISM OF RECESSIVE OBESE WOMEN

ZHANG, P.

BEIJING SPORT UNIVERSITY

INTRODUCTION: In recent years, the recessive obesity has become one of the most easily ignored health problems, among which recessive obesity in females is the more prominent. Based on the similarities between the response mechanism of maximal fat oxidation intensity in exercise and the body response mechanism caused by blood flow restriction(BFR), this paper probes into the effect of maximal fat oxidation intensity exercise combined with BFR on the improvement of body composition and blood lipids in recessive obese women, to provide a new idea of saving time for effective fat reduction, improve their health status and quality of life, and reduce the risk of cardiovascular diseases.

METHODS: After recruitment and screening, thirty recessive obese women(20.8±2.4yrs) participated in the study that was approved by IRB at Beijing Sport University. They were randomly divided into three groups, the maximal fat oxidation intensity exercise(FATmax), the maximal fat oxidation intensity exercise union together with BFR(FATmaxBFR) and the control(CON) groups. Baseline indicators were measured for all participants, including body morphology, body composition(DXA), fasting blood lipids, and VO2max. The FATmax group carried out 50min of personalized FATmax exercise intervention, the FATmaxBFR group carried out 30min of personalized FATmax exercise intervention under the condition of wearing BFR equipment; the CON group did not carry out any exercise intervention. The exercise intervention cycle is eight weeks, four times a week, and the exercise mode is walking and running on the treadmill.

RESULTS: (1) After intervention, participants in FATmax group had significant reductions in the body weight(3.16±1.54kg), BMI(1.19±0.60kg/m2) and body fat percentage(1.68±1.53%) compared to before intervention(P<0.01). There was no significant difference in changes of body weight, BMI and percentage of body fat after intervention compared to before intervention in FATmaxBFR group. (2) The FATmax group demonstrated significantly decreased systolic blood pressure compared to before intervention(6.80±6.68mmHg, P<0.05), and the decrease of systolic blood pressure in FATmax group was significantly greater than that in FATmaxBFR group(P<0.05). There was no significant change in blood pressure in FATmaxBFR group. (3) After intervention, participants in FATmaxBFR group had significant declines in level of serum triglyceride(0.46±0.61mmol/L, P<0.05). There was no significant change in blood lipid indicators in FATmax group.

CONCLUSION: Eight-week maximal fat oxidation intensity exercise can effectively reduce body fat and improve body composition of recessive obese women, and reduce the systolic blood pressure of quiet state. The exercise mode of eight -week maximal fat oxidation intensity combined with KAATSU training failed to diminish the body fat of recessive obese women within the limited time of 30 minutes, but could effectively reduce the level of serum triglyceride under this condition.

INTERMITTENT FASTING PREVENTS GLOMERULAR MORPHOLOGICAL CHANGES IN HIGH-FAT DIET MICE

YUAN, L.
TSINGHUA UNIVERSITY

INTRODUCTION: Obesity is a global epidemic phenomenon and can be accompanied by renal dysfunction or accelerating kidney diseases [1]. However, obesity-related kidney disease is easily ignored compared to diabetes, and hypertension-related kidney disease. Concurrently, intermittent fasting (IF) has greatly popular in weight loss due to its convenience of not requiring individuals to count calories and its ability to improve metabolic diseases [2]. Thus, we hypothesized that intermittent fasting could effectively prevent obesity-related renal dysfunction.

METHODS: C57BL/6 mice were randomly divided into three groups (n=7 per group): control group (Con, chow diet), high-fat diet group (HFD, high-fat diet), intermittent fasting group (HFD+IF, high-fat diet). Mice in the Con and HFD groups were free access to food for 21 weeks. Mice in the HFD+IF group were free access to food for 13 weeks and then started IF for 8 weeks. At the end of the 21-week duration, we tested serum total cholesterol (TC), serum free fatty acid (FFA), glomerular area (GA), and circumference (GC) in all mice.

RESULTS: (1) Compared to the Con group (TC: 1.93 ± 0.51; FFA: 153.75 ± 7.85; GA: 3286.86 ± 396.23; GC: 216.22 ± 13.19) the HFD group significantly increased TC ($p<0.001$), FFA ($p<0.001$), GA ($p<0.001$) and GC ($p<0.001$). (2) Compared to the HFD group (TC: 4.06 ± 0.58; FFA: 182.41 ± 6.49; GA: 5022.29 ± 534.80; GC: 265.80 ± 11.84), the HFD+IF group significantly decreased TC ($p<0.001$), FFA ($p=0.001$), GA ($p<0.001$) and GC ($p<0.001$).

CONCLUSION: As hypothesized, high-fat diet–induced obesity mice were coincident with enlargement of the glomerular area and circumference, but intermittent fasting could prevent and improve it.

Oral Presentations

OP-BM10 Muscle Architecture

AGE-RELATED DIFFERENCES IN ARCHITECTURE USING ULTRASOUND IMAGING DURING LOW RAMP ISOMETRIC CONTRACTION

BRUSCO, C.M., CARBONARO, M., MARTINO, G., LAURETANI, F., PORCELLI, S., BOTTER, A., FRANCHI, M.
UNIVERSITÀ DEGLI STUDI DI PADOVA

INTRODUCTION: The capacity of a muscle to produce force to move the human body is significantly affected by the aging process. Alongside the decline in neuromuscular function, structural changes in muscle architecture and in the morphology of the contractile and non-contractile tissues also occur with aging, which might in turn affect force capacity [1,2]. Namely, when contracted, pennate muscles change in fascicle length and angle [3], hence the absolute decrease in fascicle length and fascicle pennation angle with age [4] might also impact relative fascicle behave during contraction. In addition, aging muscles present greater muscle stiffness. As intramuscular connective tissue has a key role in maintaining the structural integrity of the muscle, these alterations might also impact how connective tissue and muscle stiffness will influence muscle shape changes during contraction [5]. In this study we analyzed age differences in fascicle behavior during ramped isometric knee extension.

METHODS: In this preliminary analyses of an ongoing study, data of five (E) elderly (76 ±4 years) and five young (Y) adults (26±2 years) were analysed. Ultrasound imaging of the vastus lateralis (VL) was recorded during isometric ramp contractions up to 30% and 50% of the maximum voluntary contraction (MVC) with slow force increase (2% MVC/s). The probe was placed longitudinally and the recording was synchronized to the force trace. Changes in fascicle behaviour (fascicle length- Lf, fascicle angle- FA, and muscle thickness- MT) were compared from the beginning of the force contractions to 10, 20 and 30% of MVC.

RESULTS: Paired sample t-tests did not reveal significant differences between E and Y were observed for Lf, FA and MT at any time point ($p>0.05$). In the E group, significant decrease in muscle thickness was observed between the beginning of the contraction to 10 ($p=0.02$), 20 ($p=0.01$) and 30% ($p<0.01$) of MVC, whereas no significant differences were detected in Lf and FA. In the Y group, no significant differences were detected in Lf, FA and MT from the beginning of the contraction to the different time points.

CONCLUSION: Although preliminary, the change in muscle morphology, as described by the decrease in muscle thickness with increased contraction levels observed in the elderly, might indicate alterations of the contractile and non-contractile tissue interfering in muscle behaviour.

References

1. Imrani L et al. (2022) J Gerontol A Biol Sci Med Sci
2. Fede C et al. (2022) Int J Mol Sci
3. Eng CM. et al. (2018) Integr Comp Biol.
4. Narici MV et al. (2021) J Cachexia. Sarcopenia Muscle
5. Holt NC et al. (2016) J Exp Biol

NOVEL INSIGHTS INTO BICEPS FEMORIS LONG HEAD FASCICLES CHARACTERISTICS USING DTI TRACTOGRAPHY.

MANTECON TAGARRO, C.J., TAKAHASHI, K., TOMARI, K., SHIOTANI, H., MAAS, H., KAWAKAMI, Y.
WASEDA UNIVERSITY

INTRODUCTION: The Biceps Femoris Long Head (BFlh) has a high injury risk due to its complex architecture, with an intramuscular aponeurosis (IntApo) where fascicles from each region (e.g. proximal, middle and distal) attach. Previous studies using ultrasound (US) methodology have primarily assessed fascicle length (FL) differences among these regions, however, the interindividual variation between regions remains unclear. Additionally, fascicles are often assumed as straight-line (e.g. running in a single plane) (1). Novel techniques like Diffusion Tensor Imaging (DTI) enable tracking of fascicles and the observation of their orientation changes and curvature. While DTI has been applied effectively to muscles like the Medial Gastrocnemius (2), its application to the BFlh remains largely unexplored. This study aims to employ DTI analysis to observe fascicle characteristics between different regions of the BFlh.

METHODS: Eight healthy subjects (four males and four females, 24.7 ± 2.3 years, 167.5 ± 7.2 cm, 62.8 ± 10.8 kg), without lower extremity injuries in the past year, participated in this study. Magnetic Resonance diffusion tensor imaging scans were taken with the subjects positioned prone and knee fully extended. Prior to imaging, subjects lay prone for 20 minutes to mitigate fluid content shifts, followed by pre-conditioning trials 50% MVC of knee flexion for five seconds. Segmentation of the BFlh muscle and IntApo was conducted utilizing 3DSlicer software, and tractography was performed by dsi_studio software. Fascicles attaching to the IntApo and intersecting at 30%, 50% and 70% of aponeurosis lengths (e.g. proximal, middle and distal regions) were selected. FL was defined as the length between muscle surface to the IntApo and calculated by multiplying the number of coordinates within the fascicle by the distance between these coordinates. Fascicle curvature (FC) was expressed as the ratio of its length to the straight-line distance between its endpoints.

RESULTS: No significant changes in FL (proximal: 113.03 ±17.455 (95% CI [95.575 – 130.485]) , middle: 117.80 ±15.938 (95% CI [101.862 – 133.738]) , distal: 112.11 ±13.845 (95% CI [98.265 – 125.955])) or FC (proximal: 2.76 ±0.194 (CI 95% [2.566 – 2.954]), middle: 2.78 ±0.249 (CI 95% [2.531 – 3.029]) , distal: 2.92 ±0.284 (CI 95% [2.636 – 3.204])) were observed within regions. However, fascicles were shown to change its orientation along its length, elucidating that the fascicles run in the sagittal and coronal planes.

CONCLUSION: DTI tractography allows to observe differences in FL and FC between regions of the BFlh. Additionally, it demonstrated that BFlh runs along the sagittal and coronal planes rather than just a single plane, which can lead to measurement errors when measuring FL using two-dimensional US methods.

References

Franchi MV et al. Med Sci Sports Exerc. 2020 Jan;52(1):233-243

Takahashi, K et al. J Anat, 2022 Aug; 241, 1324–1335.

INDIVIDUAL DISTRIBUTION OF MUSCLE HYPERTROPHY AMONG HAMSTRING HEADS: ADDING MUSCLE VOLUME WHERE YOU WANT IS NOT SO SIMPLE

FROUIN, A., LE SANT, G., BARBIER, L., JACQUEMIN, E., MCNAIR, P., ELLIS, R., NORDEZ, A., LACOURPAILLE, L.
NANTES UNIVERSITY

INTRODUCTION: The hamstring muscles play an important role in many sports, and hamstring muscle strengthening is needed to improve performance and prevent injuries (1). Hamstring strengthening programs are commonly composed of hip extension-oriented (e.g., stiff-leg deadlift) and/or knee flexion-oriented (e.g., leg curl) exercises. It is well known that a similar magnitude of muscle hypertrophy can be achieved across a wide spectrum of loading ranges from 30% to 80% of 1-RM. In recent years, low load training has been combined with blood flow restriction (BFR) to promote muscle hypertrophy (2) and enhance strength (3). However, the effect of such loading combined with blood flow restriction on the distribution of hypertrophy within the hamstring muscle group has not been investigated.

METHODS: A parallel randomized controlled trial design was implemented to compare the effect of a nine-week of High Load (HL) or Low Load-Blood flow restriction (LL-BFR) resistance training on the distribution of hamstring muscle hypertrophy. Participants were randomly allocated to one of three groups: HL, LL-BFR and control (CON). Two training sessions were composed of (a) stiff-leg deadlift and front squat and (b) a bi-set of bilateral seated leg curl and seated leg extension. They were alternated over the duration of the training program. Muscle volumes were assessed the week before and after the training program with freehand 3D ultrasound (3DUS) measurements (4).

RESULTS: Notable hypertrophy was observed for the ST (+26.5%) and SM (+17.1%) (all P values <0.01) during HL, while no changes were found for BF (+4.0%; P=1.0). LL-BFR group exhibited significant hypertrophy for SM (+21.6%), BF (+14.6%) and ST (+12.2%) (all P values <0.01).

CONCLUSION: Although LL-BFR and HL improved hamstring muscle volume to a similar extent, its distribution differed between SM, ST and BF. The hypertrophy was most in ST and SM for the HL group while it was balanced across all muscles for the BFR-LL group, the magnitude of which varied greatly among participants. These results provide new findings for optimizing training, prevention, and rehabilitation programs that aim to induce a selective hypertrophy among the hamstring muscles.

1. Maniar N, Carmichael DS, Hickey JT, et al. Br J Sports Med. 2023;57(2):109–16.

2. Biazon TMPC, Ugrinowitsch C, Soligon SD, et al. Front Physiol. 2019;10:446.

3. Lixandrão ME, Ugrinowitsch C, Berton R, et al. Sports Med. 2018;48(2):361–78.

4. Frouin A, Guenanten H, Le Sant G, et al. Ultrasound in medecine and Biology. 2023;49(6):1457–64.

TAKING INTO ACCOUNT FASCICLE CURVATURE DURING CONTRACTION AFFECTS MUSCLE ARCHITECTURE CHARACTERIZATION

BIZET, B., TRINCHI, M., MAGRIS, R., MONTE, A., ZAMPARO, P.
UNIVERSITÀ DI VERONA

INTRODUCTION: At rest, ultrasound imaging most reliable way to analyze muscle architecture is the extended field of view (Franchi et al., 2020). This method could not be applied in dynamic conditions, where muscle architecture characterization usually involves 'best fitting' of fascicles and aponeurosis in the field of view (FOV) and a linear extrapolation of both fascicles and aponeurosis outside the FOV. This method can easily be automated, thus reducing the time required for data analysis. Although most fascicles run as a "straight lines" from the proximal to the distal aponeuroses (Narici et al., 1996), fascicles could present a curvilinear path (even at rest) in different regions within a pennate muscle) (Blazevich et al., 2006); in these conditions, automated linear extrapolation could be biased. The aim of this study was to propose and test a new semi-automatic software for tracking "curvilinear fascicles" during dynamic muscle shape changes.

METHODS: 12 healthy adults performed a maximal knee extension at 75°.s-1 on an isokinetic dynamometer. Vastus lateralis ultrasound data were collected in correspondence of the 1st (proximal) and 2nd third (distal) of the thigh by means of a linear array probe (6 cm). B-mode videos were analyzed during the isokinetic phase: i) by using the automated software "ultratrack" (linear extrapolation within and outside the FOV) (Farris & Lichtwark, 2016); ii) by using a new semi-automatic software programmed in Matlab (MLE: manual linear extrapolation). With this software, the visible part of the fascicle was divided into 4 (MLE4) or 2 (MLE2) segments (to take into account the visible curvature) whereas fascicles and aponeurosis outside the FOV were linearly extrapolated (as in the case of the "ultratrack" software). The analysed parameters were: fascicle length (FL), pennation angle (PA), muscle thickness (Th), and belly length (BL). Moreover, one video was analyzed 3 times by the same investigator using MLE4 to perform ICC reliability tests.

RESULTS: Ultratrack showed higher FL, BL, and Th values and lower PA values compared to MLE4 and MLE2 (about 20% in the proximal and 40% in the distal regions). On the other hand, no significant differences were observed between MLE4 and MLE2 analysis in each of the investigated parameters. Excellent to good absolute concordance, using the 2 factors random model with "single rate" for FL, PA, BL, and Th was found (ICC=0.93; 0.90; 0.93; 0.88 respectively; P<0.001).

CONCLUSION: Failing to consider the curvilinear behavior in fascicles with significant curvature, as in the distal region of the vastus lateralis, can result in either overestimation or underestimation of muscle geometry. It appears that MLE analysis with a visible fascicle divided into 2 or 4 segments does not affect muscle geometry evaluation.

Oral Presentations

OP-BM19 Paediatric and applied biomechanics

ANALYSIS OF ANKLE JOINT MOTION IN LAYUP PERFORMANCE DURING A YOUTH BASKETBALL GAME.

CAMPANA BONILLA, M.V.
BEIJING SPORT UNIVERSITY

INTRODUCTION: The action of the ankle joint in a layup shot is crucial for youth players in a competition. Studies showed that angles of ankle joints inversion and dorsiflexion influence layup performance. Ankle joint angles and the muscles involved in ankle joint plantar flexion participate in the layup technique. The performance of layups requires a variable effect of acceleration, this happens as a consequence of high-intensity actions in the match. Therefore, these variables may be useful for understanding and estimating ankle joint movement demands in matches with young players. The objective of this study is to analyze the ankle joint angles and acceleration in layup performance in a youth basketball match.

METHODS: Six male youth basketball athletes (15.50 ± 1.05 years, 179.17 ± 8.18 cm, 73.08 ± 20.27 kg) participated in this study. The participants signed a parent informed consent and the Research Review Board of the institution approved this study. Two portable Witmotion sensors (Serial WT9011DCL-BT Bluetooth 5.0 AHRS IMU sensor 3 axes with an acceleration measurement range of 16g/s2 and a sampling rate of 20 Hz) were attached at the lateral malleolus of the participant's right and left ankles joint. The protocol consisted during the resting time of their basketball game, each subject was instructed to stand at the three-point line, after the signal of a whistle, the subject performed one layup with their dominant hand using maximum effort. Tri-axial acceleration X, Y, Z (ACCX, ACCY, ACCZ) and angles X, Y, and Z (ANGX, ANGY, ANGZ) data were collected respectively, one-way with repeated measures ANOVA and Friedman tests were used to compare the differences, significant levels were set at $p \leq 0.05$.

RESULTS: The results show significant differences in ankle joint acceleration: ACCY ($p < 0.001$) and ACCZ ($p = 0.013$), and there were no significant results in ACCX between the subjects. Meanwhile, within-subjects effects showed significant levels in ankle joint angles: ANGX ($p < 0.001$), ANGY ($p = 0.008$), and ANGZ ($p = 0.021$) subsequently. In addition, the results

obtained from the Friedman test showed significant differences between the subjects in ACCZ, ANGX, and ANGZ ($p < 0.001$).

CONCLUSION: This study analyzed the ankle joint motion in a layup during a youth basketball match. The results demonstrated substantial variations of ACCY and ACCZ in the left and right ankle movements that would influence layup performance. Furthermore, left and right ankle motion showed predominant changes in ankle angle during the layup technique between all the participants. These findings revealed that ankle angle and acceleration variations suggest a more detailed analysis of different technique levels during a high-intensity action in basketball. The estimation of acceleration and angles in this research could be a reference applicable during youth basketball matches. Moreover, the use of portable sensors might support in-field feedback for coaches and athletes.

1. Wang, L., et al. Sci Rep 13, 18667 (2023)

INFLUENCE OF TENNIS SCALING ON ACTIVATION PATTERN AND VIBRATION IN CHILDREN DURING A FOREHAND STROKE

HAUTIER, C., LE SOLLIEC, T., ZHANG, Q., GASSIER, R., GILBERT, B., TRAMA, R.

UNIVERSITÉ CLAUDE BERNARD LYON 1

INTRODUCTION: By adapting the characteristics of sports equipment to childrens physical development, sports movements can be performed more successfully and with more desirable movement patterns (1). This also allows mechanical constraints to be adapted to the childs physical abilities. That way, the International Tennis Federation has proposed the "Play and Stay" method to make tennis more accessible to all children. However, studies have yet to look at the influence of these adaptations on the muscular and vibratory stresses experienced by young tennis players. This study aimed to evaluate the vibrations and muscle activation patterns in children aged 5 to 13 performing a flat forehand following the ITF recommendations.

METHODS: Sixty junior tennis players were separated into four groups of fifteen players (Yellow, Green, Orange, and Red). Two triaxial accelerometers were taped to the back of the participants dominant hand and the rackets throat to capture the vibration signal. Also, eight surface electromyographic (EMG) sensors were fixed on arm muscles, including the Pectoralis Major, Upper Trapezius, Deltoideus Anterior, Deltoideus Medius, Biceps Brachii, Triceps brachii, Flexor Carpi, and Extensor Carpi. After a standardized warm-up, players were instructed to perform maximal isometric voluntary contractions for each muscle group, followed by fifteen maximal forehands flat. Statistical nonparametric Mapping (SnPM) analysis was used to perform statistical inferences on the EMG and vibration parameters obtained from the continuous wavelet transform.

RESULTS: No significant differences were found for EMG activation patterns. The total magnitude of vibration increased significantly from the red to the yellow category for the racket (from 1051.7 ± 362.2 to 2691.2 ± 783.8 UA, $p < 0.05$) and hand (from 526.8 ± 241.9 to 1334.4 ± 530.2 UA, $p < 0.05$). The median frequency of the hand increased between the red and yellow categories (from 158.7 ± 15.0 to 168.3 ± 15.6 Hz, $p < 0.05$), whereas it followed the opposite trend for the racket (from 206.2 ± 36.0 to 190.4 ± 26.6 Hz, $p < 0.05$). The damping time for racket vibrations did not differ between the four categories but was significantly higher in the orange group for hand vibrations.

CONCLUSION: Analysis of the various EMG parameters shows that the Play and Stay method enables children to produce an adapted activation pattern that suggests a progression in performance without any drastic change in technique during growth. The vibrations show that the vibratory stress tends to increase in proportion to the speed of the ball but that the damping time is relatively stable during growth.

REFERENCE

1) Buszard & al., 2020

HOW PERFORMANCE OF THE SPINNING HEEL KICK CHANGES AS ATHLETES MATURE?

OSULLIVAN, D.M., PROCK, M.

SEOUL NATIONAL UNIVERSITY, PUSAN NATIONAL UNIVERSITY

INTRODUCTION: The spinning heel kick is a kick in Taekwondo competition that can be awarded up to 6 points, if it knocks the opponent down. As a result of high potential reward and increase in points allocation, we can observe the spinning heel kick more frequently used in competitions and training. Therefore, the purpose of this study was to investigate how the spinning heel kick's performance related factors altered as an athlete matures from an elite level junior high-school to university level athlete.

METHODS: A total of 48 male taekwondo elite level athletes; 16 middle school, 16 high school, and 16 university, participated. After a taekwondo specific warm up the athletes performed the spinning heel kick a total of 10 times each, under the supervision of their coach and the researchers. While kicking their kinematics was recorded using motion capture system and 2 force plates. The following variables were calculated; total performance time, execution time, preparation time, the width of kicking path mediolaterally, and the maximum kicking foot speed. One way ANOVA was carried out to investigate if there were significant differences between the groups, school level, with Cohen's d calculated as the effect size.

RESULTS: The mean time to perform the spinning hook kick was 0.78 ± 0.06 s for middle school, 0.73 ± 0.06 s for high school and 0.74 ± 0.07s for university athletes. ANOVA revealed no significant differences in performance time among age groups. Likewise, no between group differences were found for preparation time. When comparing the execution time of the spinning hook kick, we found a significant between groups. Post-hoc tests revealed significant differences

between middle and high school, and between middle school and university. No differences in execution time were found. The mediolateral width of the kicking path showed no difference. Maximal kicking speed increased with the participants age and was highest for university athletes 10.56 ± 0.95 m/s, followed by high school 9.55 ± 0.80 m/s and middle school athletes 8.30 ± 1.10 m/s. The differences in maximum kicking speed were significant between groups with Post-hoc tests revealing differences between middle vs. high, middle vs. university, and high vs. university.

CONCLUSION: This study revealed age related performance differences in the spinning hook kick, with decreasing execution time of the kick and increased maximum kicking speed as the age of participants increased. However, these differences cannot be explained by differences in the preparation of the kick, as the time from the first initiation of the kicking movement until the kicking leg leaves the ground was not affected by age. Also, we found no differences in mediolateral kicking width that might explain differences in execution time and maximum kicking speed due to differences in kicking technique. Future research is therefore needed to identify the reasons leading to the age-related differences found.

INCIDENCE AND MAGNITUDE OF HEAD ACCELERATION EVENTS EXPERIENCED BY FEMALE ADOLESCENT RUGBY PLAYERS ACROSS A SEASON OF RUGBY PARTICIPATION.

SPRIGGS, N., HAMLIN, M.J., HENLEY, S., STITT, D., KABALIUK, N., SWALE, A., MELZER, T., CLARK, A., ANDERSON, T., SNELL, D., HOLDSWORTH, S., ALEXANDER, K., BASU, A., MASTERS, R., DRAPER, N.

LINCOLN UNIVERSITY, NEW ZEALAND

INTRODUCTION: There is growing concern in regard to rugby union player safety and ongoing medical problems following a concussion or long-term participation in the game. Because of the nature of rugby, players are exposed to repeated head acceleration events (HAE), potentially resulting in a concussion. These HAE can be direct (e.g. head-to-head contact) or indirect (e.g. whiplash from a tackle at the waist) and can be measured through Peak Linear Acceleration (PLA; g) and Peak Rotational Acceleration (PRA; rads/s^2) using instrumented mouthguards. Research on females and adolescent rugby players is sparse, yet they are a growing cohort wanting to play the game. It is also reported that adolescent females are at greater concussion risk and may experience concussions at a lower HAE threshold, compared to male and adult female players. Investigation of sex- and age-specific HAE magnitude and incidence is required for improving the safety of female adolescent rugby players and increase our understanding of how HAEs affect ongoing brain health.

METHODS: Eighteen female rugby players aged 12-17 years, wore an instrumented mouthguard (HIT IQ Nexus) for all school and club games and contact trainings during the 2022 rugby season in New Zealand. All HAE above 8g were recorded by the instrumented mouthguard. All sessions were recorded to verify all mouthguard detected HAE. The total amount of data collected over the season was 708.5 rugby player hours (game 266.5; training 442).

RESULTS: We found 1074 video-verified HAEs. Approximately half of these events (n = 548) were from direct head contact and 526 indirect impacts events not associated with head contact. Average impact per 1-hr of game exposure was 3.2 +/- 2.1 (mean +/- SD) and 1-hr of training exposure was 0.3 +/- 0.1. Although average impact incidence was significantly higher in games (p= <0.01) compared to trainings, game and training HAE magnitudes were not significantly different for PLA (p=0.81) or PRA (p=0.37). Games had an average PLA of 19.8 +/- 4.4 g, PRA of 1634 +/- 1372 rads/s^2, while trainings had an average PLA of 18.8 +/- 5.6 g and PRA of 1584 +/- 1145 rads/s^2. On average, each player experienced 2.0 +/- 2.2 HAE's above 55 g across a season of rugby participation.

CONCLUSION: Adolescent female rugby players are subject to a moderate number of HAE's during the season, predominantly in games. Only 3% of HAE's exceeded the 55 g threshold set by World Rugby for adult female players, which in our situation, under the new World Rugby laws would result in a single player being removed from play twice during a season of rugby participation. This study highlights the need for sex and age specific, objective data to measure head impact exposure in rugby union. Monitoring head impact magnitude and incidence is important for rugby safety and understanding the effect of concussive and non-concussive HAE in rugby union, both acutely and over the longer term.

EFFECTS OF SUPPLEMENTAL ECCENTRIC TRAINING OR CHANGE OF DIRECTION MODIFICATION TRAINING ON CHANGE OF DIRECTION PERFORMANCE AND KINEMATICS IN ADOLESCENT MALE FOOTBALL PLAYERS

NAKAMURA, H., YAMASHITA, D., NISHIUMI, D., NAKAICHI, N., HIROSE, N.

WASEDA UNIVERSITY: WASEDA DAIGAKU

INTRODUCTION: Change of direction (COD) ability is considered a critical motor ability in football, with recognized potential for improvement across various adolescent age groups. Previous studies have shown the effectiveness of eccentric training and COD modification training in enhancing COD performance among adults. However, information on the efficacy of these training methods in adolescents remains limited. This study aimed to compare the effects of different training methods on COD performance and kinematics among adolescent male football players.

METHODS: Fifty-eight junior high school male football players participated in this study and they were divided into three groups: Control group (CON group) consisted of 16 players who adhered to regular soccer training only. In addition to the regular soccer training, 21 players underwent COD modification training, which included drills at various angles and distances (COD group); another 21 players engaged in strength and plyometric training with an emphasis on the eccentric phase of movement (SP group). The seven-week intervention consisted of 12 sessions, each lasting approximately 15 minutes and held once or twice weekly. Participants underwent three trials of the Pro-Agility test and two trials of the 20 m sprint test before and after the intervention.

Total time was measured using timing gates for both the Pro-Agility and 20 m sprint tests, with the COD deficit (CODD) determined by the difference between these results. 3D kinematic data from the Pro-Agility test were obtained using a markerless motion capture system, facilitating the calculation of the center of mass (COM) velocity and kinematics for the trunk and lower limbs. The test consisted of 5 m, 10 m, and 5 m segments, each divided into acceleration (Acc) and deceleration (Dec) phases based on COM velocity, and further divided into early and late halves. The mean acceleration of the COM for each phase was computed. A two-way mixed ANOVA, incorporating both group and time as factors, was conducted, with Bonferroni-corrected pairwise comparisons applied for detailed analysis when significant interaction effects were noted.

RESULTS: Significant interactions were observed for CODD, 2nd Late Dec, 2nd Early Acc, and trunk lateral lean angle at 2nd turned foot contact. CODD was significantly improved in the COD group (p=0.027). 2nd Late Dec was significantly increased in the COD and the SP group (p=0.012 and 0.006, respectively). 2nd Early Acc was significantly decreased in the SP group (p=0.002). Trunk lateral lean angle at 2nd turned foot contact were significantly increased in the COD group (p= 0.004).

CONCLUSION: In adolescent male football players, seven weeks of strength and plyometric training improved deceleration ability in the COD task. However, it did not lead to improving COD ability. On the other hand, seven weeks of COD modification training improved deceleration ability and trunk kinematics in COD task and it led to improving COD ability.

Oral Presentations

OP-MH07 Exercise and cancer II

EXERCISE INTERVENTION IN PREVENTION AND TREATMENT OF ACUTE TOXIC ACTIONS OF PLATINUM-BASED CHEMOTHERAPY IN PATIENT WITH TESTICULAR CANCER: A CASE REPORT

OLIVA, V., UKROPCOVÁ, B., UKROPEC, J., MEGO, M., CHOVANEC, M., FORIŠEK PAULOVÁ, P., SEDLIAK, M.
COMENIUS UNIVERSITY IN BRATISLAVA, FACULTY OF PHYSICAL EDUCATION AND SPORT

INTRODUCTION: Testicular cancer (TC) is the most common type of malignancy in young adult males of European ancestry and the incidence is still increasing steadily (1). Multi-disciplinary care, including orchiectomy and cisplatin combination chemotherapy (CHT), have resulted in dramatic improvement in the cure rate for TC and nowadays is considered as one of the most curable malignancies (2, 3). However, platinum-based CHT is associated with toxic actions and dysfunctions in non-targeted tissues (4). Exercise seems to be promising as adjuvant therapy in reducing some of the toxic actions and dysfunctions in patients undergoing platinum-based CHT (2, 4, 5). This case report explored the effects of exercise intervention on body composition, muscle strength, power, muscle endurance and cardiorespiratory fitness (CRF) in TC patient during the treatment.

METHODS: Patient (age 50 y., height 172 cm, body weight 85,2 kg, BMI 28,8 kg/m2) diagnosed with seminoma underwent orchiectomy and 4 cycles of etoposide, cisplatin CHT treatment. Supervised and home-based exercise intervention was implemented during the 11-week treatment period where strength and aerobic training was performed. Electrical bioimpedance (BF511, OMRON, Japan) was used to assess fat mass, visceral fat and lean mass. Maximum muscle strength was assessed using the hand grip dynamometer (CAMRY EH101, China). Linear position transducer (FitroDyne Premium, FiTRONiC s.r.o., Slovakia) was used to assess muscle power during the counter-movement jump. Compound exercises were used to assess muscle endurance of upper and lower body. CRF was assessed by modified 3-minutes Step test ("YMCA version").

RESULTS: After implementing exercise intervention during 12-week platinum-based CHT treatment period, we observed reduction in fat mass (-2,2%), visceral fat (-2,0) and increase in lean mass (+1,1%). Despite observing slight reduction in maximum muscle strength, there were slight increase in muscle power production (+0,3%) and large increases in muscle endurance of lower and upper body (+20%, +5,7%, respectively). There was also an improvement observed in CRF (+14,3%).

CONCLUSION: Exercise intervention during anti-cancer treatment may have the potential to ameliorate and/or reverse some acute toxic effects in TC patients. Rationale exists for the promotion of exercise oncology research in this setting, in order to provide exercise recommendations for patients during the treatment.

The contribution was created with the support of APVV-19-0411.

REFERENCES:

1) Znaor A. et al. (2020). Int J Cancer. PMID: 31773729.

2) Bloomquist K. et al. (2023). Acta Oncol. PMID: 37450654.

3) Chovanec M. et al. (2017). Ann Oncol. PMID: 29045502.

4) Christensen J. F. et al. (2014). Br J Cancer. PMID: 24867693.

5) van der Schoot G. G. F. et al. (2023). J Cancer Res Clin Oncol. PMID: 37889308.

EFFECTIVENESS OF A PREOPERATIVE HOME-BASED EXERCISE PROGRAM ON QUALITY OF LIFE AND PHYSICAL PERFORMANCE AFTER LUNG CANCER RESECTION: A SINGLE-BLINDED MULTICENTER RANDOMIZED CONTROLLED TRIAL

MACHADO, P., PIMENTA, S., GARCIA, A.L., NOGUEIRA, T., SILVA, S., DOS SANTOS, C.L., MARTINS, M.V., CANHA, A., OLIVEIROS, B., MARTINS, R.A., CRUZ, J.

INSTITUTO POLITÉCNICO DE LEIRIA

INTRODUCTION: Exercise prehabilitation has shown to improve clinical outcomes after lung cancer surgery. However, its efficacy in preventing deterioration in postoperative quality of life (QoL) has not been determined. Moreover, although patients awaiting major cancer surgery express a preference to exercise in their home-based environment, most prehabilitation trials in lung cancer surgery have focused on hospital-based interventions. The main purpose of this study was to investigate whether a preoperative home-based exercise program (PHEP) prevents the deterioration in QoL after lung cancer surgery. Secondarily, it aimed to determine the effects of the PHEP on physical performance.

METHODS: A parallel, assessor-blinded, randomized controlled trial was conducted at 4 hospitals in Portugal. Patients awaiting lung cancer resection (clinical stage I-IIIA), were randomly allocated to either a non-exercise control group (n=21) or to a PHEP group (n=20). The PHEP consisted of moderate-intensity aerobic plus resistance training, with weekly telephone supervision. Primary endpoint was QoL measured with the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C-30. Secondary endpoints were exercise capacity (incremental shuttle-walk test) and muscle strength (maximal handgrip strength and 5 times sit-to-stand). Outcomes were measured at baseline (i.e., before randomization), 1-5 days pre-surgery, and 1-month post-surgery. A repeated measures analysis of variance (ANOVA) was employed to compare groups over time based on the intention-to-treat principle. The proportion of patients who had clinically relevant deterioration on QoL was analyzed based on the minimal importance difference.

RESULTS: A significant group X time interaction was found for global QoL (p=0.004). Significantly and clinically relevant differences between groups were found on global QoL at pre-surgery (mean difference [MD], 13.5 points; 95% confidence interval [CI], 2.4–24.6; p=0.019) and post-surgery (MD, 12.4 points; 95% CI, 1.3–23.4; p= 0.029), favoring the PHEP group. After surgery, the proportion of patients who had a clinically relevant deterioration on QoL was significantly lower in the PHEP group compared with the CG in the following domains: physical function (PHEP: 20% vs CG: 66.7%; p=0.004), role function (PHEP: 10% vs CG: 52.4%; p=0.006), social function (PHEP: 15% vs CG: 47.3%; p=0.043), pain (PHEP: 25% vs CG: 61.9%; p=0.028) and appetite loss (PHEP: 5% vs CG: 38.1%; p=0.020). In addition, between-group differences were found in preoperative five-times sit-to-stand (median difference, –1.8 s; 95% CI, –0.1 to –3.7 s; p=0.041) and postoperative exercise capacity (MD, 147.4 m; 95% CI, 17.3–264.2 m; p=0.027), favoring the PHEP group. No between-group differences were found on handgrip strength.

CONCLUSION: This study found that a PHEP prevents deterioration in QoL and exercise capacity after lung cancer surgery. Further research is needed to determine its efficacy on surgical outcomes.

MULTIMODAL HOME-BASED PREHABILITATION FOR COLORECTAL CANCER PATIENTS WITH REDUCED SURGERY WAIT TIMES: A PILOT SERVICE

DE KLERK, T., CAMPBELL, A.1, BRUN-LACEY, E.2, COLLINS, D.2, PITKETHLY, A.1, LOUDON, D.3, MAXWELL, D.3, KALIARNTAS, K.1

[1]EDINBURGH NAPIER UNIVERSITY, SCHOOL OF APPLIED SCIENCES., [2]NHS WESTERN GENERAL HOSPITAL EDINBURGH., [3]PAL TECHNOLOGIES LTD.

INTRODUCTION: Multimodal prehabilitation is the systematic process of improving patients physical, emotional, and nutritional status between diagnosis and surgery [1]. Patients with better health status before bowel surgery, show improved response to treatment, experience less complications, have shorter hospital stays and improved quality of life [2]. Given the short surgery wait times for colorectal cancer patients, current prehabilitation guidelines are insufficient. This pilot service evaluated the tolerability and feasibility of multimodal high intensity interval training (HITT) with higher frequency (>5 days/week) to optimise patients within reduced surgery wait times (< 4 weeks).

METHODS: Ten patients received personalised home-based exercise, breathing and pelvic floor exercise, nutritional advice and emotional support using motivational interviewing. Primary outcome: functional walking capacity (six-minute walk test [6MWT]). Secondary outcomes: muscular strength/endurance (sit to stand test [STS]), self-efficacy for exercise, anxiety/depression (Hospital Anxiety and Depression Scale [HADS]), nutritional status (Malnutrition Universal Screening Tool ([MUST]), quality of life (EQ-5D-5L), adherence, sedentary behaviour change, affect regulation and patient satisfaction. Distribution dependant, appropriate descriptive (mean±standard deviation; median/range) and inferential (paired T-tests; Wilcoxon) statistics were used and statistical significance set at $p < .05$.

RESULTS: Prehabilitation (median:20, range:6-35 days), improved all functional outcomes. Affect regulation improved significantly. 6MWT distance increased by 16.9m±96m (p=.6), STS increased by 31.1% (Mean Difference (MD) 3.5±6.2, p=.1). EQ-5D-5L Index score improved by 5.6% (MD=.04±.09, p=.1) and self-reported health status by 26.5% (MD=16±24.6, p=.07), HADS Fear by 13.6% (MD=.9±4.7, p= .5) and HADS Depression by 10.5% (MD=.4±3.9, p=.7). Patients reported 16.9% more confidence to partake in exercise (MD=10.9±20.9, p=.1). Body mass index (BMI) improved significantly (MD=.6±.6, p=.03). Resting blood pressure improved by 8.7% systolic/3.7% diastolic pressure. Patients managed mean physical exercise of 79±66 mins/session, and cumulatively 119.9±39.3 activity mins/day. Significant affective improvements in activation (arousal) (MD=.5±0.9, p<.00) and affective valence (feeling) (MD=.6±1, p<.00) were observed be-

fore/after exercise when intensity was self-selected. Adherence was excellent, patient satisfaction increased, and no adverse events occurred.

CONCLUSION: Multimodal home-based HITT prehabilitation with high frequency is feasible and tolerable within reduced surgery wait times. Optimal results may require >3 weeks of physical exercise and early referral is vital. These findings have important implications for informing current clinical practice.

REFERENCES:

1. Bolshinsky, V., et al., Multimodal prehabilitation. Dis. Colon Rectum, 2018. 61(1): p. 124-138.

2. Chmelo, J., et al., Prehabilitation. Rozhl Chir, 2021. 100(9): p. 421

VARIETY IS THE SPICE OF RESISTANCE TRAINING? – COMPARISON OF UNDULATING AND TRADITIONAL HYPERTROPHY TRAINING IN CANCER SURVIVORS: A RANDOMIZED CONTROLLED TRIAL

BAUER, N., SCHNEIDER, J., SCHLÜTER, K., WISKEMANN, J.

NATIONAL CENTER FOR TUMOR DISEASES HEIDELBERG

INTRODUCTION: Optimizing resistance training through periodization is essential for improving strength performance. In this context, undulating resistance training is considered an effective method for structuring resistance training in healthy recreational and competitive athletes (Harries, Lubans, & Callister, 2015). However, to date there are no studies in the field of exercise oncology that have compared volume-matched undulating strength training with traditional hypertrophy training in cancer survivors.

METHODS: 37 breast and 30 prostate cancer survivors were randomly assigned to either undulating (UND, n = 34, age 60±9 years) or standard hypertrophy training (STD, n = 33, age 58±11 years). Both groups performed two machine-based resistance trainings per week with matched training volume over an intervention period of 12 weeks. As primary outcome, strength performance of the knee extensors was assessed by maximal isokinetic peak torque (MIPT) and one-repetition maximum (1-RM) test. In addition, MIPT and maximal voluntary isometric contraction (MVIC) for knee, hip and elbow extensors/flexors as well as 1-RM for leg curl, rowing, lat pull-down, leg press and shoulder press were examined.

RESULTS: 27 (UND) (13 women) and 26 (STD) (16 women) patients were included in the analysis. Concerning the primary outcome, MIPT ($p<.05$) and 1-RM ($p<.001$) show that both groups significantly improved knee extensor strength. There was no significant group difference. Comparably, nearly all secondary endpoint parameters showed significant strength gains over time without group differences ($p>.05$).

CONCLUSION: Undulating and standard hypertrophy resistance training both resulted in comparable effects on strength performance in cancer survivors. Both training regimens showed no differences with regard to safety and feasibility in cancer survivors.

REFERENCES:

1) Harries, S. K., Lubans, D. R., & Callister, R. (2015). Systematic review and meta-analysis of linear and undulating periodized resistance training programs on muscular strength. J Strength Cond Res, 29(4), 1113-1125. doi: 10.1519/jsc.0000000000000712

Oral Presentations

OP-PN29 Hormonal Biology I

DOES TIMING OF ORAL CONTRACEPTIVE PILL INTAKE AFFECT EXERCISE PERFORMANCE? A RANDOMIZED CROSSOVER CONTROLLED STUDY

SMITH BISGAARD, M., HANSEN, M.

AARHUS UNIVERSITY

INTRODUCTION: Combined oral contraceptive pills (OCP) containing synthetic estradiol and one type of progestin are used by 27 to 41% of female athletes in various European countries [1-3]. Previous research indicates a potential slightly reduced exercise performance in OCP users compared to non-OCP users [4]. However, the acute effect of OCP intake on athletic performance has not been studied.

During OCP use, the endogenous levels of sex hormones are downregulated to fairly constant low levels. However, serum concentrations of the exogenous sex hormones from the OCP peak between one and two hours after pill intake [5, 6], but already after eight hours, the concentrations of exogenous hormones have declined to low levels. Whether these fluctuations affect exercise performance remains undetermined.

We aimed to investigate a potential acute effect of OCP intake on strength, power, and endurance performance in trained females.

METHODS: Twenty-two trained young females using monophasic 2nd generation OCPs were tested in a randomized cross-over controlled study. Participants completed a physical performance test protocol twice during the active OCP period. In randomized order, the participants completed the tests one hour after intake of the OCP and 24 hours after

intake of the OCP respectively. The physical tests included a balance stand test, a muscular endurance push-up test, an agility test, and measurements of isometric handgrip strength, countermovement jump height, flexibility and a maximal oxygen uptake bike test. In addition, a questionnaire about psychological wellbeing was completed before testing. Time of the day, energy intake and exercise 24 hours preceding the tests was standardized and participants were familiarized with the tests beforehand. Serum and saliva hormone analysis ensured OCP compliance and exact levels of exogenous hormones at the time of testing.

RESULTS: No significant difference in exercise performance parameters was observed between the test days; OCP intake one hour before testing versus 24 hours before testing.

CONCLUSION: Collectively, timing of OCP intake in young, trained females did not significantly affect exercise performance parameters. This study indicates, that female athletes using OCPs and pursuing to optimize their physical performance, can omit concerns on when to take their OCP.

References

1. Martin, D., et al., 2018, Int J Sports Physiol Perform.

2. Oxfeldt, M., et al., 2020, Int J Sports Physiol Perform.

3. Ekenros, L., et al., 2022, Frontiers Media S.A.

4. Elliott-Sale, K.J., et al., 2020, Springer.

5. Jung-Hoffmann, C., et al., 1991, Karger Publishers.

6. Stanczyk, F.Z., 2002, Springer. p. 211-224.

ALTERATIONS IN PERCEIVED TRAIT FATIGUE DURING THE MENSTRUAL CYCLE DID NOT AFFECT PERFORMANCE FATIGUE DURING SUBMAXIMAL KNEE EXTENSION EXERCISE TO EXHAUSTION IN EUMENORRHEIC FEMALES

BIELITZKI, R., BEHRENS, M., BEHRENDT, T., ROß, L.M., DOROW, N., SCHEGA, L.

OTTO VON GUERICKE UNIVERSITY

INTRODUCTION: The influence of the menstrual cycle (MC) on female athletic performance and its underlying mechanisms have been largely investigated with conflicting results. A recent study by Ansdell et al. (J Appl Physiol. 2019;126:1701–12) revealed that time-to-exhaustion during a submaximal task was higher on Day 21 [mid-luteal] compared to Day 2 [early follicular] without differences in the strength, voluntary activation and decline in contractile function of the knee extensors. However, endurance performance (i.e., time-to-exhaustion) is not only influenced by neuromuscular but also perceptual factors. Therefore, the present study aimed to investigate time-to-exhaustion and the perceptual responses during the same exercise used by Ansdell et al. across the MC. Furthermore, the influence of trait fatigue and trait mood (assessed over the last 7 days) was examined.

METHODS: Fifteen eumenorrheic females (24.1±3.3yrs, 63.4±4.8kg, 166.2±5.0cm) participated in a pseudo-randomized, counterbalanced cross-over study. Participants completed a familiarization session and three experimental trials on different days during the MC (Day 2 [early follicular], 14 [late follicular], and 21 [midluteal]). The fatiguing exercise consisted of isometric knee extensions at 60% of maximal voluntary isometric contraction (MVIC) torque until exhaustion. The protocol consisted of sets with 12 repetitions (3s contraction/ 2s rest). On each 12th repetition, a MVIC was performed to quantify the performance reduction (i.e., motor performance fatigue) At the end of each set perceived motor fatigue, affective valence, arousal, pain and effort percep-tion were queried. Furthermore, motivation to perform the fatiguing task (Dundee Stress State Questionnaire), trait fatigue (Modified Fatigue Impact Scale), and trait mood (Profile of Mood States) were recorded before each experimental session.

RESULTS: There were no differences in time-to-exhaustion, the MVIC decline and the perceptual responses during exercise across the 3 trials. However, motivation to perform the fatiguing task was lower on Day 2 compared to Day 21 ($p=0.030$. $d=0.45$) and trait mood was worse on Day 2 compared to Day 14 ($p=0.007$, $d=0.85$). Of note, a high but non-significant effect was found for trait fatigue ($p=0.081$, $\eta p2=0.18$) with higher values on Day 2 compared with Day 14 ($p=0.079$, $d=0.56$).

CONCLUSION: The MC had an effect on motivation to perform the fatiguing task and trait mood as well as trait fatigue with the worst values on Day 2. However, time-to-exhaustion, motor performance fatigue, and the perceptual responses during exercise were not affected. These results indicate that MC-related alterations in motivation, trait mood and trait fatigue do not inevitably affect motor task performance and/or motor performance fatigue.

INFLUENCE OF MENSTRUAL CYCLE PHASE OR HORMONAL CONTRACEPTIVE PHASE ON PEAK FAT OXIDATION

LÖFBERG, I., KARPPINEN, J.1,2, LAATIKAINEN-RAUSSI, V.1, IHALAINEN, J.1,3, LEHTI, M.1, KYRÖLÄINEN, H.1, HACKNEY, A.4, MIKKONEN, R.1

1UNIVERSITY OF JYVÄSKYLÄ; 2UNIVERSITY OF HELSINKI; 3RESEARCH INSTITUTE FOR OLYMPIC SPORT ; 4UNIVERSITY OF NORTH CAROLINA

INTRODUCTION: Estradiol (E2) and progesterone (P4) are suggested to influence substrate use during exercise [1]. Previous literature indicates higher fat oxidation during submaximal continuous exercise in the luteal phase (LP) of the menstrual cycle (MC) compared to the follicular phase (FP) [2]. Evidence regarding fat oxidation during exercise in women using hormonal contraceptives (HC) is sparse but indicates no clear differences between active (AP) and inactive hormonal

phases (IP) [3]. This study aimed to examine differences in peak fat oxidation (PFO) between hormonally confirmed MC phases in naturally menstruating women (NoOC) and HC phases in women using combined monophasic oral contraceptives (COC).

METHODS: Healthy untrained women (Tier 1) [4] aged 18–35 years with a body mass index between 19.5 and 35 kg/m² were recruited to this study and divided into NoOC- (n=35) and COC-group (n=19). Participants were measured after overnight fast in the FP/LP or the AP/IP of the MC or HC cycle, respectively. E2 and P4 were measured using immunoassays and body composition via bioimpedance. Fat oxidation was measured using indirect calorimetry during a graded treadmill PFO test consisting of 4-min stages. The initial speed and gradient were 4.5 km/h and 1.2°, respectively. The speed increased by 1 km/h in the first two stages and the gradient increased by 1.2° from the third stage onwards until participants reached a respiratory exchange ratio of 0.95 [5]. Fat oxidation was calculated for the last minute of each stage and the highest rate achieved was selected as the PFO. MC or HC phases were compared using paired t-test. Associations between E2/P4 and PFO were analyzed with multiple linear regression using fat free mass (FFM) as a covariate.

RESULTS: All participants in the NoOC-group had P4 level ≥16 mmol/l in the LP and higher E2 and P4 concentrations in the LP than in the FP ($p<0.001$). E2 and P4 did not change from AP to IP in the COC-group. In the NoOC-group, PFO was 0.40 g/min (SD 0.09) in the FP and 0.43 g/min (SD 0.12) in the LP (mean difference 0.03, 95% CI -0.02–0.07, $p=0.253$). In the COC-group, PFO was 0.44 g/min (SD 0.11) in the AP and 0.48 g/min (SD 0.12) in the IP (mean difference 0.04, 95% CI -0.01–0.09, $p=0.099$). E2/P4 were not significantly ($p>0.05$) associated with PFO in any of the MC/HC phases.

CONCLUSION: E2 and P4 fluctuations during the MC cycle or the use of COC do not notably affect PFO. This discrepancy with previous work may result from the use of different testing protocols, as most studies reporting higher fat oxidation during the LP have used prolonged single-stage exercise, which is known to be crucial for maximal lipolysis [6].

REFERENCES:

1. Oosthuyse & Bosch. 2010. Sports Med 2010, 40, 207–227

2. Hackney et al. 1994. Int J Sport Nutr 4(3):299–308

3. Williams et al. 2023. J Appl Physiol 135(3), 642–654

4. McKay et al. 2021. Int J Sports Physiol Perform 17(2):317–31

5. Amaro-Gahete et al. 2019. 7(23):10:909

6. Wolfe. 1998. Adv Exp Med Biol 441:147-56

THE INFLUENCE OF MENSTRUAL CYCLE PHASE ON DURABILITY

DOCTER, H., TAYLOR, M., MÜLLER, A., OSBORNE, J.O., SANDBAKK, Ø., DE KONING, J.J., NOORDHOF, D.A.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: In addition to maximal oxygen uptake (VO2max), fractional utilization of VO2max, and efficiency1, durability has been regarded as an important determinant of endurance performance2. Durability may be reflected by the change in any of the three other determinants over time,3. In women, a drop in repeated sprint performance following a simulated cycling race is exacerbated in the mid luteal phase4. However, it is unclear if menstrual cycle phase influences the ability to maintain efficiency. This study aimed to evaluate the ability to maintain efficiency after completing a high-intensity training session, and whether this ability is influence by the menstrual cycle.

METHODS: Twenty-four female endurance-trained females performed a high intensity training session (5x5min at 80% of velocity or power output at VO2max, 2min rest) on a treadmill or cycle ergometer in the early follicular (EF), ovulatory (O), and mid luteal (ML) phase of one menstrual cycle. Menstrual cycle phases were determined using the determined using calendar-based counting, urinary ovulation testing, and analysis of ovarian hormones. Metabolic power per kg body mass was calculated using gas exchange data during submaximal exercise (60% of velocity or power output at VO2max) before and after each training session and used as a measure of efficiency.

RESULTS: A multilevel linear model revealed a higher metabolic power after the training session ($p=0.041$, $r=0.24$) compared to before. A second model revealed that menstrual cycle phase did not significantly affect the change in metabolic power (EF vs. O: $p=0.388$, $r=0.16$, O vs. ML: $p=0.306$, $r=0.19$), although a medium effect size was found between the EF and ML phase ($p=0.058$, $r=0.35$; mean±SE running EF: -0.51±6.31W/kg, O: 6.04±14.9W/kg, ML: 13.96±6.82W/kg; cycling EF: -2.86±15.0W/kg, O: 3.69±6.65W/kg, ML: 11.6±14.9W/kg). The population of interest makes the study vulnerable for small sample sizes, which may have led to a low statistical power.

CONCLUSION: Efficiency is reduced following a high-intensity training session. There is some indication that the ability to maintain efficiency may be more compromised in the ML compared to the EF phase. However, due to the low statistical power no conclusions on the effect of menstrual cycle phase on durability can be drawn.

References:

1 Joyner MJ, Coyle EF. (2008) J Physiol. 586(1):35-44.

2 Jones, A. M. (2023). J Physiol. 0: 1–16

3 Matomäki, P., Heinonen, O. J., Nummela, A., Laukkanen, J., Auvinen, E. P., Pirkola, L., & Kyröläinen, H. (2023). Front. in Physiol., 14: 203.

4 Lee, S. J., Sim, M., Van Rens, F. E., & Peiffer, J. J. (2023). MSSE. 56(1): 92-102

PROGESTERONE AND ESTRADIOL LEVELS DO NOT CORRELATE WITH SPRINT PERFORMANCE IN YOUNG PLAYERS WITHOUT CONTRACEPTION

IMBERT, S., DAUSSIN, F.N.
UNIVERSITÉ DE LILLE

INTRODUCTION: Rugby is an intermittent team sport in which acceleration and maximal speed are key parameters involved in performance. In womens physiology, the question of whether the menstrual cycle can influence performance is increasingly present in the scientific literature. The aim is to find out whether athletes hormonal levels can influence their speed performance.

METHODS: Nineteen young female rugby players (mean age: 15.9 ± 0.7 years, mean body mass: 67.4 ± 13 kg, mean height: 165 ± 7.9 cm) playing at the highest youth level were involved in this study. Players do not take contraception. Saliva samples were taken once a week on waking to determine their progesterone (pg/ml) and estradiol levels (pg/ml) during sixteen weeks. On the same day, the players performed two 40m sprints. The sprint performances were recorded and analyzed using a Global Positioning System (GPexe GPS Micro-technology) to determine the in-situ acceleration-speed profile. The analysis allowed us to determine the maximal theoretical acceleration (A0 in m/s2) and the maximal theoretical speed (V0 in km/h). Correlation between force-velocity parameters and progesterone and estradiol levels were tested. The players were asked to fill out a questionnaire about their feelings during the different hormonal cycles.

RESULTS: No correlation was found between progesterone (52.7±41) and estradiol (4.5±2.5) levels with maximal speed (25±1.6) respectively p=0.4 and p=0.18, V0 (26.4±1.7), p=0.34 and p=0.57, and A0 (5.7±0.6), p=0.29 and p=0.32. The analysis of the questionnaire on how the players felt about their menstrual cycle. Revealed that 71% of the players felt that, at least at times, it hurt their performance and only 9% of the players thought that it had a positive impact.

CONCLUSION: While hormonal variations occur during each cycle, no correlation was observed with in situ force-velocity profile parameters. These results contrast with the players feelings. Our data suggest that in the follow-up of young female players, hormonal monitoring is not a priority, especially when considering neuromuscular performance.

Oral Presentations

OP-MH21 Exercise and vascular function

THE MECHANICAL MECHANISM OF EXERCISE IMPROVING HYPERLIPIDEMIA-INDUCED ENDOTHELIAL INJURY: SHEAR STRESS ACTIVATES PIEZO1 TO PROMOTE MITOCHONDRIAL FUSION

LIU, X.
XI'AN JIAOTONG UNIVERSITY

INTRODUCTION: Physical exercise improves hyperlipidemia-induced endothelial injury by reducing circulatory lipid levels and enhancing mitochondrial function in vascular endothelial cells. However, the exact mechanism underlying its protective effects remains uncertain, despite recent research indicating that blood flow shear stress is a key mechanism through which exercise enhances endothelial function. It is still unclear whether blood flow shear stress contributes to the exercise-induced improvement of endothelial injury caused by hyperlipidemia, and the specific mitochondrial molecular mechanism remains to be elucidated. Piezo1, as a newly discovered mechanosensitive ion channel protein, plays a crucial role in response to mechanical stress.

METHODS: In this study, we utilized long-term and short-term hyperlipidemia models to elucidate the role of exercise in improving vascular damage caused by hyperlipidemia and whether fluid shear stress is involved. Furthermore, pharmacological interventions (PIEZO1 agonists and inhibitors) and PIEZO1 knockout mice were employed to validate PIEZO1 as a key molecule in exercise-induced improvement of hyperlipidemia-associated vascular damage. Finally, utilizing cellular and molecular biology techniques, we elucidated the molecular mechanism by which fluid shear stress promotes mitochondrial fusion through PIEZO1, thereby improving endothelial function.

RESULTS: This study demonstrated that exercise can increase blood flow shear stress and ameliorate endothelial injury in both long-term and acute hyperlipidemia models. Additionally, intravenous injection of the Piezo1 agonist Yoda1 into the tail vein has a similar effect to exercise in mitigating endothelial injury. Conversely, the beneficial effects of exercise in improving endothelial injury diminish in endothelial-specific Piezo1 knockout mice and following intravenous injection of the Piezo1 inhibitor GsTMx-4, indicating that Piezo1 is a crucial molecule for exercise-induced improvement of endothelial injury. Furthermore, in vitro experiments revealed that isolated mitochondria can directly respond to fluid shear stress and Yoda1. Blood flow shear stress can enhance endothelial cell mitochondrial fusion and function by activating the Piezo1-Mfn2-eNOS signaling axis.

CONCLUSION: These findings unveil a novel mechanism by which exercise promotes endothelial cell function by increasing blood flow shear stress to activate the Piezo1-Mfn2-eNOS signaling axis, and suggest that Piezo1 may present a new target for preventing and treating hyperlipidemia-induced endothelial injury.

MICROVASCULAR FUNCTION IMPAIRMENTS AFTER STEPS REDUCTION IN YOUNG SUBJECTS

GIUSTI, L., MARCIANO, A., NERI, M., BOTTINELLI, R., PORCELLI, S.

UNIVERSITÀ DI PAVIA

INTRODUCTION: Inactivity is an important and independent risk factor for all-cause mortality, and there is increasing evidence of the importance of minimizing sedentary behavior to reduce the risk of cardiovascular diseases (1). Endothelial dysfunction plays an important role in the pathogeneses of cardiovascular diseases, and impaired endothelium dependent dilation is directly linked with cardiovascular morbidity and mortality (2). Bedrest, which is a classical model utilized to study the physiological effects of severe inactivity, showed a negative impact on endothelial function (3,4). The effects of steps reduction, a milder form of inactivity, on microvascular responsiveness are currently unclear. In the present study, we investigate the effects of 14 days of steps reduction on microvascular function, evaluating acute post-occlusive reactive hyperemia by near-infrared spectroscopy (NIRS).

METHODS: Eighteen young subjects (12 males and 6 females; age: 22±3y, weight: 69.1±11.9kg, height: 172±7cm) were assessed before (PRE) and after 14 days of steps reduction (SR). Their physical activity was monitored through an accelerometer worn on the waist. Microvascular function was estimated by monitoring changes of tissue saturation index (TSI) during a prolonged ischemia followed by a reperfusion phase. The rate of muscle deoxygenation during the first minute of occlusion (Slope1) was used as proxy of resting muscle oxygen uptake. Time of ischemia (t-isch) and the lowest TSI value reached during occlusion (TSImin) were calculated to estimate the ischemic vasodilatory stimulus. The rate of muscle reperfusion during 10s (Slope2-10s) post-ischemia and the magnitude of reperfusion (TSIpeak) were calculated.

RESULTS: Steps count was effectively reduced by 82% from PRE to SR. Slope1 was not different between PRE (-0.11±0.07%*s-1) and SR (-0.12±0.10%*s-1; p=0.436). TSImin was lower after SR compared to PRE (46.2±7.1% vs 43.2±8.5%, respectively; p<0.05). Slope2-10s was similar between PRE (1.16±0.59%*s-1) and SR (1.12±0.38%*s-1; p=0.573) but it resulted significantly reduced after SR (-13%) when normalized for the ischemic vasodilatory stimulus.

CONCLUSION: After 14 days of steps reduction, resting muscle oxygen uptake did not change whereas endothelial function was impaired. Thus, a mild reduction of daily activity induced alterations at microvascular level, which are probably due to lower nitric oxide (NO) bioavailability and partial structural vascular modifications.

CAN SET CONFIGURATION MODULATE THE ARTERIAL STIFFNESS AND POST-EXERCISE HYPOTENSION RESPONSE IN POSTMENOPAUSAL WOMEN?

RÚA ALONSO, M., REVUELTA-LERA, B., NINE, I., RIAL-VÁZQUEZ, J., FARIÑAS, J., RIVERA-MEJÍA, S.L., OVIES-GUTIERREZ, F., IGLESIAS-SOLER, E.

UNIVERSITY OF A CORUÑA - Q6550005J

INTRODUCTION: Menopause is a critical phase in women's health, increasing the risks of hypertension and vascular dysfunction (1). Resistance exercise (RE) can promote a post-exercise hypotensive response in postmenopausal women (2). Set configuration can modulate the acute cardiovascular response to RE (3,4). However, menopause may influence the acute effects to exercise (2). Therefore, the aim of this study was to explore arterial stiffness and blood pressure response in postmenopausal women after RE protocols with different set configurations.

METHODS: 50 postmenopausal women with a physically active lifestyle (37 normotensive/13 hypertensive) participated in this study funded by the Spanish Ministry of Science and Innovation (PID2021-124277OB). After a medical screening and familiarisation with the RE protocol composed by four exercises, each woman completed one control (CON) and three experimental sessions equated by intensity (12RM load), volume (144 reps) and total resting time (18min), but differing in set configuration: 9 sets of 4 reps with 45s rest (9S); 6 sets of 6 reps with 72s rest (6S); and 4 sets of 9 reps with 120s rest (4S).

Arterial stiffness, measured by pulse wave velocity (PWV), was assessed before, immediately after, and 60 min after session. Blood pressure, including systolic (sBP), diastolic (dBP), and mean arterial pressure (MAP), as well as low frequency of SBP oscillations (LFsBP), were evaluated before and after each session at intervals of 5-15, 15-25, 30-40, and 40-50min.

RESULTS: No differences between normo- and hypertensive participants were observed.

ANOVA analysis detected a main effect of time, session, and time×session interaction ($p \leq 0.002$) for PWV. Immediately after session, all RE protocols caused higher values than CON ($p \leq 0.006$). Increases compared to baseline were observed only after 6S and 9S ($p \leq 0.039$), with no significant differences between the experimental sessions. After 60min from the end of the session, all RE protocols showed a reduction in PWV compared to immediately post-exercise records ($p \leq 0.005$), without differences between experimental sessions and CON ($p \geq 0.075$). Only a main effect of time was observed for sBP, MAP and LFsBP ($p \leq 0.021$).

CONCLUSION: Set configuration may modulate the arterial stiffness response after exercise, despite the absence of a post-exercise hypotension response in physically active postmenopausal women. Long set configurations increase arterial stiffness without providing the hypotensive benefit. Thus, in order to reduce the cardiovascular risk while still reaping the benefits of RE, short set configurations (i.e., an intensity of effort of 33%, 4 out of 12) should be recommended for postmenopausal women, similar to healthy young people (3,4).

REFERENCES

1) Hulteen et al., Int. J. Sports Med, 2023

2) Le Bourvellec et al., J Appl Physiol, 2024

3) Mayo et al., J Strength Cond Res, 2016
4) Rúa-Alonso et al., Eur J Appl Physiol, 2020

COMPARATIVE EFFECTS OF DIFFERENT TYPES OF EXERCISE ON ENDOTHELIAL FUNCTION, ARTERIAL STIFFNESS, AND EXECUTIVE FUNCTION IN SEDENTARY YOUNG INDIVIDUALS: A RANDOMIZED CONTROLLED TRIAL

HUANG, J., YAN, X.
GUANGZHOU SPORT UNIVERSITY

INTRODUCTION: The present study aimed to determine whether high-intensity interval training (HIIT), moderate-intensity continuous training (MICT), and resistance exercise (RE) have different effects on endothelial function, arterial stiffness, and executive function (EF) in sedentary young individuals and explore the underlying mechanisms.

METHODS: Sixty-three sedentary participants were randomly divided into the HIIT, MICT, RE, and control groups. Macrovascular and microvascular endothelial function were assessed by measuring brachial artery flow-mediated dilation (FMD) and fingertip reactive hyperemia index (RHI), respectively. Arterial stiffness was evaluated by carotid-femoral pulse wave velocity (cfPWV), brachial-ankle pulse wave velocity (baPWV), ankle-brachial index (ABI), and augmentation index (AIx). EF performance was evaluated through Stroop and N-back tasks. The functional near-infrared spectroscopy (fNIRS) was employed to measure the cortical activation and real-time oxyhemoglobin concentration (Oxy-Hb) changes in different cerebral regions.

RESULTS: Compared to the baseline, mean shear rate, FMD, and RHI significantly increased and cfPWV significantly decreased in all three intervention groups but not the control group after 8 weeks of intervention. However, significant changes in FMD and peak diameter were seen in the HIIT group and the MICT group rather than the RE group, compared to the control group. In addition, a significant difference in the change of RHI was only observed between the control group and the HIIT group.

Compared to the baseline, the reaction time in the Incongruent Stroop task and the 3-back task significantly decreased after 8 weeks of HIIT and MICT. However, reduced reaction time in the Stroop interference task and the 2-back task were only observed in the HIIT group. During the Stroop task, the Oxy-Hb in the frontopolar area (FPA) significantly increased after 8 weeks of HIIT and MICT. Furthermore, significant increase in Oxy-Hb in the orbitofrontal area were only observed in the RE group, and significant increase in Oxy-Hb under the left of dorsolateral prefrontal cortex (L-DLPFC) and the right of dorsolateral prefrontal cortex (R-DLPFC) were only observed in HIIT. During the N-back tasks, the Oxy-Hb in the FPA region significantly increased after 8 weeks of HIIT and MICT. Furthermore, significant increases in Oxy-Hb under the L-DLPFC region were only observed in HIIT.

CONCLUSION: Eight weeks of HIIT, MICT, and RE effectively improved macrovascular and microvascular endothelial function and arterial stiffness in sedentary young individuals. However, HIIT and MICT rather than RE efficiently activated certain brain regions such as FPA and DLPFC and improved EF. Among these three exercise types, HIIT seemed to be the most effective to improve vascular and cognitive function in this population. Importantly, enhanced vascular function by exercise training is pivotal to the improvement in cognitive function.

A PHYSICAL ACTIVITY INTERVENTION WALKING-BASED CAN REDUCE PRO-OXIDANT ACTIVITY IN POLYATHEROMATIC PATIENTS

PIALOUX, V., MURA, M., RIVOIRE, E., KHENNICHE, L., THOMAS, A., MILLON, A.
UNIVERSITY CLAUDE BERNARD LYON 1

INTRODUCTION: Atherosclerosis remains a major contributor to the global burden of deaths. Atherosclerotic plaques can be located in any large artery bifurcation, as the carotid or the lower limbs (i.e. Peripheral artery disease [PAD]). As the plaque becomes unstable, it can promote thromboembolism leading into a stroke or a limp, dependent of the plaque location. A large cohort study of 3 000 participants, demonstrated that subjects with higher physical activity rates had lower odds of PAD and carotid atherosclerosis. Inflammation and oxidative stress and two major pathophysiological mechanisms involved in the development and deterioration of carotid and lower limb atherosclerosis.

The Physical Activity and Carotid Atherosclerotic Plaque haemorrhage (PACAPh) study is a 6-month interventional study. This abstract focuses on the results of circulating inflammation and oxidative stress of the PACAPh study comparing PAD non-PAD patients of the cohort.

METHODS: A total of 52 carotid atherosclerotic patients were included. At inclusion, sedentary (n=26) and non-sedentary (n=26; >8 and ≤8h/day sitting, Sedentary behaviour questionnaire); PAD (n=30) and non-PAD patients (n=22; ankle brachial index ≤ and > 0.90). Cytokines have been measured by multiplex and pro/antioxidant markers by colorimetric assay and enzymology. Wilcoxon rank-sum test was used to compare groups. Then the whole population was randomised 1:1 either in the physical activity or in the control group. In the physical activity group, the effect of the intervention on biological markers was tested in PAD and non-PAD patients. The interaction effect intervention*PAD was tested with a linear regression.

RESULTS: At inclusion, the most sedentary patients had increased blood concentrations of the pro-inflammatory cytokines CCL27, CCL11, IL1b, and MIF ($p<0.05$) in comparison with less sedentary patients. At inclusion, PAD patients had increased rates of pro-oxidant enzyme MPO ($p<0.05$) compared with patients with only carotid atherosclerosis. Moreover, the physi-

cal activity intervention decreased the concentration of MPO in patients with PAD, while it stayed stable in patients with only carotid atherosclerosis (interaction $p<0.05$).

CONCLUSION: These results suggest that the sedentary behaviour is associated with the level of circulating inflammatory markers in carotid atherosclerotic patients. It also appears that PAD increases the MPO pro-oxidant activity resulting mainly from circulating immune cells, in carotid atherosclerotic patients. More importantly, this MPO activity is reduced by our intervention specifically in PAD patients of our cohort. As our intervention is solely based on walking, it can be easily implemented in the everyday life of patients. In this context, reduce sedentary behaviour by practicing moderate intensity physical activity might be beneficial for these patients.

Oral Presentations

OP-AP09 The coach: Insights and Perspectives

EXPERT CONSENSUS ON CHARACTERISTICS IMPORTANT OR ESSENTIAL FOR ACHIEVING INTERNATIONAL PODIUM SUCCESS AS AN ELITE ENDURANCE RUNNER: A DELPHI SURVEY

ELVISH, T., KREMER, P., TROWELL, D., MILLET, E.L., TURNER, K.J., BONACCI, J., PICKERING, C., SAUNDERS, N.

DEAKIN UNIVERSITY

INTRODUCTION: Current literature identifies biological [1], psychological [2] and social characteristics [2,3] possessed by elite endurance runners. However, there is a lack of consensus on which characteristics are important for achieving podium success as an elite endurance runner. Improved understanding of the biopsychosocial profile of elite endurance-based runners can guide ongoing athlete development and allocation of resources when targeting international podium success. The aim of this study is to understand characteristics experts believe are important or essential for achieving international podium success as an elite endurance runner.

METHODS: Fourteen middle distance running (MDR) and 10 long distance running (LDR) experts participated in Round 1 and 12 MDR and eight LDR experts participated in Round 2 of a Delphi survey. Experts included coaches and practitioners who work with elite Australian able-bodied endurance-based runners. Experts were asked to rate, using a Likert scale (range:0= completely irrelevant to 5= essential), how important they believed each characteristic was for achieving international podium success in MDR and LDR. The list of characteristics presented was based on the findings of a systematic review and expert interviews, outcomes of a larger project. Characteristics endorsed as 'essential' or 'important' by >80% but <60% of experts in Round 1 were taken to Round 2. Characteristics were classified as important if ≤80% of experts endorsed the characteristic as 'essential' or 'important' [4]. Consensus was not sought beyond two rounds.

RESULTS: Of the 188 biopsychosocial characteristics presented 154 were endorsed or rejected in Round 1, hence 34 characteristics were included in Round 2. After Round 2, 22 MDR related biological, 19 LDR related biological, 30 psychological and 10 social characteristics were endorsed as being important or essential for international podium success. Biological characteristics endorsed by all MDR experts included; capacity to run rounds, maximal aerobic speed, tactical awareness and capacity to recover from training. Biological characteristics endorsed by all LDR experts; capacity to tolerate high training loads, capacity to pace, maximal oxygen uptake, capacity to recover from training, running economy and efficiency. Psychosocial characteristics endorsed by all endurance-based running experts included; ability to cope with pressure, dedication, resilience, self-belief, coach-athlete relationship and training environment.

CONCLUSION: Findings highlight the importance of a biopsychosocial approach to the development of elite endurance-based runners. These findings may be useful in continuing to profile elite endurance-based runners to better inform athlete development. Ongoing efforts to use these findings to monitor athlete progression in an effort to differentiate between those who do and do not achieve podium success, is warranted.

1.Hanley et al. (2023)

2.Vernacchia et al. (2000)

3.Huxley et al. (2017)

4.Weber et al. (2022)

THE SKILL OF SPEED: INSIGHTS FROM WORLD-CLASS SPRINT COACHES ON THE DEVELOPMENT OF SPRINTING TECHNIQUE

MASON, J., ZECH, A.

FRIEDRICH SCHILLER UNIVERSITY JENA

INTRODUCTION: Periodisation frameworks in individual sports describe the organisation of training to achieve physiological adaptations which drive improvements in key qualities such as strength, power and endurance. Few frameworks address the organisation of training for the acquisition of technique and skill, particularly in track and field. Therefore, the purpose of this research project was to elicit insights into the practices and perspectives of world class coaches regarding training design for the development of technique in sprinters.

METHODS: A qualitative research design was employed using semi-structured interviews. Seven elite sprint coaches were recruited. To be eligible, coaches must have coached at least one sprint athlete to qualification for a major international

championship. Questions related to micro and macro aspects of training designed to develop and refine sprint technique. Inductive thematic analysis was used to analyse the interview transcripts (Braun & Clarke 2006).

RESULTS: Emergent themes indicate that coaches commonly manipulate constraints to develop and refine sprint technique, including the use of sprint drills. All coaches deliberately target elements of sprinting technique multiple times per week during both preparation and competition cycles, although the temporal organisation and progression of this dedicated practice over time differs. Progressions in skill training are typically represented by increases in intensity or complexity. Multiple coaches articulated difficulties creating robust changes in technique which transfer to race performance. While coaches identified common objectives for different sprinting skills, some emphasized that there is no single model that they orient their athletes towards and instead combine their understanding of biomechanics with the unique characteristics of each individual to inform areas of focus and the subsequent prescription of training. Overall, coaches rely largely on experiential knowledge when prescribing technical training, and strategies to monitor and evaluate the outcomes of this training are varied and sometimes absent.

CONCLUSION: These insights reveal common approaches shared by elite sprint coaches regarding skill acquisition in sprinting, highlight the complexities of refining sprint technique and indicate an absence of clear framework for progressing technical training over time. This demonstrates a need for coaches to have a strong understanding of the general biomechanical features underpinning sprint performance to appropriately identify the needs of the athlete and subsequently accommodate and exploit their organismic constraints. Future research should build on traditional skill acquisition research to design ecologically valid models for the development of sprinting technique to maximise the transfer of training to race day.

Reference

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. Qualitative research in psychology, 3(2), pp.77-101.

A STUDY OF THE RESOURCES USED BY FOOTBALL TACTICAL ANALYSTS: THE ROLE OF DATA

CASTELLANOS, A.M., PORTILLO, C., COTERÓN, J., MON-LÓPEZ, D., MARQUINA NIETO, M., GARCÍA ALIAGA, A., REFOYO ROMÁN, I., MURIARTE SOLANA, D.
UNIVERSIDAD ALFONSO X EL SABIO ; UNIVERSIDAD POLITÉCNICA DE MADRID

INTRODUCTION: The role of the football-focused tactical analyst is a work area that has been in high demand in recent years (1). Key skills such as a broad knowledge of the game, being an expert in the interpretation of the opponents and ones own play, as well as strong observational skills are required (2). However, there is limited scientific information to be found on the processes of analysis and how they have incorporated eminently objective data in a profession with such an important subjective component. The study aims to analyse the resources used by analysts in their daily performance, as well as their relationship with data within the analysis process.

METHODS: The data collection was carried out employing semi-structured interviews, which were specifically designed for this field, being checked by 4 experts, and passing a pilot interview, being modified according to the feedback received. The inclusion criteria determined were (i) Spanish speakers and (ii) experience in first divisions or national teams. A total of 18 analysts participated in the study; to contact them, we used a first contact through social networks (LinkedIn, Whatsapp, Twitter,...) and then a snowball sampling, recommending colleagues who met these criteria. The interviews were conducted by video call, where the analysts allowed to record the content and its subsequent analysis. The content analysis was carried out by two researchers, triangulating the results with a third qualitative researcher.

RESULTS: The analysts subjective perception of the opposing team is the most reliable information for them, alluding to their experience to detect important aspects of them. The objective data can offer them a different perspective to the conclusion reached by them, or contrast their original idea, being an element of secondary consultation complained by the lack of general context. This may contrast with a social moment in performance analysis where it may seem that data is the most important factor in explaining performance. Likewise, there are minimal skills in video editing software, written reporting, and data provider consultation. They report no use of predictive game algorithms.

CONCLUSION: Tactical analysts rely more on their knowledge of game interpretation to develop their work, although they accept and value positively the use of the data, they do not believe it is blindly reliable due to the lack of context in which it is given.

1. Francis JW, Kyte J, Bateman M. The role of the analyst: comparative analysis of applied performance analyst job advertisements in the UK and Ireland (2021-2022). Int J Perform Anal Sport [Internet]. 2023;00(00):1–30. Available from: https://doi.org/10.1080/24748668.2023.2299178

2. Aguado-Méndez RD, González-Jurado JA, Reina-Gómez Á, Otero-Saborido FM. Perceptions of football analysts goal-scoring opportunity predictions: A qualitative case study. Front Psychol. 2021;12.

IMPROVING SPORT SCIENCE IMPACT IN ATHLETE-LED PRACTICE ENVIRONMENTS: A TRACK CYCLING PERSEPCTIVE

STADNYK, A., IMPELLIZZERI, F., STANLEY, J., MENASPÀ, P., SLATTERY, K.
UNIVERSITY OF TECHNOLOGY SYDNEY

INTRODUCTION: Like most high performance sports, track cyclists are typically supported within the training environment by coaches and interdisciplinary practitioners who, using evidence-based practices, guide the athlete through the process of performance development. To effectively impact their practices and athlete performance, practitioners must be able to

implement their knowledge and expertise in a way that complements the wider performance team. The aim of this study was to examine track cycling coaches' perspectives of the role and impact of sport science and research on their practice and the athlete development process.

METHODS: Semi-structured interviews were conducted with elite track cycling coaches (n=8) who had been working at the highest level of the sport (Olympics, UCI World Championships). The interviews addressed factors contributing to athlete preparation, and the current and potential impact of sport science on the development of elite track cyclists. Reflexive thematic analysis was conducted to identify common themes in participants' experiences and perspectives.

RESULTS: Three principal themes were identified from the data: 'conversation & the information dynamic', highlighting the impact of information and feedback within the performance team for developing collective training intelligence; 'integrating performance components for the individual', detailing the importance of individualised and integrated approaches to athletes' performance needs; and, 'science to complement the vision', examining the value of filtered data, and limitations of research in practice.

CONCLUSION: The findings highlighted two key contributors to performance team effectiveness: athletes deeply invested in, and actively contributing to, the development process; and, performance staff identifying and filtering research and data to impact decision making and athlete development. A four-stage model was developed from the collective findings for guiding sport scientists' impact in athlete-led practice environments. Additionally, the model outlines sport scientist-supportive actions for coaches and athletes, along with practice-supportive actions for researchers, to improve impact within the sport.

THE DEVELOPMENT AND IMPLEMENTATION OF A FREIREAN-INFORMED WORKSHOP ON TRAINING LOAD AND MATURATION MONITORING PRACTICES WITHIN ACADEMY-LEVEL SOCCER CLUB ENVIRONMENTS

THOMPSON, N., HUGHES, J.D., DE STE CROIX, M.B.A., ROBERTS, W.M.
UNIVERSITY OF NORTHAMPTON; UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Professional soccer academies frequently monitor training load and maturation to foster player development and mitigate injuries linked to growth (1). However, how training load and maturation monitoring data impacts coaching practice remains unclear. For both practices to be successful within club environments, it has been suggested that a collaborative, integrative approach between the key stakeholders should be employed (2). One potential solution to enhance training load and maturation monitoring practices is through employing interdisciplinary approaches (3) however, this may not be feasible for clubs with limited resources. This study adopted a Freirean-informed coach-practitioner workshop design to reflect on training load and maturation practices within each club environment and identify potential solutions to improve coaching practice .

METHODS: Youth development pathway staff from two Football Association category three academy clubs were purposively sampled (coaches, n=10; sport science practitioners , n=5). Coaches and practitioners initially reflected on training load and maturation monitoring practices within their club environment, and this consequently informed the development of the workshop. Within the 2-hour workshop , collaborative, reflective group discussions around five key statements evaluated practices of training load and maturation monitoring within each club environment. Each workshop was analysed using a deductive, reflexive thematic analysis .

RESULTS: Five higher-order themes were identified (coach biography, coach philosophy, communication of data to coaches, educating coaches and adapting monitoring practices). Coaches' biographies and philosophies appear to influence their acceptance and implementation of training load and maturation monitoring, suggesting a potential mismatch with current practices. An absence of an interdisciplinary environment, and the need for enhanced communication and education on training load and maturation monitoring data were consistently noted across both clubs. Resource limitations, particularly in human support and time constraints were identified as major barriers. In response, clubs have begun developing strategies to adapt their monitoring practices.

CONCLUSION: Individual coach biography and philosophy may have a significant impact on their approach to adopting and implementing training load and maturation monitoring practices. Although the workshop facilitated a collaborative, multi-disciplinary environment, it was evident that both clubs adopted a segmented approach to training load and maturation monitoring practices. Future research should aim to develop a collaborative, co-constructed club environment that facilitates coaches learning of training load and maturation monitoring practices.

1. Salter et al. (2020) 2. Otte et al. (2022) 3. Johnson et al. (2023)

Oral Presentations

OP-MH19 Physiotherapy II

THE EFFECT OF AN INNOVATIVE WARM-UP PROGRAM APPLIED BEFORE TRAINING ON THE PERFORMANCE OF AMATEUR SOCCER PLAYERS

VARHAN, B., GUNDAY, C., BAYKAN, Y.S., SOLAK, S., ALIYI, D., KARACIMEN, S.
ISTINYE UNIVERSITY

INTRODUCTION: The warm-up period is a common pre-exercise routine performed to transition from a resting state to the necessary preparation for a sports competition, increase performance and reduce the risk of injury. The traditional warm-up routine typically includes a short period of low-intensity aerobic exercise, followed by stretching and sport-specific exercise. The aim of this study was to investigate the effect of a dynamic innovative warm-up program applied to amateur soccer players on physical fitness parameters such as muscle strength, cardiopulmonary and muscular endurance, agility, balance and flexibility.

METHODS: 21 athletes (mean age; 22.65±1.18) and 21 sedentary individuals (mean age; 21.85±17) were included in the study. Muscle strength by hand-held myometer, vertical jump test and triple jump test; endurance levels with cooper 12 minute running test, lateral bridge test and sorenson test; agility with shuttle running test and square test; their balance was evaluated with the star balance test and their flexibility with the sit and reach test, trunk extension test and trunk flexion test. After the first evaluation, the athletes were taught the pre-training warm-up program and were asked to apply it 3 days a week for 8 weeks. The control group, consisting of healthy sedentary men, was asked to continue their normal lives. Assessments were repeated at the end of 8 weeks. The warm-up program consisted of foam rollers, dynamic stretching and elastic band traction applications.

RESULTS: The groups were homogeneous. A significant difference was found both within and between groups in the athletes in quadriceps femoris and hamstring muscle strength (bilateral), bilateral triple jump, Cooper running test, Sorenson test, shuttle running test, square test and sit and reach tests ($p<0.01$). There was no change in the control group.

CONCLUSION: This newly created warm-up program, focusing on dynamic stretching and flexibility, made positive contributions to the muscle strength, flexibility and performance of the athletes. In the light of these findings, the importance of warm-up protocols before training has been revealed and also warm-up sessions prevent injury it is recommended that similar studies be conducted in other sports branches.

ASSESSMENT OF CORE STRENGTH AND STABILITY CONTROL ABILITIES FOR MALE GYMNASTS BY USING HUBER® 360

XUE, L.
GENERAL ADMINISTRATION OF SPORT OF CHINA

INTRODUCTION: During past decades, the skills of gymnasts have become more complex and sophisticated in line with the evolution of Code of Point, gymnastics techniques and equipment. The proportion of gymnasts suffering from injuries is also increasing caused by high-intensity, high-load training. Both core strength and stability control are extremely important abilities to gymnasts, which not only affect the athletes specific techniques performance, but are also important factors in preventing sports injuries.

The purpose of this research is to measure the core strength and stability control abilities and identify the potential injury risks of high-level junior male gymnasts with using the Huber®360 platform.

METHODS: Sixteen high-level junior male gymnasts from China were involved within this study. The age, height, and weight of the study subjects are expressed in the form of M±D, which are 15.9±1.4 yr,159.3±9.6cm, and 52.1±8.3kg respectively. Inbody 720 was used to measurement the body composition of the subjects. HUBER®360was the instrument used in this research, which is a device with an oscillating platform and two handles, as well as force sensors situated beneath the motorized platform and at the handle level. The Huber 360 software can be used for objectively assessment with a series of seven functional tests. According to the study purpose and objectives, out of the 7 tests, we shall only use two tests, the Stability limit test and Maximum strength test.

RESULTS: All the study subjects completed all the tests.

1. Body composition. The average body fat percentage of the 16 gymnasts is 5.4±2.7% (range from 3.0% to 12.0%), which is an excellent data for male gymnast. The low level of body fat percentage is not only the result of long-term training, but also the specific requirement of gymnastics. From the perspective of muscle mass distribution, there is no difference in muscle mass of the group of gymnasts investigated between the left and right upper limbs (3.0±0.7kg,3.0±0.7kg) and lower limbs (7.1±1.3kg,7.1±1.3kg).

2. Stability limit test. Considering the comparison of symmetry in the diagonal direction, the result demonstrated that four subjects showed diagonal advantage characteristic, that is, the data of result are very symmetrical in all four diagonal directions. Seven subjects showed a medium symmetrical in most diagonal directions. Four subjects showed unilateral dominance characteristic, the right side result of three of them is larger than left, and the other one is opposite. Only one subject showed relatively big differences between the front and back side.

3. Maximum strength tests. Considering the unilateral maximum strength difference between the push and pull, and the maximum strength difference of push (or pull) between the left and right side, the result demonstrated that five subject showed perfect balance in the comparation of unilateral or bilateral strength. Seven subjects' results showed that the bilateral strength is balance,

CONCLUSION: The study describes a preliminary test conducted on sixteen high-level junior male gymnasts with the HUBER®360platform. The tests and the findings are of great significance, which not only give suggestion that some gymnasts may be at risk for injury due to strength imbalances, and also point out the direction of next-step training.

UNDERSTANDING PHYSICAL THERAPISTS PERCEPTIONS OF ENGAGING IN PHYSICAL ACTIVITY PROMOTION

KENNEDY, W.

NORTHEASTERN UNIVERSITY

Introduction

Physical therapists (PTs) work with diverse populations to promote function, activity participation, and quality of life. PTs are also positioned to provide physical activity (PA) promotion; however, it has been suggested that they do not consistently do this with their patients. Investigation into barriers to including PA promotion in PT clinical practice have found that knowledge, time and resources are consistent barriers. One important consideration that has not been included in this area of research is how PTs conceptualize PA promotion in clinical practice. Understanding how PTs conceptualize PA promotion can lead to the development of strategies and tools to increase the consistency in which PA promotion is implemented in clinical practice.

Methods

Semi-structured virtual interviews were conducted. Participating licensed PTs were purposively recruited from a national survey sample to reflect diverse demographics and professional settings in the United States. Participants were given a list of PA promotion approaches that were considered typical within PT practice, and then asked to provide feedback. Inductive thematic analysis was used for qualitative analytical approach. Trustworthiness was established by use of reflexivity, triangulation, and memos to serve as an audit trail.

Results

A total of 10 participants completed the interviews. Most of the sample worked in outpatient clinical settings. The sample was evenly split between PTs working primarily with adults and those working primarily with children. There were two overarching themes that emerged from the interviews. 1) Specific guidelines on PA promotion are needed and should be tailored to specific clinical settings and patient populations; and 2) PTs should be leaders in PA promotion but must become better at it. Additional themes include the process of engaging in PA promotion and access to community resources also emerged.

Discussion

The findings revealed that participants have a wide range of perspectives on what PA promotion is. PTs expressed lacking some knowledge on how to promote PA wholistically. For example, when participants were given several ways that they could promote PA, they were only familiar with some of the suggestions. Participants did express that all of the suggestions were appropriate for the clinical setting and can support their patients in engaging in PA. Further, some participants recommended that PA promotion guidelines that are tailored to specific patient populations and clinical settings would support engaging in PA promotion with their patients. Participants believed that PTs should be leaders in clinical PA promotion but acknowledged that support is needed to ensure that they can engage in it efficaciously. The findings of the study implicate that to support the PA promotion in PT clinical settings, specific guidelines are needed to support knowledge and skill development, which in turn support PTs becoming leaders in clinical

THE EFFECT OF TOTAL SLEEP DEPRIVATION ON LOWER EXTREMITY ECCENTRİC MUSCULAR STRENGTH AND ACTIVATION

GURUHAN, S.1, ATALAY, N.A.1, HIRATA, R.2, ANDREUCCI, A.2, TOR, O.B.1, RATHLEFF, M.S.2

1. GAZI UNIVERSITY, DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION, ANKARA/TURKEY. 2. AALBORG UNIVERSITY, DEPARTMENT OF HEALTH AND TECHNOLOGY, AALBORG/DENMARK.

INTRODUCTION: Sleep is an essential component for optimizing health and sports performance. It has been reported, however, that athletes experience more sleep disturbances than non-athletes [1,2] For athletic performance, it is important to study how total sleep deprivation (TSD) affects eccentric contraction, which plays a major role in increasing strength and hypertrophy and preventing injuries [3]. The aim of this study was to investigate the effects of TSD on eccentric muscle strength and activation in hamstring and quadriceps.

METHODS: Twenty-one recreationally active individuals (10 males and 11 females, 21,05±1,46 year, 21,99±2,89 kg/m2) with good sleep quality (Pittsburgh sleep quality index and 5-point Likert scale) were enrolled in the crossover study. Each participant performed two test sessions with a 2-week washout period. The first test was performed in 2 hours after waking up. The second test was performed at the same time with the first one after 24 hours of sleep deprivation. The participants performed 5 repetitive eccentric contractions (900/s) using the isokinetic system for hamstring and quadriceps muscle groups in both prone and supine positions, respectively. Surface electromyography (Noraxon Inc., USA) was used to record the activation of the Biceps femoris (BF), Semitendinosus (ST), rectus femoris (RF), vastus lateralis (VL) and vastus

medialis (VM) during eccentric contractions. The peak torque and muscle activity was calculated for statistical analysis using 2nd, 3rd and 4th repetitions of each test.

RESULTS: There was no statistically significant difference between normal sleep and sleep deprivation states in terms of eccentric muscle strength of hamstring (p=0.088) and quadriceps (p=0.304) muscles, however, a decremental trend was observed. The muscular activation of the VL muscle during the isokinetic eccentric exercise test decreased significantly (p=0.045) in the sleep deprivation state compared to the normal sleep state, while there were no significant differences between normal sleep and sleep deprivation states in terms of muscular activation of the RF, VM, BF and ST muscles (p>0.05).

CONCLUSION: Our study showed no differences in the eccentric strength of hamstrings and quadriceps muscle groups, however, a decrease in the activation of VL following a 24-hour-sleep deprivation. Therefore, eccentric exercise programs may be more tolerable in the morning hours and show muscle specificity in TSD.

NORDIC WALKING TRAINING AND DETRAINING EFFECTS ON FUNCTIONAL STATUS, PERCEIVED FATIGUE, AND QUALITY OF LIFE IN PERSONS WITH MULTIPLE SCLEROSIS

LIBERALI, G., MARTINIS, L., CORREALE, L., DELL'ANNA, S., FILOSA, A., MACHADO, F.A., TAVAZZI, E., BERGAMASCHI, R., PEYRÉ-TARTARUGA, L.A., BUZZACHERA, C.F., MONTOMOLI, C.

UNIVERSITY OF PAVIA, ITALY;STATE UNIVERSITY OF MARINGÁ, BRAZIL;MULTIPLE SCLEROSIS RESEARCH CENTRE, NATIONAL NEUROLOGICAL INSTITUTE CASIMIRO MONDINO,ITALY;FEDERAL UNIVERSITY OF RIO GRANDE DO SUL,BRAZIL

Abstract

Multiple Sclerosis (MS) is a chronic neurologic disease characterized by motor dysfunction, cognitive impairment, and a pronounced impact on quality of life. Common symptoms include fatigue, ataxia, tremors, spasticity, paralysis, and pain, which often compromise functional aspects such as balance and walking capacity. Non-pharmacologic interventions, such as exercise training, are recommended for individuals with MS and may help alleviate disease-related symptoms. Nordic Walking (NW) is a popular mode of exercise involving walking with hand-held poles. Despite its growing popularity, there is no published evidence on the NW training effects in the MS population. Hence, the present study investigated the NW training and detraining effects on functional status, perceived fatigue, and quality of life in persons with MS.

Methods

Fifteen individuals (4 men and 9 women; mean age: 44 ± 11 yr) with definite relapsing-remitting MS (EDSS score < 4) met the inclusion and exclusion criteria and were enrolled in this study. They were trained twice weekly for 8 weeks, followed by 12 weeks of detraining. All participants were tested before and after the intervention period and after training cessation (follow-up). Aerobic endurance (2-min walk test), upper- (handgrip) and lower-body (30-sec chair stand test) muscle strength, gait speed (10-m walk test), and overall functional mobility (timed up and go test) were tested. Perceived fatigue (Modified Fatigue Impact Scale) and quality of life (MS Quality of Life Questionnaire) were also evaluated.

Results

The adherence rate was as high as 81%. There were significant changes in aerobic endurance, lower-body muscle strength, overall functional mobility, and gait speed following the NW intervention ($P < 0.05$). These changes persisted after training cessation ($P > 0.05$). In contrast, upper-body muscle strength did not change following the NW intervention ($P > 0.05$). While quality of life did not change over time ($P > 0.05$), perceived fatigue was reduced following the NW intervention ($P < 0.05$). These changes in perceived fatigue, however, did not persist after training cessation ($P > 0.05$).

Conclusion

Our results suggest that eight weeks of NW training improves functional status, perceived fatigue, but not quality of life, in individuals with MS. Some favorable changes persisted even after training cessation. Such findings encourage exercise professionals and other healthcare providers to support NW training as a feasible and safe approach in the MS population.

Oral Presentations

OP-SH10 Intervention/Mindfulness

RE-IMAGINING SELF-COMPASSION: A HEALTHY, EFFECTIVE PATHWAY TO MENTAL TOUGHNESS AND PERFORMANCE UNDER PRESSURE

ZHANG, S., ZHOU, Y., GIBSON, L., MCEWAN, K.

UNIVERSITY OF DERBY

Re-imagining self-compassion: A healthy, effective pathway to mental toughness and performance under pressure

Shuge Zhang1,2*, Yutao Zho2,3, Luke Gibson1, Kirsten McEwan4

1 School of Sport & Exercise Sciences, University of Derby, UK

2 Hunan Research Centre of Excellence in Fitness, Health & Performance, China

3 College of Physical Education, Hunan University of Technology, China

4 School of Psychology, University of Derby, UK

Background: Mental toughness is commonly used to describe an athlete who strives to excel and fulfil set goals despite challenges. It involves a collection of personal recourses such as self-efficacy and optimism and reflects the ability to maintain or enhance performance under high pressure. However, traditional mental toughness training has largely focused on enriching athletes' personal resources such as mental skill use or enhancing threat detection and the ability to maintain high-level performance under pressure. Given the benefits of self-compassion in emotional regulation under difficult times in sport, in this project, we aimed to establish new evidence supporting the usefulness of a self-compassionate approach in fostering mental toughness in competitive athletes by taking a novel approach examining the interaction of athletes' self-compassion and fears of compassion in mental toughness.

Methods: Among 281 competitive athletes from 24 sports (Study 1) and 253 professional footballers from 12 teams (Study 2), we examined the interaction between athletes' self-compassion and fears of compassion on self-report (Studies 1 and 2) and coach informant rating of athletes' mental toughness and ability to maintain high-level performance under pressure (Study 2).

Results: Multilevel (clustered) moderation analysis demonstrated a positive link between self-compassion and mental toughness (regardless of self-report or coach rating), of which the relationship was stronger when fears of compassion in sport were low, not high. The negative influence of low self-compassion on mental toughness levels was amplified greater when fear of self-compassion (compared to when fear of receiving compassion from others) was low. Such results were consistent in the multisport sample (Study 1) and the professional football sample (Study 2).

Conclusion: The findings provide the first quantitative evidence of the facilitative role of interaction between self-compassion and fears of compassion in athletes' mental toughness. Incorporating self-compassion is not only a way to realise better mental well-being and enhanced morality in sport but also an effective strategy for performance enhancement. Sport organisations, coaches, and practitioners should consider incorporating a self-compassionate approach to developing athletes' mental toughness.

THE EFFECTS OF CONNECTEDNESS TO NATURE ON THE BENEFITS OF GREEN EXERCISE

ZHANG, D., LI, W., JIN, Y.

ZHEJIANG NORMAL UNIVERSITY

Introduction

Green exercise has been widely shown to provide synergistic benefits than those from exposure to other environments or from engaging in physical activity alone or being in a natural environment alone. Much of the literature has emphasized the importance of the positive effects of exposure to nature, which are affected by high connectedness to nature (CNT). Yet few studies have explored the effect of CNT on the benefits of green exercise. This study examined whether the differences of CNT in individuals play a role on exercise benefits, which is helpful to choose the suitable environment for recovery and exercise.

Methods

100 healthy college students were recruited through an advertisement at the university campus to answer a Connectedness to Nature Scale (Mayer & Frantz, 2004). Participants scoring in the top 27% were invited as the high-CNT group (14 females and 11 males), whereas participants scoring in the bottom 27% were invited as the low-CNT group (12 females and 11 males). Participants engaged in incremental cycling exercise at a moderate intensity while viewing images of nature or urban environments. Before and after cycling (test time), Chinese versions of the Profile of Mood States scale and the Rosenberg Self-Esteem Scale, and a two-choice oddball task were completed respectively.

Results

Significant interactions for environment × test time indicated that lower post-test scores in total mood disturbance, tension, fatigue subscales and higher score in vigor subscale in the natural environment condition than in the urban environment condition. An interaction for group × environment × test time showed that the high-CNT group has a significantly increased self-esteem scale scores after cycling in the natural environment, but not in the built environment, while the low-CNT group has a significantly increased self-esteem scale scores in both environments. The significant interactions for group × environment showed that the high-CNT group reports more Being Away and Fascination and Compatibility than the low-CNT group in the natural environment, and less Extent than the low-CNT group in the urban environment.

Discussion

Our results suggest that green exercise improves mood, self-esteem, and restorative experiences. Furthermore, individuals with high-CNT receive more exercise benefits in natural environments. This result might be attributed to feelings toward the natural environment. Individuals with high-CNT are closer to nature and have more positive feelings towards the natural environment, which can lead to more exercise benefits. On the other hand, individuals with high-CNT are less attracted to the urban environment and even report more negative feelings, which might impact the exercise benefits in the urban environment.

"WHY I MEDITATE?": ELITE ATHLTES' PERSPECTIVES OF USING MINDFULNESS DURING COMPETITION

LO, K.K.1, CHUNG, J.W.Y.2, SUN, F.3

1.HONG KONG SPORTS INSTITUTE; 2.KIANG WU NURSING COLLEGE OF MACAU; 3.THE EDUCATION UNIVERSITY OF HONG KONG

INTRODUCTION: Mindfulness training has shown promise in enhancing performance by reducing anxiety and increasing mindfulness and flow in elite athletes. However, there is limited understanding of how mindfulness techniques are specifically implemented during competitions. This qualitative study aims to explore the experiences of elite athletes participating in a mindfulness flow program (MFP). The research project has two primary objectives: (1) investigating the application of mindfulness during competition and (2) gathering participants recommendations and suggestions for future iterations of mindfulness-based interventions.

METHODS: A qualitative descriptive research design was employed, utilizing semi-structured interviews (Sandelowski, 2010). Twelve archers, including five who participated in the Asian Games, with an average experience of 8.9 ± 3.3 years, were recruited. Interviews were conducted after a 12-week intervention of the mindfulness flow program (MFP). Transcripts were analyzed inductively using an iterative process of reflexive thematic analysis (Braun & Clarke, 2022).

RESULTS: The qualitative findings revealed that athletes applied mindfulness practices during both practice and competition, such as "awareness of body sensation" to maintain balance in outdoor environments. Athletes engaged in exercises focusing on balance, such as standing on one leg or blindfolded practice, to enhance their body awareness. Adjustments were made based on observed differences between each shot to maintain the desired center of gravity, while accounting for external factors like wind. Moreover, athletes reported reduced reactivity to negative thoughts during competitions. Regarding intervention delivery preferences, half of the participants expressed a preference for face-to-face sessions, while others favored online-mode to save travel time. Shorter sessions (e.g., 60-75 minutes) over an extended period were preferred, with classes scheduled to avoid conflicts with sports-specific training.

CONCLUSION: This study provides valuable insights into the practical application of mindfulness techniques by athletes during competitive situations. Understanding the diverse ways mindfulness can be employed can assist psychologists and sports scientists in providing coaches with timely and relevant information to enhance athletes performance. Future research should explore how world-class athletes utilize mindfulness to enhance performance, examine the coach-athlete relationship, and investigate the broader impact of mindfulness on athletes daily lives.

REFERENCE:

Braun, V., & Clarke, V. (2022). Thematic Analysis — A Practical Guide. SAGE Publications Ltd.

Sandelowski, M. (2010). What's in a name? Qualitative description revisited. Research in Nursing & Health, 33, 77–84. https://doi.org/10.1002/nur.20362

THE EFFECTIVENESS OF GROUP-BASED RATIONAL EMOTIVE BEHAVIOR THERAPY (REBT) AND MINDFULNESS-BASED INTERVENTION (MBI) ON PERFECTIONISM AND EXECUTIVE FUNCTIONS AMONG HUNGARIAN ATHLETES

TÓTH, R., TURNER, M.J., MANNION, J., TÓTH, L.

HUNGARIAN UNIVERSITY OF SPORT SCIENCE

Introduction

In our research, we examined the effectiveness of Rational Emotive Behavior Therapy (REBT) and mindfulness-based interventions (MBI) concerning athletes perfectionism and executive functions. REBT focuses on identifying irrational beliefs and restructuring them to be more rational, while mindfulness aims to achieve acceptance and non-judgment through conscious presence. The main goal of our study was to uncover how group-based REBT and mindfulness interventions impact perfectionism, as well as executive functions (working memory, inhibition, cognitive flexibility) among athletes.

Methods

In our longitudinal study, a total of 46 Hungarian ice hockey players participated, with 12 individuals forming the REBT group, 14 in the mindfulness group, and 20 in the control group. Perfectionism was measured using the Short Almost Perfect Scale (SAPS), while executive functions were assessed using the computer-based Vienna Test System before and after the interventions. We analyzed our data using repeated measures analysis of variance (ANOVA).

Results

Our results indicate that athletes in the REBT group show significant decreases in both adaptive and maladaptive perfectionism after the interventions, along with improvements in inhibitory functions and cognitive flexibility test scores in the post-tests compared to the pre-tests. Members of the mindfulness group do not show significant differences in perfectionism before and after the interventions. However, they demonstrate improvements in information processing speed and in switching functions (cognitive flexibility). In the control group, there is a significant decrease in the speed of the test measuring cognitive flexibility in the post-tests compared to the pre-tests.

Discussion

Consequently, the restructuring of athletes irrational beliefs towards rationality can assist in reducing perfectionistic tendencies and contribute to the development of neurocognitive functions that could positively impact their athletic performance. Similarly, mindfulness-based intervention can enhance cognitive flexibility, thus contributing indirectly, if not

directly, to both mental health improvement and athletic performance. These findings could prove beneficial in shaping future research directions and expanding the toolbox of applied sports psychology.

Wednesday, 3 July 2024

08:00 - 09:15

Exchange Symposium

IS-EX01 ACSM-ECSS Exchange Symposium: High-Intensity Interval Training in the Prevention and Treatment of Cardiometabolic Disease

HIGH INTENSITY INTERVAL TRAINING IN HEALTH AND DISEASE

GIBALA, M.
MCMASTER UNIVERSITY

This presentation will consider evidence regarding the physiological basis of responses to high-intensity interval training to enhance health, with a focus on cardiorespiratory fitness and glycemic control. Emphasis will be placed on the role of brief, vigorous intermittent physical activity including emerging evidence regarding the efficacy of "exercise snacks" in both healthy individuals and those living with cardiometabolic disease.

HIGH INTENSITY INTERVAL TRAINING, THE PROS AND CONS

HALLE, M.
TECHNICAL UNIVERSITY MUNICH

This presentation will discuss the clinical role of high-intensity interval training versus moderate continuous training in different cardiovascular patient populations addressing coronary heart disease, heart failure and atrial fibrillation, particularly addressing clinical outcomes including morbidity and mortality.

Invited Symposium

IS-BM02 Explosive performance: lessons from the animal kingdom, from new testing paradigms, and from space

EXPLOSIVE STRENGTH: WHAT WE CAN LEARN FROM THE HIGH-PERFORMANCE OF ANIMALS

RUGGIERO, L.
UNIVERSITY OF KONSTANZ

Explosiveness is the ability to develop the greatest amount of force in the minimum time. This quality is key in the context of sport performance or physical activity, should the aim be to jump higher or sprint faster than competitors, to recover performance after an injury, or to avoid functional loss as consequence of immobilization, muscle disuse, or aging. To understand what makes people accelerate or decelerate faster, the spotlight is often on high-performance athletes, due to their amazing physical capabilities and resiliency. Sometimes however we overlook examples of explosive high-performance in Nature, a parallel world where Humans can learn from. In such cases, it is not about winning a medal, rather about predation and escape. Still, stakes are very high. In this presentation I will unravel the mechanisms of some of the most astonishing explosive performances in Nature, relating them to Humans, and to the lessons that we can learn out of it for the improvement of our rapid force production capacity. First, I will represent where the explosive capabilities of Human athletes stand in relation to other animals. As it can be guessed, we are not the strongest, but neither the weakest. I will then use the case of standing jumps as a model of explosive force from a static starting condition. To jump as high as possible, evolution has developed two main (divergent) mechanisms: the spring- (or latch-) and the muscle-mediated actuation. What if Humans jumped with a spring-actuated mechanism? And what if they did with a muscle-actuated mechanism? What do explosive force and jump height depend on in the two modes of actuation? And what are the drawbacks of using each mode? Such hypotheses and comparisons can shed light on the determinants of human explosive performance. Finally, I will present an example of a more dynamic situation in Nature to show how Biology can directly help sport-related outcomes. This example regards two seemingly different but congruent mechanisms in explosive performance: the predator-prey interaction in the wild and the change of direction in sport. As sport scientists and practitioners, typically we are not biologists. However, both animal- and sport-related movements are based on biological (common) principles. Some animals have exploited these principles to be high performers in their own habitat. Thus, interacting with Biology, while on one side may not provide in the short-term a performance-enhancing winning solution, may provide a framework to better understand the determinants of Human performance.

THE ROLE OF SYNAPTIC INPUTS TO MOTONEURONS IN DETERMINING RATE OF FORCE DEVELOPMENT

ŠKARABOT, J.
LOUGHBOROUGH UNIVERSITY

The motor units, comprised of the alpha motoneuron and all the muscle fibres it innervates, are the most basic elements of the neuromuscular system that transduce the summated synaptic inputs into twitches of individual muscle fibres. The key determinants of rate of force development are motor unit recruitment speed and discharge rate of the recruited motor units. The deterministic role of motor unit discharge rate characteristics in rate of force development underscores the importance of the properties of, and the synaptic input received by the motor pool in rapid force production. In the first part of this talk, I will first show computational and experimental evidence supporting the hypothesis that motor pool characteristics are directly implicated in the rate of force development of a given muscle. Specifically, I will demonstrate that the upper limit of motor unit recruitment in a given motor pool is linked to recruitment speed of motor units, and consequently, the rate of force development. In the second part of the talk, I will explore the neural substrate(s) underpinning the fast recruitment speed and high discharge rate of motor units underpinning rapid force production. I will introduce the importance of excitatory ionotropic inputs to motoneurons from the reticular formation in the brainstem, with experimental evidence suggesting the importance of augmenting the excitatory input to motoneurons via reticulospinal pathway to increase rate of force development and strength. Lastly, I will focus on the interaction of motor unit discharge characteristics and motor unit twitch properties when generating maximal rate of force development using a model of chronically resistance-trained and endurance-trained individuals that confer different adaptations to the neural and muscular system.

RAPID FORCE PRODUCTION IN REACTIVE MOVEMENTS: JUMPING WITH VARIABLE GRAVITY INDUCED STRETCH LOADS

WALDVOGEL, J.
UNIVERSITY OF FREIBURG

Explosive movements such as sprinting and jumping require a finely tuned coupling of eccentric and concentric muscle actions. It is known that stretch-shortening cycle (SSC) type actions require a well-tuned and pre-activated muscle-tendon unit (MTU), a short eccentric phase, and an immediate coupling of eccentric and concentric phases to develop high forces in a limited amount of time, to enhance reactive jump performance and to maximize energy storage and release. For meeting such criteria a perfectly coordinated interplay between the central nervous system (CNS) and the MTU is mandatory. The CNS regulates the MTU's stiffness by modulating the muscle activity prior and during ground contact, and such regulation is phase-, task- and stretch load-dependent. Previous experiments have predominantly used biomechanical methods such as electromyographic recordings, kinematics and kinetics to investigate the underlying mechanisms of SSC type actions. Technological advances such as ultrasound technique revealed direct insights into the muscle function and muscle-tendon interaction during dynamics. Furthermore, in many sports, as well as during human locomotion, requirements and environmental conditions are not necessarily constant and may change even rapidly. To functionally understand how the CNS and the MTU interaction are challenged by variable conditions, this presentation provides an overview of past and current studies investigating the effect of variable stretch load on the neuromuscular control and MTU interaction during reactive explosive movements. In such studies, the effect of variable stretch loads are limited to loading and unloading scenarios of +/- 20-30% of body weight. Stretch loads beyond these limits are normally experimentally challenging and associated with confounding effects. In contrast, parabolic flights are a unique paradigm to induce stretch loads ranging from 0.1 to 2g (-90% to +100% body weight), allowing near-natural movement execution. This presentation also provides an overview of existing parabolic flight experiments which aimed to investigate stretch load dependent modulations at the neuromuscular and muscle mechanical level. Furthermore, biomechanical and energetic consequences will be highlighted. Given the implications of overloading and unloading in weight and velocity-based trainings to enhance explosive force production, this presentation is of high scientific interest for sport scientists, coaches, athletes, as well as other practitioners. Findings from parabolic flight campaigns regarding rapid force production in overloading and unloading conditions may also inform other practitioners such as engineers in the interface with sport science.

Oral Presentations

OP-PN19 Fatigue II

INDIVIDUAL DIFFERENCES IN MENTAL FATIGUE RESPONSE: THE ROLE OF BASELINE COGNITIVE FUNCTIONS

SCHAMPHELEER, E., HABAY, J., PROOST, M., ROELANDS, B.
VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: Mental fatigue (MF) is defined as a psychobiological state induced by prolonged demanding cognitive activity [1]. It induces a subjective feeling of fatigue [2] and has implications for both physical and cognitive performance (e.g. impaired endurance and attention) [1, 3]. However, the level of emergence of MF is highly variable between individuals. Almost no factors have reliably been identified that can predict the response to MF [4]. Therefore, this study aimed to elucidate whether baseline cognitive functions could predict the susceptibility to MF and its impact on performance.

METHODS: We employed a randomized, single-blinded, counter-balanced, cross-over research design. Ninety-seven healthy participants (53 male, 32.7 ± 8.7 y) initially completed three cognitive tests (sustained attention to response task, psychomotor vigilance task, and N-BACK task) assessing their cognitive functions (attention, working memory, and response inhibition). In the experimental and control trial, participants respectively engaged in either a 45-minute Stroop task or documentary. Pre- and post-trial, participants rated their feeling of MF using a visual analogue scale (M-VAS). Post-trial, they completed a Go-NoGo task and a 15-minute cycling time trial to evaluate cognitive and physical performance. Linear regression was used to evaluate the relationship between cognitive abilities and MF effects.

RESULTS: Baseline cognitive functions did not significantly relate with M-VAS scores (F=1.527; p=.204; R2=.029) or the extent to which MF affects physical performance (F=.591, p=.670; R2=-.019). Additionally, baseline cognitive functions could not predict the effect of MF on cognitive performance, including reaction time on the Go stimuli (F=.647; p=.630; R2=-.016) and accuracy on both the Go (F=2.024; p=.098; R2=.044) and NoGo (F=1.594; p=.183; R2=.026) stimuli.

CONCLUSION: Baseline cognitive functions do not appear to reliably forecast susceptibility to MF or its effects on performance in healthy individuals. More research is needed to fully elucidate the individual response to MF, identify individuals who are more prone to MF and to develop targeted interventions.

1. Van Cutsem, J., et al., The effects of mental fatigue on physical performance: a systematic review. Sports Medicine, 2017. 47(8): p. 1569-1588.

2. Habay, J., et al., Mental fatigue and sport-specific psychomotor performance: a systematic review. Sports Medicine, 2021. 51: p. 1527-1548.

3. Russell, S., et al., What is mental fatigue in elite sport? Perceptions from athletes and staff. European Journal of Sport Science, 2019. 19(10): p. 1367-1376.

4. Habay, J., et al., Interindividual variability in mental fatigue-related impairments in endurance performance: a systematic review and multiple meta-regression. Sports Medicine-open, 2023. 9(1): p. 1-27.

PREFRONTAL CORTEX OXYGENATION DURING A MENTALLY FATIGUING TASK IN NORMOXIA AND HYPOXIA.

ROOSE, M., DE WACHTER, J., PROOST, M., HABAY, J., VERSTRAELEN, M., DE PAUW, K., MEEUSEN, R., ROELANDS, B.
VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: Mental fatigue (MF) arises from extended periods of demanding cognitive activity and impairs cognitive and physical performance [1]. Hypoxia is another stressor known for impairing performance. Typically, changes in cognitive and physical functioning at altitude are associated with alterations in brain oxygenation [2]. These changes are preferably measured in the prefrontal cortex (PFC), renowned for its role in higher-level cognitive function [2]. Therefore, we aim to examine whether oxygenation of the PFC plays a role in the development of MF.

METHODS: Twelve participants (age 22.9 ± 3.5 y; height 174.2 ± 8.2 cm; mass 69.9 ± 13.9 kg) completed four experimental trials, 1) MF in (normobaric) hypoxia (3.800m; 13.5%O2), 2) MF in normoxia (98m; 21.0%O2), 3) Control task in hypoxia 4) Control task in normoxia. Participants performed a 2-back task, Digit Symbol Substitution test and Psychomotor Vigilance task before and after a 60-min Stroop task or an emotionally neutral documentary. Brain oxygenation was measured through functional Near Infrared Spectroscopy. Subjective feelings of MF and physiological measures (heart rate, oxygen saturation, blood glucose and hemoglobin) were recorded. A 2 x 2 x 5 three-way repeated-measures ANOVA [Mental State (MF, CON) X FIO2 (normoxia, hypoxia) X Time (baseline, block 1, block 2, block 3, block4)] was used for the MVAS, fNIRS and Stroop task ACC and -RT. For data from the 2BACK, DSST, PVT, SaO2 Mood and BVAS, a 2 x 2 x 2 three-way repeated-measures ANOVA [Mental State (MF, CON) * FIO2 (normoxia, hypoxia) * Time (pre, post)] was performed.

RESULTS: The Stroop task resulted in increased subjective feelings of MF ($F(1.6, 16.2) = 19.3$, $p < 0.001$) compared to watching the documentary ($F(1.6, 15.5) = 6.3$, $p= 0.014$). 2-back accuracy was lower post task compared to pre task in MF_NOR and CON_NOR (PRE: 87.1 ± 7.72, POST 75.70 ± 12.88), while no differences were found in the other cognitive tasks. The fraction of inspired oxygen did not impact feelings of MF. Although performing the Stroop resulted in higher subjective feelings of MF, hypoxia had no effect on the severity of self-reported MF. Additionally, no evidence could be provided for a role of oxygenation of the PFC in the build-up of MF.

CONCLUSION: The role of PFC-oxygenation during the build up to MF and the associated interaction effects with altered oxygen availability were investigated within this study. Although MF was successfully induced, normobaric hypoxia seemed to have no effect on the severity of self-reported MF and subsequent cognitive function. Additionally, no evidence could be provided for the role of PFC oxygenation during a MF task.

References

1. Van Cutsem, J et al. (2017). The Effects of Mental Fatigue on Physical Performance: A Systematic Review. Sports medicine (Auckland, N.Z.), 47(8), 1569-1588.

2. McMorris, T et al. (2017). Effect of acute hypoxia on cognition: A systematic review and meta-regression analysis. Neurosci Biobehav Rev, 74(Pt A), 225-232.

IMPACT OF REPETITIVE MAXIMAL COUNTERMOVEMENT VS. SQUAT JUMPS PERFORMED UNTIL EXHAUSTION ON MOTOR PERFORMANCE FATIGUE OF THE QUADRICEPS MUSCLE AND ITS NEUROMUSCULAR UNDERPINNINGS

BEHRENS, M., HUSMANN, F., WEIPPERT, M., FELSER, S., BIELITZKI, R., BEHRENDT, T., SCHEGA, L., BRUHN, S., GUBE, M.
UNIVERSITY OF APPLIED SCIENCES FOR SPORT AND MANAGEMENT POTSDAM

INTRODUCTION: The countermovement jump (CMJ) and squat jump (SJ) are two basic movements that are required during physical activities and are used to monitor human performance. CMJ height is almost always greater than SJ height and the difference is thought to reflect the efficiency of utilizing the slow stretch-shortening cycle (SSC). The mechanisms contributing to the performance enhancing effect of the SSC include history-dependent muscle properties, recoil of elastic energy, pre-activation, and stretch reflexes. Although studies have investigated the mechanisms of the jump-dependent differences in performance, hardly any data exists on the effect of repetitive maximal CMJ and SJ performed until exhaustion on motor performance fatigue of the quadriceps muscle (i.e. decline in isometric maximal voluntary torque (IMVT)) as well as its neural (i.e. voluntary activation) and muscular (i.e. contractile function) underpinnings. It was assumed that a lower number of repetitions will be achieved in the CMJ compared to the SJ condition, with unique SSC-dependent neural and muscular adjustments.

METHODS: In a randomized, counterbalanced, crossover design, 14 males performed repetitive maximal CMJ and SJ every 4s until exhaustion, defined as a drop in jump height by 50%. Using peripheral electric nerve stimulation and dynamometry, neuromuscular function was assessed before and after exercise during each condition to analyze the impact of jump type (CMJ, SJ) on motor performance fatigue and its neural and muscular determinants. Additionally, mean heart rate (HR), blood lactate concentration (BLC), and effort perception were recorded during exercise. Motor performance fatigue as well as its neural and muscular determinants were quantified as percentage pre-post changes in IMVT (ΔIMVT), voluntary activation (ΔVA), and quadriceps twitch torque evoked by paired electrical stimuli at 100 Hz (ΔPS100), respectively.

RESULTS: Participants tended to perform fewer repetitions during CMJ compared to SJ (CMJ: 510±164, SJ: 663±308, p=0.081), while HR (CMJ: 165±15bpm, SJ: 164±17bpm, p=0.410), BLC (CMJ: 4.1±2.3mmol/l, SJ: 3.8±3.0mmol/l, p=0.370), and effort perception (CMJ: 16.5±1.7, SJ: 16.8±1.0, p=0.455) were similar between conditions. Furthermore, no differences between conditions were found for ΔIMVT (CMJ: -29.1±17.5%, SJ: -25.7±8.5%, p=0.429), ΔVA (CMJ: -30.4±21.4%, SJ: -34.9±16.7%, p=0.380), and ΔPS100 (CMJ: -16.4±20.8%, SJ: -22.7±19.9%, p=0.296)

CONCLUSION: Participants tended to perform a lower number of CMJ compared to SJ, while indices of internal load (HR, BLC, effort perception), motor performance fatigue, and the decrease in neuromuscular function were comparable between conditions. This might be related to the involvement of the slow SSC, which resulted in a greater jump height and mechanical strain during the CMJ, probably leading to an earlier exercise termination accompanied by the same extent of motor performance fatigue and neuromuscular impairments.

NEUROMUSCULAR ENDURANCE AND FATIGABILITY: SEX DIFFERENCES IN CHILDREN AND YOUNG ADULTS

LEDERGERBER, R., LICHTENSTEIN, E., ROTH, R.
EXERCISE AND TRAINING SCIENCE

INTRODUCTION: Prepubertal children exhibit distinct neuromuscular characteristics when compared to adults, including reduced voluntary activation and fatigability, and a possibly lower recruitment of larger motor units that innervate predominantly fast-twitch fibers (1,2). Depending on exercise modality, childrens fatigue is also more pronounced centrally rather than peripherally (1). Additionally, there is evidence that females may experience less fatigue than males, though studies focusing on this aspect in children are sparse (3). Hence, this study was designed to examine neuromuscular differences by age and sex in knee extensor muscle endurance until failure.

METHODS: A cohort of 23 prepubertal children (9.4±0.9y) and 23 adults (23.4±2.4y, 54% F), undertook a maximal voluntary isometric contraction (MVCpre), a task to failure at 60% of MVCpre, and a subsequent MVCpost in knee extensors. Surface electromyography (EMG) was recorded for the rectus femoris (RF), vastus medialis (VM), and vastus lateralis (VL) at 0, 25, 50, 75, and 100% of individual time to failure (TTF). Age and sex differences were quantified for TTF, MVCpre-post, and the root mean square (RMS) and median frequency (MDF) values of the EMG signals using linear models and Cohens d effect sizes.

RESULTS: Moderate age-related differences were noted in TTF (d=-0.54), along with a large age*sex interaction (d=1.06). Children experienced a greater change in MVCpost (d=0.42), with negligible age*sex interactions (d≤0.2). At the onset of the trial (0% TTF), children showed less activation in all muscles (d≥1.18), and as the failure-task progressed, age-related differences were observed in the RMS and MDF for RF, VL, and VM (d≥0.14), with minimal differences attributable to sex and age*sex interaction (d≤0.19).

CONCLUSION: Childrens reduced capacity to produce MVCpost and the smaller changes in EMG readings could indicate a dominance of central over peripheral fatigue. This is further suggested by the lower initial muscle activation in adults, indicating a conservation of larger, more fatigue-prone motor units, which might be less recruited in children (2). The observed differences in neuromuscular fatigability, especially in girls, emphasize the need for further in-depth studies that should also address sex-specific differences in training and developmental changes.

References

1. Souron R, Carayol M, Martin V, Enzo P, Duché P, Gruet M. Differences in time to task failure and fatigability between children and young adults: A systematic review and meta-analysis. Front Physiol. 2022;13:1026012. doi:10.3389/fphys.2022.1026012

2. Dotan R, Mitchell C, Cohen R, Klentrou P, Gabriel D, Falk B. Child-adult differences in muscle activationa review. Pediatr Exerc Sci. 2012;24(1):2-21. doi:10.1123/pes.24.1.2

3. Hunter SK. The Relevance of Sex Differences in Performance Fatigability. Med Sci Sports Exerc. 2016;48(11):2247. doi:10.1249/MSS.0000000000000928

EFFECT OF MENTAL FATIGUE ON COGNITIVE FUNCTION AND PHYSIOLOGICAL RESPONSES TO EXERCISE IN REFEREES

AHMED, H., DIXON, D., DAVISON, G.

UNIVERSITY OF SULAIMANI

INTRODUCTION: Introduction: Mental fatigue is a psychological phenomenon that is caused by prolonged and/or demanding cognitive activity. It is important to estimate factors that impair referees' performance especially in the second half of a football match. There is limited research on the potential effects of mental fatigue on both physical and cognitive performance of referees.

METHODS: Methods: Twelve (12) active football referees aged between 18-45 years (mean ± SD: age 32.3 ± 10.0 years) were recruited from Kent County Football Association (KCFA) to take part in the study. The referees were required to visit the laboratory on three separate occasions: a familiarisation (visit 1) and two main trials (control and mental fatigue, visits 2 and 3). Referees were required to perform a 90 min intermittent treadmill protocol after 30 min of a Stroop task: either incongruent (mental fatigue condition) or congruent (control condition). They were required to undertake the FIFA video clip test (decision-making) at the beginning (during warm-up: 13 min) and end of exercise (last 13 min). Exercise was an intermittent test which lasted 90 min in total. Heart rate, RPE and blood lactate measures were recorded before, during and after exercise. Referees also completed the PVT before and after the Stroop task, at half time and post-exercise, and the Brunel Mood Scale (BRUMS) before and after the pre-match PVT and after the post-match PVT.

RESULTS: Result: The mental fatigue condition caused a significant decrease in decision-making performance (correct decisions, beginning: 76.7 ± 7.2% decreased to end exercise: 64.6 ± 7.8%, $p < 0.001$) compared to no change in the control condition). The PVT performance was also significantly reduced post-Stroop test, at half time and post-exercise, but to a greater extent in the mental fatigue condition ($p < 0.05$).

CONCLUSION: In conclusion: mental fatigue had a negative impact on referees' cognitive performance during and after exercise. This may have implications for optimising referees' preparation and cognitive performance in real matches, which should be explored further.

Exchange Symposium

IS-EX02 CSSS-ECSS Exchange Symposium: Talents Identification of Youth Football Players

TALENTS IDENTIFICATION OF YOUTH FOOTBALL PLAYERS AND THEIR STRENGTH AND CONDITIONING TRAINING IN CHINA

LI, H.

CHINA INSTITUTE OF SPORT SCIENCE

The development of Football needs to start with youth training. The performance of elite youth football players represents the football level of a nation in the next decade. With the purpose of better understanding the strength and conditioning level of Chinese elite youth football players and identifying talents with science-based methods, the study selected 729 elite football players of U12-16, who registered under the Chinese Football Association (CFA). The players were tested with body posture, velocity, strength, endurance, agility, and flexibility in the training camp organized by CFA. It's found that compared with the youth elite football players at the same level and age in the countries strong in football, the velocity, strength, endurance, agility and flexibility of Chinese youth elite football players were relatively lower, which indicates that the strength and conditioning training in youth football players in China is overlooked to a certain extent. Meanwhile, using the method of Quartile, the study sets up the criteria of Chinese youth elite football players at the age of 12 to 16, which consists of 4 grades: outstanding, good, pass and fail. The players were encouraged to meet the requirements of pass and good. Moreover, the key players with great potential were analyzed specifically. The weaknesses of their physical fitness were pointed out, and the strength and conditioning training suggestions were provided for precise training.

RESEARCH ON ASSESSMENTS AND IMPROVEMENT STRATEGIES OF 1V1 OFFENSIVE AND DEFENSIVE ABILITY FOR YOUTH FOOTBALL PLAYERS

DINGMENG, R.

BEIJING SPORT UNIVERSITY

The "Chinese Football Association Youth Training Outline" highlights the significance of assessing and training youth football players' 1v1 ability. To better serve the talent identification, ability assessment, and training plan for elite young players,

the current study designed six scenario-based assessment methods to assess the players' performance during matches in 1v1 offensive and defensive situations. Based on the performance characteristics of 1v1 offensive and defensive behaviours, the research design consisted of three stages: action initiation, action selection, and action connection, including 12 evaluation criteria. Moreover, after investigating the relationships between players' athletic ability, coaches' subjective criteria, and the players' performance of 1v1 offensive and defensive skills, this study compared the advantages and disadvantages of different assessment methods. Research findings showed that: 1) scenario-based assessment methods are effective in capturing players' 1v1 offensive and defensive ability; 2) action selection is essential in 1v1 offensive and defensive ability; 3) players' speed quality and technical proficiency are key factors influencing their 1v1 offensive and defensive ability; 4) implementing targeted 1v1 training in various scenarios can significantly enhance players' individual offensive and defensive capabilities.

THE IMPORTANCE OF THE MUSCLE FIBER TYPE COMPOSITION FOR (YOUTH) FOOTBALL

LIEVENS, E.
GHENT UNIVERSITY

Muscle fiber type composition is an important performance determinant in multiple sports. Moreover, it has a large genetic component, contributing to talent for sports with specific exercise demands. In explosive, short duration sports elite athletes typically have a large share of fast-twitch fibers (type IIa and IIx), which contributes to larger power production capabilities. On the other hand, the best endurance athletes dispose of a large proportion of fatigue resistant slow-twitch fibers (type I). The optimal muscle fiber type composition in intermittent team sports is less straightforward, since these sports are characterized by mixed demands. Studies examining muscle fiber type composition in high level football players are scarce. Presumably because the current gold standard to measure muscle fiber type composition is an invasive muscle biopsy. In 2011, we validated a noninvasive technique to estimate muscle fiber type composition by measuring muscle carnosine based on proton magnetic resonance spectroscopy (1 H-MRS). Recently, this method was used on a cohort of 194 high level football players. A large heterogeneity in muscle fiber type compositions was found, in which 33% had a slow, 45% had an intermediate and 22% had a fast typology. Despite the fact that elite football games have become considerably faster over the past decades, rendering players' speed and power abilities as important performance characteristics, our data in elite Belgian football players rather shows the opposite: an underrepresentation of fast-twitch players. Moreover, no differences in muscle typology were found between positions (goalkeeper, center back, full back, midfielder, winger or forward). Next to positional differences, we prospectively monitored hamstring strain injuries in this cohort. Having a fast muscle typology was identified as a novel, and profound risk factor for hamstring strain injuries, which is possibly linked with a higher fatigue in fast typology players. In lab conditions FT individuals showed a more pronounced performance decrement during high-intensity exercise and need to recover longer compared to ST individuals. Which was recently corroborated in football games, as the decline in high-intensity running activities from first to second half was found to be more pronounced in players with a fast muscle typology. In conclusion, possessing a particular muscle typology is not required to play any football position at the national level. However, there are indications that FT players might fatigue more toward the end of the game compared to ST players, which likely makes them more prone to injury. Therefore, fast-twitch players might need a personalized training approach, to prevent overtraining, muscle injuries and possibly drop-out.

Oral Presentations

OP-AP02 Endurance performance

BOTH A 1-WEEK MODERATE-INTENSITY AND A 1-WEEK HIGH-INTENSITY INTERVAL TRAINING BLOCK IMPROVES DETERMINANTS OF ENDURANCE PERFORMANCE

ODDEN, I., SOLUM, K.S., MØLMEN, K.S., RØNNESTAD, B.R.
INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES LILLEHAMMER

INTRODUCTION: High-intensity interval training (HIT) is considered effective for improving endurance performance in endurance athletes. Moreover, block periodization of HIT is well-known to provide additional performance improvements in endurance athletes (1). The effectiveness of moderate-intensity interval training (MIT) and the ideal training volume in this intensity zone have been widely discussed (2, 3). Cyclists often utilize both MIT and HIT in their annual training, yet the relative effectiveness of these two training regimes remains poorly explored. Hence, we aimed to compare the within-subject responses to a one-week MIT block characterized by longer work durations but lower effort, against a standard one-week HIT block with shorter work durations but higher effort, in cyclists.

METHODS: Twenty-two cyclists (♂, 21; ♀, 1; age, 19.2(3.6)years; maximal oxygen consumption (VO2max), 69.5(6.0)mL/min/kg) first conducted a 7-day MIT block and thereafter a 6-day HIT block. Both blocks were followed by a six-day taper, and the blocks were separated by ~2 months of usual training. The MIT block included six MIT sessions with 5-7x10-14-min work intervals aiming for 14-15 on the Borg 6-20 rating of perceived exhaustion (RPE). The HIT block included five HIT sessions all performed as 5x8.75-min series with multiple short intervals targeting 16-18RPE. The cyclists´ maximal 1-min power output (PO) during a VO2max-test (pVO2max), PO corresponding to 4 mmol/L [blood lactate]

(PO@4mmol), 15-min maximal PO (PO@15min), and VO2max were assessed before and after each training block. Potential differences in pre-test values between blocks were accounted for in the statistical analysis.

RESULTS: The total work interval duration in MIT and HIT block were 7:04 and 3:42 hours, respectively, with average RPE during work intervals being 14.5(0.3) and 17.1(0.4), which corresponded to 65.8(4.2) and 70.9(5.8)% of pVO2max, 85.5(3.6) and 90.0(2.7)% of HRmax, and 2.9(0.8) and 7.5(1.5)mmol/L [blood lactate], respectively. Both the MIT and HIT block effectively improved the cyclists´ pVO2max (2.4(4.5) and 3.7(3.2)%), PO@4mmol (4.5(4.5) and 2.1(2.7)%), PO@15min (4.9(8.7) and 2.8(5.3)%), and VO2max (1.5(3.9) and 2.4(3.8)%). The improvement gains did not differ between blocks, except for the improvement in PO@4mmol which was greater following the MIT block compared to the HIT block (p=0.05).

CONCLUSION: Both a MIT block, featuring lower exercise intensity but longer accumulated work interval durations, and a HIT-block, characterized by higher exercise intensity but shorter accumulated work interval durations, effectively enhance endurance performance determinants and PO@15min. Notably, the significantly greater PO@4mmol improvement following the MIT block compared to the HIT block indicates some work intensity-specific training adaptations.

REFERENCES:

1 Clark et al. PLoS One. 2014;9(12):1–14

2 Burnley et al. Med Sci Sports Exerc. 2022 Jun 1;54(6):1032-1034

3 Foster et al. Med Sci Sports Exerc. 2022 Jun 1;54(6):1028-1031

THE INFLUENCE OF MENSTRUAL CYCLE PHASE ON SLEEP STAGES AND SLEEP QUALITY IN EUMENORRHEIC ENDURANCE TRAINED WOMEN.

TAYLOR, M., HROZANOVA, M., NORDENGEN, L., SANDBAKK, O., NOORDHOF, D.

UNIVERSITY OF TROMSØ

INTRODUCTION: Sleep is critical for physiological and psychological restoration and is widely recognized as one of the important factors for athletic recovery. There are indications that sleep may be affected by the fluctuating ovarian hormones across the natural menstrual cycle (MC). However, there is a lack of consensus in the literature due to differences in the determination and verification of MC phase, along with a focus on clinical populations rather than athletic women. Accordingly, the aim of this study was to investigate the effects of MC phase on sleep stages and markers of objective and perceived sleep quality in eumenorrheic, endurance trained women.

METHODS: Sixteen naturally menstruating, endurance-trained women (mean±standard deviation: 31±5 years; 62±7 kg, VO2max 55±5 mL·kg-1·min-1) were included. For two MCs participants used an at-home unobtrusive sleep monitor (Somnofy) and self-reported perceived sleep quality on a visual analog scale. MC phases were determined using calendar-based counting, urinary ovulation prediction testing, and serum hormone analysis of estrogen and progesterone. Only eumenorrheic cycles (i.e., cycle length ≥21 and ≤35 days, positive urinary ovulation test and mid-luteal progesterone ≥16 nmol·L-1) were included in the analysis. MC phases were defined as: early follicular- (EFP, first two nights after the start of menstruation), late follicular- (LFP, the two nights prior to a positive ovulation test), ovulatory- (OP, the night of a positive ovulation test and one night thereafter), mid-luteal- (MLP, the nights 7-8 days after a positive ovulation test), and late luteal-phase (LLP, the two nights prior to the onset of the subsequent menstruation). Data were analysed using linear mixed effect models in RStudio.

RESULTS: MC phase had a significant main effect on the distribution of light (p=0.011), slow wave (p=0.026), and rapid eye movement (REM, p=0.008) sleep. Total sleep time was (mean±SD) 7.2±0.7h in EFP and remained stable across the MC (p=0.162). Sleep stages were distributed as follows; 56±4% light, 17±4% slow wave and 27±4% REM sleep in EFP. During MLP, there was more light (+4%, p=0.008) and less slow wave (-3%, p=0.027) sleep compared to EFP. MC phase did not have a main effect on perceived sleep quality (p=0.768), sleep efficiency (p=0.115) or wake after sleep onset (p=0.214).

CONCLUSION: Endurance-trained women have more light and less deep sleep in MLP compared to EFP, despite no change in total sleep time or markers of objective or perceived sleep quality. While it is currently unclear how small changes in the distribution of sleep stages may influence an individual's recovery and wellbeing, these findings indicate that MC phase, among other factors (e.g. stress, training load, etc.), should be considered when monitoring or managing sleep in female endurance women.

THE RELATIONSHIP BETWEEN MUSCLE FUNCTIONS AND ENDURANCE RUNNING PERFORMANCE IN FOUR CLUSTERS: FROM THE CLASSIFICATION OF 120 RUNNERS BASED ON RUNNING FORMS

EIHARA, Y., KINOSHITA, M., JOTOKU, K., MAEO, S., KANEHISA, H., ISAKA, T.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: Running economy plays a critical role in endurance running performance and can be enhanced by adding strength training to daily running [1]. However, the effects of strength training on endurance running performance vary among individuals [2] because the importance of muscle functions for each runner differs depending on running forms. For example, rearfoot strikers demonstrate greater activation of biceps femoris than forefoot strikers [3]. In addition, runners with a large knee range of motion (ROM) activate rectus femoris during the propulsion while runners with a small knee ROM tend to utilize energy through the stretch-shortening cycle (SSC) [4]. This study aimed to classify runners based on running forms and examine the relationships between muscle functions and endurance running performance within classified groups.

METHODS: 120 endurance runners (60 males) participated in this study. The participants were tested for muscle functions, including isometric and isokinetic (30°/s and 180°/s) knee extension/flexion torque, slow SSC ability (CMJ height), and fast SSC ability (drop jump and 3-rebound jump performances). Endurance running performance was assessed from the oxygen cost of running at 11 km/h and seasonal records. Ankle joint angle at touch-down and knee joint ROM during the stance phase were measured during running at 11 km/h. Cluster analysis was conducted based on two kinematic variables in each sex. Pearson correlation analysis was performed in each cluster to assess the relationships between muscle functions and endurance running performance.

RESULTS: The runners were divided into four clusters for each sex. In both sexes, there was a positive relationship between knee flexion torque and endurance running performance in runners who exhibited ankle dorsiflexion at touch-down (r=0.54–0.59). A positive relationship was found between isometric knee extension torque and endurance running performance in female runners who exhibited ankle plantarflexion at touch-down (r=0.60–0.83). Isometric and slow isokinetic knee extension torque was positively correlated to running economy in male runners with a large knee ROM (r=0.52–0.61), while fast isokinetic knee flexion torque and fast SSC ability relative to slow SSC ability were positively associated with endurance running performance in those with a small knee ROM (r=0.42–0.85).

CONCLUSION: The relationships between muscle functions and endurance running performance varied depending on the individual's running forms, as suggested by previous research findings [3, 4]. In addition, knee flexion strength appeared to be more critical in males, whereas the importance of knee extension strength may be greater in females for better endurance running performance. Thus, when runners and coaches select strength training, running forms as well as sex should be considered to maximize the improvement in endurance running performance.

[1] Eihara et al. (2022) [2] Patoz et al. (2022) [3] Yong et al. (2014) [4] Lussiana et al. (2017)

ENDURANCE BEYOND LIMITS: EXPLORING THE INTERPLAY OF PERCEIVED FATIGUE AND PHYSIOLOGICAL RESILIENCE IN BACKYARD ULTRA-ENDURANCE RUNNERS

ARENALES ARAUZ, Y.L., AMPE, T., ROELANDS, B., DE PAUW, K.

VRIJE UNIVERSITEIT BRUSSEL, BELGIUM

INTRODUCTION: The Backyard Run is an ultra-endurance event where athletes run a 6.7 km lap every hour until the "last man is standing". This challenging event spans several days, imposing rigorous mental and physical demands. There is an increasing interest in exploring (1) the factors that drive individuals to surpass boundaries and (2) differences in performance. Evidence suggests that mental toughness and physiological resilience (PR), defined as the decoupling of heart rate and running speed, predict performance during ultra-endurance events (1, 2). Yet, the intricate interplay between perceived fatigue and PR during such extreme events remains unclear. We aim to explore the distinctions between proficient and less proficient runners in a backyard run, focusing on PR, perceived fatigue, and metabolic parameters.

METHODS: Eleven male ultra-runners (38 ± 8 years, BMI: 23.1 ± 1.05 kg/m², VO2max: 61.3 ± 4.4 ml/min/kg) were analyzed during a "Backyard Ultra" event in Belgium (April 2023). Runners were categorized into two performance levels based on the number of completed laps (i.e. <35 laps, >35 laps). Throughout the event, heart rate and running speed were monitored to quantify PR. Mental and physical fatigue, and glucose levels were evaluated every four laps. Additional fatigue-related blood markers (i.e. cortisol, C-reactive protein, creatine kinase) were examined before and after the event. Linear mixed-effects regression models were employed. To mitigate potential multicollinearity among fixed effects, we conducted Pearson correlations. A significance level of $p<0.05$ was used for all tests.

RESULTS: Models indicated a significant interaction effect ($p < 0.001$) between all perceived fatigue measures and performance levels, when predicting PR. Among less proficient runners (<35 laps), elevated PR was associated with increased mental and physical fatigue ($p=0.002$, $p=0.024$). In more proficient runners (>35 laps), the PR was not significantly associated with the increase in perceived mental and physical fatigue. The significant negative interaction ($p <0.001$) between glucose levels and event duration on PR was independent of performance levels. Post event, athletes exhibited elevated creatine kinase ($p<0.001$) and C-reactive protein levels ($p<0.001$), with a trending increase in cortisol ($p=0.055$).

CONCLUSION: Less proficient runners consistently show a more explicit link between perceived fatigue and PR during a backyard ultra-endurance run. This association is more complex for more proficient runners, although they feel mentally and physically fatigued, this does not affect their PR. Which possibly predicts their higher performance.

1. Jones AM. The fourth dimension: physiological resilience as an independent determinant of endurance exercise performance. J Physiol. 2023.

2. Berger NJA, et al. Limits of Ultra: Towards an Interdisciplinary Understanding of Ultra-Endurance Running Performance. Sports Med. 2024;54(1):73-93.

THE UPDATED CONCEPT OF THE POLARIZATION INDEX ENABLES THE INTEGRATION OF THREE INTENSITY ZONES IN ONE NUMBER AND IDENTIFIES POLARIZED TRAINING IN AN EXTENDED DEFINITION RANGE

STAUDNER, J., BAYER, X.1, HAUTSCH, N.1, MÖLLER, T.1, PETERSEN, P.1, TREFF, G.2

1: UNIVERSITY OF VIENNA, 2: PARACELSUS MEDICAL UNIVERSITY, SALZBURG

INTRODUCTION: The polarization index (PI) is a high-performance sports centered concept published in 2019 (Treff et al.) and currently applied in 31 peer-reviewed articles. It relates the fractions of a training intensity distribution (TID) consisting of the zones (z) 1, 2, and 3 as

PI = log10(z1/z2*z3*100) (eq. 1) and defines polarized TIDs if the result is > 2.00.

Since the publication of the PI, a variety of issues related to transforming context conditions appeared: (a) automated database entries are increasingly used, leading to previously unusual TIDs with intensity zones < 0.01; (b) TIDs are attracting increasing attention in the public health sector (Festa et al. 2023) where, due to lower total volumes and session frequencies, TIDs occur that are virtually never reported in high-performance sports as, e.g., z3 < z1 < z2, which can result in negative log10-arguments of eq.1; and (c) the general approach to quantify TIDs is more open to subjective ratings and session goal-based quantifications than before. To deal with some of these challenges, it was proposed to limit the calculation of the PI to TIDs z1>z3>z2 (Arjona et al. 2023), which would, however, limit its applicability. Here, we propose an update to adapt the PI without limiting its definition space.

METHODS: Given that z1,z2,z3 ∈ [0,1] and z1 +z2 +z3 = 1, where z1, z2 denote the measured fractions rounded to two decimals and z3 = 1-z1 - z2,

PInew =

0 if z1=0∨z3=0,

0 if z2=0∧ z3=0.01,

log10((min(z1,z3) *(max(z1,z3)-0.01))/0.01*100)*sgn(z1-z3) if z2=0∧(z1∧z3)>0.01,

log10((z1*z3)/z2*100)*sgn(z1-z3) else (eq. 2)

where sgn x:= –1 if x<0, 0 if x=0, and 1 if x>0.

RESULTS: A TID (given as z1-z2-z3) of (0.991-0.001-0.008) will be quantized to (0.99-0.00-0.01) and the respective PI results in 0, thereby indicating a non-polarized TID in contrast to 2.90 with eq. 1, indicating a polarized TID. Applying eq. 2, the PI of the TID (0.15-0.05-0.80) will result in -2.38 (non-polarized) instead of 2.38 with eq. 1.

CONCLUSION: Particularly the exclusive consideration of intensity zones with at least 1% of the total proportion avoids negative arguments in the log10 algorithm and the indication of a polarized TID if the fraction of z3 is not higher than 0.01. Furthermore, eq. 2 allows for the calculation of the PI in such "inversely polarized" TIDs while avoiding falsely positive indication of a polarized TID when z2z3>z2) with z2=0, subtracting the 0.01 fraction from the larger z1 accounts for the typical underestimation of the z3 percentages in heart rate-based quantifications. Thus, our proposal allows a broad application of the PI concept in health and performance-focused databases, regardless of the method used to quantify intensity zones. (Limited depiction of formulas due to ASCII code limitations)

References

Arjona et al. 2023 doi: 10.3389/fphys.2023.1179769

Festa et al. 2023: 10.1136/ bmjsem-2023-001749

Treff et al. 2019. doi: 10.3389/fphys.2019.00707

Oral Presentations

OP-PN02 Nutrition II

A 10-DAY (POLY)PHENOL-RICH DIET DID NOT IMPROVE RECOVERY FROM EXERCISE-INDUCED MUSCLE DAMAGE COMPARED TO A (POLY)PHENOL-RESTRICTED DIET IN RECREATIONALLY STRENGTH TRAINED MALES AND FEMALES

HANSELL, E., THORLEY, J., REYNOLDS, K.M., ŠKARABOT, J., JAMES, L.J., CLIFFORD, T.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: (Poly)phenols may mitigate exercise-induced muscle damage (EIMD), ostensibly due to their antioxidant and anti-inflammatory properties. However, such research is limited to high doses of (poly)phenols in singular foods or compounds, such as tart cherry juice or curcumin. Indeed, there is a paucity of research on whether interventions containing a range of (poly)phenolic foods can attenuate symptoms of EIMD, such as muscle function loss, and delayed onset of muscle soreness (DOMS). Providing a range of (poly)phenol-rich foods could elicit synergistic effects, enhancing the efficacy of (poly)phenol interventions, and offer an alternative to concentrated supplements. Thus, the aim of this study was to examine whether a (poly)phenol-rich diet could attenuate markers of EIMD.

METHODS: Thirty (n=18 males, n=12 females) recreationally strength trained individuals (age 23±3 y; height 1.74±0.11 m; mass 71.3±11.5 kg) were randomly assigned to a (poly)phenol unrestricted (U-POL) or (poly)phenol restricted (R-POL) diet for 10 days. The U-POL diet was further supplemented with high (poly)phenol foods (40 g/day of dark chocolate and walnuts) and the R-POL diet with low (poly)phenol foods (40 g/day of milk chocolate and peanuts). On day 8 of their diet, participants completed 200 eccentric knee extensions at 60°s-1 on an isokinetic dynamometer. Pre (PRE), post (POST), 24 h-post (24H), 48 h-post (48H), and 72 h-post-exercise (72H), maximum isometric voluntary force of the knee extensors (MIVF), DOMS (0-200mm VAS), and via femoral nerve stimulation, voluntary activation (VA), rate of twitch development within 0-50 ms (RTD.50), time to peak twitch (CT), and half relaxation time (0.5RT) were assessed. At PRE, POST and 48H, white blood cell (WBC), neutrophil (NEU), and lymphocyte (LYM) counts were measured. Mixed-model ANOVAs were used to examine for group x time-point interactions; Bonferroni adjustments were applied for post-hoc tests.

RESULTS: Energy intake, macronutrient intake, and total work completed during exercise did not differ between groups (P≥0.293). The U-POL group consumed more (poly)phenol-rich foods in total than the R-POL group (+322 g/day; P<0.001), including more fruits, vegetables, herbs and spices (+158 g/day; P<0.001), and wholegrains (+69 g/day; P=0.004). MIVF was reduced by ~31% post-exercise and remained ~12% below baseline at 72H (P<0.001). Exercise increased DOMS, which peaked at 48H (+148%; P<0.001). VA, CT, RTD.50, and 0.5RT were reduced at POST (P≤0.019), and at 24H for VA and RTD.50 (P≤0.043). NEU were elevated at POST (P<0.001), and LYM were reduced at POST and 48H (P<0.001). No significant group (P≥0.432) or interaction (P≥0.160) effects were observed for any variable.

CONCLUSION: A (poly)phenol-rich diet for 10 days did not significantly influence MIVF, DOMS, neuromuscular function, or WBC counts in the 72-h following 200 eccentric muscle contractions, possibly due to an insufficient dose and/or the inherent inter-individual variability in EIMD responses.

INCORPORATION OF N-3 PUFA INTO SKELETAL MUSCLE MEMBRANES ALTERS GLOBAL GENE EXPRESSION IN YOUNG AND OLDER ADULTS

BANIC, M., GALLAGHER, I.J., VAN DIJK, M., WITARD, O.C., DICK, J.R., GALLOWAY, S.D.R., RODRIGUEZ-SANCHEZ, N.
UNIVERSITY OF STIRLING

INTRODUCTION: The incorporation of omega-3 polyunsaturated fatty acids (n-3 PUFA) into the phospholipid membrane of human skeletal muscle cells modulates muscle protein turnover. However, differential effects of n-3 PUFA ingestion on gene expression in young and older adults are yet to be fully understood and may contribute, in part, to age-related differences in n-3 PUFA impact on skeletal muscle. We sought to determine the influence of n-3 PUFA ingestion on global gene expression profiles in skeletal muscle of young and older adults.

METHODS: Thirteen young (23±3 y, 7 female) and eleven older (67±6 y, 7 female) adults supplemented their diet, in capsule form, with 1.26g/day n-3 PUFA (720mg EPA + 540mg DHA) over 12 wk. Muscle biopsies were obtained at baseline and after 12 wk of supplementation for analysis of n-3 PUFA phospholipid membrane composition using gas chromatography, and global gene expression using microarrays. Gene category enrichment was determined using the Molecular Signatures Hallmark gene sets and data were analysed using R. Lean and fat mass was quantified via dual-energy X-ray absorptiometry, physical activity status monitored with ActiGraph GT3X+, and handgrip strength assessed using a Takei handgrip dynamometer.

RESULTS: The percent of n-3 PUFA relative to total fatty acids increased in muscle phospholipid membranes of young (+1.4 ± 0.2%) and older (+1.5 ± 0.5%) adults after 12 wk with no significant age-related differences (P>0.05). In young adults, n-3 PUFA ingestion downregulated two pathways related to bioenergetics (Ox Phos and ROS) and four pathways related to tissue regeneration (MYC targets, DNA repair, IFN-α, IFN-γ), while one pathway linked to tissue regeneration (Mitotic spindle) was upregulated. In older adults, three pathways related to tissue regeneration (Epithelial mesenchymal transition, Angiogenesis, IFN-γ) were upregulated, while one gene set related to bioenergetics (Ox Phos) was downregulated. Differential regulation of IFN-α, and IFN-γ gene sets was observed between age groups (upregulation in older adults, downregulation in young adults). Although physical activity increased from 39 ± 6% to 42 ± 6% of recorded time, there was no significant difference between age groups (P>0.05). No significant effect of n-3 PUFA ingestion on lean mass or strength was observed in young or older adults (P>0.05).

CONCLUSION: To conclude, the incorporation of n-3 PUFA into skeletal muscle membranes differentially alters gene sets involved in skeletal muscle regeneration and bioenergetics in young and older adults. These effects were unrelated to changes in physical activity status, lean mass, and strength over the 12-wk supplementation period. This study highlights the potential clinical application of n-3 PUFA supplementation in remodelling skeletal muscle across the lifespan.

THE EFFECTS OF 10 WEEKS OF SUPERVISED RESISTANCE TRAINING WITH TIME-RESTRICTED EATING OR NORMAL DIET ON BODY COMPOSITION IN OBESE MEN WITH METABOLIC SYNDROME

YAVETZ, R., LAHAV, Y., STERNFELD, R., GEPNER, Y.
TEL AVIV UNIVERSITY

INTRODUCTION: Resistance training (RT) and time-restricted eating (TRE) are established lifestyle modalities for enhancing body composition. Yet, their combined effect has yet to be determined. This study aimed to determine the effects of RT with either TRE or normal diet (ND) on fat mass (FM) and fat-free mass (FFM) in obese men with metabolic syndrome (MetS).

METHODS: In this randomized controlled trial, 32 obese men with MetS (aged 49.1±5.8y, BMI 31.0±4.0kg/m2, body fat 33.7±4.6%) were randomly assigned to TRE of 8 hours of eating and 16 hours of fasting (n=16) or ND (n=16) for ten weeks. Both groups consumed an isocaloric diet and underwent the same supervised whole-body RT three times per week. Body composition changes were assessed using dual-energy X-ray absorptiometry (DXA) scans pre- and post-intervention. A 2-way repeated measures ANOVA evaluated the within- and between-group differences and interaction.

RESULTS: After 10 weeks of intervention, body weight significantly decreased for the TRE group (-1±1.4 kg, p=0.02) and slightly increased (0.3±1.8 kg) for the ND group. Both dietary interventions decrease FM (TRE: -2.3±1.2 kg, ND: -2.2±1.7 kg, p<0.001 for both), with no significant differences between the groups. Although both groups showed a considerable improvement in FFM (TRE: 1.3±1.1 kg, p=0.001, ND: 2.5±0.9 p=0.001), the increase was more substantial in the ND group (p=0.003), indicating a differential effect of diet on muscle mass gains in combination with RT.

CONCLUSION: Both TRE and ND, along with RT, improve body composition in obese men with MetS, but ND was more effective in enhancing FFM. This suggests that meal timing and duration can influence muscle mass.

INGESTION OF A BLEND CONTAINING WHEY PLUS COLLAGEN PROTEIN INCREASES BOTH MYOFIBRILLAR AND MUSCLE CONNECTIVE PROTEIN SYNTHESIS RATES

AUSSIEKER, T., HERMANS, W.J.H., KAISER, J., HENDRIKS, F.K., HOLWERDA, A.M., SENDEN, J.M., VAN KRANENBURG, J.M.X., GOESSENS, J.P.B., SNIJDERS, T., VAN LOON, L.J.C.

MAASTRICHT UNIVERSITY

INTRODUCTION: Ingestion of whey protein has been reported to increase myofibrillar but not muscle connective protein synthesis rates both at rest as well as during recovery from exercise. It has been speculated that the inability of whey protein ingestion to increase muscle connective protein synthesis rates is attributed to an insufficient provision of glycine as a precursor for de novo collagen synthesis. Recently, we defined a whey and collagen protein blend (5:1 ratio) to improve post-prandial plasma glycine availability following protein ingestion. The present study assessed the ability of such a whey and collagen protein blend to increase both myofibrillar and muscle connective protein synthesis rates both at rest and during recovery from exercise.

METHODS: In a randomized, double-blind, parallel design, 28 young men (age: 25±5 y; BMI: 23.6±2.3 kg/m2) were randomly allocated to receive either 30 g of protein (25 g whey and 5 g collagen protein; BLEND, n=14) or a non-caloric placebo (PLA, n=14). Subjects received primed continuous intravenous infusions with L-[ring-13C6]-phenylalanine. Following a single session of unilateral leg resistance type exercise (leg press and leg extension), subjects ingested either BLEND or PLA. Blood and muscle biopsy (both legs) samples were collected in post-absorptive state, immediately after ingestion and over a subsequent 5 h recovery period to assess both myofibrillar and muscle connective protein synthesis rates. Time-dependent variables were analyzed by a two-factor repeated-measures ANOVA. Non-time-dependent variables were compared between treatment groups using an independent t-test. A statistical level of $P<0.05$ was accepted. All data are expressed as mean±SD.

RESULTS: Protein ingestion strongly increased plasma amino acid concentrations, including plasma leucine, glycine, and proline concentrations ($P<0.001$), whilst placebo ingestion showed no changes ($P>0.05$). There were no differences in post-absorptive myofibrillar and muscle connective protein synthesis rates between treatments ($P>0.05$). Post-prandial myofibrillar and muscle connective protein synthesis rates were higher in the exercised compared with the rested leg ($P<0.001$). In addition, myofibrillar protein synthesis rates were higher in BLEND compared to PLA in both the rested (0.038±0.008 and 0.031±0.006%/h, respectively; $P<0.05$) and exercised (0.052±0.011 and 0.039±0.009%/h, respectively; $P<0.01$) leg. Muscle connective protein synthesis rates were higher in BLEND compared to PLA in the rested (0.062±0.013 and 0.051±0.010%/h, respectively; $P<0.05$), but not the exercised (0.090±0.021 and 0.079±0.016%/h, respectively; $P=0.11$) leg.

CONCLUSION: Ingestion of a blend containing whey (25 g) plus collagen (5 g) protein increases both myofibrillar and muscle connective protein synthesis rates at rest and further increases myofibrillar but not muscle connective protein synthesis rates during recovery from exercise in recreationally active, young men.

PERSONALIZED HYDRATION STRATEGY IMPROVED FLUID BALANCE AND EXERCISE PERFORMANCE IN THE HEAT

WANG, H., LI, H., EARLY, K.

ZHEJIANG NORMAL UNIVERSITY

INTRODUCTION: Typically, sweat rate and sweat electrolyte losses have a large inter-individual variability and this makes specific hydration plan for a large population so difficult. However, a personalized approach to hydration can overcome this issue to meet a person's particular fluid and sodium needs. Thus, the purpose of this research was to investigate the effects of a personalized hydration strategy (PHS) on body fluid balance and high-intensity intermittent exercise performance.

METHODS: Twelve healthy, active participants completed a maximal oxygen consumption test (VO2max) and two 5-day trial arms. One arm was under normothermic condition (NOR; ~23°C) and the other arm was under hyperthermic condition (HYP; ~35°C). Each arm began with 3 days of familiarization exercise phase, which consisted of a 45min treadmill run at 50% VO2max. After the familiarization phase, participants randomly performed the main exercise trial with a either PHS and control (CON; day 4 and 5). The PHS was prescribed according to a participant's fluid and sweat sodium losses during familiarization phase. CON was selected the commercially available electrolyte beverage drinking ad-libitum. The main exercise trial consisted two phases: first phase was 45min treadmill run at 50% VO2max and second phase was high-intensity intermittent exercise (HIIT) at 80%VO2max, 5% grade for 60s followed by a fast walk at 40%VO2max, 5% grade for 30s until voluntary fatigue. Fluid replacement was only allowed in the first phase of exercise trial. PHS participants drank the solution with amount equally distributed every 10min, whereas CON participants drank ad-libitum. Participants then crossed over to the second arm with a washout period of 7 days to result in the following trials: NOR+PHS, NOR+CON, HYP+PHS, and HYP+CON. Canal temperature (Tc), heart rate, thirst perception, rating of perceived exertion (RPE), and the parameters of fluid balance (sweat and urine sodium [Na+]) were assessed.

RESULTS: In PHS trials, participants had a significantly greater fluid intake and less body mass loss compared to CON, regardless of environmental condition (all $p<0.001$). HYP+CON produced the lowest sweat Na+ concentration (56.2±9.0mmol/L) compared to other trials (all $p<0.001$). Under NOR condition, no HIIT exercise performance advantage

was found in PHS. However, under HYP condition, participants in HYP+PHS had a lower RPE (9±3 vs. 10±3, p=0.03) and Tc (37.0±0.4°C vs. 37.1±0.5°C, p=0.03) in the first phase of exercise compared to HYP+CON. HYP+PHS had the lowest thirst perception (3.6±2.4) compared to HYP+CON in the second phase (4.2±2.2, p=0.004) and HYP+PHS had a greater HIIT exercise performance (765±452s) compared to HYP+CON (548±283s, p=0.04).

CONCLUSION: PHS reinforces fluid intake and successfully optimizes hydration status and offset sweat sodium loss, regardless of environmental conditions. However, PHS may be or is more important to prevent negative physiological consequences during high-intensity exercise in the heat.

Oral Presentations

OP-PN07 Molecular Biology and Biochemistry III

METABOLOMIC PROFILE OF SWIMMING SESSIONS PERFORMED AT DIFFERENT EXERCISE INTENSITIES IN HIGH PERFORMANCE SWIMMERS

GOVUS, A., LAWLER, N.G., MITCHELL, L.J.G., GOLDSMITH, C., KOZLOVSKAIA, M., PYNE, D.B.
LA TROBE UNIVERSITY

INTRODUCTION: Metabolic phenotyping uses mass spectrometry to comprehensively profile hundreds to thousands of metabolites (the products of metabolism) in a small blood volume (~0.02-0.10 mL). Such information can provide a detailed overview of the metabolic responses to swimming sessions performed at difference exercise intensities. This study explored the metabolic responses associated with three swimming sessions performed in the moderate, heavy, and severe exercise intensity domains in high performance male and female swimmers.

METHODS: Sixteen (9 males, 7 females, age: 16-24 years) Tier 3 swimmers performed a 12 × 25 m step test to determine their critical swimming speed. One week later, swimmers undertook three swimming sessions performed in the moderate (5 × 400 m on 6' at A1/A2 speed), heavy [3 × (8 × 100m on 1' 40 holding critical speed, 100 m recovery on 2')], and severe exercise intensity domains [3 × (1 × 35 m dive max on 2', 2 × 50 m dive max on 3', 200 m recovery on 5']. Each session was scheduled two days apart. 1.0 mL capillary whole blood samples were collected before and immediately following the cool down for each session, centrifuged and 0.1 mL of blood plasma was frozen for metabolic phenotyping using 1H-NMR and LC-MS spectrometry to give broad lipoprotein, lipidomic and amino acid coverage.

RESULTS: Preliminary random forest classification analysis of pre- vs. post-exercise time points revealed that exercise in the severe domain altered metabolites involved in membrane structure and energy metabolism (triacylglycerol's and phosphatidylethanolamine's), whereas exercise in the heavy and moderate domain mainly altered free fatty acids involved in oxidative energy metabolism and the inflammatory response (e.g., eicosatrienoic acid). Analysis of the log2fold change of post/pre-exercise values between swimming sessions distinguished different fatty acid profiles involved in cell membrane structure and the inflammatory response between sessions performed in the moderate, heavy, and severe domains, respectively. However, the metabolomic profile of the swimming sessions performed in the moderate and heavy domains could not be discriminated from each other as they showed a similar metabolic response.

CONCLUSION: Similar metabolic responses (altered fatty acid metabolism) were observed in the swimming sessions performed within the moderate and heavy domains, but changes in metabolites involved in cell membrane structure and the inflammatory response were key features of exercise performed in the severe intensity domain. Further research is needed to understand the variability and long-term metabolomic responses to routine swimming training in high performance swimmers.

BACKYARD RUNNING: A GUT MICROBIAL SHIFT AFTER AN ULTRA-ENDURANCE RUNNING EVENT

AMPE, T., ARENALES ARAUZ, Y.L., DEMUYSER, T., ROELANDS, B., DE PAUW, K.
VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: Both ultrarunning, an extreme sport pushing participants to their physiological limits, and the gut microbiota have gained enormous interest in recent years. Despite this growing interest, research on physiological responses during ultra-endurance events is limited, especially research on the relation with the gut microbiota1,2. Therefore, this study aims to fill this gap by exploring changes in the gut microbiota during a Backyard ultra-endurance running (BYR) event. Understanding these alterations is crucial for understanding their impact on energy metabolism, immune function and long-term health.

METHODS: Eight male ultrarunners (41 ± 9 years old, BMI: 23.0 ± 1.1 kg/m²), with personal BYR records ranging from 100.5 km to 677 km, were monitored before, during and after a BYR event. Gut microbiome was examined before (pre), immediately after (post) and two weeks after the event (recovery). Athletes diets were tracked using Food Frequency Questionnaires (pre and recovery) and food diaries (during). Together with the diet, other gut related metadata (e.g. medicines, surgeries,…), as well as performance data during the event (e.g. heart rate, pace, lactate,…) were collected in order to correlate and/or correct for during the gut microbiome analysis.

RESULTS: Preliminary results show differences in beta-diversity of the gut microbiome between pre, post and recovery samples. On phylum level, a shift in the Bacteroidetes/Firmicutes ratio was observed, with a decreased abundance of

Bacteroidetes post event compared to pre event in 6 out of 8 athletes. Additionally, in 6 out of 8 recovery samples, an increased abundance of Bacteroidetes compared to post and pre event was shown. Consistently, on family level, Prevotellaceae exhibited lower abundance in the post and higher abundance in the recovery samples. For Bifidobacteriaceae a higher abundance was found post event for 5 athletes. Lastly, results indicate a high variance in Lachnospiraceae abundance across the different time points.

CONCLUSION: Performing an ultra-endurance running event is associated with a temporary shift in bacterial composition in the gut and with the increased/decreased representation of some bacterial phyla and families immediately after the event and after recovery. Correcting for and/or correlating the gut microbiome data with the diet and metadata of the athletes, should confirm these results. Notwithstanding, the abundance of Prevotellaceae and Lachnospiraceae are typically associated with a higher fiber intake, which was lower during the event. Further analysis on species level, as well as metabolomic analysis should reveal further details on the effect of an ultra-endurance running event on the gut microbiome.

1. Grosicki, G. J. et al. (2019). Rapid gut microbiome changes in a world-class ultramarathon runner. Phys. Rep., 7(24), e14313.

2. Sato, M. et al. (2022). Alterations in intestinal microbiota in ultramarathon runners. Sci. Rep., 12(1), 6984.

METABOLOMIC SIGNATURE OF SHORT-TERM LOW ENERGY AVAILABILITY

NUSSER, V., MURPHY, C., WASSERFURTH, P., KOEHLER, K.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: The impact of low energy availability (LEA) on metabolic processes has been widely documented in the literature, with notable alterations observed in various metabolic, endocrine and physiological pathways, e.g., sex hormones as well as indicators of bone and iron metabolism. However, a comprehensive understanding of the metabolic perturbations associated with LEA remains elusive. Metabolomics, capable of analyzing a vast array of metabolites at once, provides a unique opportunity to uncover the potentially complex metabolic signature of LEA, which holds promise for improved detection and characterization of LEA status.

METHODS: In this study, we employed nuclear magnetic resonance-based metabolomics to quantify 250 metabolites and metabolite ratios in post-intervention blood samples obtained following short-term exposure to LEA (15 kcal/kg fat-free mass (FFM)/day) and normal EA as control (CON; 40 kcal/kg FFM/day). Blood samples utilized in our analysis were sourced from two larger crossover design studies (n=13, 85% males, aged 23.2±3.5 years), one of which involved daily aerobic exercise across both conditions, expending 15 kcal/kg FFM/day. We used generalized estimating equations to evaluate the effects of LEA on metabolite concentrations, while employing multiple logistic regression to predict LEA status based on metabolic profiles.

RESULTS: We observed significant condition effects in 120 out of 250 metabolites, independent of exercise. Notably, triglycerides (LEA vs. CON: 0.63±0.20 vs. 0.99±0.44 mmol/L, adjusted $p<0.05$), fatty acids (9.22±1.38 vs. 10.65±2.51 mmol/L, adjusted $p<0.05$), ketone bodies (0.30±0.25 vs. 0.03±0.02 mmol/L, adjusted $p<.001$) and very-low density lipoprotein (VLDL) sub-classes (adjusted $p<0.05$) exhibited significant differences. Furthermore, the stepwise inclusion of these variables into a logistic regression model demonstrated their ability in predicting LEA status (LEA ~ Acetoacetate + Total triglycerides + Ratio of saturated fatty acids to total fatty acids, AIC=18.3, $p<.001$).

CONCLUSION: Our analysis revealed significant group differences across a broad spectrum of metabolites, indicative of a transition towards increased fat utilization, ketosis, VLDL lipolysis and lipid transfer to high-density lipoprotein particles. These findings underscore the potential of metabolomics for identifying the metabolic signature of LEA, which may in turn be used to identify individuals currently exposed to LEA.

EFFECTS OF ECCENTRIC CYCLING EXERCISE TRAINING WITH NEUROMUSCULAR ELECTRICAL STIMULATION AND COMPRESSIVE GARMENT ON PHENOTYPES AND MITOCHONDRIAL METABOLISM IN T LYMPHOCYTES

PENG, S.C., LU, T.Y., LO, K.M., WANG, J.S.

CHANG GUNG UNIVERSITY

INTRODUCTION: Eccentric cycling training improves exercise performance via lower metabolic demand. Assistive devices like neuromuscular electrical stimulation (NMES) and compressive garments (CG) are reported to attenuate muscle damage following high-intensity eccentric exercise. Mitochondria in T lymphocytes dominate acquired immunity and metabolism. The current understanding of eccentric cycling exercise combined with assistive devices on mitochondrial functions in T-lymphocytes remains unclear. This study attempted to evaluate the effects of eccentric cycling exercise training combined with assistive devices on phenotypes and mitochondrial metabolism of T lymphocytes.

METHODS: Twenty sedentary healthy males were randomly assigned to either eccentric cycling with assistive devices (ECA, n=10) or eccentric cycling only (ECC, n=10). Cardiopulmonary exercise testing (CPET) was conducted to determine aerobic fitness. All subjects performed ECA or ECC at an intensity of 60% to 120% maximal workload progressively on a bicycle ergometer for 40 min/day, 5 days/week for 5 weeks. A high-resolution respirometer and flow cytometer were used for analyzing mitochondrial metabolism and phenotypes in T lymphocytes. Statistics were presented using two-way repeated measures ANOVA with Bonferroni post-hoc test.

RESULTS: The ECA (176 ± 7 vs. 190 ± 8 watts, p<0.05) and the ECC (174 ± 2 vs. 192 ± 7 watts, p<0.05) both increased work rates of CPET after training for 5 weeks. The ECA decreased the pain visual analogue scale on the first week of exercise training (ECA:2.0 ± 0.5 vs. ECC:4.0 ± 0.2, p<0.05), compared to the ECC. An elevation of the percentage of central memory T cells (CD45RO+62L+) was observed in the ECC (20.9 ± 0.9 vs. 26.3 ± 2.4 %). Moreover, the intervention enhanced mitochondrial fatty acid oxidation (FAO) of lymphocytes in both ECA (29.0 ± 2.7 vs. 37.7 ± 2.9 pmol/s/106 cells, p=0.044) and the ECC (28.4 ± 3.3 vs. 38.3 ± 2.5 pmol/s/106 cells, p=0.039), the latter also increased respiration of Complex II of electron transport chain (ETC) (17.8 ± 2.2 vs. 23.7 ± 1.6 pmol/s/106 cells, p=0.023).

CONCLUSION: The ECA predominately alleviates perceived muscle soreness during exercise training. In addition, both ECA and ECC increase mitochondrial FAO capacity, whereas only the ECC enhances ETC Complex II metabolism, and there is no significant difference between the two regimens.

Oral Presentations

OP-MH08 Resistance training in older adults

INVESTIGATING THE EFFECTS OF PEER-VOLUNTEER SUPERVISED RESISTANCE TRAINING ON PHYSICAL FUNCTION AND STRENGTH IN COMMUNITY-DWELLING OLDER ADULTS.

DOWLING, C., KING, L., FITZPATRICK, P., OHAGAN, C.

SOUTH EAST TECHNOLOGICAL UNIVERSITY CARLOW

INTRODUCTION: Resistance training (RT) improves physical function (PF) and strength in older adults. However, a dependency on health and exercise professionals may hinder older adults' accessibility to RT. Replacing health and exercise professionals with peer volunteers may increase the accessibility of RT to older adults. The aim of this study was to determine the effectiveness of peer supervised RT for improving PF and strength in older adults.

METHODS: Stage 1: Six RT trained older adults (68 ± 4 years, 50% female) completed a 4-week programme of workshops to prepare them for supervising RT sessions. The programme was designed and delivered by the lead researchers and topics included anatomy, principles of RT, RT for older adults, RT safety, exercise instruction, intensity monitoring, and an externally accredited sports first aid qualification.

Stage 2: Ninety-eight community dwelling, healthy older adults (67 ± 4 years, 86% female) were randomly assigned to Peer Supervised RT (PEER), Professionally Supervised RT (PRO), or to a non-exercise Control (CON). Training groups completed 10 weeks of RT, training twice weekly. PF was assessed using the Timed Up-and-Go (TUG) and the 30 Second Chair Stand Test (30CST). Strength was measured using Handgrip dynamometry (HG). A two-way repeated measures ANOVA determined the effects of training and supervision type on physical outcomes.

RESULTS: Drop-out rates were similar in PEER (22%) and PRO (25%). However, retention (defined as returning a completed training diary, attending > 50% of training sessions, and participating in all testing sessions) was higher in PRO (72%) than PEER (60%). Participants attended 80% of training sessions with no difference between groups. TUG improved in both PEER (8.24 ± 0.31s vs 7.00 ± 0.20s; $p < 0.001$, $\eta p2 = 0.31$) and PRO (7.70 ± 0.28s vs 6.78 ± 0.178s; $p < 0.001$, $\eta p2 = 0.26$), as did 30CST (PEER; 16.90 ± 0.85 stands vs 22.05 ± 1.00 stands; $p < 0.001$, $\eta p2 = 0.56$, PRO; 16.65 ± 0.77 stands vs 23.30 ± 0.91 stands; $p < 0.001$, $\eta p2 = 0.72$) and HG (PEER; 27.10 ± 1.89kg vs 28.84 ± 1.83kg; $p = 0.013$, $\eta p2 = 0.10$, PRO; 29.25 ± 1.713kg vs 33.28 ± 1.67kg; $p < 0.001$, $\eta p2 = 0.41$). There were no changes in any of the outcome measures in CON.

CONCLUSION: A 4-week programme of workshops was sufficient at providing voluntary peers with the skills required to effectively supervise a 10-week RT intervention for older adults. Peer supervised RT was as effective at improving PF and strength as professionally supervised RT.

THE ADAPTIVE RESPONSE DURING THE FIRST 8 WEEKS OF RESISTANCE TRAINING IN ELDERLY AND YOUNG ADULTS: A PRELIMINARY ANALYSIS

SPINELLO, G., SAMPIERI, A., GOLDIN, E., MASARIN, A., FRANCHI, M.V., CAMPA, F., CASOLO, A., PAOLI, A., MORO, T.

UNIVERSITY OF PADUA

INTRODUCTION: Aging is an inherent aspect of human life, characterized by a progressive decline in muscle mass and strength1. Older adults typically experience decreased muscle mass, alteration in muscle fiber size and composition, and impaired neuromuscular function compared to younger adults2. Physical exercise, particularly resistance training (RT), plays a primary role in counteracting age-related problems3. Understanding differences in adaptive response to RT between elderly and younger adults is crucial to optimize training outcomes for both populations. Therefore, we aimed to study changes in response to 8 weeks of RT focused on lower limbs between young adults (Y) and elderly (E).

METHODS: Fourteen young adults (23.7±3.0 years) and seven older adults (71.9±5.7 years) underwent a progressive dynamic RT program (3 times/week) for 8 weeks. Training protocol involved 3 sets of leg press, lunges, and leg extension and 3 upper body exercises (2 sets). Neither group had prior experience with RT. Participants were assessed at the beginning (T0), after 4 (T1) and 8 (T2) weeks. Isometric muscle strength was evaluated during maximal voluntary force (MVC) and submaximal trapezoidal contractions (15, 35, 50, and 70%), with concurrent recording of high-density surface EMG (HDsEMG) from vastus lateralis muscle. Dynamic muscle strength was evaluated with 1RM leg press and leg extension.

Body composition and muscle size (CSA) were assessed with DXA and ultrasonography (US), respectively. Moreover, muscle biopsies were obtained at T0 and T2.

RESULTS: Preliminary results demonstrated a significant increase in strength parameters. Specifically, isometric MVC significantly increased (p<0.001) from T0 to T1 (Y=+8.52%, E: +15.51%) and from T0 to T2 (Y= +20.49%, E= +17.78%) in both groups and from T1 to T2 in Y only (+8.22%). Similar results were observed in 1RM test. US analysis revealed a time x age interaction (p<0.001) for quadriceps CSA: in particular, Y significantly increased muscle size at all time points, whilst E increased only from T0 to T2. Consequently, the ratio between MVC and CSA was unaltered in the Y group but increased from T0 to T2 in the E group.

CONCLUSION: Our results suggest that an 8-week RT improved muscle strength parameters and CSA in both cohorts. However, it appears that the adaptive mechanism might be different: in the elderly strength gain seems more attributable to neural adaptation rather than morphological changes. This hypothesis could be further confirmed by the analysis of HDsEMG and muscle biopsies.

1= Lexell J, 1993

2=Mc Leod, 2016

3=Fiatarone, 1994

SYNERGISTIC RELATIONSHIP BETWEEN CHANGES IN MUSCLE MASS AND BIOELECTRICAL IMPEDANCE ANALYSIS PARAMETERS AFTER 12 WEEKS OF RT IN OLDER WOMEN

STAVINSKI, N., MAGALHÃES, J., ROSA, G., SARDINHA, L., CYRINO, E.

STATE UNIVERSITY OF LONDRINA

INTRODUCTION: Bioelectrical impedance analysis (BIA) parameters are often associated with cellular health and plausibly with muscle function. On the other hand, it is unknown whether prospective changes in muscle thickness due to resistance training (RT) are associated with changes in BIA-derived parameters. Therefore, we aimed to analyze the synergistic relationship between changes in muscle mass and BIA-derived parameters following 12 weeks of RT in older women.

METHODS: One hundred and seventeen older women (69.4 yrs ± 5.7 yrs) were allocated either to a RT group (n = 56) to be submitted to a 12-week RT full-body program or to a control group (n = 61). Both groups were evaluated at the beginning of the study and after 12 weeks using a BIA device to assess reactance (Xc, ohms), resistance (R, ohms), and phase angle (PhA, °), while a B-mode ultrasound was used to determine muscle thickness of three sites (arm flexors, and lateral and mid-thigh). The sum of the three sites was used as a surrogate for muscle thickness measurements (SUMmt). Dual-energy X-ray absorptiometry was also used to estimate total fat mass (FM). Repeated measures correlation was used to examine the synergistic relationship between BIA parameters and muscle thickness over time, while linear mixed models with a random intercept were used to determine the relationship when adjusted for age and FM.

RESULTS: After the intervention, Xc significantly increased in RT group (48.3 ± 7.8 to 52.8 ± 7.4) and reduced in control group (49.4± 8.22 to 46.7± 8.20), with a significant group*time interaction at the follow-up (P < 0.001). R increased only in RT group (555 ± 68 to 571 ± 63), while PhA increased in the RT group (4.97 ± 0.52 to 5.28± 0.50) and reduced in the control group (5.03 ± 0.48 to 4.78 ± 0.52), with a significant group*time interaction at the follow-up (P < 0.001). The SUMmt (cm) increased in RT group (18.2 ± 3.1 to 19.4 ± 3.0) and reduced in the control group (18.5 ± 2.8 to 17.9 ± 2.7), with a significant group*time interaction at the follow-up (P < 0.001). The SUMmt was associated with Xc (rrm = 0.50), R (rrm = 0.42), and PhA (rrm = 0.44) in the RT group, whereas no significant association was found between SUMmt and the BIA parameters in the control group (P ≥ 0.050). When adjusted by age and FM, a one-unit increase in the SUMmt in the RT group was associated with an increase of 0.83 ohms (CI 95%: 0.13/1.55 ohms) in Xc and 0.11° (CI 95%: 0.07/ 0.15°) in PhA, but not associated with R (P = 0.625). On the other hand, a one-unit increase in the SUMmt in the control group was associated with a reduction of -7.50 ohms (CI 95%: -12.6/-2.4 ohms) in R and 0.07° (CI 95%: 0.02/0.12°) in PhA, but it was not associated with Xc (P = 0.922).

CONCLUSION: Changes in SUMmt induced by RT can explain a significant part of the BIA parameters in older women. Our results suggest that changes in muscle thickness due to RT might have a role in cellular health.

THE EFFICACY OF 12-WEEK PROGRESSIVE HOME-BASED STRENGTH AND TAI-CHI SNACKING PROGRAMME IN OLDER ADULTS: A MIXED-METHOD RANDOMISED CONTROL TRIAL

LIANG, I.J., PERKIN, O.J., WILLIAMS, S., MCGUIGAN, P.M., THOMPSON, D., WESTERN, M.J.

UNIVERSITY OF BATH

INTRODUCTION: Preventing frailty in older age is crucial for maintaining independence, preventing falls, sustaining a good quality of life, and reducing the strain on health and social care due to population ageing. Currently, only 20% of adults aged 65 years or more meet the recommended guidelines for muscle strength and balance, with common participation barriers such as low self-efficacy, limited attendance at leisure settings, time constraints, and fear of pain or injury. This study aimed to investigate the efficacy of a home-based strength and Tai-Chi "exercise snacking" intervention as an easily accessible and engaging exercise solution for older adults.

METHODS: Following a qualitative study and a pilot trial examining 28-day versions of the exercise programme to establish feasibility and improve acceptability [1-2], a 12-week randomised controlled trial was conducted. The trial aimed to

explore the efficacy of exercise snacking in improving physical function and psychological outcomes. Pre-frail older adults (n=90) were randomly assigned to either 12 weeks of progressive twice-daily 10-minute strength and Tai-chi exercises or a waitlist control group. Physical function and self-reported psychological outcomes were assessed at baseline, 4, 8, and 12 weeks. Additionally, a subset of 26 intervention participants underwent semi-structured interviews to provide feedback on their experiences. Quantitative data were analysed using linear mixed models, while qualitative data were analysed using a deductive framework analysis.

RESULTS: Intervention participants exhibited improvements in strength and balance, as measured by the Short Physical Performance Battery, with estimated mean differences of 1.73 [95% CI 1.31/2.16; p<0.0001] at week 4, 1.36 [95% CI 0.95/1.77; p<0.0001] at week 8, and 1.42 [95% CI 1.00/1.85; p<0.0001] at week 12 compared to the control group. Qualitative findings indicated that participants found the programme accessible and beneficial, enhancing self-efficacy in physical activities for older adults.

CONCLUSION: A 12-week, home-based, 20-minute daily progressive exercise snacking programme can yield clinically meaningful improvements in physical function. This approach presents a low-cost, scalable method to increase strength and balance exercise participation among pre-frail older adults.

REFERENCES:

1. Liang, I. J., Francombe-Webb, J., Mcguigan, P. M., Perkin, O. J., Thompson, D., & Western, M. J. (2023). The acceptability of homebased exercise snacking and Tai-chi snacking amongst high and low function UK and Taiwanese older adults. Frontiers in Aging, 4.

2. Liang, I. J., Perkin, O. J., McGuigan, P. M., Thompson, D., & Western, M. J. (2021). Feasibility and acceptability of home-based exercise snacking and tai chi snacking delivered remotely to self-isolating older adults during COVID-19. Journal of aging and physical activity, 30(1), 33-43.

THE EFFECTS OF INDIVIDUALIZED FLYWHEEL INERTIAL VERSUS FREE-WEIGHT EXERCISE BASED ON MAXIMUM POWER LOAD IN OLDER ADULTS

SMAJLA, D., STERMECKI-PUKL, M., ŠARABON, N., SPUDIC, D.

UNIVERSITY OF PRIMORSKA

INTRODUCTION: Resistance training stands out as an effective tool for older adults, slowing the aging process and preventing declines in muscle performance and functional ability. As an alternative to gravity-dependent weights, flywheel inertial devices have emerged, offering the potential for subjects to generate greater force and power. This capability is crucial in mitigating the decline in muscle power output, a primary consequence of aging [1]. Numerous studies have undertaken comparisons between flywheel training and traditional weight-based training [2,3]. However, past research has often overlooked the objective equalization of intensity between flywheel and weight-based training, thereby limiting the conclusiveness and comparability of the effectiveness of both training methods. Our research aimed to assess the impact of a six-week exercise protocol (twice weekly) on the functional abilities of elderly individuals.

METHODS: The subjects were randomly divided into two groups. Both groups performed all-out squats at peak power loading conditions, where the experimental group (EG: N=16, 69,3 ± 5 years) used a flywheel inertial device and the control group (CG: N=14, 67,2 ± 13 years) exercised with a hex-bar (exercises for other muscle groups were identical). Before the six-week protocol, subjects underwent two familiarization visits and initial measurements, including determining the load where maximum power output was achieved (flywheel and hex-bar), balance assessment in tandem stance, up-and-go test, sit-to-stand test, the strength of knee flexors and extensors on the isokinetic device.

RESULTS: Analysis of variance revealed no significant effect of time or time-group interaction. Both groups demonstrated significant improvement in the sit-to-stand test (EG: 25 % vs. CG: 20,2 %, $p < 0,001$) and the up-and-go test (EG: 13,1 % vs. CG: 8,5 %, $p < 0,001$). An improvement was also detected in the test of maximal strength of the knee extensors (EG: 51.7 % vs. CG: 51.2 %, $p < 0.001$) and knee flexors (EG: 48.8 % vs. CG: 33.8 %, $p < 0.001$).

CONCLUSION: Flywheel inertia-based exercise has demonstrated itself as a viable alternative to traditional training by offering variable resistance based on the exercisers performance in the preceding repetition. While the EG showed slightly greater relative improvements, conducting more extended intervention studies is essential for drawing definitive conclusions in the future.

REFERENCES

1. Sañudo, B. et al. Effect of flywheel resistance training on balance performance in older adults. A randomized controlled trial. J. Sport. Sci. Med. 18, 344–350 (2019).

2. Onambélé, G. L. et al. Neuromuscular and balance responses to flywheel inertial versus weight training in older persons. J. Biomech. 41, 3133–3138 (2008).

3. Spudić, D., et. al.. Influence of inertial resistance squat exercise protocol based on novel exercise intensity determination on physical fitness of older adult women. Exerc. Qual. Life 11, 29–36 (2019).

Oral Presentations

OP-AP12 Elite Running

BACKYARD RUNNING: PUSHING THE BOUNDARIES OF HUMAN PERFORMANCE

DE PAUW, K., JONES, A.M., AMPE, T., ARENALES ARAUZ, Y.L., ROELANDS, B.
VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: Backyard running is an extremely demanding ultra-endurance event where athletes strive to complete a 6.7 km lap every hour. As a 'last man standing' competition, the event concludes when the second-to-last participant quits, leaving the final runner to complete the ultimate lap. Remarkably, several athletes have surpassed the 100-lap mark, equivalent to an astounding 670 km. As the popularity of extreme ultra-endurance events continues to grow, understanding the physiological, psychological, and medical implications of participating in events like backyard running is paramount for safeguarding athletes' health and promoting informed training and participation strategies. Therefore, our objective is to assess the influence of backyard running on various aspects of performance, i.e. pacing, resilience, cognitive functioning and cardiovascular responses.

METHODS: Twelve male ultrarunners (38 ± 8 years old, BMI: 23.5 ± 1.6 kg/m², VO2max: 60.8 ± 4.7 ml/min/kg) participated in this study, with personal Backyards records ranging from 15 to 101 laps, covering distances between 100.5 km to 677 km. Participants were monitored during the "Backyard Ultra" event held on April 15th, 2023, in Kasterlee, Belgium. Cognitive performance was determined using a cognitive test battery COGNITION, including 8 cognitive tasks, before, during and after the event. During the event the rating of perceived exertion (RPE), lactate and heart rate (HR) were assessed. Physical performance was investigated using the total amount of completed laps and running speed per lap. Linear mixed-effects regression models were applied, and post-hoc t-tests were conducted using the Satterthwaite's method. A significance level of $p<0.050$ was employed for hypothesis testing.

RESULTS: Athletes completed 34 ± 17 laps equalling 227.8 ± 113.9 km with average speeds starting at 9.0 km/h and slowing down to 7.5 km/h at the end of the event. Based on the 5 training zones assessed for each participant after their cardiopulmonary exercise testing, participants ran 85.2% in zone 1 (i.e. recovery), 9.5% in zone 2 (i.e. long duration endurance), 0.1 % in zone 3 (i.e. extensive endurance), and 0.0% in zones 4 and 5 (i.e. intensive endurance and resistance, respectively). Physiological resilience (i.e. HR/speed) altered between athletes, with significantly lower values in the more proficient backyard runners at the end of the event ($p<0.050$). HR and lactate levels remained constant, whereas a progressive increase in RPE was noticed ($p\leq0.001$). A significantly worsened reaction times was observed for several cognitive tasks after the event ($p\leq0.050$), indicating reduced psychomotor speed.

CONCLUSION: These observations underscore the pivotal role of cognitive performance in constraining extreme ultra-endurance running. It also suggests that implementing strategies that enhance psychomotor speed could potentially have a positive effect on one's performance in such demanding endurance activities, including backyard running.

THE INFLUENCE OF 2-WEEK TRAINING OVERLOAD ON PHYSIOLOGICAL RESPONSES AND MARKERS OF TRAINING STRESS IN ENDURANCE ATHLETES

TALSNES, R.K., KVAM, N.O., STENSHEIM, J., SANDBAKK, Ø., NOORDHOF, D.
NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: Endurance athletes are susceptible to an imbalance between training load and recovery, which can result in maladaptation, an unexplained decrement in performance and potential overtraining syndrome. In order to prevent athletes from transitioning along the continuum from being acutely fatigued towards overtraining syndrome, early detection and subsequent adjustments to the training process are imperative. Several studies have investigated the influence of training-overload protocols on various physiological responses and subjective-fatigue markers. Nevertheless, there is a need for contemporary knowledge into the comprehensive influence of training overload on physiological responses and markers of training stress commonly used in the overtraining literature. Therefore, this study aimed to investigate the influence of 2-week training overload on physiological responses and markers of training stress in endurance athletes.

METHODS: Nine trained endurance athletes (distance-runners and triathletes, n=6 males; VO2max = 66.8±4.9 mL·min-1·kg-1; n=3 females, VO2max = 56.6±6.6 mL·min-1·kg-1) completed 1-week baseline training, 2-week training overload (50-70% progressive increase in training load) and 1-week recovery (30-40% reduction in training load from baseline). Immediately after each training period, physiological responses during submaximal steady-state stages and a maximal incremental time to exhaustion (TTE) test while treadmill-running were assessed, as well as subjective fatigue measures and blood biomarkers.

RESULTS: No changes from baseline to after training overload were found for TTE and VO2max, although both increased after the recovery period (Δ31±24 sec and 80±75 mL·min-1, P<.05, respectively). Both maximal heart rate and blood lactate levels during the TTE test (-4±3 beats·min-1 and -1.5±1.7 mmol·L-1, P<.05), as well as heart rate and blood lactate levels at the same submaximal speed (-5±3 beats·min-1 and -0.4±0.4 mmol·L-1, P<.01), were reduced after training overload. However, these physiological responses were normalized to baseline-values following the recovery period. Subjective-fatigue markers (1-10) including perceived readiness (-2.3±1.3-point, P<.01), muscle soreness (-1.8±1.9-point, P=.02),

and fatigue (-2.3±1.8-point, P<.01) were impaired after training overload but normalized to baseline-values after the recovery period.

CONCLUSION: This study provides valuable insights into the comprehensive influence of training overload in endurance athletes. The present findings indicate that sports practitioners should incorporate information derived both from regular physiological tests and subjective fatigue-markers to detect maladaptive states at an early stage.

*Preliminary analyses due to ongoing data collection. Data including more participants and blood biomarkers with relevance for both overtraining syndrome and relative energy-deficiency in sports will be presented.

UPHILL AND HORIZONTAL INTERVAL RUNNING SESSIONS: EFFECTS ON PHYSIOLOGICAL AND NEUROMUSCULAR PARAMETERS

DANTAS DE LUCAS, R., MATTOS, B.K., TREMEL, A.C., LANZARINI, L.D.V., BORSZCZ, F.K., GUGLIELMO, L.G.A., TURNES, T.
FEDERAL UNIVERSITY OF SANTA CATARINA

INTRODUCTION: The physiological and neuromuscular effects of uphill running training need for more evidence, to improve knowledge and a proper prescription (Barnes et al., 2013). It is well known that running at different speeds and slopes induces changes in predominantly concentric or eccentric muscle contractions, which could influence the acute and chronic responses (Lemire et al. 2008). This study aimed to compare the acute physiological and neuromuscular parameters from two-interval running sessions performed by incline and horizontal treadmill settings.

METHODS: Twelve endurance-trained runners performed two incremental running tests until exhaustion (De Lucas et al. 2021), and two interval sessions composed of 10 repetitions of 1 min at maximal speed or incline that were obtained in the incremental tests (i.e. maximal aerobic workload), with recovery periods between repetitions of 1 min. VO2 and heart rate (HR) were continuously measured and averaged for each exercise interval, and for the entire session. Accordingly, the O2 pulse was calculated as the ratio of VO2/HR. Before and immediately after the 3rd, 6th, and 10th repetitions, the runners performed a countermovement jump (CMJ) to assess the neuromuscular performance. Paired t-test and ANOVA were used for analysis.

RESULTS: The maximal workload obtained from the incremental tests, and then used for interval sessions were 17.5 +/- 1.0 km/h and 17.0 +/- 1.7%, respectively, for horizontal and incline tests. The mean VO2 of the entire exercise intervals was lower for horizontal than incline sessions (52.5 +/- 6.5 and 54.7 +/- 6.7 ml/kg/min; ~91% VO2max, p =0.03), while HR was significantly higher for horizontal than the uphill session (163 +/- 10 and 157 +/- 9 bpm, respectively; p =0.01). In this way, the O2 pulse was greater for uphill than the horizontal session (25.2 +/- 3.8 and 23.3 +/- 3.4 ml/beat, respectively; p <0.01). In comparison to the baseline values of CMJ height obtained before the horizontal (32.5 +/- 4.3 cm) and incline sessions (32.8 +/- 4.4 cm), there was a decrement after the 3rd repetition for both sessions (31.5 +/- 4.4 and 31.6 +/- 3.8 cm, respectively). However, there was an augment after the 6th (33.0 +/- 4.5 cm), and 10th (33.2 +/- 4.3 cm) intervals only during the horizontal interval session. During the uphill session, the CMJ values after the 6th (31.9 +/- 4.2 cm) and 10th interval (32.2 +/- 4.1 cm) was similar to the baseline.

CONCLUSION: The interval sessions (10×1:1-min) performed by incline and horizontal at the maximal aerobic power can elicit different VO2 and HR responses, suggesting a greater cardiac efficiency during the uphill running. Regarding neuromuscular performance, one could observe that a more concentric running (i.e uphill) seems to induce more fatigue than horizontal (and eccentric) running during this kind of interval session.

1. Barnes, K.R., et al. Int J Sports Physiol Perform (2013)

2. Lemire, M., et al. Res Q Exerc Sport (2018)

3. De Lucas, R.D., et al. Res Sports Med (2021)

THE EFFECTS OF MODERN FOOTWEAR TECHNOLOGY ON RUNNING ECONOMY: CAN TREADMILL TESTS PREDICT OUTDOOR RESULTS?

BELTRAMI, F., BAUMANN, G., NOLÉ, M., SPENGLER, C.M.
ETH ZURICH: EIDGENOSSISCHE TECHNISCHE HOCHSCHULE ZURICH

INTRODUCTION: Modern running shoes have revolutionized long-distance performances by decreasing the oxygen uptake (VO2) required to run at a given speed, which is termed running economy. Most studies performed to date rely on treadmill testing, but the extent to which these findings translate to outdoors running is not known. This study therefore aimed to compare running economy and perception of effort and comfort between running on a treadmill and running on an athletics track, using two different footwear, a modern running shoe combining high compliance, resilience and a longitudinal carbon plate in the midsole and a typical entry-level shoe.

METHODS: Following a familiarization trial including an incremental test, 16 well-trained male runners (weight 70 ± 6 kg, age 28 ± 5 years, peak oxygen uptake [VO2peak] 64 ± 4 ml·kg-1·min-1, peak running speed 20.0 ± 0.8 km·h-1) completed two testing visits, once on a treadmill and once on an athletics track. Each experimental visit consisted of twelve 5-min runs at submaximal speed (16 km·h-1) alternating two different footwear conditions: an entry-level running shoe (30 mm ethyl vinyl acetate [EVA] midsole thickness; weight 300 g per shoe; forefoot compliance 0.006 mm·N-1, resilience 74.5%) and a modern, carbon-plated running shoe (40 mm Polyether-block-amide [PEBA] midsole; weight 205 g per shoe; forefoot compliance 0.008 mm·N-1, resilience 85.1%). The shoe order was randomized and balanced between each of the four replicates, but kept constant between days. Gas exchange and heart rate were measured continuously

throughout the runs whereas as perception of effort and comfort were assessed at the end of each run using a 10-cm visual analogue scale. For comparisons, the last 2 min of each 5-min run were averaged across the repetitions.

RESULTS: With the modern running shoe, participants showed improved running economy on the treadmill (2.4 ± 1.1% and on the track (4.0 ± 1.2%), and lower heart rate on the treadmill (-1.3 ± 0.6%) and on the track (-2.0 ± 0.6%), compared with the entry-level shoe (all P < 0.001). Additionally, all participants showed reduced VO2 with the modern shoes whether tested on the treadmill (range -0.9 – -4.5%)) or track (range -2.0 – -6.7%). Perceived effort was lower with the modern shoes on both surfaces (P < 0.001) while perceived comfort was higher (P < 0.001). The magnitude of the differences in VO2 between shoes was smaller during treadmill than during track running (P < 0.001, Cohen dz 1.13). Differences in VO2 measured between shoes on the treadmill did not correlate with the differences measured on the track (relative differences r = 0.258, P = 0.336; absolute differences r = 0.340, P = 0.336).

CONCLUSION: Systematic testing with four replicates showed that the benefit of the modern running shoe during outdoor running could not be estimated from treadmill testing. Athletes should thus be encouraged to rely on outdoor testing or other metrics when choosing between different modern shoes.

ESTABLISHMENT OF PHASE SEPARATION METHOD USING IMU AND MEASUREMENT OF MUSCLE ACTIVITY DURING ONE RUNNING CYCLE ON A TREADMILL

KAJIWARA, W., HIROSE, K., KONDO, A., MIYAMOTO, N., UDA, S., ONODERA, K., NAKANO, H., TAKEDA, M.

DOSHISHA UNIVERSITY

INTRODUCTION: In this study, we attempted to analyze electromyograms (EMG) for each phase of a running cycle (4 phases: braking-, propulsion-, recovery-, and pre-activation phase) using motion phase detection by Inertial measurement unit (IMU).

METHODS: One male 800 m runner (34 years, 184 cm, 70 kg) was measured on a treadmill (RL2700E X 1000, Rodby, Sweden). The running speed increased gradually and reached the predetermined 25 km/h velocity after 10 seconds. An IMU (1000 Hz, DSP wireless motion sensor, Sports Sensing, Japan) was attached to the pelvis, thighs, lower leg, and feet, and the data were acquired during the running at the 25 km/h velocity for 15 cycles. IMUs data were processed for 8 s (15-23 s) after confirming that the subject had reached a constant speed of 25 km/h. To divide 4 phases of one running cycle, the posture (roll and pitch angles) of the waist, thigh, lower leg, and foot were estimated using the Extended Kalman Filter (EKF), and joint angles was calculated during running. The subject was captured with a camera (200 Hz, Basler ace, BASLER, Germany) from right beside the treadmill (90 degrees to the subject) during running, and the video data was used as a valid basis for estimating the running phase and joint angles estimated from IMUs. EMG (1000Hz, DSP wireless EMG sensor, Sports Sensing, Japan) was measured at 10 locations on the right leg: (1) gastrocnemius, (2) soleus, (3) tibialis anterior, (4) biceps femoris long head, (5) semitendinosus, (6) vastus lateralis, (7) rectus femoris, (8) tensor fasciae latae, (9) gluteus maximus, and (10) rectus abdominis.

RESULTS: The correlation coefficient (r) between the joint angle data estimated by the IMU and measured by the camera was r = 0.86 (p < 0.01) for the hip, r = 0.99 (p < 0.01) for the knee joint, and r = 0.83 (p < 0.01) for the ankle joint, showing a high correlation between them for all joints. The joint angle changes estimated from the IMU were divided into 4 phases of running based on the timing of each phase of one cycle obtained from the video data. As a result, the feature points of the joint angle at the timing of each running phase were clarified. Based on these featured angle joint points of the IMU, the 4 phases of one running cycle were divided for all 14 steps. The mean average errors for the phase separation timing between the IMU and the video were 0.003 ± 0.0024 sec for the braking-phase, 0.004 ± 0.0029 sec for the propulsion-phase, 0.003 ± 0.0031 sec for the recovery-phase, and 0.002 ± 0.0025 sec for the pre-activation-phase, and all within 2 standard deviations. The ten muscle activities measured showed phase-specific activity during 4 phases of one running cycle.

CONCLUSION: Based on the results of this study, it would be possible to divide a running cycle into 4 phases using the estimated joint angles changes measured by IMU, and to establish a method for analyzing muscle activity for each phase.

1. Howard et al. (2018) 2.Hernandez et al. (2021)

Oral Presentations

OP-SH01 Physical Education and Pedagogics I

EFFECTS OF CLASSROOM-BASED ACTIVE BREAKS AND STANDING DESK ON HEALTH-RELATED FITNESS AND EXECUTIVE FUNCTIONS IN ADOLESCENTS

PRIVITERA, M., DE GIORGIO, A., CORREALE, L., LIBERALI, G., MARTINIS, L., DELLANNA, S., BERNARDES, A.G., IVANISKI-MELLO, A., PEYRÉ-TARTARUGA, L.A., MONTOMOLI, C., BUZZACHERA, C.F.

UNIVERSITY OF PAVIA, ITALY; ECAMPUS UNIVERSITY, ITALY; FEDERAL UNIVERSITY OF RIO GRANDE DO SUL, BRAZIL.

Introduction

Adolescents spend much of their daily time in schools, which are ideal settings for promoting health-related behaviours. Unfortunately, schools have often neglected such behaviours, including physical activity, due to their focus on academic achievement and economic restrictions. Decreased levels of physical activity, however, may compromise the scholarly purposes of academic achievements. A plausible solution is to promote time-efficient physical activity interventions, such as breaking up prolonged sedentary times with light-intensity physical activity and/or using standing desks. Whether such interventions affect parameters of health and fitness and executive functions, however, is still uncertain. We, therefore, investigated the single and combined effects of classroom-based active breaks and using standing desks on adolescents health-related fitness and executive functions.

Methods

Participants were 100 secondary school students (78% females, aged 15 to 17 yr). Four classes were randomly assigned into one of four groups: control (CT, n = 20), active breaks (ACT, n = 26), standing desks (STD, n = 26), and active breaks and standing desks combined (ACT+STD, n = 28). In both the ACT and ACT+STD groups, participants completed 3 × 8-min active breaks per weekday for 12 weeks, while in both the STD and ACT+STD groups participants completed 3 × 8-min using standing desks. In the ACT+STD group both interventions were alternate. Health-related fitness, i.e., muscular strength/power/endurance, aerobic endurance, flexibility, and blood pressure, and executive function, i.e., short-term working memory, visual attention, and task switching, were assessed at baseline and post-intervention. ANCOVA tests using baseline values as covariates were used, with P-value set as <0.05.

Results

The adherence to the interventions was relatively high (>80%). There were significant improvements in muscular endurance, aerobic endurance, flexibility, and systolic blood pressure (P<0.01), primarily in the ACT group. Similarly small, but non-significant trends were observed for muscular strength (P=0.06) and diastolic blood pressure (P=0.06). No between-group differences were observed for muscular power and all indicators of executive function (P>0.05).

Conclusion

Our findings suggest that classroom-based physical activity interventions appreciably impact health-related fitness, but not executive function, in secondary school students. The most noticeable benefits were observed when breaking up prolonged sedentary times with light-intensity physical activity. These results underscore the importance of incorporating physical activity breaks within classroom settings.

This research was funded by the Ministero dellIstruzione (DD 90 20/10/2022).

GAME ON, GRADES UP? INVESTIGATING THE IMPACT OF A TEACHER AND PUPIL DESIGNED ACUTE PHYSICAL ACTIVITY BREAK ON CHILDRENS COGNITION

DIXON, S., TEMPEST, G.D., HETTINGA, F., MCCULLOGH, N.

NORTHUMBRIA UNIVERSITY

Introduction

Physical Activity (PA) is beneficial for children's physical and mental health. Schools play a crucial role in children's health promotion strategies, and amidst a demanding academic curriculum, PA breaks should be optimised to promote key cognitive and psychological variables linked to academic performance. Feasibility, ease of implementation, and effectiveness from key stakeholders perspectives should also be considered. Utilising an acute approach provides insight into the immediate impact of PA break strategies, complementing long-term PA research. Therefore, the primary aim of this study was to examine the impact of an acute PA break, designed by children and teachers, on children's cognitive function.

Methods

In a prior study, we co-designed a PA break with children and teachers, which resulted in a 5-min PA break, consisting of playground games, performed outdoors with the whole class. Using a fully repeated measures design, preadolescent children (n=120, aged 5-11 years old) completed 5-min of playground games, usual practice (The Daily Mile) and a control (no PA) condition in a randomised and counterbalanced order. Rating of perceived exertion (RPE 1-10 scale) was measured following each PA condition and cognitive function (Stroop and Connections Tests) was measured pre, post (10-min) and following (45-min) each condition. A dependent t-test (RPE) and separate Condition (playground games, usual practice, control) by Time (pre, post, follow-up) repeated measures ANOVAs (response time and/or accuracy) were conducted (significance level, p=0.05).

Results

Perceived exertion was higher for the playground games (M=4.89, SD=2.83) vs. the usual practice (M=3.60, SD=2.87) condition (t(103) = -3.98, p<0.001). For the Connections Test, a main effect of Time (F(2,194) = 12.09, p<0.001), indicated improved accuracy pre to post (M=76.42, SD= 30.08, M=80.57, SD= 35.01) vs. post to follow-up (M=81.91, SD= 33.71). Whereas for the Stroop Test, a Condition by Time interaction (F(3,318) = 3.15, p=0.023), indicated no change in accuracy between conditions pre to post. However, accuracy reduced post-10min to follow-up in the playground games (M=93.75, SD=12.85) condition vs. usual practice (M=95.55, SD=10.44) and control (M=95.42, SD=10.77) conditions. No significant effects were recorded for response time (p>0.05).

Conclusions

A PA break consisting of playground games was co-designed to promote physiological and cognitive benefits. Compared to usual-practice, playground games felt more physiologically challenging, yet children's cognitive function was maintained at 10-min, but not 45-minutes later. These findings acknowledge the importance of the timing and type of cognitive assessment employed, and contribute to the development of feasible and effective, child and teacher led PA breaks, to harness cognitive benefits throughout the school day.

OPERATIONALISING PHYSICAL LITERACY: INVESTIGATING A PLAY-BASED PRACTITIONER EDUCATION PROGRAMME FROM PRACTITIONER TO CHILD IN THE UK

WING, K., DE STE CROIX, M., ROBERTS, W.M., BAKER, C.

UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: There is currently a growing inactive population of young people globally. It is widely recognised that practitioner education could impact children's Physical Literacy (PL) and subsequent Physical Activity (PA) throughout life [1]. Boing is a workshop-based programme that aims to help practitioners develop children's PL through active play; however, the programs impact is unknown. The aim of this study was to explore the efficacy of practitioner training and reach to children as the end user, using a novel, multi-method RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) approach.

METHODS: 926 practitioners from 45 organisations were recruited. Three sequential questionnaires explored practitioner education pre, post and 6-months after training for self-reported attributes: knowledge, confidence and attitude (Likert scale). Wilcoxon signed-rank tests for non-parametric data investigated changes in attributes. Rank-biserial correlation [r] was utilised to calculate the effect size [2]. Further Bayesian statistical analysis was utilised to investigate changes between organisational groups. Practitioner interviews (n=17) captured perceived barriers and facilitators to use 1-year post-training. Finally, the child's voice was explored using Unfinished Stories: a novel drawing-based interview approach with 12 children from 3 organisations. Thematic content analysis was completed on both verbal data (practitioner and child) and visual narratives (child).

RESULTS: Quantitative: Perceived attributes towards PL was poor across the UK. Boing training elicited significant changes across all organisational groups ($p<0.001$, $r=0.94$). This was retained 6-months after training, however, significant decreases between post training and 6-months were evident ($p=<0.001$, $r=0.49$). Notably organisational groups did not differ with extreme evidence found for equal groups ($BF10 =<0.001$).

Qualitative: Five higher-order themes emerged from practitioners including organisation structure and paedology. Practitioners reported widespread adoption of Boing, however, barriers such as reduced contact time and policy led to practitioners not maintaining use over the year. Three higher-order themes emerged from children, including digital play and social interaction. Children described technology, identified family/friends and detailed sport/games with adults commonly absent. This differed from the practitioner narrative.

CONCLUSION: Current knowledge, confidence and attitude toward PL among practitioners is poor. Boing is effective at improving this; however, further support is required to promote continued use. Despite this, children have their own unique view of play that differs from their adult counterparts. The role of unsupervised and digital play must be acknowledged if the voice of the child is valued in child-centred research and policy [3] to promote PA throughout life.

[1] Durden-Myers et al. (2018)

[2] Goss-Sampson (2019)

[3] UN Committee: Rights of the Child (1991)

EDUCATORS' PERCEPTIONS OF RISKS FOR PHYSICAL ACTIVITY RELATED INJURIES IN EARLY CHILDHOOD EDUCATION AND CARE (ECEC)

SOLLERHED, A.C.

KRISTIANSTAD UNIVERSITY

Introduction

Many parents worry that children will injure themselves in physical activity, which leads them to banning physically active play to a high degree. Educators in early childhood education and care (ECEC) also seem to worry about children getting hurt in physically active play, which can lead to restrictions on childrens ability to move in ECEC. The diminution of opportunities for physical activity contributes to several risks for ill health, for example being overweight and developing other health problems as well as affecting the development.

Aim

The aim of the study was to investigate ECEC educators' experiences, and perceptions of risks in children's physical activities and the ways these perceptions influenced the educators' decisions to offer opportunities for physical activities and movement in ECEC.

Methods

Semi structured interviews were carried out with 18 ECEC educators, 17 females and one male, working in five preschools in Sweden. The educators were either preschool teachers or day-care-assistants with 5-38 years in service in ECEC. The length and depth of the interviews varied, but they generally lasted between 30 and 90 minutes. The interviews were

digitally recorded and transcribed verbatim before analysis. The transcripts were analyzed by a combination of thematic analysis and qualitative content analysis.

Results

The analysis revealed three themes with adherent sub-themes.

1. Responsibility for the children included the sub-themes Caretaking and Empathy.

2. Fear of being accused included the sub-themes Fear of being hung out in media and Fear of being seen as unaccountable in the work team.

3. Low competence in movement included the sub-themes Low expectations on children's movement skills and Low personal movement skills.

Discussion

The educators described that they felt a great responsibility for the childrens safety towards the parents. If the children got hurt, they sometimes felt personal pain and anguish because they found it distressing when children hurt themselves. But they also feared being accused of not taking good care of the children. The fear of being exposed in the media was palpable, as was the fear of their colleagues opinions about what activities children could be allowed to do. Overall, their competence in leading physical activities with the children was perceived as low, resulting in limitations on the range of movement and what the children were allowed to do. Their own motor skills were limited, and many movements were considered too difficult to perform, both for themselves and for the children.

Conclusion

ECEC educators' concern about injuries and overprotective behavior risks hindering children from physical activity and movement, which in the long run can pose a a great risk to children's health and wellbeing, which should be taken under consideration. Finding a balance between safety and allowing children to explore and learn risk-management is essential for overall well-being.

Oral Presentations

OP-MH05 Disabilities and sport participation

ACUTE EFFECTS OF A MOTOTHERAPY SESSION ON THE EXPLOSIVE STRENGTH OF PEOPLE LIVING WITH DIFFERENT ABILITIES. PILOT STUDY.

PATANÈ, P., RE, F., STURARO, E., FEBBI, M., VANDONI, M., CARNEVALE PELLINO, V., GATTI, A., MARIN, L.
MASTER DEGREE COURSE OF MOTOR SCIENCES

INTRODUCTION: The literature shows that sports activities improve the overall well-being of the individual, inducing the body to produce endorphins. There is a significant reduction in stress levels and an overall improvement in the perception of ones body image even among people living with disabilities.

Freestyle Motocross is a sport activity, born from motocross, in which athletes perform stunts during jumps. In Italy, in 2008, the champion Vanni Odera, with a multidisciplinary team, created the "Freestyle Motocross Therapy" (FMX). An adapted version that allows people living with disabilities to get on a motorcycle with a trained rider, and ride a safe track. FMX has also been carried out with great success in hospitals, but the acute effects on participants functional capabilities have not yet been evaluated. The aim of this study was to evaluate the acute effects of an FMX session on the explosive strength of the upper limbs of a sample of people living with different abilities.

METHODS: Twelve people with different abilities (2 female), age 23±10.6, where recruited, received study information, signed an informed consent and completed the Satisfaction Profile (SAT-P) questionnaire, which investigates quality of life. Each person freely choose one of the three motocross events, held in Northern Italy between 15/05/2022 and 15/10/2022 , at the end of which perform the FMX. The posture on the bike was adapted to the abilities of each participant who could sit: on the side, on the tank with the legs crossed or on the passenger seat. To assess the explosive strength of the upper limbs, participants performed the medicine ball throw test (2 kg.) before (T0) and after (T1) the FMX. In both sessions, three throws were done and the best result, misured in meters, was considered.

RESULTS: SAT-P shows that the quality-of-life levels of the sample are homogeneous among the participants. In the medicine ball throw, 11 out of 12 participants improved the achieved distance at T1 compared to T0; the result, expressed as mean and standard deviation, (2.62±0.91; 2.10±1.07) is statistically significant (P-Value < 0.05).

CONCLUSION: Data show that, in acute, the FMX experience improved explosive strength.

Since we haven't done interventions to improve muscle strength, it's clear that results are due to a nervous system response. Moreover, caregivers reported that for a few days there were improvements in the performance of activities of daily living and mood. Although more studies are needed, it's possible to hypothesize that FMX may be a good integration of the care pathway of people living with different abilities.

THE ACUTE EFFECTS OF SITTING VOLLEYBALL PERFORMANCE ON THE SPINAL CURVATURES, RANGE OF MOTION AND MUSCULOSKELETAL PAIN IN ELITE-LEVEL PLAYERS

GAWEL, E., ZEBROWSKA, A., ZWIERZCHOWSKA, A.

AKADEMIA WYCHOWANIA FIZYCZNEGO IM. JERZEGO KUKUCZKI W KATOWICACH

INTRODUCTION: Lower limb amputation is known to significantly disturb body's biomechanics. The preliminary research conducted by the authors of the present study suggests that there is a relationship both between the impact of the impairment and the impact of sitting volleyball (SV) training on the structural and functional changes in player's body, however there is still lack of research that evaluated this issue in terms of initial playing position lateral lower limb amputation vs. no amputation. The aim of the study was to (1) identify and compare the structural (depth) and functional (ROM) state of the spinal curvatures and pelvis in the sagittal plane of able-bodied SV players and amputee SV players in terms of compensatory mechanism, (2) indicate the dominant location of the compensatory changes and the dominant model of the compensatory mechanisms in each of the analyzed groups of players, (3) identify the prevalence and location of the musculoskeletal pain and its predictors related to body's compensatory mechanisms.

METHODS: 26 elite-level SV players from 6 European countries participated in this study. They were divided into SG1 of lateral amputee SV players, SG2 of able-bodied SV players. A natural experiment method (SV game) was used in the study, followed by acute assessment of the functional changes in the spinal curvatures and theirs ROM assessed by Medi Mouse. Moreover, a Nordic Musculoskeletal Questionnaire from the last 7 days was used to assess the prevalence and location of the musculoskeletal pain.

RESULTS: Both groups were characterized by normative thoracic kyphosis, however deeper angle was observed in SG2, that simultaneously was characterized by decreased ROM both in flexion and extension. Moreover, in both groups a decreased depth of the lumbar lordosis angle and pelvis tilt (85%, 77%) were observed the most frequent, including decreased depth of theirs ROM. In SG1 statistically significant relationships were observed between years of SV training and the depth of pelvic tilt ($R=(-0.58)$, $p<0.05$), while in SG2 years of SV training correlated with the depth of thoracic kyphosis angle ($R=0.62$, $p<0.05$). Shoulders pain was reported the most frequent, that was found to correlate with years of SV training ($R=0.6$, $p<0.05$) in SG1 and with the depth of pelvic tilt ($R=(-0.69)$, $p<0.01$) in SG2. Furthermore, in both groups shoulders pain was found to correlate with ROM of the thoracic spine in extension(SG1) or lumbar spine in extension (SG2).

CONCLUSION: The impact of the lower limb amputation on the magnitude of the anteroposterior spinal curvatures seems to be suppressed by the impact of SV performance (extrinsic compensation). Pelvic tilt and lumbar spine can be indicated as the most common location of the compensatory changes. Moreover, SV training seems to induce functional adaptations in theirs ROM. Shoulders seems to be the most frequent location of the pain, that may be associated both with sitting position and functional adaptations in the musculoskeletal structures.

PERIODIC HEALTH EVALUATION IN PARA ATHLETES: A POSITION STATEMENT BASED ON EXPERT CONSENSUS

SILVA, A., PINHEIRO, L., VERHAGEN, E., OCARINO, J., FAGHER, K., AHMED, O., DALTON, K., MANN, D., WEILER, R., OKOTH, C., BLAUWET, C., LEXELL, J., KNEEPENS, H., DERMAN, W., WEBBORN, N., RESENDE, R.

UNIVERSIDADE FEDERAL DE MINAS GERAIS

INTRODUCTION: Para athletes present a broad range of sports-related injuries and illnesses, frequently encountering barriers when accessing healthcare services1. Furthermore, their diverse impairments and the specialized equipment used in competitions require individualized approaches to comprehend their overall health2. The Periodic Health Evaluation (PHE) is a valuable tool for continuously monitoring athletes' health, screening for health conditions, and identifying barriers to athlete's performance3. Additionally, the PHE assists in the surveillance of health problems by establishing baseline information for each athlete and providing crucial information in case of emergencies. This position statement aims to guide sports healthcare providers in the PHE for para athletes across key impairment categories: intellectual, musculoskeletal, neurological and vision.

METHODS: A panel of sixteen international experts, including epidemiologists, physiotherapists, optometrists, and physicians with expertise in para athlete health, convened via videoconferences to discuss the position statement's purpose, methods, and themes. They formed working groups to address underlying medical condition, cardiorespiratory, neuromusculoskeletal, nutritional status, mental and sleep health, concussion, and female para athlete health assessment considerations. The PHE's effectiveness lies in its comprehensive approach.

RESULTS: Health history review can provide insights into factors impacting para athlete health, inform physical assessments, and help healthcare providers understand each athlete's needs. During the PHE, considerations should encompass the specific requirements of the sport modality and the impairment itself. The evaluation enable early interventions tailored to the athletes health history. Moreover, the PHE serves as an opportunity to educate para athletes on preventive strategies that can be integrated into their training routines, enhancing their performance and overall health.

CONCLUSION: This position statement can potentially enhance clinical practice and improve the healthcare quality for para athletes, ultimately contributing to their overall health and well-being.

References

1. Van de Vliet P. Let's Talk Facts - What Healthcare Providers Really Need to Know about Paralympic Athletes. ASPETAR Sport Med J 2016;5:74–9.https://www.aspetar.com/Journal/upload/PDF/2016310103620.pdf

2. Fagher K, Forsberg A, Jacobsson J, et al. Paralympic athletes' perceptions of their experiences of sports-related injuries, risk factors and preventive possibilities. Eur J Sport Sci 2016;16:1240–9. doi:10.1080/17461391.2016.1192689

3. Ljungqvist A, Jenoure P, Engebretsen L, et al. The International Olympic Committee (IOC) Consensus Statement on periodic health evaluation of elite athletes March 2009. Br J Sports Med 2009;43:631–43. doi:10.1136/BJSM.2009.064394

"2032 IS A DREAM FOR US": EXPLORING AMPUTEE FOOTBALL PLAYERS' UNDERSTANDING OF CLASSIFICATION IN PARA SPORT AND ITS APPLICATION TO AMPUTEE FOOTBALL

ESATBEYOGLU, F., GULTEKIN, B., KAYIRAN, H.

BOZOK UNIVERSITY

INTRODUCTION: The goal of the Para sport classification is to group athletes with a similar impairment into classes to increase participation and promote fair competition by minimizing the impact of eligible impairment on the outcome of competition. Despite its popularity, amputee football is not recognized as one of the Para sports by the International Paralympic Committee (IPC) due to it is lack of an evidence-based classification system. Therefore, the aim of this study was to explore the views of amputee football players on classification in Para sport and how it can be applied to amputee football.

METHODS: Semi-structured one-to-one dept interviews were conducted with 12 amputee football players (11 outside, 1 goalkeeper) aged 28.2 ± 5.57 years with 8.4±5.12 years amputee football sport experience. The participants' amputation levels were reported as transhumeral (n=1), knee disarticulation (n=3), transtibial (n=3), and transfemoral (n=5). Hermeneutic phenomenological analysis was used to capture the understanding of amputee football players views on Para sport classification and its application to amputee football for future direction. Transcribed interviews were analyzed inductively, followed by a deductive analysis.

RESULTS: Four themes were identified based on our analysis: (1) effect of amputation level, (2) meaning of amputation cause (acquired vs congenital), (3) lack of knowledge related to Para sport classification, and (4) its application amputee football classification.

CONCLUSION: The findings of this study suggest the need for a multidisciplinary scientific approach in order to establish an evidence-based classification system in amputee football. The international governing body of amputee football should be encouraged to initiate a fair classification system in amputee football according to the requirements by the IPC.

HIGHER PREVALENCE OF OSTEOPENIA IN NON-SPORTS ACTIVE COMPARED TO SPORTS ACTIVE WHEELCHAIR USERS

RISVANG, L.C., LILJEGREN, A.M.F.2, BAUMGART, J.K.3, VAN DIJK, J.W.4, STRØM, V.1,5, RAASTAD, T.1, JONVIK, K.L.1

1NORWEGIAN SCHOOL OF SPORT SCIENCES, 2WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCE, 3NORWEGIAN UNIVERSITY OF TECHNOLOGY AND SCIENCE, 4HAN UNIVERSITY OF APPLIED SCIENCES, THE NETHERLANDS, 5SUNNAAS HOSPITAL

INTRODUCTION: Wheelchair (WC) users are at high risk of low bone mineral density (BMD) due to a lack of mechanical loading. Weight-bearing exercise can impact bone health, and thus, this study aimed to investigate the prevalence of low BMD in sports active versus non-sports active WC users and among different impairments.

METHODS: In this cross-sectional study, BMD of lumbar spine, hip, and femoral neck were measured by dual-energy x-ray densitometry. Participants were defined as sports active if they were currently active in organized sports for >1 yr. WC users answered an adapted International Physical Activity Questionnaire (IPAQ-SF) for the week before testing. Data are presented as mean±SD or mean difference [CI]. One-way ANOVA, independent t-tests, and Pearson correlation analyses were employed. Only valid scans were included; analysis n is provided where data are missing.

RESULTS: The study included 64 Norwegian WC users (35±10 yrs; 41% female; 50% sports active). Impairments were spinal cord injury (SCI; n=26), cerebral palsy (CP; n=21), spina bifida (n=7) or other (n=10). Overall, the BMD of the lumbar spine (n=62), hip (n=63), and femoral neck (n=63) was 1.10±0.22, 0.80±0.15 and 0.79±0.16 g/cm^2, respectively. The prevalence of osteopenia (Z-score<-1.0) was 45% for the lumbar spine, 69% for the hip, and 75% for the femoral neck.

Sports active had a lower prevalence of hip osteopenia than non-sports active (56% and 83%, n=32 vs. n=28; P=0.011). However, the BMD Z-scores did not significantly differ (0.4 [-0.1 – 1.0]; P=0.11). No differences were seen for lumbar spine or femoral neck BMD Z-scores. Lumbar spine BMD was weakly correlated with IPAQ-SF score (Pearson R=0.29; n=56; P=0.029). Lean body mass was moderately correlated with both lumbar spine and hip BMD (Pearson R=0.53 and R=0.43, respectively; n=60; both P<0.001), but no association was found for either current weekly strength training sessions or years of strength training experience with any of the BMD sites (all P>0.05).

Lumbar spine BMD Z-score was lower in those with congenital compared to acquired impairments (1.1 [0.4 – 1.9]; n=32 vs. n=29; P=0.004), in line with the tendency towards lower BMD Z-scores in those with CP compared to SCI (-1.2 [-2.4 – 0.0]; n=20 vs. n=24; P=0.050). However, hip BMD Z-score tended to be lower in those with acquired than congenital impairments (-0.5 [-1.1 – 0.0]; both n=31; P=0.056).

CONCLUSION: Osteopenia was highly prevalent, varying from 45% at the lumbar spine to 75% at the femoral neck. Those with congenital impairments had lower BMD at the lumbar spine but higher BMD at the hip than those with acquired impairments. Sports active had a lower prevalence of hip osteopenia than non-sports active, although no differences were seen in Z-scores. Strength training is generally recommended to improve bone health but was not associated with BMD in our population. Thus, further investigations of the effects of sports participation and strength training are highly warranted.

Oral Presentations

OP-MH14 Exercise and COVID-19 I

POST-COVID-19 SYNDROME (METABOLIC SYNDROME CONNECTION) AND EXERCISE INTERVENTION BENEFITS

KWAK, Y.S.
DONG-EUI UNIV

INTRODUCTION: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has infected millions of people worldwide and caused a pandemic that is still ongoing. The virus can cause a disease named as COVID-19, which is composed of multi systemic manifestations with a pulmonary system predominance with often damage to numerous other cells and organs, leading to an array of symptoms. Many individuals have reported persistent symptoms and/or complications lasting beyond 4 weeks, which is now called post-COVID-19 syndrome. While the precise definition of Post-COVID may be lacking, the most common symptoms reported in many studies are fatigue and dyspnea that last for months after acute COVID-19. Other persistent symptoms such as cognitive and mental impairments, chest and joint pains, palpitations, myalgia, smell and taste dysfunctions, cough, headache, and gastrointestinal and cardiac issues were reported.

The purpose of this integrative review is to summarize and evaluate post-COVID-19 syndrome from a biological perspective and also discuss about physical exercise interventions. It is thus imperative to study post-COVID (short-term) and long-COVID (long-term) effects, specifically as local and systemic pathophysiological outcomes of other coronavirus-related diseases with the exercise interventions.

METHODS: Pubmed, CINAHL, Scopus, Web of Science and Google Scholar search engines were used to identify the definition, mechanism, pathophysiology of short and long post-COVID and to find long COVID-19 and exercise-intervention benefits.

RESULTS: Medical treatments for COVID-19 (anticoagulants, corticosteroids, anti-inflammatory drugs, oxygenation therapy and ventilation) and vaccination have improved patient outcomes. The majority of patients will recover spontaneously or after acute-phase management, but clinicians are now faced with long-term complications of COVID-19 including a large variety of symptoms, defined as "post-acute COVID-19 syndrome". Since the lungs are the most involved organs and the post-COVID prolonged and persistent effects are mainly related to the pulmonary system, it is crucial to define and predict the outcome and to determine the individuals that can progress to fibrosis and loss of function of lungs. The findings from our review indicated that there were four pathophysiological categories involved: virus-specific pathophysiological variations, oxidative stress, immunologic abnormalities, and inflammatory damage.

CONCLUSION: Although studies examining the pathophysiology of post-COVID-19 syndrome are still relatively few, there is growing evidence that this is a complex and multifactorial syndrome involving virus-specific pathophysiological variations that affect many mechanisms but specifically oxidative stress, immune function, and inflammation. Further research is needed to elucidate the pathophysiology, pathogenesis, and longer term consequences involved in post-COVID-19 syndrome. This recent research summarizes the current literature regarding the pulmonary complications in post-COVID syndrome and the management of these conditions with regular physical exercise. Multicomponent exercise-intervention program (4-5 days per weeks, 35-60% HRR, 100-250 minutes aerobic exercise) considered especially for the post-COVID syndrome patients were recommended with all forms of psychological support such as meditation and MBI. Adopting life style changes will be helpful to reduce post-COVID-19 syndromes

EXERCISE THERAPY IN SUBJECTS WITH POST-COVID-19 SYNDROME: EXPLORATORY DATA ANALYSIS OF DROPOUTS OF A TRAINING INTERVENTION STUDY

SICK, J., STEINBACHER, V., KOTNIK, D., KOENIG, F., RECKING, T., BENGSCH, D., KOENIG, D.
UNIVERSITY OF VIENNA

INTRODUCTION: Between 6.5 and 28.5% of people infected with SARS-CoV-2 experience long-lasting sequelae described as the Post-COVID-19 Syndrome (PCS). Recently, exercise has been investigated as a non-pharmacological therapy and it has shown to improve physical function, health-related quality of life and symptom severity. Nevertheless, some experts raised concerns about the implementation of exercise therapy in this population as post-exertional malaise (PEM) is a frequent symptom. This data analysis describes the characteristics of a study sample that discontinued an exercise intervention in order to identify possible predictors for dropout.

METHODS: As part of a randomized controlled trial, 47 patients with PCS were allocated to 12 weeks of endurance or concurrent training. Patients with PEM or a Post-COVID-19 Functional Status Score of ≥3 were excluded. The sample was grouped into subjects that finished the intervention (n=28) and dropouts (n=19) and subsequently analyzed via a group comparison of metric (independent t-Test or U-Test) and categorical data (chi-squared test). Furthermore, a logistic regression model with several predictors (BMI, age, days since COVID-19 infection, VO2peak, SF36 score, fatigue score and number of symptoms) as well as the odds ratios for dropout of the most prevalent symptoms were calculated.

RESULTS: Reasons for dropout were viral or bacterial infection (n=7), COVID-19 reinfection (n=5), compliance issues (n=4), worsening of symptoms (n=2) and injury (n=1). Dropouts and non-dropouts did not significantly differ in any demographic or outcome variable at baseline. A trend towards significance was found for the number of PCS symptoms reported at inclusion (non-dropouts: 4.7±2.6, dropouts: 6.4±3.2, p=0.058). No independent risk or protective factors were identified in

the logistic regression (p=0.345). Dizziness was the only symptom significantly associated with dropout (OR: 7.6, 95% CI: 1.4; 42.1, p=0.021).

CONCLUSION: Two subjects discontinued the training due to a worsening of their symptoms. Despite screening for exercise intolerance before enrollment, this could possibly be related to PEM. Otherwise, the overall high dropout-rate in this sample might be attributed to increased rates of respiratory tract infections and possible PCS-related alterations in immune function which increase susceptibility to infections. Dizziness could be a predictor for poor exercise tolerance, however further investigation and larger samples are needed.

THE EFFECT OF A BLENDED DIGITAL AND FACE-TO-FACE REHABILITATION PROGRAMME ON PHYSICAL FITNESS AND FUNCTIONAL CAPACITY IN PEOPLE WITH LONG-COVID.

SIMPSON, A., GALE, L., KILLINGBACK, C., DUKE, C., FENWICK, A., MOORE, D., WILLIAMS, A., HALEY, P., PEARSON, M., CROOKS, M.

UNIVERISTY OF HULL

INTRODUCTION: Long-Covid symptoms affect approximately 3% of the UK population (1.9 million people), highlighting the pressing need for an effective and scalable rehabilitation intervention. This study aimed to assess the efficacy of a novel blended rehabilitation programme on physical fitness and functional capacity of individuals with self-reported long-Covid.

METHODS: Participants enrolled on a 12-week rehabilitation programme, consisting of two distinct phases. The initial 6 weeks involved remote live group-based and on-demand exercise sessions, while the subsequent 6 weeks transitioned to in-person rehabilitation sessions at local council leisure centres. Throughout the programme participants received telephone consultations and engaged in educational and social activities. Physical fitness and functional capacity were measured using the 30 second sit-to-stand (STS) test and the Duke Activity Status Index (DASI) at baseline and after 6- and 12-weeks of rehabilitation.

RESULTS: 141 participants enrolled, 69% were female, mean (SD) 50 (12) years. Significant improvements were observed in physical fitness and functional capacity. Mean (SD) 30 second STS repetitions increased from 10 (6) at baseline, to 12 (6) at 6-weeks and 14 (5) at 12-weeks of rehabilitation ($P<0.001$, $\eta2= 0.173$), with 62% of participants demonstrating an improvement of more than the minimally clinically important difference (MCID) of 2 repetitions over the course of the rehabilitation programme. Similarly, DASI scores improved from 34 (15) at baseline to 39 (14) at 6-weeks and 42 (14) at 12-weeks of the programme ($P<0.001$, $\eta2= 0.268$), with 58% of individuals demonstrating improvements of more than the MCID (5 units).

CONCLUSION: A blended digital and face-to-face rehabilitation programme resulted in statistically and clinically important differences in physical fitness and functional capacity in patients with self-reported long-Covid and may provide a scalable solution to assist in widescale treatment of long-Covid.

FEASIBILITY AND EFFICACY OF AN UNSUPERVISED AEROBIC EXERCISE TRAINING PROGRAM FOR PARTICIPANTS WITH PERSISTENT SYMPTOMS >12 MONTHS AFTER SARS-COV-2 INFECTION: A RANDOMIZED CONTROLLED PILOT STUDY

WIEWELHOVE, T., EMMEL, C., SCHNEIDER, C., EIßMANN, M., BRUDER, O., SCHMIDT, B.

IST UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: The aim of the present pilot study was to assess the feasibility and general efficacy of a twelve-week individualized aerobic exercise training intervention for patients with persistent symptoms following a SARS-CoV-2 infection (long COVID syndrome).

METHODS: A total of 62 individuals with persistent symptoms, including respiratory issues, headaches, and concentration problems, 12 months post SARS-CoV-2 infection, were randomized into the intervention or control group, stratified by age and sex. Following initial assessments and detailed training consultations, the intervention group underwent a 12-week unsupervised aerobic endurance training intervention. The control group was instructed to maintain their existing activity levels at the time of the initial assessment for 12 weeks without engaging in additional systematic training. Both groups documented each training session using monitoring software. After 12 weeks, both groups underwent a final assessment. Self-reported health parameters (e.g., severity of persistent symptoms after SARS-CoV-2 infection), body composition (including muscle and fat mass), and spiroergometric and performance-related measures (e.g., VO2max and W at ventilatory thresholds 1 and 2) were recorded during the initial and final assessments. Out of the initially randomized 62 individuals, a total of 54 were included in the final analysis due to dropouts. The analysis was conducted as an intention-to-treat, per-protocol, and as-treated analysis, as well as using regression methods (difference-in-differences approach [DID]).

RESULTS: The calculated confidence intervals from the DID showed no clinically relevant differences in the changes of measured parameters between the groups. The calculated effect sizes from the DID revealed small to moderate positive effects on various self-reported health parameters favoring the endurance training intervention, but no effects on body composition and spiroergometric measures. When comparing analysis principles, fewer positive effects on various self-reported health parameters were observed in the per-protocol analysis compared to the intention-to-treat and as-treated analyses. The effects on body composition and spiroergometric measures did not differ based on the analysis principle. Training monitoring indicated low adherence.

CONCLUSION: An unsupervised endurance training program had a slight positive impact on relevant health perception parameters in individuals with persistent symptoms after SARS-CoV-2 infection. Regarding changes in physiological and

subjective health and performance markers, the intervention showed neither efficacy, likely partially attributed to low adherence, nor harm.

PERSISTENCE OF DYSPNEA, FATIGUE AND EXERCISE INTOLERANCE 2 YEARS AFTER THE ORIGINAL SARS-COV-2 INFECTION: IN THE SEARCH FOR PATHOPHYSIOLOGICAL MECHANISMS

BALDASSARRE, G., ZUCCARELLI, L., FAVARETTO, T., URSELLA, C., PALOMBA, A., SOZIO, E., TASCINI, C., GRASSI, B.
UNIVERSITY OF UDINE

INTRODUCTION: Following the acute infection with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a substantial percentage of patients refer persisting and often debilitating symptoms like dyspnea, fatigue and exercise intolerance. These symptoms are often grouped in a syndrome termed "Long COVID". The aim of the present study was to evaluate the persistence of Long COVID symptoms after about 2 years from the original infection, and to investigate potential pathophysiological mechanisms.

METHODS: After about two years (26±5 months, x±SD) from the original COVID-19 infection, 26 sedentary patients, males and females, were recruited for the present study. Among these patients, 12 (Long COVID; 57±6 yr) complained the persistence of symptoms related to Long COVID, whereas 14 (CTRL; 57±8 yr) did not refer these symptoms. Quality of life was assessed by the SF-36 questionnaire. Microvascular/endothelial function (increased femoral artery blood flow) during passive leg movements was evaluated by Eco-Doppler. Knee extensors maximal muscle force was assessed by isometric dynamometry. Participants performed an incremental test (INCR) and a moderate-intensity (MOD) exercise on a cycle ergometer. Pulmonary gas exchange was determined. Skeletal muscle oxidative function was evaluated in-vivo by determining the recovery kinetics of skeletal muscle O2 uptake ($\dot{V}O_2$m) by near-infrared spectroscopy and the repeated occlusions method.

RESULTS: Significantly lower scores were observed in Long COVID vs. CTRL patients in all the investigated domains by SF-36, indicating a poorer quality of life in the first group. No signs of sarcopenia were identified by an ultrasound index of muscle mass. Muscle strength was similar between the two groups. The variables evaluating microvascular/endothelial function were not different in the two groups, although below reference values. During INCR, $\dot{V}O_2$peak (23.0±4.9 vs. 26.6±6.3 mL/kg/min; p=0.12) and "ventilatory thresholds" were not significantly different in Long COVID vs. CTRL. Signs of inefficiency of pulmonary ventilation (slope of pulmonary ventilation vs. CO2 output greater than >38) and a different ventilatory pattern (greater respiratory frequency, lower tidal volume) were observed in a subgroup (n=4) of Long COVID. Both pulmonary $\dot{V}O_2$ on-kinetics during MOD and $\dot{V}O_2$m-off kinetics following MOD were not different between the two groups

CONCLUSION: More than two years after an initial infection with the SARS-CoV2 virus, some symptoms belonging to the Long COVID syndrome (i.e. dyspnea, fatigue and exercise intolerance) are still present in some patients. Nevertheless, no differences were observed between Long COVID and CTRL patients for almost all variables evaluating the pathophysiological mechanisms potentially responsible for the symptoms which were investigated. Symptoms may be attributable to other factors (i.e. psychological/neurological) which were not investigated.

(Funding: Italian Ministry of University and Research, PRIN Project 2022LBBKHX)

Oral Presentations

OP-MH22 Epedimiology

LOST IN TRANSLATION: AWARENESS, UNDERSTANDING, AND INTERPRETATIONS OF ORAL HEALTH ADVICE FOR ATHLETES – A PILOT STUDY.

BURLEIGH, M., SIMPSON, A., OHANLON, R., HENRIQUEZ, F., EASTON, C.
THE UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Carbohydrate supplementation is recommended to support performance. This has implications for oral health as frequent carbohydrate consumption causes dental decay and erosion. The prevalence of dental diseases in elite athletes exceeds that of the general population and impacts on performance and quality of life. Dental disease can be prevented by improving oral hygiene and reducing carbohydrate consumption frequency. Dental healthcare professionals (DHP) should consider barriers to behaviour change when advising athletes. Other members of the athlete support network, including coaches, may also provide advice. However, prevention advice given by DHP and Coaches and its applicability to Athletes is currently unknown.

METHODS: Guidelines for preventing dental disease in elite sports settings were reviewed. An online questionnaire, consisting of multiple-choice, scenario-based, and open-box questions was constructed to assess the knowledge and attitudes of Athletes, Coaches and DHP regarding dental disease risk and prevention. The questionnaire was piloted with Athletes (N=10) and Coaches (N=11) at the Scottish Athletics Track and Field Championships and to DHP at Glasgow Dental Hospital (N=11). DHP and Coaches were asked what dental advice, if any, they provided. Athletes were asked what dental advice they had received from their Coaches or DHP. Knowledge scores were compared with chi-squared tests and open-box question responses were analysed with deductive thematic analysis.

RESULTS: Knowledge of dental disease risk in elite athletes was poor (Correct responses Athletes 46 SD 11%, Coaches 34 SD 20%, DHP 38 SD13%). 27% of DHP believed athletes were at increased risk of disease. A greater proportion of DHP felt they had a role in the provision of diet advice relating to dental disease prevention compared to Coaches (Coaches=45%, DHP=100% p=0.04). When asked about their role in disease prevention in Athletes, there was no significant difference between groups (Coaches=36%, DHP=18% p=0.06). All DHP indicated they deliver diet advice to every patient, but only 30% of Athletes stated they had received diet advice from their DHP. Thematic analysis revealed athlete oral health was an unfamiliar topic for all groups and that DHP and coaches feel athletes are responsible for their own oral health.

CONCLUSION: Athletes, coaches, and DHP are unaware of the high prevalence of dental disease in elite sports. Despite DHP stating that they delivered targeted preventative advice, the results of the thematic analysis and responses from Athletes indicate this advice is either inadequate or not delivered. Coaches did not feel confident delivering advice to prevent dental disease. Organisations with responsibility for Athlete wellbeing should raise awareness of risk factors of dental disease specific to elite sports and ensure Athletes, Coaches and DHP are aware of feasible evidence-based ways to reduce risk.

INJURY TRENDS IN SOUTH AFRICAN FEMALE RUGBY UNION PLAYERS

PAUL, L., VILJOEN, W., READHEAD, C., SEWRY, N., CANTWELL, L., JONES, B., HENDRICKS, S.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Over the past decade, womens rugby has experienced rapid growth. This increase in participation has led to an emphasis on both performance and player safety. Understanding injury trends at various participation levels, enables development of injury prevention strategies tailored to these different levels, thus improving the development pathway for young female players. Therefore, the aim of this study is to report the different match injury tends in different age groups (U16, U18, U20 and National) among female rugby union players.

METHODS: All data were collected from annual South African women's rugby provincial or international competitions for each age group in 2023. These competitions include the u16 and u18 Girls Youth Weeks, SA U20 Women's competition and WXV 2 international Women's tournament (National level). All injuries used for analysis were match time-loss injuries. Injury data were presented as counts, proportions, and injury rate. Overlap of confidence intervals were used to determine significant differences between groups.

RESULTS: The highest injury incidence occurred in the U16 age group, while the lowest injury incidence was observed at the National level (U16: 88 (95% confidence intervals (95%CI): 50-125) injuries per 1000 player hours, National: 25 (95%CI: 0-53) injuries per 1000 player hours). Tackle related injuries had the highest injury proportion, except at the National age group. U16, U20 and National age groups exhibited the highest concussion incidence (U16: 21 (95%CI: 3-39) concussions per 1000 player hours, U20: 17 (95%CI: 5-29) concussions per 1000 player hours, National: 17 (95%CI: 0-40) concussions per 1000 player hours). The tackle event was the highest contributor to concussions (64% average), except at the National age group.

CONCLUSION: When examining patterns across U16 to National female rugby union age groups, there is a decrease in injury rates as the age groups increase. This study highlights that youth players are at higher injury risk than senior players. Tackle-related injuries remain the primary contributors to injury proportions, particularly for concussions. It is vital to prioritize tackle technique coaching and conditioning for female rugby players to address these injuries

STUDDING THE RELATIONSHIP BETWEEN LIFESTYLE HABITS AND PEDBE CLOCK IN SCHOOLED CHILDREN

PLANS SALAS, E., VASILEVA, F., FONT-LLADÓ, R., HOMS-ÀVILA, J., CAZORLA, J., BARRETINA, J., ESTELLER, M., LÓPEZ-ROS, V., PRATS-PUIG, A., JÓDAR, A.

ESCOLA UNIVERSITÀRIA DE LA SALUT I LESPORT - UNIVERSITAT DE GIRONA

INTRODUCTION: The Paediatric-Buccal-Epigenetic (PedBE) clock (1) may be used to determine the environmental factors that influence the DNA methylome in children.

Lifestyle is the individual habits, behaviours and choices that define the way of living such as: physical activity (PA), sleep and nutrition. Healthy lifestyle habits are associated to a number of health-related outcomes.

Integrated Neuromuscular Training (INT) is a comprehensive approach of physical training that focuses on motor competence. However, the relationship between the INT and the epigenetic age in children has never been studied before.

Our aim was to study whether childhood lifestyle habits as well as a 3-month-INT can affect the PedBE clock.

METHODS: A total of 40 children [7.58±0.34 years; 60% girls] were enrolled in the study. Subjects were recruited from schools in Cassà de la Selva and Salt.

Data on PA, sleep and nutrition were collected for the descriptive study. Based on the WHO recommendations (2); 60 minutes of moderate or vigorous PA per day, 10 hours per day of sleep, and a score of 8 or more in the Kidmed test were used to categorize two groups: children compliant and non-compliant whit those recommendations. For the analytical study, children were randomly divided into two groups: control or intervention group. The intervention group developed an INT program as a warm-up in physical educations lessons in the schools.

Genome-wide DNA methylation analysis was conducted on saliva samples using the Illumina Methylation Epic Array v2.0. Measures of epigenetic age acceleration were calculated using the PedBE clock. Triaxial Actigraph GT3X accelerometers

(Actigraph, Pensacola, FL, USA) were used to asses PA. Sleep data was collected with self-assess questionnaire. The Kidmed test was use to collect nutritional data. CAMSA protocol were assessed to evaluate motor competence.

RESULTS: Children compliant with physical activity and sleep recommendations showed 6 and 4-month decrease, respectively in PedBE clock when compared with non-compliant (both $p<0.037$). No differences were observed for diet recommendations. Although non-statistical significance was reached, children who undergo the INT showed a 1-month decrease in PedBE, whereas the control group showed an increase of 1.18 months.

CONCLUSION: The combination of healthy lifestyle habits and the application of the INT at school, may reverse epigenetic aging in school-children. More studies are needed for a better understanding of the mechanisms behind those associations.

BIBLIOGRAPHY:

1. McEwen LM, O'Donnell KJ, McGill MG, Edgar RD, Jones MJ, Macisaac JL, et al. The PedBE clock accurately estimates DNA methylation age in pediatric buccal cells. Proc Natl Acad Sci USA. 2019;201820843.

2. WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization; 2020.

THE TIME COURSE OF INJURY RISK AFTER RETURN-TO-PLAY IN PROFESSIONAL FOOTBALL

ZHANG, G., BRINK, M., AUS DER FÜNTEN, K., TRÖß, T., WILLEIT, P., MEYER, T., LEMMINK, K., HECKSTEDEN, A.

SAARLAND UNIVERSITY

INTRODUCTION: Injury risk in professional football remains high in the weeks following return-to-play (RTP). However, the time course of injury risk after RTP (i.e., the hazard curve) is largely unknown. Given the economic and competitive implications of injury burden, this knowledge gap impedes on RTP decision-making and post-RTP player management. Therefore, this study aimed to characterize the hazard curve for non-contact, time-loss injuries after RTP in male professional football (soccer) and to investigate the influence of the severity of index injury and the playing position.

METHODS: Media-based injury records from the first German football league were collected over four seasons as previously published [1]. Time-to-event analysis [2] was employed for the non-contact, time-loss injury after RTP. The Kaplan-Meier survival function was used to calculate the cumulative hazard function, from which the continuous hazard function was retrieved by derivation. The severity of index injuries was categorized according to the time loss concept: minimal (1-3 days), mild (4-7 days), moderate (8-28 days), and severe (>28 days) [3]. The playing position was considered as the players main position when the subsequent injury occurred, including goalkeeper, defender, midfielder, and forward.

RESULTS: 1623 observed and 1520 censored events from 646 players were analysed. The overall shape of the hazard curve was compatible with an exponential decline of injury risk, from an approximately two-fold level shortly after RTP towards baseline, with a half-time of about four weeks. The peak of the hazard curve was slightly delayed for moderate and more clearly for severe index injuries, as compared to minimal and mild index injuries. In contrast to other playing positions, forwards encountered a rising risk of subsequent injury after RTP. The greatest plunge of injury risk was seen in goalkeepers within the first two weeks after RTP.

CONCLUSION: For the first time this study determined the trajectory of subsequent injury risk and its influencing factors in male professional football. The demonstrated approach to estimating excess injury risk after RTP is expected to support RTP decision-making in practice. Moreover, the continuous hazard curves allow for informed specification of required follow-up period in epidemiological studies and verification of the proportional hazard assumption in data analysis.

References

[1] Aus der Fünten, K., et al., 2023. Epidemiology of football injuries of the German Bundesliga: a media-based, prospective analysis over 7 consecutive seasons. Sports Medicine-Open, 9(1), p.20.

[2] Singer J.D., Willett J.B. Applied longitudinal data analysis: Modeling change and event occurrence. Oxford university press; 2003. 289-95 p.

[3] Fuller, C.W., et al., 2006. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. Scandinavian journal of medicine & science in sports, 16(2), p.83-92.

ENHANCED SOLEUS AND HIP MUSCLES STRENGTH TRAINING CAN ALTER BIOMECHANICAL RISK FACTORS FOR ANTERIOR CRUCIATE LIGAMENT INJURY IN FEMALE ATHLETES

XINRONG, Z., BING, Y., YUE, M.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Females tend to land with a higher risk of ACL injury in comparison to males [1,2]. Research suggests that strength training programs can effectively reduce the risk of ACL injuries among female athletes [3,4,5]. Current ACL injury prevention programs primarily focus on enhancing hamstring, hip, and core muscles. However, recent studies have confirmed that during landing, soleus strength aids in the posterior translation of the tibia relative to the femur [6], reducing anterior shear force on the knee and consequently lowering ACL load [7]. To our knowledge, no study has observed whether enhanced soleus can reduce the risk of ACL injury during landing tasks. Considering the fact that the magnitude of ACL strain stems from multiplanar loading conditions and hip muscles provide the most contributions to controlling frontal displacement, the present study aimed to investigate the effect of enhancing the soleus in addition to hip muscles on additive beneficial biomechanical modifications during landing in female athletes.

METHODS: Thirty-nine female athletes were randomly assigned to soleus and hip (SAH n=13), only hip (HIP n=13), and control (CON n=13) groups. SAH and HIP underwent an 8-week strength training program and performed three sessions per week. Three-dimensional hip, knee, and ankle kinematic and kinetics data were obtained while the participants performed the bilateral and unilateral drop jumps. peak isometric strength of the plantar flexor and hip abductors was measured. Two-way repeated measures analyses of variance were conducted for each dependent variable to determine the effects of 4 weeks and 8 weeks of strength training

RESULTS: SAH showed increased peak isometric torque of the soleus in comparison to HIP (P=0.045, d=1.30) and CON (P=0.029, d=1.03). Peak isometric torque of the hip abductors increased in SAH (P=0.001, d=1.88) and HIP (P=0.04, d=1.30) compared with the CON. Plantar flexion angle at initial contact increased in SAH compared with the HIP (P=0.01, d=1.28) and CON (P=0.002, d=1.25). vGRF decreased in SAH compared with HIP (P=0.043, d=1.28) and CON (P=0.032, d=0.99). Anterior knee joint load was lower in SAH compared with HIP (P=0.02, d=1.44) and CON (P=0.02, d=2.00). Knee internal rotation moment in SAH was decreased compared with HIP (P=0.02, d=1.50) and CON (P=0.01, d=1.50).

CONCLUSION: Compared to strength training targeting only the hip, combined strength training of the hip and soleus muscles can further enhance lower limb biomechanical benefits associated with reducing the risk of ACL injuries. Therefore, the soleus muscle should be included in ACL injury prevention programs.

1.Boden B P et al.(2000) 2.Shimokochi Y et al.(2008) 3.Hewett T E et al.(2006) 4. Jeong J et al.(2021) 5.Pfile K R et al.(2013) 6. Maniar N et al.(2020) 7.Elias J J et al.(2003)

Oral Presentations

OP-SH17 Psychology/Stress and Anxiety

UNDERSTANDING THE USE OF SUPERSTITIOUS RITUALS IN SPORTS PEOPLE

MORRIS, B., THORNTON, C., NEAVE, N., ALLEN-BAKER, G.

NORTHUMBRIA UNIVERSITY

Before kick-off, centre pass, opening tip, and the bell ring, athletes from grassroots to the international stage perform bazar actions which seemingly have nothing to do with their sport. These actions are known as Superstitious Rituals (SRs); actions which individuals believe to be powerful in controlling luck or external variables. SRs are commonplace in sporting environments, whereby the difference between success and failure can be attributed to the smallest variable. It is therefore important to understand how athletes use SRs and how they, in turn, influence the athlete. This study explored the experiences of athletes to better understand how they both view and experience SRs. 16 individual semi-structured interviews and five focus groups were conducted with 30 participants. Three themes were identified during the thematic analysis process: Identifying Superstitions vs Pre-Performance Rituals; The Lifecycle of Superstitious Rituals; and Sporting Classifications & The Influence of Competitive Prestige. The results demonstrate the physical and mental impacts that SRs and Pre-Performance Rituals (PPRs) have on athletes, and how SRs and PPRs differ in their timings and intent. Additionally, how athletes form SRs was found to influence whether they are maintained or disappear once they are perceived to no longer work for their intended purpose. Findings challenged prior SR literature and suggested that PPRs and SRs have been interchanged leading to incorrect identification and measurement across sporting demographics (i.e., professional, team, individual, novice) and occasions. Distinguishing SRs and understanding their impact acts as a foundation for future research into whether these rituals can be beneficial or detrimental to athletes. It places the groundwork for informing grassroot Sunday league coaches, up to the top 1% of athletes, to pull on some 'lucky' underwear or ditch that 'game winning' shirt number.

ANALYSIS OF EXERCISE STRESS SCALE IN COLLEGE PHYSICAL EDUCATION CURRICULUM:BASED ON EFA AND CFA

SHEN, F.J.1, CHEN, L.Q.2, LIU, Y.3, WEI, Z.1

1 MYONGJI UNIVERSITY 2 QUZHOU COLLEGE OF TECHNOLOGY 3 HEZE MEDICAL COLLEGE

Physical education is an important part of university curriculum, aiming at promoting students physical and mental health development. However, in college physical education courses, some students may experience various pressures related to physical exercise in the process of participating in physical activities.This will affect college students physical education curriculum, enthusiasm for participation and their intention to continue to participate in sports activities in the future. Therefore, it is very important to evaluate and analyze the influencing factors of sports stress in college physical education courses.The sample of this study comes from 513 students((316 male, 197 female) in several universities in Sichuan and Henan, China. In this study, SPSS 27 andAMOS 25 were used for statistical analysis, and exploratory factor analysis and confirmatory factor analysis were used to explore the sports stress scale of college students in physical education courses.The purpose is to fully understand the potential factors that affect college students exercise stress.The results of the exploratory factor analysis indicate that sports-related stress can be extracted into four factors. These factors are as follows:1. Interpersonal Relationship Stress with Physical Education Teachers: 3 observed variable. 2. Behavioral Stress from Physical Education Teachers: 3 observed variable. 3.Academic Stress: 7 observed variable. 4.Training Stress: 5 observed variable. In total, there are 18 observed variable. The overall variance explained by these factors is 83.603% The KMO value is .966. Additionally, the reliability analysis for each variable yields the following results: Interpersonal Relationship

Stress with Physical Education Teachers (α = .881),Behavioral Stress from Physical Education Teachers (α = .870), Academic Stress (α = .958),Training Stress (α = .955). The results of the confirmatory factor analysis indicate the following fit indices:RMSEA=.080,GFI=0.810,NFI=912, TLI=.922,CFI=.931. All the standardized factor loading coefficients are above .7. This study demonstrates that through exploratory factor analysis and confirmatory factor analysis, researchers can explore and validate the fundamental dimensions of sports-related stress. By considering these dimensions, researchers can propose various stress coping strategies to enhance the continuity of sports participation.

EFFECTS OF RESISTANCE EXERCISE TRAINING ON DEPRESSIVE SYMPTOMS AMONG YOUNG ADULT WOMEN WITH SUB-CLINICAL GENERALIZED ANXIETY DISORDER: PRELIMINARY RESULTS OF A RANDOMIZED CONTROLLED TRIAL

O SULLIVAN, D., RICE, J., LYONS, M., GORDON, B.R., HERRING, M.P.
UNIVERSITY OF LIMERICK

Young adult women are at risk for Generalized Anxiety Disorder (GAD) and Major Depressive Disorder (MDD), which are highly comorbid. The antidepressant effects of resistance exercise training (RET) are established; however, little is known among young adult women with at least subclinical, or analogue, Generalized Anxiety Disorder (AGAD) with or without comorbid subclinical, or analogue, Major Depressive Disorder (AMDD).

PURPOSE: This preliminary analysis of an ongoing fourteen-week randomized controlled trial quantified the comparative efficacy of low versus moderate-to-high intensity, guidelines-based RET on depressive symptoms among young adult women with AGAD with or without comorbid AMDD.

METHODS: 22 young adult women (21.7±2.6 y) with AGAD (Psychiatric Diagnostic Screening Questionnaire GAD subscale ≥6 and Penn State Worry Questionnaire ≥45) with or without AMDD (Psychiatric Diagnostic Screening Questionnaire MDD subscale ≥9) were randomized to low or moderate-to-high intensity RET. Following a two-week familiarization, participants completed eight weeks of twice-weekly, one-to-one, World Health Organization and American College of Sports Medicine guidelines-based RET with loads of approximately 20% or 75% one-repetition maximum (1RM). The 16-item, self-reported Quick Inventory of Depressive Symptomatology (QIDS) measured depressive symptoms at baseline, end of familiarization (pre-week 1), week 4, 8, and 1-month follow-up. A 2 (group) x 5 (timepoint) RM-ANOVA examined differences between low and moderate-to-high intensity RET. Hedges' d effect sizes (95%CI) quantified the magnitude of differences in change between groups across time. Cohen's d effect sizes (95%CI) quantified the magnitude of within-group change.

RESULTS: No significant group x time interaction was found for depressive symptoms ($F(4,68)=1.46$, $p=0.223$; d=0.70 [95%CI: -0.22 to 1.63]). A significant main effect for time was found ($F(4,64)=11.42$, $p<0.001$); depressive symptoms were reduced following both low (d=0.52 [95%CI: -0.48 to 1.51]) and moderate-to-high (d=1.38 [95%CI: 0.49 to 2.27]) intensity RET from baseline to week 8. Antidepressant effects persisted at the one-month follow-up for low (d=0.78 [95%CI: -0.24 to 1.79]) and moderate-to-high (d=1.79 [95%CI: 0.80 to 2.78]) intensity.

CONCLUSION: Moderate-to-high intensity RET induced stronger reductions in depressive symptoms, with a moderate-to-large magnitude effect, compared to low intensity RET. However, the difference in change between groups (d=0.70) was not significant, potentially due to the small, preliminary sample size. Both low and moderate-to-high intensity RET induced potentially clinically-meaningful, moderate and large magnitude [within-group] reductions in depressive symptoms, respectively, that persisted at one-month follow-up.

ACUTE EVALUATION STRESS AND COGNITIVE PERFORMANCE IN CHILDREN: PROTECTIVE EFFECTS OF PHYSICAL ACTIVITY

LUDYGA, S., HANKE, M., SCHWARZ, A., LEUENBERGER, R., GERBER, M.
UNIVERSITY OF BASEL

Background: Over the last decade, children at the transition to adolescence report increasing levels of school-related stress. Acute stress has detrimental effects on higher-order cognition, such as inhibitory control, which can affect performance in examinations. However, higher levels of physical activity have been associated with better inhibitory control in children. We aimed to investigate whether physical activity can reduce the impact of acute evaluation stress on this cognitive ability. Additionally, we examined cognitive control processes, such as conflict monitoring and resolution, as potential mechanisms underlying a protective effect of physical activity.

Methods: Children aged 10 to 13 years wore accelerometers over seven consecutive days and recalled their physical activity. Using a cross-over design, 109 participants showing either low (30 min/d or less) or high levels of moderate-to-vigorous physical activity (60 min/d or more) completed a stress (Trier Social Stress Test for Children) and a control condition in randomized order. Before and after the experimental conditions, a Stroop Color-Word test was administered. Event-related brain potentials elicited by this cognitive task (i.e. PSW, N200) were recorded using electroencephalography. Moreover, salivary cortisol was collected at regular intervals throughout both the stress and control conditions.

Results: In comparison to the control condition, participants showed higher salivary cortisol concentrations, $d = 0.33$, $p < 0.001$, and a pre- to posttest decrease of accuracy on incompatible trials of the Stroop Color-Word task in the stress condition, $d = 0.27$, $p = 0.005$. Path-analyses indicated that the stress-induced decrease in accuracy was more pronounced in participants with low compared to high moderate-to-vigorous physical activity, $\beta = -0.22$, $p = 0.015$. With regard to event-related brain potentials, a lower decrease of PSW amplitude was related to a lower reduction of accuracy in the stress condition, $\beta = 0.21$, $p = 0.016$, but this change was not related to moderate-to-vigorous physical activity. Both the N200 and PSW components did not mediate the association between moderate-to-vigorous physical activity and stress-related performance changes on the Stroop Color Word task.

Conclusion: Acute evaluation stress increases cortisol levels and impairs inhibitory control in children, partly due to alterations in conflict resolution. The detrimental effect on behavioral performance is less pronounced in children with low physical activity levels, but its underlying neurocognitive mechanisms remain unclear.

09:30 - 10:45

Invited Symposium

IS-AP01 Bridging the gap between sport science and sport practice when working with female athletes

EXPERIENCES FROM «GOLD-STANDARD» SCIENTIFIC STUDIES ON THE FEMALE ATHLETE

NOORDHOF, D.
NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

The female ovarian hormones, estrogen and progesterone, fluctuate throughout a 21-35 cycle and result in four distinct hormonal environments i.e., menstrual cycle phases. Since, the ovarian hormones exert an effect on more than just production, there is recently great interest in studying the effect of menstrual cycle phase on training, recovery and performance. Recent methodological guidelines on how to perform studies in sport and exercise science with women as participants recommend the use of the so called "three-step method" when investigating the effect of menstrual cycle phase on training, recovery and/or performance in non-hormonal contraceptive users (1,2). The three-step method consists of calendar-based counting (i.e., reporting the first day of menses in a diary), daily urinary ovulation testing starting at day 8, and a mid-luteal venous blood sample (3). When recruiting participants for such studies, only regularly menstruating women i.e., having menstrual cycles lasting ≥ 21 and ≤ 35 days in the two months prior to recruitment, resulting in ≥9 menstrual cycles per, and not having used hormonal contraceptives in the three months prior to recruitment, can volunteer (1,2). Subsequently the three-step method is used to determine and verify the menstrual cycle phases in which participants are tested. A posteriori, data of menstrual cycles that are not considered eumenorrheic i.e., menstrual cycles <21 or >35 days, anovulatory cycles (no positive urinary ovulation test before the next menses), and/or a mid-luteal (7-9 days after a positive urinary ovulation test) progesterone level <16 nmol•L-1, need to be excluded from analysis (1). As these disturbed menstrual cycles do not show the expected hormonal fluctuations, failure to exclude these cycles could mask potential changes in training, recovery and/or performance over the menstrual cycle. Finally, the exercise tests performed should be repeated over two menstrual cycles for the study to be classified as following "gold standard methodological control" (2). This presentation will highlight the benefits of using such a demanding and rigorous approach and experiences obtained when performing studies following these guidelines. Consequently, this presentation will be relevant for all researchers and sport practitioners considering starting projects in which they will investigate the effect of menstrual cycle phase on training, recovery and/or performance.

1 Elliott-Sale et al. Sports Med 2021; 51(5):843-861.

2 Smith et al. Int J Sport Nutr Exerc Metab 2022; 32(2):114-127.

3 Schaumberg et al. J Sci Med Sport 2017; 20(11):965-969.

EXPERIENCES FROM WORKING WITH FEMALE ATHLETES IN AN APPLIED SETTING

BRUINVERLS, G.
UNIVERSITY COLLEGE LONDON

The popularity and interest in female sport has grown exponentially over the last few years. With this, the professionalism of female athletes and associated sporting environments has increased. Female athletes are pushing boundaries and breaking barriers all the time, however best practice for optimal training and support is still relatively in its infancy. The increasing evidence base highlighting the self-perceived impact of the menstrual cycle on exercise performance emphasizes the need for menstrual health screening and longitudinal tracking. However, with limited and potentially challenging guidelines, many practitioners are unsure how a proactive female athlete health monitoring approach can be implemented without 'opening a can of worms'. Little longitudinal research has been conducted in applied settings, and the application of research pertaining to female health from lab-based studies can be challenging. Typically, only a couple of hormonal time points are studied, which do not reflect the known day-to-day hormonal changes through a menstrual cycle, the implications of menstrual dysfunction, or the effects of hormonal contraception use. Given that athletes need to be able to perform on any day of their cycle this must be considered in future research. However, gold standard testing methodologies are extremely challenging to implement in applied settings, but this must not deter, and ideally research can be conducted alongside tracking. The effects that hormonal changes can have on other physiological systems and homeostatic processes are well established. Therefore, collecting and tracking female health data can provide useful contextual understanding, while also indicating any potential need for medical input. As women's sport is becoming more professional with more data analysis and given the self-reported data on the potential performance detriments that the menstrual cycle can have, tracking female health markers is an important consideration. Opportunistic 'real world' research should also be considered as this could provide a good way to bridge the overt gap between research and prac-

tice. This presentation will discuss an approach to tracking and monitoring female athletes in an applied setting, discussing how 'on the ground' monitoring can be used as a tool for practitioners and how research can be conducted in conjunction.

FEMALE ATHLETE RESEARCH – COMBINING SCIENCE AND PRACTICE

MIKKONEN, R.
UNIVERSITY OF JYVÄSKYLÄ

The female athlete population includes several unique hormonal profiles (1). Some athletes are naturally menstruating, others use combined or progestin-only hormonal contraceptives, still others have menstrual disturbances ranging from sub-clinical to clinical and which may or may not be caused by low energy availability or the multistressor environment of elite sport. Where the three-step or two-step methods for identifying menstrual cycle phases or characterizing the hormonal profiles of naturally menstruating females are important for research striving to identify the influence of sex hormone concentrations and ratios on specific mechanisms or characteristics of sports performance (2,3), it is important to recognize that these methods are not appropriate for females that are not naturally menstruating. Furthermore, these laboratory methods are not easily applied to practice and are not necessarily feasible. As a universal blueprint for training according to a natural menstrual cycle phase does not exist, the need for menstrual cycle tracking for purposes beyond menstrual (and thereby physical) health are questionable. Nevertheless, monitoring the menstrual cycle (including ovulation) and hormonal contraceptive cycles and identification of patterns in symptoms or performance that may be related to changes in hormonal concentrations may be useful for athletes, coaches, and support staff like physicians as well as researchers. In practice, menstrual and hormonal contraceptive cycle monitoring are helpful for avoiding/identifying menstrual dysfunction and decreased health and performance that are often linked to low energy availability and relative energy deficiency in sport (4). In addition, menstrual and hormonal contraceptive cycle monitoring may allow us to modify approaches to training and/or nutrition if consistent negative patterns in subjective feelings around training or within performance emerge. Communication and collaboration are needed between science and practice to better inform research and practice. In addition, communication and collaboration with clinicians regarding ´the relationship between menstrual health and health and performance is important to best serve our female athletes and improve their (and clinician) body literacy. This presentation will highlight the variety in hormonal profiles that may be observed in the female athlete population and will present practical reasons for cycle tracking and reporting of / considering hormonal profiles in both research and practice including considerations for female athletes without natural/eumenorrheic cycles.

1 Colenso-Semple et al. Front Sports Act Living 2023; 5: 1054542.

2 Elliott-Sale et al. Sports Med 2021; 51(5):843-861. 3 Janse DE Jonge et al. Med Sci Sports Excer 2019; 51(12):2610-2617 4 Mountjoy et al. Br J Sports Med 2023;57(17):1073-97.

Invited Symposium

IS-PN02 To the Moon and beyond: the physiological consequences of hypo-gravity and muscle disuse, and possible exercise countermeasures

METABOLIC AND MECHANICAL ASPECTS OF HUMAN LOCOMOTION IN HYPO-GRAVITY

PAVEI, G.
UNIVERSITÀ DEGLI STUDI DI MILANO

Human locomotion evolved and has been tuned over the year to cope with Earth gravity. This evolution ended up with walking as the preferred gait for everyday activities; whereas, when more speed is needed, running is the gait of choice. When the first astronauts landed on the Moon, they faced for the first time a lower gravity (almost 1/6 of Earth) and they adopted also (and mostly) other two gaits: skipping (the gallop for bipedal) and hopping (the gait of kangaroos). In the beginning it was thought that this shift was driven by mechanical and balance constrains, however we showed that the metabolic energy required to perform those bouncing gaits was greatly reduced in hypo-gravity, much more than in walking and running (Pavei et al. 2015). This decreased metabolic demand was parallel to a decreased mechanical work performed by the muscle-tendon system while locomoting in hypo-gravity, where not only a decreased in potential energy but also a reduced work to swing the limbs occurred. The reduced gravity decreased the locomotion efficiency, thus from a whole-body perspective it seems that the spring that usually helps muscles in the bouncing gaits was less compressed and hence less able to store and release elastic energy. This is probably given by the evolution that tuned the muscle-skeletal unit to the 1g level and it is not as effective in low gravity conditions. In this respect, the lowered metabolic demand could be even lowered whether the spring could be adjusted to the new hypo-gravity level, and this is likely to be obtained with external aids, such as passive (or active) tools. From bed-rest studies, a decrease in maximal aerobic power is reported. However, the impact of this decrease on exercise with low mechanical (and metabolic) demand, e.g. locomotion, has not well addressed yet, and those few studies reported no differences in metabolic power. Hence, we could say that locomotion could still be feasible from a cardio-metabolic point of view. On the other hand, in order to locomote muscles have to generate the needed amount of force and work, which should be coupled by tendons activity. Muscles and tendons are known to incur a great impairment post bed-rest or microgravity permanence, the muscle-tendon sys-

tem could possibly be able to maintain a walking gait, but maybe could not a bouncing gait. Another problem regards the posture and balance necessary to locomote, both seem to be impaired after a permanence in microgravity, making potentially difficult an independent locomotion. Unfortunately, there are no studies that can answer now "could astronauts move after a one-way flight to Mars?". We think that if astronauts will not follow an intensive program of countermeasures aims to use their limbs once out of the shuttle, it would be unlike that the lower metabolic demand of locomotion could help!

THE IMPACT OF VARIABLE GRAVITATION ON MUSCLE–TENDON INTERACTION AND FUNCTION

ALBRACHT, K.
GERMAN SPORT UNIVERSITY

Since Yuri Gagarin's pioneering flight in 1961, numerous missions of varying length and on a range of platforms have explored space and its effects on the human body. To maximize the benefits of future Mars and moon missions, extravehicular activities in low-gravity environments will be essential during human exploration. In sustained missions (Artemis 2), crewmembers are required to move from a defective rover to a safe location over distances of up to 12 km. A simple fall due to muscle weakness or lack of locomotor control could result in injuries or spacesuit damage that could be life-threatening. Ultrasonic visualization of muscle fascicle and tendon (SEE) behavior during locomotion has demonstrated the importance of the storage and release of elastic energy by the Achilles tendon in running and walking, and that the plantar flexor muscles modulate their behavior depending on gait type, speed, and external loading. Despite the relevance of this topic to both space travel and rehabilitation, only a few studies have examined the behavior of muscles and tendons in simulated or real hypergravity. The shorter peak SEE length observed during running in simulated 0.7 g may be the result of lower muscular forces acting on the SEE (Richter et al., 2021a). The longer fascicles observed during running in simulated (0.7 g) hypogravity may result in an increased strain on the z-disks, which in turn may be beneficial for muscle mass preservation. Decreasing g-level from 1 g to simulated Martian and lunar gravity resulted in hypogravity-induced alterations in SEE length, and contractile behavior that persisted between simulated running on the moon and Mars (Richter et al., 2021b). This should be taken into account when evaluating exercise prescriptions and the transferability of locomotion practiced in lunar gravity to Martian gravity. Monti et al. (2021) assessed fascicle behavior during the locomotor-like task—drop jump—during a parabolic flight. Upon landing, gastrocnemius medialis fascicles showed lengthening in all gravity levels below and above 1 g and quasi-isometric fascicle behavior in 1 g. Such behavior was potentially due to the lower level of muscle pre-activation (Waldvogel et al., 2021), implying a modulation of the muscle's mode of operation toward a damping function. Thus, existing studies have demonstrated that the consequences of locomotion in hypogravity are not limited to a mere reduction in mechanical loading but also to an altered contractile behavior, which could affect the muscle's work capacity upon return to daily activities in a 1 g environment and may require specific attention for adequate countermeasures and during the rehabilitation phase.

Monti, E., et al. (2021). Frontiers in Physiology, 12, 714655. Richter, C., et al. (2021a)

Npj Microgravity, 7(1), 1–8. Richter, C., et al. (2021b)

Scientific Reports, 11(1), 22555

Waldvogel, J., et al. (2021)

Frontiers in Physiology, 12, 614060.

"I HOPE MY LEG DON'T BREAK, WALKING ON THE MOON" - NEUROMUSCULAR ADAPTATIONS TO DISUSE AND SPACE FLIGHT, AND THE ROLE OF EXERCISE COUNTERMEASURES

FRANCHI, M.
UNIVERSITY OF PADOVA

It is likely that space explorations will become more common very soon, considering how much effort is being put in by national space agencies and private companies. Man on the Moon part II or space hotels, like the "Voyager Station" idea don't seem to be just a dream anymore. However, one "dark side of the Moon" is that astronauts experience a dramatic loss of muscle mass following exposure to hypo-gravity and muscle disuse. This is accompanied by even bigger decrease in muscle strength and power, development of insulin resistance and detrimental metabolic and mitochondrial dysfunctions. Lower limbs muscles, and especially the anti-gravity muscles (such as the plantar flexors and the knee extensors), undergo significant wasting (~20% of fibre atrophy after 6 months of space flight for the triceps surae) (Rittweger 2018), despite the astronauts perform daily intense physical exercise that instead, on earth, would lead to muscle hypertrophic responses. Thus, even if muscle atrophy and weakness have been object of research since the 1990s, we still do not fully grasp the mechanisms regulating this dramatic muscle wasting and the strategies that are in place to counteract such atrophic process (in flight or post flight) are still not enough. Of course, the small sample size of astronauts involved in these studies, the different durations of each mission, the type of adherence of exercise programs in flight, have makes things a bit more complicated (Narici & de Boer 2011). Nevertheless, studies employing simulated micro/hypo-gravity on earth through the means of bed rest or limb suspension/casting models have provided useful data on muscle disuse and unloading not only important for space flight missions, but also of extreme interest for bed-ridden patients in hospital settings. Lately, our laboratory has focused on muscle disuse and the study of the causes of muscle weakness, from muscle morphological adaptations (Franchi et al. MSSE 2022) and the instability of the neuromuscular junction occurring after short-term bed rest and limb suspension (Monti et al. 2021; Sarto et al. 2022), to the study of single fibre proteomics to

identify the molecular remodelling of muscle unloading (Murgia et al. 2022). With a short journey from whole muscle to molecular adaptations to disuse conditions, this presentation aims to unravel some of the nueromuscular responses to unloading in space flight and with simulated micro-gravity conditions, trying to answer a simple question: "Can we really get to Mars and have a walk?". Moreover, new unpublished data (at the present time) regarding specific exercise countermeasures after a period of muscle unloading will be presented, with the aim to spark a discussion between sports scientists, exercise physiologists, and biomechanics experts, on what could be the best exercise strategies to counteract disuse atrophy.

Invited Symposium

IS-MH01 Exercise, Aging, and Metabolic Health: Decoding Intracellular and Extracellular Redox Signals

AGEING INDUCES ATTENUATED RESPONSES OF SKELETAL MUSCLE TO CONTRACTILE ACTIVITY: MECHANISMS AND EFFECTS

JACKSON, M.
UNIVERSITY OF LIVERPOOL

Minor episodes of denervation of skeletal muscle fibres occur throughout life and are rapidly repaired. Substantial denervation of muscles occurs as a result of trauma and disease and can lead to severe atrophy and eventual loss of the muscle fibres. Age-related loss of skeletal muscle mass and function (sarcopenia) is associated with loss of innervation of groups of muscle fibres and loss of motor neurons. Ageing related changes in muscle are also associated with dysregulation in the generation and/or handling of reactive oxygen species (ROS) in muscle. In normal physiology generation of ROS and redox signalling pathways play an important role in mediating specific responses of skeletal muscle to contractile activity. This process involves generation of ROS at specific sub-cellular sites in the muscle fibres. We have investigated the role of denervation in controlling ROS activities within muscle. Data from experimental models in which ROS regulation is modified, such as mice lacking SOD1 and those in which muscles undergo experimental denervation indicate that loss of motor neuron integrity leads to large increases in mitochondrial peroxide generation in the denervated muscle fibres. Furthermore, this increase occurs in mitochondria of neighbouring innervated fibres indicating a propagation of the process within the muscle. This local increased generation of peroxides by mitochondria appears to affect overall muscle redox homeostasis leading to oxidative damage and to dysregulation of adaptive responses to contractile activity. Implications for prevention and treatment of sarcopenia will be discussed.

SUBCELLULAR REDOX SIGNALING CONTROLLING SKELETAL MUSCLE METABOLISM IN HEALTH AND DISEASE

HENRIQUEZ-OLGUIN, C.
UNIVERSITY OF COPENHAGEN

Regular physical activity is a cornerstone of health, staving off aging and diseases such as type II diabetes and cardiovascular disease. Acute exercise introduces a multifaceted intracellular stress, with numerous post-translational modifications believed to underpin the health benefits of sustained exercise training. Reactive oxygen species (ROS) are posited to serve as second messengers, triggering cytoprotective adaptations such as the upregulation of enzymatic scavenger systems. However, a significant knowledge gap exists between the generation of oxidants in muscle and the exact mechanisms driving muscle adaptations. Over the past decade, our research has shed light on the compartmentalized sources of ROS—specifically mitochondria and the membrane-bound NADPH oxidase complexes (NOX)—and their contributions to immediate and long-term exercise responses. We discovered that NOX2, in particular, plays a pivotal role in the acute response to exercise, driving the expression of genes that underpin adaptation. Our innovative use of NOX2 inhibitors, mitochondria-targeted antioxidants, and advanced imaging techniques has revealed that NOX2 is a primary source of cytosolic H2O2 during exercise in vivo, essential for the translocation of the glucose transporter GLUT4 and subsequent glucose uptake in muscle. This presentation will describe the cellular mechanism of how exercise improves redox fitness in skeletal muscle to improve muscle function and insulin sensitivity.

EXERCISE-INDUCED SYSTEMIC RESPONSE: THE ROLE OF CIRCULATING EXTRACELLULAR VESICLES

CAPOROSSI, D.
UNIVERSITY OF ROME FORO ITALICO

Regular physical exercise (PE) leads to a systemic adaptation to redox homeostasis perturbation, one of the hallmarks of exercise adaptation. Extracellular vesicles (EVs) circulating in the body and secreted from various cell types, including skeletal muscle cells, contain various regulatory molecules and mediate intercellular communications and tissue crosstalk. Studies have shown that PE can alter the molecular composition of EVs, impacting their ability to communicate with other cells and modulate physiological processes. Considering that the health-related benefits of a physically active lifestyle are partially driven by various bioactive molecules released into the circulation during exercise, collectively termed "exerkines", there has been a rapidly growing interest in the role of EVs cargo as "carriers" in the multi-systemic, adaptive response to exercise. Indeed, a potential mechanism by which plasma EVs released during exercise impact ageing and diseases related to redox impairment is increased delivery of redox components, such as redox transcription factors and

antioxidants. Thexerciseis presentation will offer a general overview on the biology of exercise-induced EVs and their putative role on health maintainance and disease prevention, with a focus on redox homeostasis control.

Oral Presentations

OP-AP04 Pacing statistics

PACING STRATEGIES IN ELITE INDIVIDUAL MEDLEY SWIMMERS: A DECISION TREE APPROACH

CHANG, C.K.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: This study aims to investigate the pacing strategy and the importance of the four different stroke in men's and women's 200- and 400-m individual medley competitions in Olympic Games and World Swimming Championships between 2000 and 2021, excluding 2008 to 2010.

METHODS: The time in each lap and overall race were retrieved from the World Aquatics website. The final data comprised a total of 1937 data points (1052 for men, 885 for women) for the 200-m event and 1192 data points (607 for men, 585 for women) for the 400-m event. The standardized time for each stroke was calculated by dividing the actual time by a reference time specific to each stroke to accommodate the inherent disparities among the four strokes and the impact of the diving start in butterfly. The reference time was derived from the respective laps in single-stroke finals in the in the 2017 World Swimming Championships. A decision tree method was applied. The binary dependent variables were qualified or non-qualified in heats and semifinals, and medalists or non-medalists in finals. The independent variables were the pace in each stroke, represented by the ratio of standardized time in the specific stroke to the sum of standardized time in all four strokes. A total of 10 decision trees with the Classification and Regression Tree algorithm were established: heats, semifinals, and finals in men's and women's 200-m medley; and heats and finals in men's and women's 400-m individual medley. The decision tree models was established. The binary dependent variables were qualified or non-qualified in heats and semifinals, and winning medals in finals. The independent variables were the ratio of standardized time in each stroke to the sum of standardized time in all four strokes. The normalized importance of each stroke in each decision tree was calculated.

RESULTS: In men's and women's 200-m and 400-m individual medley, butterfly held the highest normalized importance in winning medals in the finals. The pace in butterfly was the first node in eight of the 10 decision trees, except men's 200-m semifinal and 400-m final, in which backstroke was the first node. The cut-off values for pace in butterfly in these eight models indicated that a pace larger than 0.236–0.245, i.e. spending relatively longer standardized time, in butterfly was associated with a higher likelihood of being qualified or winning medals in these competitions. It is noteworthy that the pace in this study is relative to each swimmer's performance in all four strokes.

CONCLUSION: Elite swimmers who spend a higher ratio of standardized time in butterfly is associated with a higher likelihood of winning medals or qualifying for the next stage in most international men's and women's 200-m and 400-m individual medley. Excellence in butterfly is the most crucial determinant in success in individual medley events while proficiency in at least one other stroke enhances the likelihood of winning.

BEYOND PACE: PREDICTING 1500M FREESTYLE TIMES WITH MULTI-FEATURE RANDOM FORESTS

RUSSOMANNO, T.
TUM / UNB

INTRODUCTION: Advances in technology have led to a loads of data in many sports, making data-driven models increasingly popular for performance analysis (Silva. et.al., 2007). Different models have been applied to swimming, predicting individual event performance based on various datasets (Wu et.al.,2021). In long-distance swimming, the pace strategy (PS) follows a U-shaped curve (Lara and Del Coso, 2021). This means professional swimmers start and finish fast, maintaining a relatively consistent speed with minor fluctuations in between. This study investigates the use of a Random Forest model to predict final race times based on athletes heat times and pace strategy.

METHODS: Race data from five Olympic Games (Sydney, Athens, Beijing, Rio, and Tokyo) were analyzed, containing both heats and finals data. Data were obtained from the FINA website (https://www.fina.org), providing split times for every 50m and final times for each race. A total of 174 races were analyzed. The dataset was divided into two parts: one for training the model (heat data) and the other for evaluation (final data).Relevant features like mean time, speed at different distances, and total time were selected for model training. A Random Forest model was trained with optimal hyperparameters: 200 estimators, max_depth =8, max_features=sqrt, min_samples_leaf=1, random_state=42.

To evaluate the models performance, the following metrics were used: Mean Squared Error (MSE), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), R-squared and Explained Variance Score.

RESULTS: On the training data, the model achieved a Mean Squared Error (MSE) of 5.09, Root Mean Squared Error (RMSE) of 2.25, Mean Absolute Error (MAE) of 1.708, R-squared of 0.953, and Explained Variance Score of 0.968. On the final dataset, the model achieved an MSE of 32.53, RMSE of 5.70, MAE of 4.40, R-squared of 0.94, and Explained Variance Score of 0.94. This indicates a slight decrease in model performance on the new data, with an average prediction error of

around 5.7 seconds. In a race lasting approximately 14 minutes, this translates to an error of less than 0.58% of the total time.

CONCLUSION: The analysis consistently revealed a U-shaped pace strategy profile employed by all athletes across all races, regardless of whether they were competing in heats or finals. This finding highlights the consistency of this approach in 1500m swimming. The chosen Random Forest model demonstrated worthy performance on the training data, explaining over 95% of the variance in total final times. This indicates the models ability to effectively learn the underlying patterns and relationships within the dataset. Still, when applied to the evaluation data (final times), the models performance exhibited a slight decrease, resulting in an average prediction error of approximately 5.7 seconds. This study showcases the promising potential of Random Forest regression for predicting swimming times. Utilizing features derived from both heat and final performance.

A RACE BETWEEN TWO RACES: POSITIONING AND POWER DEMANDS DURING CYCLING IN A SPRINT TRIATHLON WORLD CHAMPIONSHIP

NOLTE, S., QUITTMANN, O.J.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Drafting in short-distance triathlon cycling introduces variable power demands [1,2]. Performance evaluations solely based on cycling split times may overlook the differing power requirements experienced by riders even within the same bike group. Factors like positioning within the bike group could influence power demands and subsequently initial fatigue in the following run segment of a triathlon [3].

METHODS: We analyzed power data and television-based positional information from the 2020 male sprint triathlon World Championship event held in Hamburg. Specifically, we focused on five of the eight riders from the leading bike group, examining their power profiles and power distributions. Employing hierarchical Bayesian models, we analyzed the association between positioning within the group and the power demands during accelerations following turns. Our study was preregistered and has open data and code available.

RESULTS: Within the same bike group, athletes showed distinct power profiles and employed different positioning strategies. Notably, as athletes positioned themselves further back during a turn, they demonstrated higher peak power (+24.2 W [4.8; 36.7] per position; mean [95% credibility interval]) and 10 seconds mean power (+19.3 W [10.5; 27.1]) during subsequent accelerations. However, the effect of positioning was less pronounced on the 20 seconds mean power (+6.3 W [-1.4; 13.6]), and it had a negative impact on the 20 seconds mean power before the turn (-13.4 W [-20.8; -4.99]).

CONCLUSION: The positioning of athletes during cycling in a triathlon can impact the power demands, potentially influencing the performance during the subsequent running leg. Our findings indicate that to reduce power demands, athletes should position themselves at the front of the group during turns and towards the back for the remainder of the cycling segment. However, employing this strategy will likely compromise cooperative group work. Therefore, athletes and coaches must develop positioning strategies based on data and experience, tailored to individual abilities. Future studies should aim to correlate power variability with running performance in races, while accounting for individual running performance levels.

[1] Bernard et al. (2009). Med Sci Sports Exerc

[2] Etxebarria et al. (2014). Int J Sports Physiol Perform

[3] Walsh (2019). Sports (Basel)

DIFFERENCES IN PACING DURING A 100KM ULTRA-TRAIL MARATHON BETWEEN TOP-10 AND NOT TOP-10 FINISHERS.

DE WAAL, S., JACOBS, S., LAMBERTS, R.

UNIVERSITY OF STELLENBOSCH

INTRODUCTION: Pacing strategies during endurance efforts are learned behaviours which vary depending on athlete experience, race length, and terrain [1]. Previously, optimal ultra-trail marathon running pacing strategies have been described as 'steadier' [2] or by 'limiting' fluctuations in speed [3]. These pacing analyses were limited by electronic timing systems which use indiscriminate distances between checkpoints. Therefore, the aim of this study was to determine the pacing strategies and relative importance of uphill, downhill and level running for ultra-trail marathon performance in top 10 (TOP-10) runners and non-top 10 (NOT TOP-10) runners in a 100 km ultra-trail marathon.

METHODS: Fifty male finishers (TOP-10: n = 6, NOT TOP-10, n = 44) and forty-six individual segments (1.5 ± 1.2 km) were analysed based on 2021 100 km UTCT STRAVA data. Twenty-three uphill (net gradient > 1.0%), 16 downhill (net gradient <-1.0%) and 7 level (net gradient between +1.0% - -1.0%) were analysed. Individual segment speeds, normalised to average race pace (segmentrel), and CV% were used to identify pacing strategies. Mann Whitney-U tests were used to compare TOP-10 and NOT TOP-10 finishers. Spearman Rank correlations were used to measure the association between overall race performance and uphill, downhill, and level running performance. Significance was set at $p<0.05$ for all tests.

RESULTS: Uphill running had the strongest relationship with overall performance ($r = 0.826$, $p <0.01$). Substantially weaker relationships between overall running performance and level ($r = 0.402$, $p<0.01$) and downhill ($r = -0.382$, $p<0.01$) running performance were found. The CV% was significantly lower in TOP-10 (32.10 ± 1.81) than NOT TOP-10 (35.39 ± 4.43) ($U = 24$, $r = 0.46$, $p <0.01$), with both groups characterised by a positive pacing strategy. In 12 of the first 17 segments, TOP-10 fin-

ishers ran significantly slower (segmentrel) than NOT-TOP 10 finishers ($p < 0.05$). Inversely, TOP-10 finishers ran 7 of the last 11 segments (segmentrel) quicker than NOT-TOP 10 finishers ($p < 0.05$).

CONCLUSION: Uphill running performance remains a valuable measure of overall trail running performance as it represents a higher percentage of overall running demand. Sport scientists and laboratory technicians should continue to use uphill exercise tests to determine variation in ultra-trail marathon performance [4]. TOP-10 runners have diminished decay in initial running speed than NOT TOP-10 runners, despite a generally high variation in pace and net positive split in ultra-trail running. Neuromuscular fatigue [5] may contribute to the disparity in segmentrel between TOP-10 and NOT TOP-10 runners during the latter phases of an ultra-trail marathon.

AN EMPIRICAL STUDY ON THE SPEED CHARACTERISTICS OF MALE 20KM RACE WALK ATHLETES AT DIFFERENT PERFORMANCE LEVELS

PEI, L.

CHINIA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: This study aims to investigate the correlation between athletes rankings and various segmented and Speed indicators, while contrasting the disparities in Speed patterns and Speed indicators among athletes of different proficiency levels.

METHODS: A cohort of 47 athletes who completed the 20km race walk at the 2023 Budapest World Athletics Championships was selected for this study. Correlation analyses were conducted on rankings and different segmented and Speed indicators, elucidating differences in Speed patterns and Speed indicators among athletes with varying skill levels. The study seeks to unveil Speed rhythm patterns conducive to maximizing athletes potential. Utilizing a quasi-experimental design, athletes were categorized into three groups based on their performance in the competition. Descriptive statistics were applied to indicators such as segmented Speeds per 1km, segmented Speeds per 5km, starting Speed, peak Speed, minimum Speed, sprint Speed, and various Speed coefficients. Correlation analyses were performed when the data exhibited significance under the assumptions of normality and variance analysis. Following the identification of data disparities, post-hoc tests were conducted to specifically compare differences between pairwise groups, as per the requirements of English-language journals.

RESULTS: There is a significant negative correlation between rankings and segmented Speeds at 1-5km, 6-10km, and 16-20km compared to the average Speed. However, there is no correlation between rankings and segmented Speed at 11-15km compared to the average Speed. Athletes of different proficiency levels exhibit variations in each 5km segment, and as the segment distance progresses, the differences between the groups also increase accordingly. The correlation between rankings and minimum Speed, as well as sprint Speed, is greater than the correlation with starting Speed and peak Speed. In most segments, there are significant differences in the averages between athletes of different proficiency levels. Moreover, as the segmented Speed progresses, the differences between proficiency levels also increase.

CONCLUSION: High-level athletes show minimal Speed variation throughout the entire race, with segmented Speeds consistently higher than the starting Speed, and relatively small differences between segment Speeds. In contrast, low-level athletes are more likely to experience a continuous decline in Speed, with a larger proportional decrease and an earlier occurrence of segmented Speeds falling below the starting Speed. Peak Speed tends to occur earlier, typically around the 2km mark after the start of the race in the mens 20km race walk event. The optimal Speed rhythm for maximizing athlete potential in the mens 20km race walk is characterized by minimal overall Speed variation, especially in starting Speed, peak Speed, and segment Speeds, with peak Speed occurring late and starting Speed lower than most other segmented Speeds. Recommendations include emphasizing improvement in peak Speed and starting Speed for competition among high-level athletes, creating gaps in the 10-15km segment, and enhancing the pace in the later stages. For low-level athletes, the focus could be on improving minimum Speed to enhance Speed reserve capacity.

Oral Presentations

OP-PN13 Nutrition/Low energy availability

LOW ENERGY AVAILABILITY AND LEPTIN LEVELS OF RECREATIONAL AND ELITE FEMALE CROSSFIT ATHLETES - PRELIMINARY DATA FROM AN EXPLORATORY CROSS-SECTIONAL STUDY.

NAKAMOTO, F.P., QUARESMA, M., SANTOS, C., NARESSI, L., ALMEIDA, H., SILVA, N., MANCINI, S., HACKER, W., ALVARES, L., FERREIRA, R., SANTOS, R.

CENTRO UNIVERSITÁRIO SÃO CAMILO

INTRODUCTION: CrossFit® (CF) is characterized as a constantly varied, high-intensity, functional movement training program, performed with little or no rest between bouts, combining strength and endurance exercises. Due to CF characteristics, female CF practitioners may be at risk to experience low energy availability (LEA), which is the etiological process underpinning several disturbances such as hormone imbalance and consequent Relative Energy Deficiency in Sports (RED-S). The aim of this study is to verify possible LEA and leptin levels of recreational and elite female CF athletes.

METHODS: This is a cross-sectional study with nonprobability sampling. Inclusion criteria: healthy female CF practitioners aged 18-39 years, CF training experience ≥1 year; 5-7 training sessions (5-7 hours) per week for ≥6 months for the recreational practitioners group (RG); ≥12 hours of CF practice per week for ≥6 months for the elite group (EG). Subjects visited the laboratory once. They answered a health and sociodemographic questionnaire plus the Low Energy Availability in Females Questionnaire (LEAF-Q). Resting energy expenditure (REE) via indirect calorimetry and body composition (bioelectrical impedance analysis) were assessed in a fasting state, followed by blood test (levels of leptin). Data were analyzed using Jamovi® 2.3.21 version.

RESULTS: Data of a preliminary sample of 12 subjects are presented as mean (SD). Students t-test showed no differences regarding age (31.7 (5.6) and 30.2 (7.2) years), body mass index (23.9 (2.1) and 25.6 (1.8) kg/m2), REE (1645.7 (184.6) and 1595.8 (147.4) kcal/day), and daily energy intake (EI: 1569.7(774.2) and 1847.2(422.1) kcal/day) between RG (n = 6) and EG (n = 6), respectively. Body fat percentage (BF%: 23.6(3.8) and 18.5(3.0); p = 0.028), fat free mass (FFM: 45.1(4.0) and 55.4(4.1) kg; p = 0.001), and leptin levels (7.1(2.0) and 0.8(0.1) ng/mL; p < 0.001) were significantly lower in the EG (bellow reference range). About 90% of leptin levels variability is explained by the multiple regression model (R2: 0.895; p < 0.001). After controlling for group, EI, and BF %, the linear regression model showed that group (EG) was negatively associated with the levels of leptin, independently of EI and BF % (B = -5.820; 95% IC: -7.43 to -4.22; p < 0.001). EA calculation resulted in 26.29 and 20.37 kcal/kg FFM/day for RG and EG, respectively. LEAF-Q scores were 4.7 (RG) and 7.0 (EG).

CONCLUSION: We found probable LEA in female CF practitioners, especially in the EG. An EA of < 30 kcal/kg FFM/day is typically defined as clinically LEA, which in mid- and long-term results in health implications with impairment of many body systems. It has been shown that LEA suppressed the 24-h mean and amplitude of the diurnal rhythm of leptin in other female athletes, but this is the first study to show it in CF elite female athletes. It might precede other perceived disturbances associated with RED-S in this population. Our results are preliminary and further investigation is necessary.

DEVELOPMENT AND VALIDATION OF A RISK-ASSESSMENT TOOL FOR ENERGY DEFICIENCY IN YOUNG ACTIVE FEMALES: THE FEMALE ENERGY DEFICIENCY QUESTIONNAIRE (FED-Q)

SALAMUNES, A.C., WILLIAMS, N., KOLTUN, K., KURUPPUMULLAGE DON, P., DE SOUZA, M.J.
PENNSYLVANIA STATE UNIVERSITY

INTRODUCTION: Athletes who fail to consume sufficient energy are at risk of serious consequences to reproductive and skeletal health. Estimating energy availability has clear limitations for real-life assessments. Metabolic hormones and resting metabolic rate tests are precise measurements, but may not be feasible in clinical practice. Questionnaires may be valuable to estimate the risk of energy deficiency. We aimed to develop and validate a risk-assessment tool for energy deficiency in young exercising women using disordered eating subscales and self-reported health-related information.

METHODS: This study is a retrospective analysis of seven studies in competitive female athletes and recreationally active women [n=202, age 21.7±0.3 years, body mass index (BMI) 21.21±0.14 kg/m2, presented as mean±S.E.M.]. Participants completed the Women's Health and Exercise Laboratory's Health, Exercise and Nutrition Survey (HENS), the Three-Factor Eating Questionnaire (TFEQ), and the Eating Disorder Inventory – 3 (EDI-3). Fasting serum total triiodothyronine (T3) was assessed with chemiluminescence. Participants were categorized as energy deficient if they had T3 <73.2 ng/dL, and as energy replete otherwise. The following variables were tested as potential predictors of low T3: age of menarche and gynecological age; HENS items related to disordered eating, menstrual status, and bone health; cognitive restraint (CR) from TFEQ; and Perfectionism, Body Dissatisfaction (BD), and Drive for Thinness from EDI-3. The dataset was divided into a model set (n=152; 21.8±0.3 years, 21.23±0.16 kg/m2) and a validation set (n=50; 21.6±0.4 years, 21.15±0.3 kg/m2). The model set was used to fit stepwise logistic regressions on 500 random iterations using Akaike information criterion. Predictors included in at least 400 models were used in a final logistic regression model, which was tested on the validation set to determine sensitivity and specificity.

RESULTS: The predictors included in the final logistic regression model were: BMI; number of menstrual cycles experienced in the last 6 months (from HENS), a binary predictor to control for oral contraceptive use, CR from TFEQ, and BD from EDI-3. When tested on the validation set, the model yielded a 73.7% sensitivity and a 93.5% specificity to detect T3 <73.2 ng/dL, therefore yielding an 86% accuracy. Using the clinically used T3 cut-off of 80 ng/dL, the model yielded 75% sensitivity, 96.7% specificity, and 88% accuracy.

CONCLUSION: The model has yielded high accuracy to predict the probability of having energy deficiency and was validated against a reliable physiological marker, serum T3 concentrations. The Female Energy Deficiency Questionnaire was developed from a large dataset of exercising women from various competitive and recreational sports; therefore, it is applicable to a wide population. At present, this is the only questionnaire that has been validated to be used as an indicator of energy deficiency in exercising women beyond endurance athletes and dancers.

SYMPTOMS OF EATING DISORDERS AMONG SWEDISH FEMALE ELITE ATHLETES AND RECREATIONAL ACTIVE WOMEN

MELIN, A., AHLGREN, M., KJAER, J.B., LINNÉR, S., LOSSIUS, L., PAGELS, P., POJSKIC, P., RAGNARSSON, T., EDLUND, K.
SPORTS SCIENCE

INTRODUCTION: Symptoms of eating disorders (EDs) have been reported to be more frequent within the elite sport environment compared to the general population. In this study we aimed to investigate symptoms of EDs among female elite athletes and recreational active women, and the associations to exercise behaviour and perceiving well-being.

METHODS: Swedish national team athletes [Tier 4 (n=172), 24.8 ± 6.1 years of age] from 24 sport disciplines, and aged matched recreational active women [Tier 1-2 (n=100), 25.8 ± 6.7 years of age] were recruited via sport organisations and social media. The protocol of this two-step study included an anonymous on-line survey comprising of the Eating Disorder Examination Questionnaire [(EDE-Q); a Global score >2.30 categorised participants as having symptoms of EDs], the Major Depression Inventory [(MDI) a total score >25 categorised participants as having moderate/severe depression], the Exercise Addiction Inventory [(EAI) a total score >24 categorised participants as having exercise addiction], and the Low Energy Availability in Females Questionnaire to assess menstrual cycle disturbances (MCD) and gastrointestinal (GI) problems [a GI-score >3]. Participants with symptoms of EDs who providing their contact information were invited to a clinical EDE interview for differential diagnosis (DSM-5).

RESULTS: Among all subjects (25.2 ± 6.3 years, training 13.3 ± 6.6 h/week), 27% had symptoms of EDs, of which 40% participated in the clinical EDE interview confirming an ED diagnosis in all but one participant. More of the participating recreational active women had symptoms of EDs compared to the elite athletes (36% vs. 21%, p=0.010). There were no differences in training load (14.3 ± 7.1 vs. 13.0 ± 6.2 h/week, p=0.167), BMI (22.7 ± 2.8 vs. 22.7 ± 2.9, p=0.840) or the frequency of MCD (34% vs. 29%, p=0.567) between participants with and without symptoms of EDs. Participants with symptoms of EDs had a greater weight fluctuation (11.8 ± 8.5 vs. 9.6 ± 6.2, p=0.019), a higher GI-score (3.4 ± 2.3 vs. 2.5 ± 1.8, p=0.004), and more reported having moderate to severe depression (49% vs. 14%, p<0.001), exercise addiction (42% vs. 20%, p=0.001) as well as perceived poorer general health (p<0.001), worse life-situation (p<0.001), and lower self-esteem (p<0.001), compared to those without ED symptoms.

CONCLUSION: In contrary to earlier reports, we found that symptoms of EDs confirmed by diagnostic interviews were more common in this group of Swedish recreational active women than the included national team athletes. The surprisingly high prevalence of symptoms of EDs in the present study could be due to respons bias (e.g., people with EDs are more prone to participate). However, the overwhelming association between ED symptoms and poor well-being emphasise the need for implementing prevention strategies in both the general population and within Swedish elite sport. Future intervention studies focusing on primary, secondary and tertiary prevention initiatives are warranted.

EXPERT CONSENSUS ON DIETARY STRATEGIES FOR BODYBUILDERS AND POWERLIFTERS BEFORE AND AFTER COMPETITION: A DELPHI STUDY

BUECHEL, C., MINEHAN, M., ETXEBARRIA, N., PUMPA, K.

UNIVERSITY OF CANBERRA

INTRODUCTION: Natural bodybuilding and powerlifting require repeated cycles of weight reduction and weight gain to optimise body composition for competition. Energy restriction in athletes can be associated with risks related to low energy availability, such as disruptions to metabolic rate and endocrine systems [1]. Despite abundant research on weight loss strategies for competition in athletes, the recovery period after achieving weight loss remains poorly understood. This study seeks to identify strategies used in practice to guide fat loss and energy restoration in bodybuilders and powerlifters before and after competition.

METHODS: Fifteen international experts including academics, coaches, and sports dietitians experienced working with bodybuilders and powerlifters, were recruited to participate in a 3-round Delphi survey. The first round consisted of open-ended questions relating to weight management strategies. A thematic analysis was used to formulate statements for the Round 2 survey where participants were asked to rate their level of agreement using a 5-point Likert scale. Statements that did not reach a consensus of over 70% were revised and re-circulated in Round 3.

RESULTS: The retention rate was 80% across the 3 surveys. Round 1 generated 85 statements used in Round 2, consisting of the themes "multidisciplinary support", "weight loss time frames", "weight loss nutrition", "peaking and competition day", "negative impacts of weight loss", and "post-competition recovery". Fifty-five statements reached consensus and the remaining were revised into 41 statements (30 revised and 11 new) for Round 3. The final survey formed consensus on 20 statements, leaving 21 statements without consensus, primarily on topics of refeeding strategies within "weight loss nutrition" and "post-competition recovery". Experts agreed that individualised athlete weight management strategies required multidisciplinary teams for health and performance. Additionally, bodybuilders reduce body weight to a greater extent than powerlifters, requiring different recovery strategies post-competition.

CONCLUSION: In bodybuilders and powerlifters, key strategies for fat loss during competition preparation include aiming for 0.5-1% body weight loss per week, maintaining high protein intake, periodising carbohydrates, and using diet breaks and refeeds to support adherence. Individual plans for post-competition energy restoration should be in place, catered towards off-season body composition goals. Bodybuilders would benefit from an acute increase in energy intake alongside body weight, followed by controlled refeeding into the off-season.

References:

1. Fagerberg, P. Negative Consequences of Low Energy Availability in Natural Male Bodybuilding: A Review. Int J Sport Nutr Exerc Metab. 2018;28(4):385-402.

ARE ENDURANCE ATHLETES AT HIGHER RISK OF DEVELOPING FOOD ALLERGY OR FOOD INTOLERANCE THAN THE GENERAL POPULATION? A PILOT STUDY.

HALL, B., SIKORA, M., KAMINSKI, T., ZAJAC, T., SIATKOWSKI, S., MIKOLAJCZYK, R., PILZAK, K., ZEBROWSKA, A.
JERZY KUKUCZKA ACADEMY OF PHYSICAL EDUCATION IN KATOWICE, POLAND

INTRODUCTION: Long-term strenuous exercise can compromise the intestinal barrier, leading to the escape of undigested dietary and microbial molecules into the blood, triggering an inflammatory response. This may cause sensitization to normally harmless substances like food proteins, potentially exacerbated by artificial ingredients in sports supplements. Such adverse reactions, whether immune-mediated (food allergies) or not (food intolerances), can affect athletes performance, nutrition, and health. Despite the rising prevalence of allergic diseases, research on food allergies in athletes, especially endurance athletes, remains limited.

METHODS: Twenty-one healthy endurance athletes (female n = 8, male n = 13), aged 39.1±5.3 years, participating in long-distance running, cycling, or triathlon for approximately 7.3±5.6 years took part in the study. Their body composition was evaluated by means of bioelectrical impedance analysis (InBody 570, Seoul, South Korea) and aerobic fitness during a graded exercise test performed on a treadmill (h/p/cosmos, Nussdorf-Traunstein, Germany) or a cycle-ergometer (Lode Excalibur Sport, Groningen, Netherlands). The participants were asked to complete the validated EuroPreval/PAFA questionnaire on food allergy and food intolerance. Venous blood for determination of specific IgE was withdrawn from the cubital vein at rest.

RESULTS: The participants had low body fat percentage (females: 18.0±6.4 vs. males: 13.3±5.9%) and high aerobic fitness, as indicated by their VO_2max, particularly in females (females: 48.1±4.8 vs. males 48.3±5.6 ml/kg/min). A majority (71.4%, n = 15) of participants reported adverse reactions to food giving an estimated prevalence of 71.4% (95%CI 47.8 – 88.7%). The most frequently reported problem foods were: cow's milk (33.3%), pea (33.3%) and wheat containing gluten (26.7%). Energy gels or beverages, and protein sport supplements induced adverse reactions in 20.0% and 13.0% of those reporting adverse reactions, respectively. The majority of reported symptoms and their time of onset indicated food intolerance rather than food allergy. Only three individuals were sensitised (IgE ≥ 0.35 kU /L) to crustaceans (n = 1), hen's egg white (n = 1), whilst the third participant was sensitised to eight foods: wheat flour, rye flour, rice, almond, tomato, carrot, celery, and potato. None of these foods were reported in the questionnaire by these individuals.

CONCLUSION: Self-reported adverse reactions to food, particularly food intolerances, are common among endurance athletes and may exceed general population rates. The findings underscore the need for larger studies to verify these preliminary observations and explore the implications for athlete health and performance management. The study recruitment is in progress.

Oral Presentations

OP-PN04 Molecular Biology and Biochemistry I

NEW INSIGHTS INTO EXERCISE-INDUCED SKELETAL MUSCLE GENE EXPRESSION IN MEN AND WOMEN

TAYLOR, D., REISMAN, E., GARNHAM, A., HOFFMAN, N., HAWLEY, J., CARUANA, N., BISHOP, D.J.
VICTORIA UNIVERSITY

INTRODUCTION: Exercise stimulates numerous adaptations in skeletal muscle, including increased mitochondrial content. The currently accepted dogma proposes that transient changes in the mRNA of mitochondrial genes after a single session of exercise are a major determinant of subsequent adaptations to training. However, the use of only 1 or 2 time-points post exercise, small sample sizes, and a lack of consideration for the effect of sex, has left major gaps in our understanding of exercise-induced mitochondrial gene expression.

METHODS: RNA sequencing was performed on muscle biopsies collected before, during, and 0, 3, 6, 9, 12, 24, and 48 hours following a single session of high-intensity interval exercise from 20 healthy untrained men (27.3 ± 6.3 y; 179.6 ± 10.2 cm; 81.5 ± 12.5 kg) and 20 healthy untrained women (27.6 ± 5.6 y; 166.5 ± 7.8 cm; 68.0 ± 9.9 kg). The exercise session consisted of 4 x 4-min intervals at an intensity between each participant's lactate threshold (LT) and peak power output (PPO), interspersed with 2 min of recovery.

RESULTS: Our adoption of the most extensive post-exercise biopsy time course to date allowed us to identify more than 10,000 genes never previously reported to be differentially expressed by aerobic exercise; the vast majority were identified 9 to 48 hours post-exercise. Of these, 1016 were mitochondrial genes, with over 800 not previously reported to be altered by aerobic exercise. Soft clustering of the 1,016 mitochondrial differentially expressed genes revealed six characteristic patterns of expression, including clusters of early (3-6 h), mid (9-12 h), and late (24-48 h) responding genes. We also identified 675 mitochondrial genes that were downregulated 24-48 h post exercise, including most oxidative phosphorylation complex subunits. Transcription factor enrichment analysis using an aggregated ChIP-Seq dataset library identified the MYC transcription factor network as a key regulator for many of these gene clusters. Similarly, p53 was identified as an important regulator of late-responding genes. Although there were over 500 genes detected as differentially expressed between men and women at baseline, sex had a minimal effect on the expression of mitochondrial genes in response to exercise.

CONCLUSION: Our unique study was able to produce the most extensive description to date of the exercise-induced transcriptome, with over 14,000 genes identified as differentially expressed. Interestingly, several diverging patterns of expression for mitochondrial genes were found, indicating regulation by various transcriptional factor networks and potentially a high degree of variance in post-transcriptional regulation. By obtaining a statistical power above 0.85, and use of an exercise intensity based on both LT and PPO, we were able to detect fewer sex differences for exercise-induced mitochondrial gene expression than previously assumed.

DYNAMIC PROTEOMIC RESPONSES TO AEROBIC VERSUS RESISTANCE TRAINING IN HUMAN SKELETAL MUSCLE.

STEAD, C., THOMAS, A.C.Q., D'SOUZA, A.C., MCKENDRY, J., LIM, C., SIEKMANN, I., PHILLIPS, S.M., BURNISTON, J.G.
LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: We investigated muscle adaptations to aerobic training (AT) versus resistance training (RT) during the early untrained-state versus longer-term trained-state using novel deuterium oxide labelling and proteomic techniques. Our study aims to generate new insight into training mode-specific muscle adaptations by measuring protein-specific changes in abundance and synthesis rates.

METHODS: In a within-subject longitudinal design, 14 (8F/6M) healthy individuals (20± 2y, body mass: 70±21 Kg) completed 10-wks of thrice weekly unilateral resistance (RT: 3 sets × 10-12 reps 80% 1-repetition maximum (RM) leg press and leg extension) and unilateral aerobic (AT: 4 × 5 min one-legged cycling at 65% Wattmax) training. Biopsies were taken at the start and end of a 1-week free-living period prior to training (Baseline), the 1st-wk of training (Early), and the 10th-wk of training (Later). Participants consumed deuterium oxide across all 3 study periods. Muscle samples (n = 5 individuals, 1M/4F) were analysed by liquid chromatography tandem-mass spectrometry. Within-subject 2-way ANOVA investigated interactions between exercise mode (RT vs AT) and study period (Baseline x Early x Later) in protein-specific abundance and synthesis rates. Significant differences ($p<0.05$) were investigated using bioinformatic analyses (proteins reported as UniProt identifiers).

RESULTS: RT increased ($p<0.005$) 1RM leg press 116% (+65±10kg) and 1RM leg extension 76% (+16±5kg), whereas AT increased ($p=0.025$) unilateral Wmax 17% (+21±17W). Proteomic analysis quantified 2883 abundance and 1465 synthesis rates. Mixed-protein FSR (%/d) increased (34% NS) during Early RT only and was 15% above Baseline during Later RT and AT. Early RT increased the turnover of 22 (primarily myofibrillar) proteins, whereas Early AT increased the turnover of glycolytic enzymes and the abundances of 10 proteins of the KEGG pathway 'Oxidative phosphorylation' (OXPHOS; FDR = 0.03). Later AT increased the abundance of proteins associated with 'Cellular respiration' (FDR = 1.2e-17), including 16 Complex I (CI) subunits. Both RT and AT significantly increased abundance of 48 mitochondrial proteins, including 5 CI accessory subunits and regulators of mitochondrial quality (OPA1, MAIP1, AFG32, CHC10, MIC26, and GHITM). Later AT specifically increased the turnover of regulators of mitochondrial proteostasis, including the HSP70 co-chaperone BAG3 and eIF5A. Later RT specifically increased the turnover of 21 proteins, including glycolytic enzymes and regulators of mitochondrial morphology and quality control, such as CHCHD2 which increased ($p < 0.01$) in turnover rate from 5.7±4.9 %/d at Baseline to 13.6±2.8 %/d in Later RT.

CONCLUSION: AT and RT resulted in improvements in mitochondrial quality via training-mode specific changes in abundance and synthesis rates. Remodelling of CI was specific to AT, whereas RT increased in the abundance and turnover of proteins associated with mitochondrial quality independent of changes in OXPHOS catalytic subunits.

SINGLE-NUCLEI GENE EXPRESSION IN SKELETAL MUSCLE DOES NOT MIRROR A TRAINING-INDUCED INCREASE IN INSULIN SENSITIVITY IN INDIVIDUALS WITH TYPE 2 DIABETES

HANSEN, M.1, GROTHEN, J.E.R.2,3, KARLSEN, A.1, PEDERSEN, T.Å.2, SIDIROPOULOS, N.4, HELGE, J.W.1, DELA, F.1,5
1 DEPARTMENT OF BIOMEDICAL SCIENCES, UNIVERSITY OF COPENHAGEN, DENMARK 2 GLOBAL DRUG DISCOVERY, NOVO NORDISK A/S, DENMARK 3 NOVO NORDISK FOUNDATION CENTER FOR BASIC METABOLIC RESEARCH, UNIVERSITY OF COPENHAGEN, DENMARK 4 COMPUTATIONAL BIOLOGY, AI & DIGITAL RESEARCH, NOVO NORDISK A/S, DENMARK 5 DEPARTMENT OF BIOCHEMISTRY AND PHYSIOLOGY, RIGA STRADINS UNIVERSITY, LATVIA

INTRODUCTION: Training improves insulin sensitivity in patients with type 2 diabetes (T2D) (1), but the underlying mechanisms are only partly understood. Single-nuclei RNA-sequencing (snRNA-seq) offers the opportunity to study fibre type-specific gene expression changes. This is the first study to examine nuclei-specific gene expression changes in skeletal muscle in individuals with T2D and healthy controls (CON) in response to a short-term high-intensity training (HIIT) program. We hypothesised that snRNA-seq of muscle biopsies would reveal marked diabetes- and training-induced responses.

METHODS: Ten males with T2D (57±2 years, BMI 31±1 kg/m2, HbA1c 53±1 mmol/mol) and ten male CON (53±2 years, BMI 31±1 kg/m2, HbA1c 37±1 mmol/mol) completed two weeks of one-legged HIIT on a cycle ergometer. Insulin sensitivity (clamp + leg balance technique) was measured previously (2). We prepared a single nuclei suspension from muscle biopsies from untrained (UT) and trained (T) legs and used the 10X Genomics system for the preparation of snRNA-seq Libraries, which were sequenced using an Illumina NextSeq550snRNA-seq. QC, cluster identification and differential expression testing were analysed using the Seurat (v4), and we identified differentially expressed genes (DEGs) between two groups of nuclei using a Wilcoxon Rank Sum test. Fibre type distribution was confirmed through immunohistochemistry.

RESULTS: Insulin-stimulated leg glucose clearance was 33±24% higher in T legs compared to UT legs in both groups (2).

Single-nuclei RNA-sequencing in 38 biopsies yielded 135,225 nuclei in total, and we profiled 99,970 myonuclei. In the UT legs, there were 249 DEGs between the groups, with equal distribution between fibre types. When comparing UT and T legs, there were no differences between the number of DEGs in the groups (222 DEGs in CON and 234 DEGs in T2D).

Almost no genes related to the citric acid cycle, glycolysis, glycogenolysis, or beta-oxidation differed between the groups in the UT leg. In T2D there was no effect of training on genes related to glycolysis and glycogenolysis. However, CON had multiple DEGs for glycolytic and glycogenolytic enzymes (i.e. enolase, glycogen debranching enzyme, glycogen phosphorylase) in the type 2A and type 2X fibres in the T leg compared to the UT leg. There were no changes in fibre type distribution after training, and the immunostaining and the snRNA-seq fibre type distributions were in accordance with each other.

CONCLUSION: HIIT improves skeletal muscle insulin sensitivity, but the modest single-nuclei gene expression changes did not mirror this response. Mostly, genes related to glycolysis and glycogenolysis in type 2 muscle fibres displayed significant differences between the groups in response to training. Overall, the pattern of altered gene expressions does not seem to explain the marked change in muscle insulin sensitivity.

References

1. Kanaley et al., Med Sci Sports Exerc, 2022

2. Dela F et al., Acta Physiol, 2019

THREE BOUTS OF RESISTANCE EXERCISE NORMALIZE SR CA2+ HANDLING IN MYOTONIC DYSTROPHY TYPE I PATIENTS

HANDEGARD, V., ØRSTAVIK, K.2, LUNDE, P.K.3, SEYNNES, O.1, PAULSEN, G.1, LOUCH, W.E.3, RAASTAD, T.1

1. NORWEGIAN SCHOOL OF SPORT SCIENCES. 2. OSLO UNIVERSITY HOSPITAL. 3. OSLO UNIVERSITY HOSPITAL AND UNIVERSITY OF OSLO

INTRODUCTION: Myotonic Dystrophy type I (DM1) is the most common adult-onset muscular dystrophy and patients presents with muscle weakness. DM1 skeletal muscle show reduced expression of central Ca2+ handling proteins, such as the Ryanodine Receptor (RyR; 1) and the Sarcoplasmic Reticulum (SR) Ca2+ ATPase (SERCA; 2). Increased intracellular resting levels of Ca2+ has been shown in DM1 myotubes (1). Together these findings indicate disrupted Ca2+ homeostasis. The aims of this study were therefore to (1) establish if SR Ca2+ handling is different in DM1 patients compared to healthy controls, and (2) investigate if resistance exercise (RE) could alter SR Ca2+ handling in DM1 patients.

METHODS: DM1 patients (DM1) and healthy controls (Ctrl) underwent three bouts of unilateral moderate-heavy RE (leg press and knee extension), with 72 hours of recovery between bouts. Maximal force (MVC) of the knee extensors was measured at baseline and 5 minutes, 3, 24, 48, and 72 hours after bout 1, 72 hours after bout 2 and 24 hours after bout 3. M. vastus lateralis biopsies were obtained at baseline and 24 hours after bout 3. SR Ca2+ handling was investigated using a SR vesicle preparation. Muscle tissue homogenate was analysed for RyR, SERCA1a, SERCA2, Phospholamban (PLB; total and phosphorylated) expression using Western blotting. Baseline data were investigated with one-way ANOVA or t-test. Effects of RE were analysed with a mixed model with time and disease as fixed effects. Data are expressed as mean ± standard deviation.

RESULTS: MVC was not different between DM1 and Ctrls at baseline. DM1 had higher Ca2+ uptake rates than Ctrls, with no differences between DM1 and Ctrls in Ca2+ release rates. DM1 also showed higher SR Ca2+ load compared to Ctrls. No baseline differences were detected in expression of SERCA1a, SERCA2, PLB, p-PLB, or RyR, although p-PLB/PLB ratio tended to be higher in DM1 (p=0.068). MVC was reduced by 14 % 3 hours after RE in DM1 (p=0.037), before returning to baseline whereas Ctrls increased from baseline to 24 h after RE (p=0.031). The groups were not significantly different from each other at any time point. Maximal Ca2+ uptake rate decreased after three bouts of RE in DM1 (p=0.01), while Ctrls were unchanged. The Ca2+ release rate was higher in DM1 compared to Ctrls after RE (p=0.04). DM1 showed lower p-PLB compared to Ctrls after RE (p=0.004). None of the other proteins investigated changed expression after RE.

CONCLUSION: DM1 had a higher Ca2+ uptake rate and a higher SR Ca2+ load at baseline compared to Ctrls. We speculate if p-PLB play a role in the different Ca2+ uptake rate between DM1 and Ctrls. The acute MVC reduction in DM1 indicate a slightly lower exercise tolerance compared to Ctrls, however DM1 still recovered after 24 hours. Interestingly three bouts of RE seem to have a normalizing effect on SR Ca2+ uptake rate in DM1 patients which could be explained by a reduction in p-PLB.

(1) Santoro et al., 2020

(2) Ravel-Chapuis et al., 2017

Oral Presentations

OP-BM04 Neuromuscular Physiology I

PHYSICAL FATIGUE FOLLOWS PERCEIVED RATHER THAN ACTUAL TIME

MATTA, P.M., BAURÈS, R., DUCLAY, J., ALAMIA, A.
UNIVERSITÉ TOULOUSE III – PAUL SABATIER

INTRODUCTION: The influence of the mind on physical performance has been extensively demonstrated in the last decades (1). In line with these findings, we highlighted in a previous study how unconsciously manipulating time perception significantly slowed down the accumulation of neuromuscular fatigue (2). Here, we move forward by addressing two important yet unresolved questions: 1) What are the neural correlates of this effect, and 2) Is this effect persistent in the absence of motivational confounds (i.e., performance goals)?

METHODS: 24 subjects participated in four separate sessions in which they performed 100 isometric knee extensions against a fixed resistance (20% of their maximal torque). While the rest time between contractions was identical (5s) for each session, each contractions real (R) and perceived (P) time were independently manipulated. In each session, the contractions' time was either short (10s) or long (12s), while the digital clock displayed in front of the participants was either Normal (N) or Biased (B). This led to 4 counterbalanced conditions: N10 (10s P, 10s R), N12 (12s P, 12s R), B10 (10s P, 12s R), B12 (12s P, 10s R).

Using electroencephalographic recordings, we measured power changes in motor (beta [13-31Hz]) and frontal (theta [4-8Hz], alpha [8-12Hz] and beta [13-31Hz]) areas over the 100 contractions. Simultaneously, the root mean square of the quadriceps electromyographic activity (EMG) was computed. For each measurement, we extracted the integral over all contractions. Finally, pre to post-exercise changes in the quadriceps Maximal Voluntary Torque (MVT) were assessed. Repeated measures ANOVAs and paired t-tests were performed using frequentist and Bayesian frameworks to evaluate both the difference and absence of difference between sessions.

RESULTS: Pre to post-MVT decrease was larger in N12 (-24.2±2.3%) compared to N10 (-20.3±1.7%), B10 (-21.5±1.8%), and B12 (-20.1±1.5%) ($p<.05$). Similarly, EMG increase over the 100 contractions was greater in N12 (187.8±13.1a.u.) compared to N10 (180.1±9.8a.u.), B10 (181.0±9.7a.u.), and B12 (182.3±12.4a.u.) ($p<.05$). Importantly, there was no difference between N10 and B10 for both MVT and EMG ($p>.05$, Bayes Factor (BF)<.3). Regarding the underlying neural correlates, no difference was observed between the sessions in beta power of the motor area ($p>.05$, BF<.3). At the same time, frontal power in theta and beta bands exhibits a significant difference between N10 and N12 ($p<.05$), but no difference ($p>.05$, BF<.3) between B10 and N10, and N12 and B12, respectively.

CONCLUSION: Our study shows a subjective time-dependent accumulation of physical fatigue irrespective of motivational factors. Interestingly, this effect is observed only when the clock is slowed down, suggesting that fatigue accumulation can be reduced but not accelerated. This effect is mediated by an oscillatory dynamic that follows subjective time in frontal but not motor areas.

1. Noakes, Appl Physiol Nutr Metab, 2011

2. Matta et al., Psychophysiology, 2023

EXACERBATING PAIN IMPAIRS CYCLING PERFORMANCE WITHOUT ALTERING CORTICOSPINAL EXCITABILITY AND INTRACORTICAL INHIBITION

ZHANG, J., MCCLEAN, Z.J., HONARVAR, N., MORGAN, S., MACINNIS, M.J., ABOODARDA, S.J.
UNIVERSITY OF CALGARY

INTRODUCTION: During high-intensity exercise, pain arises from the accumulation of metabolites (e.g., H+, K+) and increased intramuscular pressure (1). While the contribution of pain on impaired exercise performance is poorly understood, studies using experimental pain models have suggested that the increased inhibitory afferent feedback and augmented feedforward central drive can accelerate the achievement of the sensory tolerance limit to compromise performance (2). While prior studies have investigated the effect of experimental pain on isometric exercise tasks, little is known about corticomotor modulations to painful stimuli during ecological dynamic tasks such as cycling. Accordingly, this study aimed to examine the effect of experimental pain on corticospinal excitability, intracortical inhibition, and neuromuscular function during cycling.

METHODS: Nine healthy, adult participants (2 females) completed a counterweighted single-leg cycling ramp incremental test to obtain peak power output (PPO) followed by two experimental sessions wherein single-leg cycling at 60% of PPO was performed to task failure. Sessions were performed either without (CTRL) or with (PAIN) an experimental pain intervention consisted of a complete vascular occlusion of the contralateral resting leg combined with electrical stimulation of thigh muscles. To measure corticospinal excitability and intracortical inhibition, 2 femoral nerve stimuli, 5 unconditioned single-pulse transcranial magnetic stimuli (TMS), and 5 short- and 5 long-interval paired TMS pulses were elicited every five minutes during cycling to evoke Mmax, MEP, SICI, and LICI, respectively. Following each stimulation epoch, the bike pedals were locked and participants performed a brief maximal voluntary contraction (MVC) combined with femoral nerve stimuli to characterize neuromuscular function. Subjective ratings of leg pain, fatigue, and effort were also measured every 5 min.

RESULTS: Despite a shortened time to task failure in the PAIN condition (37±12min vs. 61±21min; P=0.015), no differences in neuromuscular function (i.e., MVC force, voluntary activation, and quadriceps twitch force) were present between conditions. Additionally, there were no between-condition differences in Mmax, MEP, SICI, or LICI during cycling (all P>0.05). Contralateral leg pain ratings were higher in PAIN than CTRL (P<0.001), but exercising leg pain was higher in CTRL than PAIN (P=0.015). No differences between fatigue or effort appeared between conditions.

CONCLUSION: Pain impaired exercise performance, but this impedance occurred independently from the intracortical, corticospinal, and neuromuscular pathways governing voluntary movement. Instead, regardless of the amount of inhibitory afferent feedback, exercise terminated once individuals achieved a maximal tolerable limit which was accelerated and primarily determined by perceived pain.

1. Cook et al., 1997, MSSE

2. Azevedo et al., 2022, APNM

FATIGUE-INDUCED ALTERATIONS IN THE SPATIAL DISTRIBUTION OF LUMBAR ERECTOR SPINAE MUSCLE ACTIVITY IN OLDER VERSUS YOUNG ADULTS

PARRELLA, M., BORZUOLA, R.1, SICILIANO, F.P.1, ARVANITIDIS, M.2, NUCCIO, S.1, FALLA, D.2, PIACENTINI, M.F.1, MACALUSO, A.1

1 UNIVERSITY OF ROME FORO ITALICO; 2 UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Fatigue resistance of the trunk extensor muscles is associated with mobility in older adults (1). However, the neuromuscular mechanisms associated with age-related changes in fatigue resistance of these muscles are unclear. When muscle fatigue occurs, changes in the spatial distribution of motor unit activity within a muscle or muscle group play a significant role in modulating motor output (2). This study aims to examine how ageing affects the spatial distribution of lumbar erector spinae (ES) activity during a fatiguing task. Preliminary findings are reported here and will be updated at the time of the congress.

METHODS: Fourteen volunteers, 7 older (O, age: 66±1) and 7 young (Y, age: 25±2), performed an isometric trunk extension at 30% of their maximal voluntary isometric force until failure. High-density surface electromyography signals were recorded using a 13x5 grid of electrodes placed over the lumbar ES. Mean power spectral frequency (MNF) was computed across the entire grid, and the x- and y-coordinates of the centre of gravity (CoG) of the root mean square (RMS) map were measured for the medial-lateral and cranial-caudal direction, respectively. Force steadiness was quantified using the coefficient of variation of force (CVf). A two-way mixed ANOVA was used to detect differences in MNF, CoG coordinates and the CVf over time (5 epochs of equal duration) and between groups. The Wilcoxon test was performed to compare endurance time between groups.

RESULTS: Endurance time did not differ between groups (Y: 85.80±48.60s; O: 81.00±39.60s) (p=0.90). MNF significantly decreased from the beginning to the end of the fatiguing task in both Y (p<0.01) and O (p<0.01). There was a significant time*group interaction for the x-coordinate of the CoG (p<0.01), indicating a shift of the CoG in the lateral direction in O, while the opposite was observed in Y, particularly for the last two epochs. A trend was observed for the y-coordinate (p=0.08) with O exhibiting a more caudal position of the CoG compared to Y. Lastly, CVf significantly increased at the end of the fatiguing task in both Y (p=0.01) and O (p=0.01).

CONCLUSION: Preliminary observations show comparable trunk extension endurance in older and young subjects together with a comparable decrease in MNF and an increase in CVf during the sustained task. However, the spatial distribution of ES activity differed between groups, suggesting a different motor control strategy to counteract fatigue of the ES with ageing. Likely, a different load sharing within the ES muscle occurs. However, this does not affect endurance time.

REFERENCES

1) Habenicht et al., Journal of neuroengineering and rehabilitation, 2020

2) Farina et al., Journal of electromyography and kinesiology, 2008

ACUTE CHANGES IN H-REFLEX AND V-WAVE FOLLOWING SINGLE AND CONCURRENT EXERCISE SESSIONS

GOMES, M., GONÇALVES, A., VILA-CHÃ, C., PEZARAT-CORREIA, P., MENDONCA, G.V.

FACULTY OF HUMAN KINETICS - UNIVERSITY OF LISBON

INTRODUCTION: Concurrent exercise (CE) combines resistance and aerobic exercise to enhance strength (S) and endurance (E). While short-term endurance training increases the H-reflex excitability, resistance training enhances V-wave amplitude, reflecting spinal and supraspinal adaptations, respectively (1). The acute impact of combining both stimuli on the aforementioned parameters remains largely unknown. This study explored H-reflex and V-wave acute changes following single and CE sessions completed in both orders (SE and ES)

METHODS: Ten healthy, trained males (22.8±2.5yrs) participated in this crossover-design study, with baseline assessments and four randomized exercise sessions (S,E,ES,SE). E sessions involved 30 min of treadmill running at a velocity 25%>1st ventilatory threshold, and S sessions included back squats with varied loads (40-90%1RM) and loaded/unloaded jumps. All CE sessions included a 20-min rest between modalities. Assessments of soleus evoked V-wave amplitude, H-reflex recruitment curves, maximal voluntary contraction (MVC) and rate of torque development (RTD) of the dominant limb plantar flexors were conducted at baseline and immediately after each session. Paired samples t-tests between baseline

and post-session evaluated the individual impact of each session, and a one-way repeated measures ANOVA assessed differences between session types. Significance was set at $p<0.05$

RESULTS: MVC and peak RTD of the plantar flexors significantly decreased in all sessions (-13.9 to -19.1% and -24.1 to -31.3%, respectively, $p<0.05$). RTD during the first milliseconds of contraction was unaffected, but subsequent epochs (50-150ms) showed a larger decline in all sessions, with significant differences between E (-40.2±17.5%) and S (-19.4±14.1%) ($p<0.05$). This was concomitant with similar declines in soleus electromyography amplitude across all sessions (-36 to -62%, $p<0.05$). No changes were observed in M-wave amplitude. The normalized V-wave amplitude decreased similarly after all sessions (-13 to -30%, $p<0.05$). Sessions incorporating E exercise reduced the maximum normalized H-reflex amplitude (-17.9 to -25.6%) with significant differences from S session ($p<0.05$). H-reflex excitability threshold remained unchanged, while the slope of the ascending limb of the recruitment curve significantly decreased after both CE sessions (-48.3 to -49.8%, $p<0.05$)

CONCLUSION: E exercise alone reduces the MVC and RTD of the plantar flexors, along with the neural drive to the active muscles. Such effects might compromise the quality of subsequent S sessions. Regardless of training sequence, CE acutely reduces the excitability of the H reflex, which suggests an acute impact on modulation at the spinal level. Ultimately, this indicates that altered H-reflex excitability may have an etiological role in the CE interference effect and this is novel.

1.Vila-Chã C,Falla D,Correia M, Farina D. Changes in H-reflex and V-wave following short-term endurance and strength training. J Appl Physiol (2012).112(1):54-63

Oral Presentations

OP-BM20 Sports Biomechanics

PROFILING PACING AND UNDERLYING KINEMATICS DURING 400M FRONT-CRAWL WITH EMBEDDED SENSORS AND FUNCTIONAL MODELING OF LARGE DATABASE: HIGHLIGHTING THE TECHNICAL REGULATIONS OF VARIOUS PERFORMANCE LEVEL

BOUVET, A., NICOLAS, G., BIDEAU, N.
LABORATOIRE MOUVEMENT SPORT SANTÉ

INTRODUCTION: Monitoring of the 400m front-crawl test is of crucial interest to provide valuable feedback on performance and technique, driving construction of training plan and race strategy. Thus, some studies looked at pacing during this event but were limited to split times with narrow performance level [1], reduced sample size [2], and without technical considerations [3]. Then, there is a need for analyzing pacing and kinematics associated with performance at various levels, especially because speed management regarding individual stroke mechanics remains unclear. This study aimed at modeling kinematical features during 400m tests to profile functional patterns of pacing and technical regulations according to specific performance groups and the overall population.

METHODS: 123 trained to elite swimmers performed a 400m all-out in front-crawl with an Inertial Measurement Unit (Xsens DOT, The Netherlands) on the sacrum. Participants were divided into 4 balanced groups from lowest (G1) to best (G4) final time. Speed, stroke rate (SR), stroke length (SL) and jerk cost (JC) were computed by lap and fitted using hierarchical generalized additive models [4] to describe both the relationships between kinematics and performance and evaluate profiles of regulation across the laps. Fisher tests and visualizations of the functional responses were used for interpretations. Significance was set at $p<0.05$.

RESULTS: Significant relationships with performance displayed an inverse-sigmoïd shape for SL, with inflection points at 1.12 and 1.62 m/stroke, and a rising shape for JC with a deviation for G1. Kinematical profiles displayed significant regulations as reverse J-shape pacing with deviation for G1 that steeper this pattern, reverse J-shape and positive profile for respectively SR and SL functional response with both common opposite deviations for G1 and G4 that correspondingly mitigate and steeper the global regulation, U-shape for JC with deviation for G2 that mitigate the common profile, by opposition of G3 and G4 that steeped it with a higher extent for G4.

CONCLUSION: Useful technical benchmarks regarding the common and group-specific kinematical regulation across 400m on a large database were provided. Key points of global performance are a SL and a JC respectively higher to 1.25 m/stroke and 15 g^2/s^2x10-3, even if low intra-cyclic acceleration fluctuations is fundamental for improvement beyond G3. Preserving energy for finish, by the ability to lower the fast start and accentuate the end spurt is a determinant of progress. Such effective pacing involves typical kinematical regulations targeting to maintain stroke smoothness as much as possible, while displaying both opposite and major variations in SR and SL modulations. This framework allows to tailor and drive the development of race strategy by understanding and diagnosing the underlying technical requirements of successful pacing skills.

1. Lipinska et al., 2020, 2. Correia et al., 2023, 3. Morais et al., 2019, 4. Pedersen et al., 2019

BOWLING ACTION TECHNIQUE DIFFERENCES BETWEEN ELITE & SUB-ELITE CRICKET FAST BOWLERS USING 3D BIOMECHANICAL ANALYSIS

RAMAN, S.A., NIMISHAANTH, S.S., ARUN, C., THIAGARAJAN, K.A., ARUMUGAM, S.
SRI RAMACHANDRA INSTITUTE OF HIGHER EDUCATION & RESEARCH

INTRODUCTION: Cricket fast bowlers utilise various techniques to help propel the ball faster, including some techniques which carry injury risk. Biomechanical studies have demonstrated technique related factors which can influence performance and injury risk. This study aims to evaluate technique differences between elite and sub elite fast bowlers, to understand the factors contributing to performance and injury risk.

METHODS: 15 male Indian elite and 15 sub elite fast bowlers underwent 3D biomechanical analysis of their bowling action in an indoor biomechanics lab. Front foot Peak Vertical Ground Reaction Force (pVGRF), Lateral Trunk Flexion (LTF), Knee Flexion at Front Foot Contact (KF at FFC), Maximum Knee Flexion (MKF) during front foot contact phase, Stride Length (SL), Ball Release Height (BRH) and ball speed were calculated. After tests for normality, the t-test (parametric method for normally distributed variables) & Mann Whitney U test (non-parametric method for variables not following normal distribution) were used to study differences among the groups.

RESULTS: Elite bowlers when compared to sub elite bowlers, had significantly higher mean pVGRF ($p=0.03$), SL ($p<0.001$), MKF ($p=0.02$), LTF ($p=0.008$), BRH ($p=0.02$) and ball speed ($p=0.019$). Mean KF at FFC showed no difference between the two groups ($p=0.85$).

CONCLUSION: Elite bowlers bowled with longer stride length and higher ball release height which could contribute to the greater bowling speeds. Elite bowlers demonstrated higher lateral trunk flexion and higher ground reaction forces which carries higher risk of lumbar spine injury. However, elite bowlers also had higher knee flexion during front foot contact phase, which could mitigate injury risk to some extent. These findings are important for injury prevention, however need to be considered along with other factors such as bowling workload, strength & conditioning status and spinal maturity.

PRELIMINARY STUDY ON THE DISTRIBUTION OF CONTACT FORCES OF A CLIMBER IN DIFFERENT TYPICAL POSITIONS

BONELLI, E., COLOMBO, A., RAMPICHINI, S., LIMONTA, E.
POLITECNICO DI MILANO

INTRODUCTION: Sport climbing is transitioning from a niche to a mainstream activity. Understanding of this sport's biomechanics is still fragmentary. We have developed sensors to measure the 3D contact force vectors between a climber and the climbing holds (1). Such an apparatus has been employed to characterize the kinetics of 2 typical positions at 3 different wall angle. In this preliminary data analysis we report the force distribution on 3 climbing holds.

METHODS: We recruited 16 climbers (8m, 8f, age 26±7yr, height 1.71±0.06m, body mass 66±9kg, right handed, climbing level >18 in IRCRA scale). One position was characterized by fully extended legs and flexed dominant arm (A), the other by bent legs and fully extended dominant arm (B). Climbers had feet on 2 holds 0.46m apart and right hand on a hold 1.44m or 1.62m above the footholds, depending on subject height. The 3 holds were identical 0.06m deep crimps. After familiarization, climbers alternated 10x10s repetitions of A and B, with 30s recovery time. This sequence was repeated at 3 wall angles: +5, 0, -5 degrees from vertical. The magnitudes of hand (FHand), right (FRfoot) and left (FLfoot) foot forces during A or B were normalized by body mass. The 2 positions and the 3 wall angles compose 6 scenarios: A+5/0/-5 and B+5/0/-5. For each triplet (scenario, subject, hold), we tested reliability (ICC>0.5) of the 10 measures. Unreliable triplets were excluded, the 10 measures of reliable triplets were averaged, then outlying triplets were removed (Matlab function robustcov). Average values for each triplet were then considered. We performed a Shapiro-Wilk test to check the distributions normality and a two-way RM-ANOVA (factor: position; level: wall angle; $\alpha=0.01$) to assess differences among scenarios.

RESULTS: Forces in the 6 scenarios are normally distributed, except for a slightly non-normal distribution for FHand in A0. FLfoot is independent of wall angle, and larger in A than in B (A-5: 0.55±0.04, A0: 0.55±0.04, A+5: 0.52±0.06, B-5: 0.34±0.03, B0: 0.34±0.03, B+5: 0.33±0.04). The difference FRfoot - FHand instead highlights a significant ($P<0.001$) load transfer as the wall angle transitions from -5 to +5 degrees in both positions (A-5: 0.43±0.03, A0: 0.29±0.04, A+5: 0.15±0.06, B-5: 0.02±0.09, B0: -0.05±0.09, B+5: -0.12±0.08). FLfoot appears higher than FRfoot in all scenarios (A-5: 0.12±0.07, A0: 0.16±0.08, A+5: 0.16±0.08, B-5: -0.01±0.06, B0: 0.01±0.06, B+5: 0.03±0.05).

CONCLUSION: In both positions, body kinematic adaptation to changing wall angle is predominantly homolateral, between the hand and the same-side foot. The load on the other foot is unaffected by wall angle. Load distribution is predominantly contralateral, as FLfoot is larger than FRfoot in all but one scenarios. These findings provide valuable bases to characterize climbing strategies and optimize training.

REFERENCES: (1) Colombo et al, Frontiers in Sports and Active Living, 2023

BIOMECHANICAL IMPACT: SPINAL ELONGATION AND SHRINKAGE IN GOLF PUTTING

UGBOLUE, U.
UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Putting constitutes nearly half of a golfers total strokes per round, demanding precision, accuracy, and control (1). Spinal overextension results in strains and sprains in supporting ligaments and muscles, while spinal compression, leading to issues like trapped nerves, occurs as the spine comes closer together (2; 3). The absence of studies using

motion capture systems creates uncertainty about the optimal method for measuring spinal changes during golf putting. Therefore, this study applied kinematic techniques to investigate how slope and distance constraints impact spinal elongation and shrinkage of the Lumbar and Thoracic regions during golf putting at 3ft and 7ft distances.

METHODS: Fifteen amateur golfers were selected to take part in testing within the biomechanics laboratory of the University of the West of Scotland. The fifteen participants performed three putts from three different slope constraints; Flat, Uphill and Downhill and two different distance constraints: 3ft and 7ft. Retroreflective markers were placed on the spinal processes from the cervical (C7) to lumbar (L5) spine. Four phases of the golf putting tasks were assessed (Address; Top of the Back Swing; Impact and Follow through). Vicon Motion Capture was used to collect data and process data on the movement of the thoracic and lumbar regions of the spine. Statistical analyses comprising of Shapiro-wilk tests, and a 3-Way ANOVA were applied to the distance constraint, slope constraint, spinal level datasets and their interactions. A one-way ANOVA was applied to the golf putting phases with respect to the changes in spinal movement at the spinal levels. Independent sample t-tests for distant constraints in relation to spinal phase were produced.

RESULTS: In terms of elongation and shrinkage of the spine, correct placement of retroreflective markers on the spinal processes was key in enabling successful tracking and measurements of the spinal processes and distances between the markers. Significant differences were found when comparing 3ft and 7ft distance constraints, all slope constraints, and spinal levels ($P < 0.05$, $F > 0.066$) at the Impact and Follow through phases with respect to the Address phase. However, no significant differences in spinal elongation / shrinkage were observed between Address and Top of the Back Swing for all distance constraints and spinal levels ($P < 0.05$).

CONCLUSION: The results offer valuable insights for golfers regarding spinal elongation and shrinkage. The study unveils a consistent trend of spinal compression in both lumbar and thoracic regions throughout various phases of the putting swing.

REFERENCES:

1) Tanaka & Iwami, Percept Mot Skills, 2018

2) Boden & Javis, Phys Med Rehabil Clin N Am, 2009

3) Forsyth, J. Bone Surg, 1964

Oral Presentations

OP-AP17 Fatigue and recovery measurements

DEVELOPMENT AND EVALUATION OF A MULTIPARAMETER PREDICTION MODEL FOR RECOVERY AND STRESS MONITORING IN ELITE ICE HOCKEY: A LONGITUDINAL STUDY

EGGENBERGER, P., BUFFAT, N., WEBER, T., GUBLER, R., BRUNNER, E.

OST - EASTERN SWITZERLAND UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Youth and adult athletes in high-level sports experience an elevated risk for injury and illness during phases of higher training and competitive load. When recovery is neglected under these circumstances, psychological and physical health problems might arise. These are referred to as nonfunctional overreaching or overtraining syndrome, OTS (1,2,3). OTS is characterized by athletic performance beeing reduced for more than 3-4 weeks up to months. Concurrent symptoms include mood and sleep disturbances, feelings of depression, respiratory tract infections, and weight loss, among others. This condition is highly prevalent, with 10-20% of young adult and about 29% of young athletes from various sports beeing affected (4). To our knowledge, no validated and reliable measurement system currently exists, that would allow for preventive, early diagnosis of overreaching states that might lead to OTS (5). The aim of this study is to develop and evaluate a multiparameter prediction model to assess the recovery and stress state of athletes.

METHODS: Twenty-five male ice hockey players from the highest level Swiss leagues, at their respective age groups, participated (i.e., National League, n = 11, age = 24.8+-4.1 years and U20, n = 14, age = 18.5+-1.5 years). Over 5 - 10 weeks during the in-season (i.e., competition phase) measurements were performed on 10 separate days, either after 1 day of recovery or after a day with match/intensive training. The test battery comprised 40 predictor variables from counter movement jump (CMJ), heart rate variability (HRV), executive function, tympanic temperature, weekly rating of perceived exertion, and sleep measurements. The Stress Recovery Short Scale (SRSS) served as reference variable. Least Absolute Shrinkage and Selection Operator (LASSO) regularized regression analysis was performed for variable selection, training, and cross-validation of a binomial prediction model.

RESULTS: Based on 163 timepoints of measurement, our developed LASSO regression model predicted SRSS scores < 5 (i.e., highly stressed state) with very good performance (area under curve, AUC = 0.921, sensitivity = 0.889, specificity = 0.843). The prediction model retained variables from all applied measurement methods, with HRV, CMJ, and sleep beeing represented among the 10 most important predictive variables.

CONCLUSION: Due to the multisystemic nature of overreaching and OTS states, we conclude that a multiparameter prediction model, containing relatively easily measurable parameters, might be most reliable and practicable for long-term monitoring in athletes.

REFERENCES:

1) Daly, E., et al. (2022). Front Sports Act Living, 4, 1058326.

2) Jones, C. M., et al. (2017). Sports Med, 47(5), 943-974.

3) Kiely, J. (2018). Sports Med, 48(4), 753-764.

4) Matos, N. F., et al. (2011). Med Sci Sports Exerc, 43(7), 1287-1294.

5) Weakley, J., et al. (2022). Int J Sports Physiol Perform, 17(5), 675-681.

WHAT IS THE DIFFERENCE BETWEEN CENTRAL AND PERIPHERAL RATINGS OF PERCEIVED EXERTION? A META-ANALYSIS

MACPHERSON, T., GRAHAM, M., MCLAREN, S., ATKINSON, G., WESTON, M.
NORTHUMBRIA UNIVERSITY

INTRODUCTION: Despite the potential of dRPE to provide a more precise appraisal of exercise exertion, questions exist of its usefulness and worthwhileness due to lack of differences between the two constructs. We aimed to quantify the magnitude of the difference between RPE-P and RPE-C (P–Cdifference) and to explore the moderating influence of methodological factors that could impact P–Cdifference.

METHODS: In accordance with PRISMA guidelines. we searched five academic databases for original research articles published up to October 2023 and available in English. A Boolean search phrase was created to include search terms relevant to internal load / ratings of perceived exertion (19 keywords), dRPE (20 keywords) and exercise/ training sessions (60 keywords). We obtained the mean difference between peripheral and central RPE, as well as the standard deviation of the difference, by extracting individual data and calculating the mean difference in ratings manually (i.e. peripheral exertion score minus central exertion score), allowing dominance between the two perceptual ratings to be assessed. The final data sample included 94 datasets, from 70 individual studies and included 2167 participants from a mixture of activity levels. Random effects meta-analyses were conducted on each dataset to determine the extent of the P–Cdifference. To explore moderator effects of the P–Cdifference, we utilised subgroup comparison analysis when two of more studies were available for analysis. The categorical moderators that we used were study population, exercise modality and whether familiarisation was reported in the study. Magnitude-based decisions provided interpretation of the P–Cdifference in relation to a threshold of 10% of the mean dRPE scores (0.6 arbitrary units [au]). A P–Cdifference was only declared clear if the probability for the difference was ≥ 95% (i.e., very likely).

RESULTS: Random effects meta-analysis revealed no clear rating dominance between RPE-P and RPE-C (0.6 Category–Ratio 10 arbitrary units [au]; 95%CI: 0.4 to 0.7). Moderator analysis showed study population explained 27% of the variance in the P–Cdifference ($\tau = 0.76$, $r^2 = 0.27$), with RPE-P clearly dominant in disabled (1.3 au; 95%CI 0.7 to 1.8 au) and normal/ healthy (0.9 au; 95%CI 0.5 to 1.3 au) participants when compared to RPE-C. Exercise mode explained 13% of the heterogeneity of the P–Cdifference ($\tau = 0.76$, $r^2 = 0.13$), with RPE-P clearly dominating during arm crank (2.1 au; 95%CI 1.4 to 2.8 au) and cycling (0.8 au; 95%CI 0.5 to 1.1 au) exercise when compared to RPE-C. Familiarisation failed to explain the heterogeneity of the P–Cdifference ($\tau = 0.76$, $r^2 = 0.00$), although when studies reported habituation to RPE procedures, RPE-P was dominant (0.8 au; 95%CI 0.6 to 1.0 au).

CONCLUSION: We found the pooled effect to show no clear dominance for either RPE-P or RPE-C but our moderator analysis helped to explain the variance in P–Cdifference and thus supporting dRPE to be sensitive in detecting methodological changes.

RESPIRATORY AND MUSCULAR PERCEIVED EXERTIONS IN YOUNG FEMALE FOOTBALLERS

GONZALEZ-ARTETXE, A., ESNAL-ARRIZABALAGA, O., GARCÍA-TABAR, I., LOMBARDERO, S., LOS ARCOS, A.
FACULTY OF EDUCATION AND SPORT, UNIVERSITY OF THE BASQUE COUNTRY, UPV/EHU

INTRODUCTION: The rating of perceived exertion (PE) provides a simple, non-invasive, no-cost, and valid method for assessing internal workload of the training sessions (1). Since this gestalt could represent an oversimplification of the psychophysiological construct (2), several studies suggested the deconstruction of PE to assess training related perceptual sensations in male footballers (3,4). Respiratory and muscular PEs (i.e., PEres and PEmus) were recently assessed in female football (5,6). However, the differences between PEres and PEmus within and between training sessions remained unclear in female players (6). It was therefore deemed necessary to further clarify and analyse the quantification of the perceived training load differentiating between PEres and PEmus in female young footballers.

METHODS: Sixteen female trained footballers (age: 17 ± 1 years; range: 15 to 21) belonging to the third team of a Spanish first-division club declared their PEres and PEmus after each training session (3,4) during seven weeks of the in-season competitive period. They performed three training sessions during the habitual week: I) Tuesday: football specific training, II) Thursday: strength and football specific training, and III) Friday: football specific training. Only the players that completed all training sessions were considered.

RESULTS: Observations registered were 104 per each type of training, and 5-7 per player in each type of training. Players declared greater PEres than PEmus for all type of trainings: I) Tuesday (PEres: 4.94 ± 0.82, PEmus: 3.64 ± 0.79; $p < .001$, Cohen's d = 1.21), II) Thursday (PEres: 4.13 ± 0.76, PEmus: 3.52 ± 1.12; $p = .031$, Cohen's d = 0.60), and III) Friday (PEres: 3.63 ± 0.69, PEmus: 2.90 ± 0.54; $p = .003$; Cohen's d = 0.89). Players declared greater PEres after Tuesday training in comparison to Thursday ($p < .001$, Cohen's d = 1.36) and Friday ($p < .001$, Cohen's d = 1.82), and after Thursday in comparison to Friday ($p = .005$, Cohen's d = 0.83). Players declared greater PEmus after Tuesday ($p = .002$; Cohen's d = 0.95) and Thurs-

day (p = .021; Cohen's d = 0.65) trainings in comparison to Friday, but significant differences were not found between Tuesday and Thursday sessions (p = .540; Cohen's d = 0.16).

CONCLUSION: Training PEres was always greater than PEmus, being the differences higher for the hardest training session. This suggests that the deconstruction of PE provides additional information about the female footballers' internal workload. These outcomes are of interest for the strength and conditioning staff to adjust conditional specific contents, especially strength exercises, during the training week in this population. Furthermore, the internal workload decreased as the match got closer.

REFERENCES

1. Foster et al. 2001
2. Hutchinson and Tenenbaum 2006
3. Los Arcos et al. 2014
4. Los Arcos et al. 2015
5. Romero-Moraleda et al. 2023
6. Wright et al. 2020

HEART RATE VARIABILITY IN REGULAR SEASON AND PLAY-OFF COMPETITIONS IN PROFESSIONAL ARCHERS

YUAN, S.C., HUANG, Y.F., CHANG, C.K.

NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: Archery is a precision close-circuit sport. Archers have to adjust their arousal level under competition pressure for optimal performance. Heart rate variability (HRV) represents the balance between autonomic nervous system. The purpose of this study is to investigate heart rate variability before and during regular-season and play-off competitions in professional archers.

METHODS: Four male and four female archers from a professional team in Chinese Enterprise Archery League were recruited. The participants wore a portable HRV device (Largan Health AI-tech, Taichung, Taiwan) before and during League competitions from April to October, 2023. HRV data during the 30-min period before the competitions (B) and the 15-min period during the competitions (D) were analyzed. Overall, 12 regular season (RE) and 6 play-off (PO) competitions were included.

RESULTS: During RE competitions, heart rate (HR) was significantly increased from before competition (B:95.37±11.59; D:110.11±15.51 bpm, p<0.001) while low-frequency power (LF) (B:43571.5±20867.0; D:19203.6±12634.7, p<0.001), high-frequency power (HF) (B:9733.2±6478.1; D:5403.6±3900.3, p<0.001), and LF/HF ratio (B:5.50±2.67; D:4.50±2.92, p=0.020) were significantly decreased. During PO competitions, HR was significantly increased from before competition (B:99.44±11.14; D:111.62±15.01 bpm, p<0.001) while LF (B:37288.0±23012.8; D:15819.7±10135.6, p=0.000), HF (B:8691.3±7340.9; D:4280.0±3831.6, p<0.001) were significantly decreased. Pre-competition HR was significantly higher in PO than RE (RE:95.37±11.59; PO:99.44±11.14 bpm, p=0.040) while root mean square of successive differences between normal heartbeats (RMSSD) (RE:66.65±26.95; PO:56.27±28.74, p=0.031) and standard deviation of the normal-normal interval (SDNN) (RE:82.87±19.68; PO:74.14±22.25, p=0.016) were significantly decreased. During-competition rMSSD (RE:63.41±28.04; PO:53.43±26.45, p=0.036) SDNN (RE:79.25±19.16; PO:71.09±21.11, p=0.019) were significantly lower in PO than RE.

CONCLUSION: The results showed that professional archers had a significant increase in heart rate and a noticeable decrease in sympathetic and parasympathetic nervous system activity during RE and PO competitions. It suggested that professional archers perceived higher tension and stress even though they tried to suppress arousal. The lack of difference in LF/HF before and during PO competitions indicated that the participants experienced higher stress and pressure The participants exhibited a significant decrease in relaxation level and autonomic nervous system activity in PO compared to regular season matches, experienced higher stress and pressure, possibly due to the close association with final rankings. Individualized stress adaptation training may be necessary for these group of elite archers for optimal performance in competitions.

ADEQUATE RECOVERY DAYS BETWEEN SOCCER MATCHES FOR FEMALE SOCCER PLAYERS

CHEN, T.C.1, CHOU, T.Y.1, NOSAKA, K.2

1. NATIONAL TAIWAN NORMAL UNIVERSITY, TAIPEI, TAIWAN; 2. EDITH COWAN UNIVERSITY, JOONDALUP, WA, AUSTRALIA

INTRODUCTION: Our previous study [Chou et al. Int J Environ Res Public Health. 2021;18:4134] showed that muscle damage and performance measures took 4-5 days for female soccer players to return to the baseline following a 90-min Loughborough Intermittent Shuttle Test (LIST) that mimics running activities in a soccer match. The study also found that the total distance covered in the LIST was 5-7% shorter for the second to sixth LISTs than the first LIST when the LIST was performed 6 consecutive days, and decreases in muscle strength and other performance measures were still evident at 5 days after the sixth LIST [Chou et al. 2021]. No study has investigated how many days are necessary between matches for good performance with minimum muscle damage, thus the present study compared four different intervals between three LISTs for changes in muscle damage and performance parameters.

METHODS: Thirteen well-trained female university soccer players performed three bouts of 90-min (15-min x 6 sets with 3-min between sets) LIST with four different intervals between bouts; one (1d), two (2d), three (3d) and four days (4d), with more than 12 weeks between bouts in a counterbalanced order. Heart rate (HR), blood lactate (LA), rating of perceived exertion (RPE) and distance covered in each LIST were measured. Changes in several muscle damage markers [maximal voluntary isometric torque of the knee extensors (MVC-KE) and flexors, muscle soreness, plasma creatine kinase activity and myoglobin concentration], and performance parameters [countermovement jump, 30-m sprint, 30-m timed hop test, agility T-test, 6x10-m shuttle run, Yo-Yo intermittent recovery test level 1 (YYIR1)] before the first LIST, 1 hour after each LIST, and 1-5 days after the third LIST were compared among the conditions by a two-way of repeated-measures ANOVA.

RESULTS: The total distance covered in the first two LISTs (10,268±412m) was not different among the conditions, but that was 6-9% ($P<0.05$) shorter in the third LIST for the 1d and 2d conditions than the 3d and 4d conditions. HR, RPE and LA concentration in the three LISTs were not different ($P>0.05$) among the conditions. Changes in all measures were smaller ($P<0.05$) in the 3d and 4d conditions (e.g., the decrease in MVC-KE at 1 day after the third LIST was -13±4% and -10±3%, respectively) when compared with the 1d and 2d conditions (-20±7%, -18±5%). Performance parameters showed smaller ($P<0.05$) changes in the 4d (e.g., the decrease in YYIR1 at 1 day after the third LIST was -9±3%) and 3d (-13±6%) conditions when compared with the 1d (-19±4%) and 2d (-20±8%) conditions.

CONCLUSION: These results suggest that muscle damage and fatigue accumulate when LIST was performed three consecutive days or every other day, but if more than three days were inserted between matches, this could be minimized. However, even for the 4 days interval, some extent of muscle damage is inevitable, which possibly taxes the body for several days.

Oral Presentations

OP-AP13 Basketball Training

QUANTIFYING THE EXTERNAL TRAINING LOADS OF HIGHLY TRAINED MALE YOUTH BASKETBALL PLAYERS BY YEAR, TERM AND POSITION

FULLAGAR, H., LEVER, J., DUFFIELD, R., MURRAY, A., BARTLETT, J.
REYKJAVIK UNIVERSITY

INTRODUCTION: Current insights on the training demands within highly trained youth basketball academies are limited. Specifically, there remains a lack of detail on the specific physical demands and how they may differ between training blocks or playing positions. Therefore, this study aimed to describe the external training load of highly-trained male youth basketball players, based on training year, term, and playing position.

METHODS: Data was collected from 41 male youth basketballers (age = 17.4±0.9 years, height = 203.2±8.3 cm, mass = 91.2±13.3 kg) over two academy seasons from all on-court coach-led training sessions using a commercially available Local Positioning System. The academy provides a fulltime residential basketball development program alongside academic commitments. Linear mixed-models and pairwise comparisons were used to analyse by training year (Y1, Y2, Y3), term (T1, T2, T3, T4) and playing position (Backcourt, Frontcourt) for a variety of external load metrics, with significance set at $p \leq 0.05$.

RESULTS: Results showed no differences in external load metrics between training years. Significant differences existed between training terms, with total distance greater in both T3 and T4 than T1 and 2 ($p<0.03$). Total PlayerLoad was significantly greater in T4 than T1 ($p<0.001$) and 3 ($p=0.004$). Distance/min was greater in T2, T3 and T4 than T1 ($p<0.01$). PlayerLoad/min was higher in T4 than T1 and T2 ($p<0.01$). Backcourt players showed significantly greater distance/min ($p=0.011$), PlayerLoad/min ($p=0.011$) and deceleration counts ($p<0.001$). Overall, limited year-on-year change existed in external training load metrics ($p>0.05$), though volume ($p<0.001$) and intensity ($p<0.001$) differed between terms. Backcourt players completed higher-intensities ($p=0.011$) than Frontcourt players.

CONCLUSION: The results of this study show limited changes in training volume and intensity between years. However, within-season analysis by training term showed significant differences for most training load metrics, indicating a seasonal periodisation of training. Overall, this suggests that this academy environment implements a structured training program within the year, likely related to maximising skill development training. Collectively, this study provides contemporary reference points for practitioners for the external training loads experienced within youth basketball development pathways.

LONG-RANGE SHOTS IN 3X3 BASKETBALL: A COMPARISON OF CATCH-AND-SHOOT AND PULL-UP SHOTS

MADARAME, H.
SHIGAKKAN UNIVERSITY

INTRODUCTION: Making long-range shots from outside the arc is crucial to winning a game in 3x3 basketball because it results in twice as many points as a shot attempted from inside the arc. In traditional 5-on-5 basketball, it has been prevalent for about a decade to assess the performance of long-range shots by classifying the shots into two types, catch-and-shoot (CS) or pull-up (PU), depending on the process from the time the shooter receives the ball to its release. While stud-

ies analyzing shooting performance in 3x3 basketball are increasing [1-3], no studies have analyzed long-range shots in 3x3 basketball by classifying them into CS or PU. Therefore, this study aimed to investigate the proportion and success rates of CS and PU in 3x3 basketball games for men and women.

METHODS: The number of successful and unsuccessful shots attempted from outside the arc were recorded separately for CS and PU while watching videos of 191 games from the 2019 3x3 World Cup. Chi-square tests were used to 1) compare the proportion of CS and PU attempts between men's and women's games, 2) compare the success rates of CS and PU respectively between men's and women's games, and 3) compare the success rates of CS and PU within the same sex. The significance level was maintained at 5% by the Benjamini & Hochberg method.

RESULTS: The number of CS attempts exceeded the number of PU attempts in both men's (717 vs. 478 [60.0% vs. 40.0%]) and women's (586 vs. 372 [61.2% vs 38.8%]) games, with no sex difference in the proportion of CS and PU attempts (P = 0.61). While there was no sex difference in CS success rates (24.4% vs. 24.2%; P = 0.94), PU success rates were significantly higher in men's (27.2%) than in women's (17.7%) games (P = 0.005; effect size = 0.11). When success rates were compared within the same sex, there was no difference between CS (24.4%) and PU (27.2%) success rates in men's games (P = 0.37), but the CS success rate (24.2%) was significantly higher than the PU success rate (17.7%) in women's games (P = 0.04; effect size = 0.08).

CONCLUSION: Analysis of long-range shots separately for CS and PU showed no difference in the proportion of attempts between men's and women's 3x3 games, but there was a difference in the success rate between men's and women's 3x3 games. The results suggest the need for sex-specific training and tactics in 3x3 basketball.

1. Erculj et al. (2020) 2. Boros et al. (2022) 3. Madarame (2023)

POSITION DIFFERENCES OF LOWER EXTREMITY STIFFNESS IN WOMENS CHINESE BASKETBALL ASSOCIATION (WCBA) COMPETITION ATHLETES

WANG, D., WANG, Z., YANG, M., QU, K., MAO, X., YANG, X., ZHANG, Z., FANG, W.
SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Lower extremity injuries (ankle and knee) are most common in basketball. With the increasing participation of women in sports, including basketball, concerns about the risks of sports injuries and their influence on performance have been raised. Womens Chinese Basketball Association (WCBA) competition is the highest level of women's basketball competition in China. Injury prevention is a vital component for good performance. Stiffness pertains to both injury and performance, which represents the capacity of mechanical and neurophysiologic mechanism integration to prevent injury and improve performance. Basketball players can be classified by position as forwards, centres and guards. Each position was characterized by its risk of injury and specific exercise pattern. It was expected that a difference in stiffness characteristics among basketball players based on position.

METHODS: A total of 124 participants were recruited for this study, including 63 forwards, 22 centres and 39 guards. Stiffness was evaluated in the pre-game and in-game phases of the 2020-2021 WCBA season. Quasi-static stiffness measurements of muscles and tendons were collected via a handheld myometer (Myoton AS, Tallinn, Estonia) on seven sites of each leg (lateral gastrocnemius, medial gastrocnemius, soleus, Achilles tendon, biceps femoris, rectus femoris, and patellar tendon). Vertical stiffness was evaluated through vertical hop (sing leg) and drop jump (both legs) test with OptoGait optical detection system (MicroGate Corporation, Bolzano, Italy) .

RESULTS: The Kruskal-Wallis test and post hoc Bonferroni pairwise comparisons found significant differences in stiffness of the left patellar tendon (PT) in guards than centres (p = 0.004) and in guards than forwards (p = 0.012), right PT stiffness in guards than centres (p = 0.016) and in guards than forwards (p = 0.017), mean PT stiffness in guards than centres (p = 0.003) and in guards than forwards (p = 0.008); stiffness of the right soleus (SOL) in guards than forwards (p = 0.033), stiffness of the left biceps femoris (BF) in centres than forwards (p = 0.049) and in centres and guards (p = 0.038); and stiffness of the left vertical stiffness (hopping) in forwards than centres (p = 0.041).

CONCLUSION: Forwards, centres and guards were characterized by significantly different stiffness values. This might provide basketball coaches with information on lower extremity stiffness at different positions, which could be utilised for athletic performance enhancement and injury prevention.

THE COMPETITION LOAD AND SPORTS PERFORMANCE CHARACTERISTICS OF ELITE WOMEN'S 3X3 BASKETBALL TEAM

LI, D., WANG, L.
CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The 3x3 basketball is an emerging Olympic sport, but there are relevant few sport science and sport performance research on it. This study aim to analyze the game load and performance characteristics of the Chinese womens 3x3 basketball team in 7 matches of the "2019 3x3 Womans Series (3WS)" and 15 matches of the" 2021Olympic Test Matches (OTM)" in Shanghai.

METHODS: This study subjects consisted 9 athletes from the Chinese womens 3x3 basketball team(5 guards and 4 centers; average age: 24.1±3.8 years; average height: 180.4±8.8cm; average weight: 78.2±10.9kg). We used the Global Positioning System(GPS) "CATAPULT"(Catapult Group International Ltd,Australia) and "Polar team pro" (Finland, Polar Electro Oy) sensors to collect and analyze internal and external loads. The Lactate Scout (Germany, Senslab GmbH) was used to

test blood lactate (mmol.L-1) to analyze the internal load stress. The significance of differences with * indicating P<0.05 and ** indicating P<0.01.

RESULTS: 1) The 3WS averaged duration time was 1754"±41", match density was 53%, the OTM averaged duration time was 1634"±342", and match density was 59%.

2) The 3WS Playload™ and Playload™min were measured at 132.86±18.36a.u, 7.43±0.59a.u**↑. The OTM Playload™ and Playload™min were measured at 120.53±25.31a.u**↓, 7.19±0.48a.u**↑.

3) The 3WS explosive movements was 27±7.46times**↑, the OTM explosive movements was 23±9.1times**↑.

4) The 3WS average movement changes was 1080±163 times(excluding jumping). Among acceleration:139.5±12.5; deceleration:138±28; changes of direction(COD)-Left: 390±105; COD-right: 354.5±116.5; the number of COD-left and COD-right was almost 2.8 times higher than the number of acceleration and deceleration.

5) The OTM maximum HR 185±14.5bpm, average HR 155±12bpm. The distribution of zones follows: Zone-1: 15.4%,Zone-2:12%,Zone-3: 22.6%, Zone-4: 43.4%, Zone-5: 13.4%.

The 3WS maximum HR 200±25bpm**, average HR 168±19bpm**. The distribution of zones follows: Zone-1: 0%**, Zone-2: 8.0%**, Zone-3:17.5%**, Zone-4:29%**, Zone-5:47.5**.

6) The 3WS blood lactate were measured at 6.97±2.8 mmol·L-1 after 2 minutes, and 4.84±1.8mmol·L-1 after 10 minutes. The OTM blood lactate were measured at 6.86±1.05 mmol·L-1 after 2 minutes, and 4.10±0.65 mmol·L-1 after10 minutes.

CONCLUSION: In elite Womens 3x3 basketball, the Playload™min has significant increased. The main factors contributing to the increase of explosive movements and acceleration, deceleration, COD-left and COD-right(>3.5m/s). The 3x3 basketball not only is the proportion of anaerobic and glycolytic energy systems significantly higher than 5x5 basketball, but aerobic recovery capacity is also crucial. It requires higher levels of power endurance, and speed agility from players. If players participate in both 3x3 and 5x5 basketball games simultaneously, there is a higher risk of injury, so caution should be exercised.

INDIVIDUAL CUMULATIVE MATCH LOADS IN THE LIQUI MOLY HANDBALL BUNDESLIGA OVER AN ENTIRE SEASON

BAUMGART, C., HOPPE, M.W., SAAL, C.

UNIVERSITY OF WUPPERTAL

INTRODUCTION: For training control and injury prevention, knowledge of the individual match loads is essential. However, in elite handball, these loads have not been adequately described using quantitative measurements. The aim of this study was to quantify the cumulative match loads in the LIQUI MOLY Handball Bundesliga (HBL) over an entire season.

METHODS: The match loads of two men's handball teams were recorded during each competitive match of the season 2021/2022 (a total of 66 matches) using a validated radio-based positioning system (Kinexon Perform LPS, Kinexon GmbH, Munich). Match loads were operationalized based on the number of completed matches, playing time, total distance covered as well as the number of sprints, jumps, shots on goal, passes, and impacts. For validity reasons, only players with at least six match appearances (a total of 30 players) were considered. Quantiles of cumulative match loads (Q) were used for statistical analysis.

RESULTS: On average (Q50), 27.5 matches are played per season (Q0 = 9; Q25 = 20; Q75 = 30; Q100 = 32), corresponding to an average cumulative playing time (Q50) of 12 hours (Q0 = 1; Q25 = 7; Q75 = 19; Q100 = 26). The average cumulative values over the entire season are as follows:

- Total distance covered: Q50 = 56.9 km (Q0 = 4.9; Q25 = 35.1; Q75 = 90.3; Q100 = 134.5)
- Number of sprints: Q50 = 77 (Q0 = 8; Q25 = 47; Q75 = 150; Q100 = 912)
- Jumps: Q50 = 256 (Q0 = 10; Q25 = 120; Q75 = 393; Q100 = 960)
- Shots on goal: Q50 = 107 (Q0 = 6; Q25 = 49; Q75 = 148; Q100 = 244)
- Passes: Q50 = 1,137 (Q0 = 74; Q25 = 512; Q75 = 2,360; Q100 = 5,319)
- Impacts: Q50 = 216 (Q0 = 10; Q25 = 69; Q75 = 399; Q100 = 519)

CONCLUSION: The cumulative match loads in the HBL demonstrate significant inter-individual variation. In both teams, there are some players who suffer very high loads at the end of the season. These results can be attributed, among other factors, to the varying demands of different playing positions and the effective playing time of regular players. Further studies are necessary to transfer these findings into the practice of elite handball.

Oral Presentations

OP-PN30 Physiology/Mixed Session I

O2 DIFFUSION LIMITS OXIDATIVE CAPACITY IN YOUNG AND MIDDLE-AGE, BUT NOT IN ELDERLY MUSCLE

PILOTTO, A., ADAMI, A., ANSALDO, M., LAURETANI, F., RE, R., BOTTER, A., FRANCHI, M.V., BOTTINELLI, R., ROSSITER, H.B., PORCELLI, S.

UNIVERSITY OF PAVIA

INTRODUCTION: Aging leads to significant decrease in aerobic capacity, cardiovascular function (1), muscle strength and power, muscle mitochondrial oxidative capacity and capillarity (2). In older people, muscle fiber atrophy and loss of fiber oxidative capacity (3,4) may counter effect muscle capillary rarefaction (4) and thereby protect O2 diffusive flow into contracting muscle fibers by increasing the capillary supply region (5). We aimed to evaluate age-related differences in muscle oxidative capacity and O2 diffusion in vivo.

METHODS: Twelve young (YG; 26±5 y), nine middle-aged (MID; 57±5 y) and twelve old (OLD; 78±5 y) individuals volunteered. They underwent an incremental cycle-ergometry to the limit of tolerance for peak oxygen uptake (VO2peak). In a different occasion vastus lateralis VO2 recovery rate constant (k) was measured by near-infrared spectroscopy during repeated transient occlusions after moderate exercise. Duration and timing of occlusions were manipulated to keep tissue saturation index (TSI) within 10% bounds of two different O2 availability conditions: not-limiting (HIGH) and limiting (LOW) (6). kHIGH provides an estimate of muscle oxidative capacity, while the difference between kHIGH and kLOW (Δk) is inversely proportional to capillarity (a high Δk reveals O2 diffusion limitation). One-way ANOVA with Tuckey's post hoc test was used to test differences among groups and one sample t test was used to test Δk difference from zero in each group. Linear regression was utilized to analyze correlation of VO2peak with kHIGH and Δk.

RESULTS: YG had greater VO2peak than MID and OLD (35.7±8.2 vs. 30.1±5.6 and 24.2±4.4 ml*min-1*kg-1 respectively; $p<0.05$). kHIGH was greater in YG (2.97±0.55 min-1) compared to MID (2.09±0.63 min-1, $p<0.05$) and OLD (2.04±0.57 min-1, $p<0.01$), but MID and OLD were not different ($p=0.985$). Δk was significantly greater than zero ($p<0.05$) in YG (1.32±0.70 min-1) and MID (0.62±0.62 min-1), but not in OLD (0.02±0.65 min-1; $p=0.941$). Linear regression showed VO2peak significantly correlated with both kHIGH ($r=0.40$; $p<0.05$) and Δk ($r=0.38$; $p<0.05$).

CONCLUSION: Age-related differences in maximal aerobic capacity were related to skeletal muscle oxidative capacity and O2 diffusion limitation. Unlike young and middle-aged muscle, diffusive capacity was not limiting to muscle oxidative capacity in the elderly. Thus, our data suggest age-related muscle adaptations help to protect muscle oxidative function in older aging. Future analyses on muscle samples to better characterize muscle structure and function will help to gain insights into age-related differences in limitations to intramuscular O2 flow.

[1] Chodzko-Zajko et al, 2009, MSSE

[2] Conley et al, 2000, J Physiol

[3] Nilwik et al, 2013, Exp Gerontol

[4] Proctor et al, 1995, J Appl Physiol

[5] Barnouin et al, 2017, J Cachexia Sarcopenia Muscle

[6] Pilotto et al, 2022, J Physiol

TEMPORAL RECOVERY DYNAMICS OF PERCEIVED COGNITIVE FATIGUE AND PREFRONTAL CORTEX OXYGENATION AFTER A SUSTAINED COGNITIVE ACTIVITY

GUBE, M., BEHRENS, M., WEIPPERT, M., BRUHN, S.

UNIVERSITY OF ROSTOCK

INTRODUCTION: Performing sustained cognitive activities (SCA) can lead to perceived cognitive fatigue as well as changes in motivation, affective valence, arousal, as well as boredom and has been shown to impair endurance performance and motor control during various tasks. However, the temporal recovery dynamics of the perceptual responses and oxygenation of the prefrontal cortex after SCA have rarely been studied. For this reason, temporal recovery dynamics of perceived cognitive fatigue and other perceptual responses as well as prefrontal cortex oxygenation were investigated for 60 min after an SCA

METHODS: In a randomised, counterbalanced cross-over design, 30 subjects (females: 15; age: 23 ± 2.9 years; BMI: 20.5 ± 3.1 kg*m-2) completed an SCA task (60min digital Stroop task) and a control task (60 min watching a neutral video). Thereafter, a neutral video was watched for 60 min in both conditions to monitor temporal recovery of variables. Development and recovery of perceived cognitive fatigue and other perceptual responses (e.g., motivation, affective valence, arousal, boredom) during and after SCA were assessed at regular time intervals with visual analogue scales. Furthermore, oxygenation of the prefrontal cortex was measured using functional near-infrared spectroscopy (fNIRS). Data were analysed using repeated measures ANOVAs.

RESULTS: No significant interactions of time x condition were observed for perceived cognitive fatigue ($p = .834$; $\eta p2 = .013$), motivation ($p = .132$; $\eta p2 = .061$), affective valence ($p = .397$; $\eta p2 = .035$), arousal ($p = .397$; $\eta p2 = .035$), boredom (p

= .894; ηp2 = .010). For oxygenation of the prefrontal cortex, trends for interactions were found (O2Hb; HHb; tHb; TSI%: p ≥ 0.093; ηp2 ≤ .064). No main effects of condition were shown for all parameters. No time effects were found for perceived cognitive fatigue as well as all other perceptual responses. Time effects were found for O2Hb, tHb and TSI% (p ≤ .011; ηp2 ≥ .100) but not for HHb (p = .096; ηp2 = .064).

CONCLUSION: Although no interaction effects were found for the perceptual responses, it appears that the initial level of prefrontal cortex oxygenation (baseline TSI%) is not achieved until 30 min after the SCA, while a full recovery was observed already during the first minute of recovery after the control task. These results indicate distinct temporal recovery dynamics of prefrontal cortex oxygenation but not the perceptual responses and emphasise the need for a multiparametric assessment to explain potential effects of SCA on subsequent cognitive or motor performance.

SKELETAL MUSCLE FIBER COMPOSITION AND BLOOD PRESSURE AFTER ACUTE AEROBIC EXERCISES

YLINEN, V., VALTONEN, R.I.P., STENBÄCK, V., MÄKELÄ, K., HERZIG, K.H., NÄPÄNKANGAS, J., JUNTTILA, J., TULPPO, M.
UNIVERSITY OF OULU

INTRODUCTION: The inter-individual responses vary from no change to marked reduction in blood pressure (BP) after an acute and chronic aerobic exercise. The physiological background for heterogeneity in BP responses after chronic or acute aerobic exercise is not known. We hypothesized that skeletal muscle fiber type may modify BP responses after an acute aerobic exercise.

METHODS: Normotensive participants (12 males and 8 females, age 27±6, maximal oxygen uptake 45±7 ml/kg/min) performed two 30 min aerobic exercises, continuous and interval intensities, by bicycle ergometer on separate days with BP measurements before and 60 min after exercises. BP was measured three times at baseline and 5 min intervals after exercises. Area under the curve after exercises (AUC) was calculated for systolic BP. Continuous aerobic exercise was 30 min at intensity of 60% of maximal exercise capacity. Aerobic interval exercise consisted of 8 x 1 min high intensity intervals (80-90% of maximal exercise capacity) with two min easy cycling between the intervals. The average workload was equal for both exercises (60% of maximal exercise capacity). Muscle biopsy was taken from vastus lateralis on separate day and the proportion of fast and slow fibers was counted.

RESULTS: The average proportion of fast type fibers was 55±17% (range 16-84%). The change in systolic BP from baseline to 60 min recovery phase was -9±10 mmHg (range -18 - +8) and -9±8 mmHg (range -10 to +3) in continuous and interval exercises, respectively (time p<0.001, group p=ns, time·group interaction p=ns). AUC for systolic BP was -386±387 mmHg·min (range -591 - +348) and -399±228 mmHg·min (range -347 - +183) after continuous and interval exercises (p=ns), respectively. The change in systolic BP from baseline to 60 min recovery and the AUC for systolic BP were correlated with the proportion of fast muscle fibers after interval exercise (r=-0.53, p=0.023 and r=-0.59, p=0.010, respectively) but not after continuous exercise (r=-0.20, p=0.42 and r=-0.19, p=0.45, respectively).

CONCLUSION: Inter-individual differences in post exercise BP responses are associated with skeletal muscle phenotype particularly after interval exercise. Participants with large amount of fast muscle fibers result in superior BP response after interval exercise compared to subjects with a low number of fast muscle fibers.

JOINT EFFECTS OF EXERCISE AND FASTING ON TELOMERE LENGTH: IMPLICATIONS FOR CELLULAR AGING

SELLAMI, M., ALMURAIKHY, A., ELRAYESS, M.
QATAR UNIVERSITY

INTRODUCTION: Aging is a fundamental biological process that progressively impairs the functionality of the bodily systems, leading to increased risk of diseases. Telomere length is one of the best biomarkers of aging. Recent research has focused on developing interventions to mitigate the effects of aging and improve the quality of life.

Some of these strategies are diet and exercise. Intermittent fasting is often used to manage weight and metabolic health. Similarly, aerobic exercise is considered an effective strategy to enhance longevity and health span via its multi-system anti-aging effects. Elite athletes usually live considerably longer than the general population and people with moderate level of physical activity have a significantly lower risk of dying during the same time frame compared to the sedentary group. The relationship between exercise, fasting, and telomere length is a topic of significant interest and ongoing research especially in active and sedentary women . Therefore, the objective of this longitudinal study is to investigate the combined effect of exercise and fasting on telomere length, oxidative stress markers, metabolites and lipid profile.

METHODS: Twenty-nine young, non-obese, and healthy females were randomized into two groups: the first group (n=16) is the control group, they underwent a 4-week exercise training program, and the second group underwent 4-week exercise training program during while fasting for 14 hours (n=13). Blood samples were collected at baseline, and measurements of clinical traits, cytokines including IL-1 beta, IL-1RA, IL-6, IL-10, IL-22, MCP-1/CCL2, and TNF-alpha, and telomere length were performed before and after intervention.

RESULTS: Telomere length has increased significantly (p≤0.05) from the baseline in the exercise while fasting group, but showed no significant change in the control group. Moreover, a significant difference (p=0.02) was found in the mean change in telomere length between the two groups, together with reduced TNF-alpha (p=0.01) and energy fatigue (p=0.02) in exercise and fasting group compared to control group. Additionally, a significant positive correlation was observed between the mean change in telomere length and HDL in the exercise while fasting group only.

CONCLUSION: This study is the first to report an increase in telomere length after combining fasting with training, suggesting that exercising while fasting may be an effective tool for slowing down the aging rate. Further studies using larger and more diverse cohorts are warranted.

ESTIMATING AEROBIC CAPACITY OF MILITARY PERSONNEL USING BODY COMPOSITION INDEX

CHENG, Y.T., CHEN, J., LI, Y., CHEN, C., SHIH, Y.
UNIVERSITY OF TAIPEI

INTRODUCTION: Routine military training encompasses a wide range of physical activities such as walking, running, and jumping, imposing high physical demands on military personnel (1). The maximal physical capability of military personnel is high related with the maximal metabolism test (MMT) (2,3). However, traditional methods of measuring maximal metabolism are costly and complex, limiting their practical application efficiency. Thus, this study aims to analyze the most suitable combination of non-invasive body composition physiological parameters to predict military personnels MMT.

METHODS: Ninety-two male military personnel (age: 25.8 ± 3.5 years, height: 160.3 ± 3.9 cm, weight: 59.1 ± 8.5 kg) were recruited to undergo body composition analysis and MMT. Statistical methods employed included simple regression analysis and multiple regression analysis to construct the combination of physiological parameters most correlated with MMT.

RESULTS: Body fat percentage (BFP) has the highest coefficient of determination for MMT ($R2 = 0.215$, $p < 0.001$). The prediction model is [MMT = 51.79 – 0.394 × BFP]. The combination of BFP, resting heart rate (HRrest), and age has the highest coefficient of determination for MMT ($R2 = 0.401$, $p < 0.001$). The prediction model is [MMT = 74.39 – 0.345 × BFP – 0.150 × HRrest – 0.427 × age].

CONCLUSION: M Goran et al. mentioned that lean body mass (LBM) has a major influence on MMT. Obesity and overweight are not necessarily negatively related to MMT, but excess fat does have an adverse impact on submaximal energy metabolism (4). Gažarová et al. reviewed that human obesity status should not only refer to BMI, body weight or body fat mass, but also muscle mass and body fat mass to determine whether sarcopenia or obesity affects daily exercise performance (5). Increased body fat is related to a decrease in the MMT level of adolescents. In terms of parameters for predicting MMT, obesity represented by BFP is more suitable than BMI (6). Benno K et al. confirmed in 2020 that the correlation between MMT and LBM is higher than that of body weight, and less so (7), but the results of this study found that the combination of LBM and BFP showed that the regression statistics of LBM was not significant ($p > 0.05$), and only BFP can predict MMT ($p = 0.002$). The results of this study show that the combination of multiple physiological parameters such as BFP, HRrest, and age has a high coefficient of determination for predicting MMT to predict the maximum physical combat capability of military personnel, to shorten the assessment time and effectively allocate appropriate troop deployment.

Reference:

1. Knapik and East, US Army Med Dep J., 2014
2. Zwilling, et al., Sci Rep., 2020
3. Dawes, et al., Strength Cond J., 2021
4. Goran, et al., Int J Obes Relat Metab Disord., 2000
5. Gažarová, et al., Rocz Panstw Zakl Hig., 2023
6. Monda, et al., J Clin Diagn Res., 2017
7. Krachler, et al., Eur J Prev Cardiol., 2015

Oral Presentations

OP-MH25 Exercise and COVID-19 II

EFFICACY OF A JUST-IN-TIME ADAPTIVE INTERVENTION IN MAINTAINING PHYSICAL ACTIVITY IN OLDER ADULTS DURING THE COVID-19 PANDEMIC.

MAIR, J., AGUIAR, E.J., BUCHAN, D., SCULTHORPE, N.
SINGAPORE-ETH CENTRE

INTRODUCTION: Nationwide lockdowns in 2020 due to the coronavirus pandemic severely limited opportunities to engage in physical activity (PA). Worldwide step count data has since shown that, on average, PA declined by 27% in the first 30 days since declaration of the pandemic [1]. Older adults were among those considered more vulnerable than others and were asked to stay home for longer. Just-in-time-adaptive-interventions (JITAIs) can be delivered remotely via smartphones, at scale, providing real-time 'in the moment' behaviour change support to people when they need it most. This study describes the efficacy of a personalised JITAI on PA in older adults during the COVID-19 pandemic.

METHODS: The JitaBug mHealth app delivered just-in-time PA promotion messages that were adapted using real-time PA (from Fitbit Charge 4), location, and weather data to encourage achievement of personalised PA goals. We tested the preliminary efficacy of JitaBug with older adults in a 6-week quasi-experimental study between October – December

2020. The intervention was delivered entirely remotely. Physical activity was measured using an Actigraph wrist-worn accelerometer during a baseline and follow-up period and using intra-day Fitbit data throughout the intervention. Actigraph data were processed using the GGIR package v2.1.0 and synchronised Fitbit data were analysed using the stepmetrics package v0.1.2 using R. Metrics of interest were time spent inactive and in low, and moderate-vigorous intensity PA, daily step count, and peak step cadence (as a proxy of intensity). Differences in PA between baseline and post-intervention were analysed using a paired-samples t-test.

RESULTS: Thirty-one older adults (mean ± SD; 65.5 ± 5.4 years) completed the intervention. Valid Actigraph and Fitbit data were obtained from n=27 and n=24 participants, respectively. There was no significant change in Actigraph-measured time spent inactive (mean difference; 10.2 mins; p=0.936), light intensity PA (-9.31 mins; p=0.98), or moderate-vigorous PA (-4.02 mins; p=0.835) due to the intervention. At baseline, average daily step count was 8581 ± 3559 steps/day, while peak30 and peak60 cadences were 86 ± 22 steps/min and 73 ± 22 steps/min, respectively, indicating overall low intensity PA.

CONCLUSION: The findings revealed that the JitaBug mHealth intervention supported older adults to maintain PA during the COVID-19 pandemic despite significant disruption to PA opportunities. JITAIs are a promising way to promote PA remotely to older adults in everyday life and may be used to reach those who may otherwise have limited access to PA support.

[1] GH Tison, R Avram, P Kuhar, et al. Worldwide Effect of COVID-19 on Physical Activity: A Descriptive Study. Ann Intern Med.2020;173:767-770.

SLEEP AND PHYSICAL ACTIVITY CHARACTERISTICS IN UNIVERSITY STUDENTS DURING THE COVID-19 PANDEMIC: A DESCRIPTIVE CROSS-SECTIONAL WRIST ACTIGRAPHY STUDY

STEFANSDOTTIR, R., ROGNVALDSDOTTIR, V., ARNARSDOTTIR, A., GISLADOTTIR, T., JOHANNSSON, E., GESTSDOTTIR, S., JAKOBSDOTTIR, G.

UNIVERSITY OF ICELAND

INTRODUCTION: The COVID-19 pandemic impacted people's physical and mental health and affected countless individuals globally (1). University students are a subgroup that might be sensitive to changes as they are experiencing major life transition entering adulthood (2). Recent studies have reported that university students sleep behavior changed (3) during the pandemic and similarly, students reported a drastic decline in their physical and mental health (4). However, most studies during COVID-19 have solely relied on subjective data, and thus lacking information obtained with objective measures. The aim of the study was to objectively investigate the free-living sleeping patterns, clock times and physical activity (PA) characteristics of university students in Iceland during the pandemic, including exploring gender differences and the association between sleep and PA.

METHODS: Free-living sleep and PA were measured with wrist actigraphy (Actigraphy GT3X+) for one-week in January 2021 in 76 first year (24.4 ± 3.5 years) students (females 43%). Unpaired t-tests were used for gender comparisons and linear regression was used to evaluate the association between sleep and PA.

RESULTS: On average students went to bed at 01:41 hours (±78 min) and rose at 09:05 hours (±96 min). Females spent more time in bed, slept longer, and went to bed and rose earlier than males (all ps<0.05). No association was found between weekly PA counts and sleep duration, quality, variability, or social jetlag. However, a correlation between PA counts and bedtimes over the entire week was detected.

CONCLUSION: Findings from this descriptive analysis indicate that university students in Iceland sleep less than recommended and demonstrate a late sleep schedule. The COVID-19 pandemic affected sleep and physical activity differently in female and male university students as females went to bed earlier, slept longer and were more physically active compared to males. Earlier bedtimes correlated with higher PA counts, which could highlight the importance of practicing proper sleep hygiene and underline the importance of consistent sleep routine for overall health and well-being during challenging times or personal hardship.

References:

1.Wilson et al. The impact of the COVID-19 pandemic on US college students physical activity and mental health. Journal of Physical Activity and Health. 2021;18(3):272-8.

2.Auerbach et al. WHO world mental health surveys international college student project: prevalence and distribution of mental disorders. Journal of abnormal psychology. 2018;127(7):623.

3.Lukowski et al. Undergraduate student stress, sleep, and health before and during the COVID-19 pandemic. Behavioral Medicine. 2022:1-15.

4.Gestsdottir et al. Health and well-being of university students before and during COVID-19 pandemic: A gender comparison. Plos one. 2021;16(12):e0261346.

DOSE-RESPONSE EFFECTS OF AN ONLINE, PRENATAL, AND POSTPARTUM PILATES-BASED PROGRAM ON LOW BACK PAIN, SLEEP DISTURBANCES, AND DEPRESSION DURING THE COVID-19 LOCKDOWN

MELONI, M., MANCA, A., VENTURA, L., CONSOLI, G., FENU, S., MURA, G., DERIU, F., CUGUSI, L.
UNIVERSITY OF SASSARI

INTRODUCTION: This study aimed to evaluate the effects of an online, prenatal Pilates-based program on low back pain (LPB) severity, sleep quality, mood, and depression levels in pregnant women. Additionally, the study sought to assess the potential benefits of continuing the training post-partum. Furthermore, we aimed to investigate the relationship between the amount of exercise and its impact on prenatal and post-partum outcomes.

METHODS: This study employed an exploratory, single-group pre-post intervention design. One-hundred and sixty-six pregnant women meeting specific eligibility criteria volunteered for this study (certified low-risk pregnancy; aged between 18 and 45 years; single pregnancy; gestational age between 20 and 28 weeks; normal BMI). Participants engaged in a Pilates-based telerehabilitation program during pregnancy and post-partum via an online platform. Outcome measures including weight control, LBP disability, sleep quality, mood, and mental health were assessed at baseline and after completion of both pre-partum and post-partum training.

RESULTS: Bonferroni-adjusted pairwise comparisons revealed significant gains in weight at large effect sizes only in low (+12.2%; p<0.0001) and intermediate-amount exercisers (+9.6%; p<0.0001), while high exercisers did not increase their weight in a significant manner (+3.8%; p=0.13). Adjusted pairwise comparisons revealed a significant increase in LBP-related disability in low (+93.1%; p<0.0001) and intermediate exercisers (+84.9%; p<0.0001), while high exercisers did not display significant increase in disability (+42.7%; p=0.21). Adjusted pairwise comparisons showed a significant increase in sleep disturbance in low-amount exercisers (<1.5 hours/week; +24.3%; p=0.005) but not in intermediate (1.5 to 3 hours/week; +4.6%; p=0.50) and high-amount ones (>3 hours/week; -0.1%; p=0.91). Pairwise comparisons showed significant increases in depression scores in all groups of exercisers, at large effect sizes (low-amount: +51.5%; p<0.0001; intermediate-amount: +42.9%; p<0.0001; high-amount: +35.6%; p=0.003). Regarding the effects of the post-partum intervention, pairwise comparisons revealed a significant reduction of sleep disturbances (-24.1%; p= 0.003) and depression scores (-15.9%; p=0.04) only in intermediate exercisers.

CONCLUSION: Approximately 270 minutes of home-based, tele-Pilates exercise were needed to prevent LBP worsening, and sleep deterioration in pregnant women. A different pattern was outlined for those women resuming the Pilates-based intervention at post-partum, with 150 minutes emerging as the "dose" of exercise capable to induce the largest improvements in LBP, sleep, and mood disturbances. Further research with larger sample sizes and control groups is needed to confirm these results and enhance methodological rigor.

CROSS-COUNTRY SKIING DEMAND INCREASED DURING AND AFTER COVID-19: A CASE STUDY FROM THE BLACK FOREST IN GERMANY

SCHMIDT, L., ROTH, R.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION

In early 2020, the Covid-19 pandemic caused major disruptions in all areas of society. While many public and private facilities were forced to close, outdoor recreation experienced a revival as people flocked to natural areas, using them as a place to socialise and build resilience in times of contact restrictions [1]. Few studies have investigated this effect in winter activities [2]. This study aimed to investigate pandemic-induced changes in cross-country skiing (XC) demand in the Black Forest, Germany, controlling for weather and temporal conditions.

METHODS

XC demand was recorded hourly using photoelectric sensors during the winter months of 2017-2023 (except 2020, when one sensor was missing). Weather data included air temperature (T), dew point (DT), sunshine duration (S) and precipitation (P) and were collected from nearby weather stations. In a 2017-2019 reference period, Spearman's rho (rs) and visual analysis of scatter plots determined the relationship between variables and XC demand. Correlated variables, interactions and XC demand from reference period were then used to train a quasi-Poisson (QP) model to predict XC demand in pandemic years, which were split into 2021 (lockdown), 2022 (eased restrictions) and 2023 (post-covid). The Mann-Whitney U test was used to identify significant (p<0.05) differences between XC demand in pandemic periods and QP model predictions.

RESULTS

Day-of-week (rs=0.4), time-of-day (rs=-0.3), DT (rs=-0.35), S (rs=0.34) and P (rs=-0.29) showed weak correlations with XC demand. Visual interpretation of scatter plots showed these correlations to be considerable. T did not correlate with XC demand (rs=0.0). However, a multivariate scatter plot analysis revealed a negative interaction between T and P in relation to XC demand, indicating that XC demand decreases when P occurs at higher T. Day-of-week, time-of-day, DT, S and the interaction of T and P showed a significant effect on XC demand in the QP model. XC demand in 2021 was 49% higher than QP model predictions (p<0.001). XC demand in 2022 and 2023 was 28% (p=0.009) resp. 22% (p=0.001) higher than QP model predictions.

CONCLUSION

Compared to pre-pandemic levels, XC demand was significantly higher in all pandemic periods studied. This study provides an example of a lasting effect of increased outdoor recreation demand, particularly in XC, after the pandemic. These findings highlight the importance of nature as a recreational space and of activities such as XC for psychophysical well-being and their social role as a source of resilience, especially in times of crisis [1]. Possible negative effects of increased demand, such as overcrowding and increased conflict potential, must not be neglected and require efficient and ongoing visitor management and monitoring, as well as appropriate training for natural area managers [3].

REFERENCES

1) Pröbstl-Haider et al. (2023) JORT

2) Schlemmer & Schnitzer (2023) JORT

3) Ferguson et al. (2023) JORT

ASSOCIATION BETWEEN COVID-19 PANDEMIC AND OLYMPIC COMPETITIVENESS: DIFFERENT RESULTS FROM TOKYO AND BEIJING

CUI, D.1,2, GUO, J.2,3, ZHANG, X.2

1 CHINA INSTITUTE OF SPORT SCIENCE 2 CAPITAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS

INTRODUCTION: The impact of COVID-19 pandemic on elite sports has been widely reported since 2020 [1]. Although many countries have undertaken elite sports recovery programs in Olympic preparations [2], many concerns remained ahead of the Beijing 2021 Summer Olympic and Paralympic Games and the Beijing 2022 Winter Olympic and Paralympic Games [3]. But without global post-Olympic evidence, it is hard to answer pre-Olympic concerns and measure the recovery of elite sports across countries. How and how much the intra-pandemic Olympic Games have been affected remains unknown. The aim of this study was to assess the association between domestic COVID-19 epidemic and global Olympic competitiveness of all the member countries.

METHODS: The investigated games were the Tokyo 2020 Summer Olympic and Paralympic Games, and the Beijing 2022 Winter Olympic and Paralympic Games. Competitiveness was characterized in both participation quotas and medal shares. For pandemic, transmission and symptoms were quantified by the number of infections and deaths, respectively. All data were collected from the Internet. Data were sourced from the official websites of 7 organizations, including IOC, IPC, WHO, UN Department of Economic and Social Affairs, Eurostat, Johns Hopkins University and Our World in Data. The Olympic variables were the change in participant share (CPS) and the change in medal share (CMS) for a country during the past Olympiad. The pandemic variables were the cumulative number of death cases (CDC) and CDC per unit of population (CDCP), and the cumulative number of the confirmed cases (CCC) and CCC per unit of population (CDCP). The study was conducted using SPSS 26.0 statistical software with 2-sided Pearson correlation analysis. Significance was set at $P<0.05$.

RESULTS: At the Tokyo Summer Olympics, CPS was most significantly positively correlated with CDC ($r204=0.27$, $P<0.001$) and CMS was most significantly negatively correlated with CDC ($r100=-0.46$, $P<0.001$). At the Beijing Winter Paralympics, CPS was most significantly positively correlated with CDCP ($r52=0.35$, $P= 0.010$) and CMS was most significantly negatively correlated with CCC ($r23=-0.51$, $P=0.013$). No significant associations were found between Olympic variables and pandemic variables at the Tokyo Summer Paralympics and the Beijing Winter Olympics.

CONCLUSION: At the Tokyo Summer Olympics, elite sports in urbanized countries with more severe pandemics recovered faster overall, but their medal competitiveness also declined more. This effect faded at the Beijing Winter Olympics, but appeared at the Winter Paralympics, highlighting the delayed impact of pandemics on global elite para sports. This study also demonstrates the power of multi-sourced Internet 'big data', and may inspire research across public health and elite sports and inform decision-making in elite sports recovery from pandemic.

REFERENCES:

1. Vitale JA et al., Biology of Sport, 2021

2. Kemp S et al., Br. J. Sports Med, 2021

3. Fagher K et al., BMJ Open Sport Exercise Med, 2022

Oral Presentations

OP-SH18 Physical Education and Pedagogics II

THE ASSOCIATIONS OF ENJOYMENT AND PHYSICAL ACTIVITY ON THE DOMAINS OF SELF-CONCEPT AMONG HUNGARIAN ADOLESCENTS

BERKI, T., TÓTH, L., CSÁNYI, T.

HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

Introduction

One of the most important driving forces of sports activities is enjoyment, which reflects on feelings such as pleasure, liking, and fun. The enjoyment of sports has been studied extensively by researchers in recent years, but little is known about the relationship between the enjoyment of physical activity (PA) and physical education (PE). However, previous studies have shown that internal motivational factors, such as enjoyment, can positively influence young peoples psychological behavior. Therefore, our study aims to investigate the relationships between two forms of enjoyment (PA and PE) and students self-concept in early adolescence. We also investigate the role of physical activity on self-concept variables.

Material and methods

The sample consisted of 315 students ranging between 10-14 years old (Mage=12.63). Self-Description Questionnaire-I was used to measure the eight domains of Self-Concept (Reading, Mathematics, General School Concept, Physical Ability, Physical Appearance, Peer Relations, Parent Relations, and General Self-Concept). Enjoyment was measured with two scales. The Physical Activity Enjoyment Scale reflected PA enjoyment outside of school and the Factors Influencing Enjoyment of Physical Education Questionnaire reflected PE enjoyment in school. The short version of the International Physical Activity Questionnaire was used to assess the participants vigorous, moderate, and walking types of PA outside of the school. Hierarchical regression analysis was conducted on each self-concept variable.

Results

Our final model revealed that Vigorous PA were a significant predictor for Physical Appearance (β=.15) and Physical Ability (β=.19). PA Enjoyment were significant for General Self-concept (β=.29), Physical Ability (β=.28), Physical Appearance (β=.16), Peer Relation (β=.16) and Parent Relation (β=.22). PE Enjoyment significantly predicted General School (β=.17), Physical ability (β=.27), Peer Relation (β=.21) and Parent Relation (β=.22). Furthermore, boys perceived higher level on most of the domains of self-concept. The variance was explained by 44% of the highest and 5% of the lowest in our models.

Conclusions

Physical activity did not play a crucial role, which was indicated by only a few significant associations and the low effect values. However, enjoyment of PA and PE had a significant impact on self-concept. Both variables had a strong effect on social variables, and those who had a high level of enjoyment in both forms perceived better physical abilities. An interesting difference between the two forms of enjoyment is that the enjoyment of PA is general, while the enjoyment of PE strengthens the self-concept in school. This study highlights the importance of physical education since physical educators can contribute to creating a more positive school environment with the proper physical education class.

INTERVENTIONS WITH A FOCUS ON COGNITIVE ACTIVATION IN PHYSICAL EDUCATION: A SYSTEMATIC REVIEW WITH META-ANALYSIS

TÖPFER, C., ENGELHARDT, S., CARL, J., HAPKE, J.

FRIEDRICH-SCHILLER-UNIVERSITY JENA

Introduction

Conceptualizations such as Concept-based Physical Education or Teaching Games for Understanding (TGfU) highlight the importance of cognitive learning in PE. Cognitive activation is the in-depth mental engagement with sport and movement-related learning objects (Engelhardt et al., 2023). Five potential goals of cognitive activation in PE are suggested: (health-related) knowledge, motor skills, game performance and understanding, reflective ability and motivation (Engelhardt et al., 2023). We examined the effectiveness of interventions that focus on cognitive activation in PE.

Methods

A systematic review was conducted to analyse the current research situation in German- and English-speaking countries (Page et al., 2021). We searched in national and international databases (e.g., SPORTDiscus, Scopus) in the period from 2000-2022, using a variety of search terms reflecting the idea of cognitive activation (e.g., reflection, cognitive engagement). Title, abstract and full-text screening as well as data extraction and risk-of-bias assessment were carried out by two independent reviewers. We conducted a meta-analysis (Review Manager 5.4) with all controlled studies to assess their effectiveness (including sub-group analyses).

Results

We incorporated a total of 3.418 hits into the screening process (Cohens kappa: 0.75-0.96), resulting in 30 intervention studies being included in data extraction. The majority of the studies came from the USA and Spain. Half of the studies (n=15) followed a control group design. The majority of the intervention programmes were based on methodological approaches such as TGfU or 5-E-learning cycle. Empirical evidence of learning outcomes could be identified for (health-related) knowledge (g=0.54), motor skills (g=0.56), game performance and understanding (g=0.48), and motivation (g=0.39). Reflective ability was not empirically measured in any of the intervention studies.

Discussion

The systematic review demonstrated that cognitive activation in PE not only promotes knowledge-related outcomes, but also influences a variety of other outcome variables (e.g., motivation). However, there are limitations with regard to the scope of the data available. Due to the small number of studies with a control group design, further studies are needed to strengthen the robustness of the meta-analytical findings.

References

Engelhardt, S., Hapke, J. & Töpfer, C. (2023). Kognitive Aktivierung im Sportunterricht: ein Scoping Review zur Umsetzung methodisch-didaktischer Merkmale und zugrundeliegender konzeptioneller Grundannahmen. Unterrichtswissenschaft. https://doi.org/10.1007/s42010-023-00178-x

Page, M. J., Mckenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

UNVEILING THE HOLISTIC TAPESTRY OF MOVEMENT, IDENTITY, AND WELL-BEING: INTEGRATING PHYSICAL ACTIVITY WITH AESTHETIC EXPERIENCE THROUGH CULTURAL KINETICS

XU, Y., HE, Z.

PEKING UNIVERSITY

Background and aim:

In the context of China, where cultural traditions are intricately woven into the fabric of daily life, the fusion of aesthetic experience with physical activity is not merely a method to encourage physical movement but a holistic approach to embrace cultural heritage. This research explores innovative methodologies that amalgamate cultural-heritage-inspired aesthetic experiences with physical activity, aiming to enhance holistic physical and socio-cultural well-being among higher education participants.

METHODS: An active research was conducted. We developed and executed two experiential workshops in collaboration with multidisciplinary experts, drawing inspiration from cultural heritage to blend aesthetic experience with physical activity. These workshops, open to students and faculty in higher education, were evaluated through qualitative surveys and semi-structured focus groups. The first workshop integrated ancient Chinese poetry, Guqin music, and classical dance to create a comprehensive learning environment that nurtures body, mind, and spirit. The second workshop, centered around Kunqu opera, encouraged participants to engage with opera-style physical movements and contemplate gender and identity aesthetics through the roles of Sheng (male) and Dan (female).

RESULTS: The incorporation of cultural heritage into physical activity fostered a unique and immersive learning experience, enriching participants' understanding of body movement, cultural identity, and holistic well-being. Feedback highlighted the benefits of immersive learning, collaborative group dynamics, the interdisciplinary mentorship, and the synthesis of practice and performance. The majority of participants reported enhanced imagination and creativity in physical movement and activity.

Conclusions:

These workshops conducted in this active research transcend traditional physical education by highlighting the synergy between physical, cultural, and aesthetic dimensions of well-being. They advocate for physical literacy as a pivotal element of a holistic, culturally enriched lifestyle in China, thereby broadening the cultural significance of physical activity.

GENERATIONAL DIFFERENCES IN PROMOTING EXERCISE BEHAVIOR THROUGH MOBILE PHONE APPLICATIONS: THE MEDIATING ROLE OF COGNITIVE INVOLVEMENT AND AFFECTIVE INVOLVEMENT

SU, R., MENG, M., CHEN, C., CHEN, L., WEI, W., WANG, D.

BEIJING NORMAL UNIVERSITY

Introduction: Mobile phone applications are impacting and changing the health concepts and behaviors of individuals in the different generations in China. In this study, based on the Stimulus-Response theory, we construct a dual-path mediation model to reveal the mechanism through using mobile phone applications influences exercise behavior while considering generational differences.

Methods: This study using a stratified random sampling method, finally 4390 samples were selected from 32 provinces in China. Using mobile phone applications behavior, cognitive involvement, affective involvement, and exercise behavior were measured through questionnaire. Statistical analysis used the product coefficient method, exploring relationships between variables through structural equation modeling, and the intermediate effects of the model are estimated through the Monte Carlo bootstrapping method. Furthermore, stratified regression analysis is applied to test the moderating effects of generational differences. Data analysis was performed using R program version 4.10 and Amos 20.0, with a significance threshold set at $p < 0.05$.

Results: (1) Cognitive involvement as a significant mediator in the relationship between using mobile phone applications and exercise behavior ($Z = 3.40$, 95% CI [0.08, 0.28], $p < 0.001$). (2) Affective involvement shows a positive influence on cognitive involvement, and both emotional and cognitive involvement as significant the chain mediating roles in the connection between using mobile fitness applications and exercise behavior ($Z = 3.29$, 95% CI [0.06, 0.23], $p < 0.001$). (3) The moderating effect of the different generations in promoting exercise through using mobile fitness applications is not significant (difference = -0.05/0.05/0.09, SE = 0.08/0.08/0.06, $p = 0.55/0.54/0.13$).

Conclusion: Using mobile phone applications serves as a beneficial approach to exercise behavior, and cognitive involvement and affective involvement mediate the relationship between using mobile phone applications and exercise behavior. There is no generation difference in the using mobile phone applications and exercise behavior.

Oral Presentations

OP-SH11 Psychology/Cognition I

ECHOES OF SILENCE: EVALUATING THE EFFECTS OF AUDIENCE RESTRICTIONS ON ELITE GOLF PERFORMANCE

LUNDKVIST, E., LARSSON, R., KALÉN, A.
UMEÅ UNIVERSITY

Introduction

The unique circumstances of the COVID-19 pandemic offered an opportunity to study the effect of audience presence on athletic performance. This research focused on professional golf, an individual sport where performance can be quantitatively measured, providing a clear view of the impact of spectators. Drawing on theories of social facilitation [2, 3] and psychological pressure[4], this study aimed to explore how the presence, absence, and limited presence of spectators influenced PGA TOUR golfers performances over the 2018-2022 seasons. This exploration is rooted in the broader context of how environmental factors affect athletic performance, contributing to the ongoing discussion in sports psychology and performance analysis.

Methods

The performance of 832 professional golfers across five seasons (103 00 golf rounds) of the PGA TOUR was analysed before, during and after audience restrictions. Performance metrics were examined using two-level linear mixed models [1].

Results

The findings revealed a complex relationship between audience presence and golfer performance. Overall, players performed best in the absence of spectators. Conversely, the presence of an audience following the pandemic showed better performance levels than with audience before the pandemic, indicating a possible effect of the decision making learned without an audience. Notably, experience and skill level of the players did not interact with these results.

Discussion

The study highlights the nuanced interplay between athlete performance and audience presence, suggesting that presence of spectators influence professional golfers performance. This research extends the understanding of social facilitation in sports, emphasizing the need for personalized approaches in athlete preparation and coaching. Future research directions include using underlying performance measurements to understand what parts of the game where the players performed differently, qualitative interviews to get the players experiences of playing with and without an audience and physiological measurements to further understand what might cause the differences.

References:

1. Aarts, E., et al., A solution to dependency: using multilevel analysis to accommodate nested data. Nature neuroscience, 2014. 17(4): p. 491-496.

2. Zajonc, R.B., Social Facilitation. Science, 1965. 149(3681): p. 269-274.

3. Böheim, R., D. Grübl, and M. Lackner, Choking under pressure – Evidence of the causal effect of audience size on performance. Journal of Economic Behavior & Organization, 2019. 168: p. 76-93.

4. Jane, W.-J., Choking or excelling under pressure: Evidence of the causal effect of audience size on performance. Bulletin of Economic Research, 2022. 74(1): p. 329-357.

EFFECTS OF PRESSURE AND MOVEMENT REINVESTMENT ON PERFORMANCE IN EXECUTION-ONLY AND DYNAMIC FOOTBALL SHOOTING TASKS

SULLIVAN, R., UIGA, L.1, MASTERS, R.S.W.3, ANSON, G.1, NIEUWENHUYS, A.1
1 UNIVERSITY OF AUCKLAND; 2 MANCHESTER METROPOLITAN UNIVERSITY; 3 UNIVERSITY OF WAIKATO

Introduction

The Theory of Reinvestment predicts that pressure negatively impacts expert players' execution of perceptual-motor skills, due to conscious reinvestment of explicit knowledge about how to perform the skills (i.e., 'conscious motor processing'). The current project examined whether trait reinvestment and conscious motor processing can explain effects of pressure in 'execution-only' and 'dynamic' performance situations, where opponents' actions may require the sudden cancellation or adaptation of ongoing movement.

Methods

Across four studies, experienced football players performed shots on goal against a goalkeeper and defending players who either stood still ('execution-only'; Study 1, n = 30) or who occasionally moved to intercept players' shots ('dynamic'), in which case players were instructed to completely inhibit (Study 2, n = 15) or redirect their shots (Study 3, n = 30; and Study 4, n = 30). Performance pressure was manipulated by means of an evaluative audience or a combination of contingencies (monetary reward, video recording, error feedback). Players' trait reinvestment was determined with the Movement Specific Reinvestment Scale. Conscious motor processing was assessed using established questionnaires or by means of

a skill-focused dual-task. Measures of performance included shooting accuracy, inhibition/redirection success, reaction- and shot completion times.

Results

Findings from Studies 1 and 2 indicate that pressure did not significantly impact conscious motor processing or shooting accuracy. In Study 2, anticipated goalkeeper movement, caused attention to shift away from the target and towards the goalkeeper (p =.003), resulting in reduced shooting accuracy (p = .01). Furthermore, players who were characterized as high trait reinvestors showed greater inhibition success under pressure (p = .04). Studies 3 and 4 are currently ongoing and results will be available at the time of presentation.

Discussion

Findings thus far suggest that anticipation of goalkeeper movement (i.e., dynamic performance situations), negatively impacts target-related attention and shooting accuracy in football players. In addition, findings suggest that pressure may facilitate inhibitory performance in those players who go about their skill execution in a deliberate and self-conscious manner. Results from Studies 3 and 4 will reveal whether these results extend to situations where players redirect rather than inhibit their shots in response to goalkeeper/defender movement and further uncover potential benefits of trait reinvestment.

INHIBITORY CONTROL MEDIATES THE ASSOCIATIONS BETWEEN MODERATE-TO-VIGOROUS PHYSICAL ACTIVITY AND ADOLESCENTS` OFF-TASK BEHAVIOR IN THE CLASSROOM

BERGER, M., GERBER, M., BRAND, S., MÖHRING, W., PÜHSE, U., LYDIGA, S.

UNIVERSITY OF BASEL

Background: Off-task behavior in the classroom means not focusing on the current learning task but fidgeting, making noise, or being passive. Individual cognitive states and profiles may underlie this behavior. Accumulating evidence suggests that moderate to vigorous physical activity (MVPA) benefits academic behavior (1, 2) and a set of cognitive abilities (3). However, it remains unclear if these MVPA-related cognitive benefits translate into reduced off-task behavior.

Aim: This cross-sectional study investigates the direct association between MVPA and off-task behavior as well as mediations by different cognitive domains in adolescents.

Sample: 46 male and 67 female adolescents aged 13 ± 1.3 years were recruited from local schools in the greater area of Basel, Switzerland.

Methods: Participants recalled their MVPA with the 7-day physical activity recall protocol. Using video cameras, their classroom behaviours were recorded and a 6-min period was rated for off-task behaviour. Additionally, participants completed computerized cognitive tasks in a group setting. The tasks encompassed a modified Flanker task, which assessed both inhibitory control and cognitive flexibility, a Sternberg paradigm, which assessed working memory, and an Emotion Recognition task.

Results: Path-analyses revealed that higher MVPA was associated with less off-task behaviour. Inhibitory control accounted for a partial mediation of this association. The mediating role of inhibitory control was most pronounced for the relation between MVPA and off-task behaviours related to noise (e.g. speaking out of turn).

Conclusion: These findings provide a first indication that curricular and extracurricular physical activities targeting specific improvements in inhibitory control may promise transfer effects to favourable classroom behaviours.

References:

(1) Alvarez-Bueno, C., Pesce, C., Cavero-Redondo, I., Sanchez-Lopez, M., Garrido-Miguel, M., & Martinez-Vizcaino, V. (2017). Academic achievement and physical activity: A meta-analysis. Pediatrics, 140, 1–14.

(2) Carlson, J. A., Engelberg, J. K., Cain, K. L., Conway, T. L., Mignano, A. M., Bonilla, E. A.,...Sallis, J. F. (2015). Implementing classroom physical activity breaks: Associations with student physical activity and classroom behavior. Preventive Medicine, 81, 67–72

(3) Ludyga, S., Gerber, M., Pühse, U., Looser, V. N., & Kamijo, K. (2020). Systematic review and meta-analysis investigating moderators of long-term effects of exercise on cognition in healthy individuals. Nature Human Behaviour, 4, 603–612

SELECTIVE ATTENTION OF ELITE VERSUS YOUTH BIATHLETES IN REST AND AFTER PHYSICAL LOAD

BIRKLBAUER, J., DIRNBERGER, J.1,2, BUCHECKER, M.1, SATTLECKER, G.3, FINKENZELLER, T.1, KÖSTERS, A.1, WIESINGER, H.P.1,4

1: DEPARTMENT OF SPORT & EXERC SCI, UNIVERSITY OF SALZBURG; 2: OLYMPIC TRAINING CENTER SALZBURG; 3: INTERNATIONAL BIATHLON UNION; 4: INSTITUTE OF NURSING SCI & PRACTICE, PARACELSUS MEDICAL UNIVERSITY

INTRODUCTION: Attention abilities are critically important for performance in self-paced and far-aiming sports, enabling athletes to focus on targets and resist distractions. Accordingly, elites in shooting and archery showed better selective attention compared to their lower-level counterparts (1). In biathlon, demands on attention are arguably even greater, as shooting has to be completed under time constraints and significant physical exertion. First indications of enhanced conflict control in biathletes with superior shooting performance were derived from cluster analyses (2). Based on these preliminary findings, we hypothesized that elite outperform youth biathletes in visual interference control of attention during rest and even more after physical exertion.

METHODS: Twenty-six youth biathletes (14 males; 15.4±1.1 yrs of age) and 14 European and World Cup biathletes (10 males; 22.7±3.1 yrs) fired 3 x 5 shots in prone and standing shooting positions without physical load followed by 2 x 5 shots in both positions during a simulated pursuit race. According to their usual race distance, elites had to roller ski 5 loops of 2.5 km and youth 5 loops of 1.5 km in their individual race pace. Selective attention was assessed using a modified Eriksen-Flanker Task both before the rest condition and after the simulated competition. 50m-shooting performance was measured on a scale from 0 to 10 rings.

RESULTS: Frequentist 2-way ANOVAs revealed neither significant group differences ($p>.562$) nor interaction effects ($p>.302$) in the interference scores or incongruent trials of response times (RT) and errors with low effect sizes ($\eta2p<0.028$). These findings were supported by Bayesian analyses providing anecdotal to moderate evidence in favour of no group (BFincl<0.544) or interaction (BFincl<0.453) effects. With large effects ($\eta2p>0.165$) and strong evidence supporting a change (BFincl>11.6), RT improved from pre to post test in both incongruent and congruent trials by 14±28 ms ($p=.002$) and 14±25 ms ($p=.009$), respectively. Elites outperformed youth athletes in their shooting performance ($p<.001$; $d=1.991$) with decisive evidence (BF10>1000).

CONCLUSION: Our findings contradict previous results in conventional shooting and archery sports, as elite biathletes showed no better flanker conflict control than youth. Hence, selective attention, as measured by the Flanker Task, seems not to be a determining factor for biathlon performance. Mindfulness training, which has been shown to improve the attention networks in elite shooters and archers (1), may not be as promising in biathlon. The improvements in RT after the simulated race are in line with the observation that maximum physical exhaustion facilitates information processing speed in the Flanker Task (3), which can be explained by the astrocyte-neuronal lactate-shuttle hypothesis.

REFERENCES:

1 Lu et al., Front Psychol, 2021

2 Würth et al., Sci & Nordic Skiing III, 2016

3 Finkenzeller et al., Eur J Appl Phys, 2018

Oral Presentations

OP-SH04 Sport management and law I

A STUDY ON THE CHINESE TAIPEI TOP-TIER BADMINTON PLAYERS' SPONSORSHIP

TSENG, Y., CHENG, S.

TSINGHUA UNIVERSITY

Introduction

Sports sponsorship has become a vital strategy in corporate marketing. While sponsorships involving sports events, organizational entities, and venue naming rights are common, athlete endorsements often yield superior results. However, conflicts between athletes and sponsoring brands frequently arise, which few of the previous researches in Chinese Taipei have been discussed from the perspective of athlete endorsements. This paper supplements this perspective, aiming to understand the overview of corporate sponsorship of badminton in Chinese Taipei, the current status of athletes receiving corporate sponsorship and their understanding of sponsorship. The goal is to foster mutually beneficial relationships between corporations and athletes.

Method

This study employs a semi-structured interview method. Data collection is based on the theoretical framework formed around the four major benefits of sports sponsorship proposed by Howard and Crompton (1995), the basic standards of endorsers proposed by Micik and Shanklin (1994), and the "FRED (representing Familiarity, Relevance, Esteem, and Differentiation)" principle of ideal endorser selection factors proposed by Cheng (2001). Ten top badminton players from Chinese Taipei, who have participated in the Olympic event, are selected for interviews. Data analysis involves coding the interview text according to the interview outline, followed by classification, reorganization, and comparison with existing literature.

Results

(1) Enterprises and corporate teams have established performance-oriented signing mechanisms, tending to provide excellent sponsorship resources for top athletes. They primarily assess athletes based on the professionalism of their sports projects, competition results, social image, and potential when selecting athletes as brand endorsers or training targets. (2) Athletes have a certain understanding of the traits of endorsers and how to maintain good relationships with sponsors, but their understanding of sponsorship concepts and long-term partnerships with sponsors is limited. (3) Sponsorship conflicts often occur when athletes receive sponsorships from similar enterprises, which are often caused by competition between enterprises.

Discussion

To promote better cooperation and reduce sponsorship conflicts, athletes should understand the basic concepts of sports sponsorship and the traits required of endorsers. Management departments should address issues such as lack of resources for athletes and encourage enterprises to invest in sports sponsorship to improve athletes competitive levels and promote sponsoring enterprises.

References

Cheng, S. T. (2001). Analysis of sports marketing warfare: marketing competition on the field. Taipei City: Hanwen.

Howard, D. R., & Crompton, J. L. (1995). Financing sport. Morgantown, WV: Fitness Information Technology.

Miciak, A. R., & Shanklin, W. L. (1994). Choosing celebrity endorsers. Marketing Management, Chicago, 3(3), 50-60.

HOW SCENE FEATURES OF E-COMMERCE LIVE STREAMING INFLUENCE CONSUMERS' PURCHASE INTENTION? AN EMPIRICAL STUDY FROM THE FIELD OF SPORTING GOODS

LI, Z., GUO, Z.1, WANG, Y.2

1.TSINGHUA UNIVERSITY; 2.SHANGHAI UNIVERSITY OF SPORT

Introduction

The scale of live-streaming users reached 765 million, and the transaction scale in 2022 reached 3.5 trillion in China. Live streaming has offered new opportunities for retailers to increase their sales (Zheng et al., 2023). Many sporting goods brands began to take advantage of live-streaming platforms to improve product sales volume. Previous research focused on the anchors' features how to impact the purchase intention; however, the underlying mechanism by which scene feature influences consumers' purchase intention is still unknown. Thus, this study aims to explore the relationship between purchase intention (PI) and scene features, which include visual appeal (VA), presence (PR), scene-product matching (SM) in the sporting goods field. Flow experience (FE) and sport identification (SI) as mediating and moderating variables respectively.

Methods

Data were collected through snowballing referrals on social software (i.e., WeChat and QQ) and several anchor's fan groups of sporting goods e-commerce live streaming via an online questionnaire from March 10 to 20, 2023. 340 valid questionnaires were gathered. Using structural equation modeling to analyze the path influence relationship between the variables and test hypotheses through SPSS26.0 and AMOS 26.0.

Results

Firstly, VA ($\beta = 0.24$, $p = 0.008$), PR ($\beta = 0.31$, $p < 0.001$) and SM ($\beta = 0.39$, $p < 0.001$) positively impact FE. From the perspective of the path that scene features affect PI, VA ($\beta = 0.31$, $p = 0.009$), PR ($\beta = -0.03$, $p = 0.751$), and SM ($\beta = 0.32$, $p = 0.003$). Moreover, FE contributes positively to PI ($\beta = 0.26$, $p = 0.036$). The variances explained for FE and PI are 0.67 and 0.82, respectively. Secondly, FE has a significant mediating effect between scene features (i.e., VA, PR, SM) and PI; the mediating effect accounts are 45.3%, 72%, and 44.4%, respectively. Thirdly, the regression coefficient of interaction term (FE×SI) is 0.001 ($t = 0.16$, $p = 0.987$), indicating that the model's explanatory power is weak.

Discussion

This study totally proposed 11 hypotheses while two were refused. We suggested that sporting goods vendor create an attractive and matching scene to enhance PI. An authentic outdoor environment as the scene can give consumers a more immersive feeling than using a virtual store. PR has no significant effect on PI, which echoes previous conclusion. The consumer is relatively rational and objective, and needs more factors to stimulate the purchase intention. Moreover, a strong sales atmosphere makes consumers who watch e-commerce live streaming to get pleasure may have antipathy. Contrary to prior research in the United States. SI has no significant moderating effect between FE and PI. Consumers with low SI can buy sporting goods for fitness activities. In addition, the main crowd is young people, who buy it for liking sporting trend culture or impulse buying.

References

Zheng, S. et al., (2023). J. Retail. https://doi.org/10.1016/j.jretconser.2022.103240

THE MEDIATION EFFECT OF INVOLVEMENT BETWEEN SERVICE QUALITY, SATISFACTION, AND BEHAVIOR INTENTION IN FITNESS CENTER

HUANG, C.H.

NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: The fitness industry in Taiwan has experienced rapid growth over the past decade. As customers increasingly demand high-quality service from fitness centers, it has become imperative for these establishments to provide top-notch sports and recreation services. Given that service quality is central to the mission of sport and recreation centers, understanding the nature of service quality is of paramount importance. Customers play a significant role in focusing on service quality and identifying what they perceive as quality in the fitness market, especially in terms of satisfaction and behavioral intention.

In the fitness industry, consumers participation in exercise, engagement with specific sports centers, and involvement in fitness center services indicate the importance of involvement. Service encounters influence the leisure experience of

participants and act as antecedents of activity involvement. Involvement represents an internal state variable that reflects the amount of arousal and interest to engage in an activity and serves as a mediator of consumer behavior.

This study aims to explore the relationship among service quality, involvement, satisfaction, and behavior in fitness centers in Taiwan. Additionally, it seeks to examine the mediating effect of participant involvement between service quality, satisfaction, and behavioral intention.

Method:

For this study, a questionnaire was designed to investigate the service quality, involvement, satisfaction, and behavior intention of fitness center participants, utilizing a five-point Likert-type scale. First, Exploratory Factor Analysis (EFA) was employed to extract the main items of service quality and involvement. Subsequently, the primary factorial dimensions of service quality and involvement were incorporated into Structural Equation Modeling to examine the relationships among service quality, involvement, satisfaction, and behavior intention. Finally, the mediation effect of involvement between service quality, satisfaction, and behavior intention was also tested.

RESULTS: In the EFA, there were initially 21 items for motivation, resulting in the extraction of four factor dimensions: Employees, Ambience, Price, and Convenience. According to the Structural Equation Modeling, the results showed that service quality positively and significantly influences satisfaction, behavior intention, and involvement. Involvement positively and significantly affects behavior intention but does not significantly influence satisfaction. Through bootstrapping within a 95% interval, it was found that both the direct and indirect effects are significant for both satisfaction and behavior intention. Involvement partially mediates the relationship between service quality, satisfaction, and behavior intention.

Discussion:

Service quality holds significant importance in the fitness industry in Taiwan. To enhance customer satisfaction and behavioral intention, fitness center managers should closely monitor the quality of the ambience and employees within the physical environment. Participants perceive the importance of engaging in an activity based on perceived quality in fitness centers, and involvement mediates the relationship between service quality, satisfaction, and behavioral intention. A higher level of customer involvement corresponds to greater input into the service delivery process and, consequently, the final outcome.

ENVIRONMENTAL SUSTAINABILITY GOVERNANCE IN MEGA SPORT EVENTS: INSIGHTS FROM FIFA WORLD CUP 2022 PRACTICES

YAO, F., WANG, P., LIU, B., GUO, Z.
TSINGHUA UNIVERSITY

Introduction

Multiple stakeholders are highly involved in environmental sustainability governance when holding mega sports events, as governance subjects to influence governance outcomes. Therefore, it is necessary to summarize an environment sustainability governance model in a mega event, especially from the collaborative stakeholder perspective. This paper aims to analyze how stakeholders collaborate upon environmental sustainability issues in the case of FIFA World Cup Qatar 2022 (FWC 2022).

Methods

Original materials of this empirical case study are derived from open sources, including academic journals and book chapters, official reports and documents from FIFA and FWC 2022, media releases etc. We proceed with these materials in three steps. Firstly, providing explanation of the SFIC analytical framework. Secondly, categorizing the stakeholders of FWC 2022, and extracting the four governance elements in line with that in the SFIC model. Thirdly, concluding a framework for future mega sports events on environmental sustainability governance.

Results

According to SFIC collaborative governance model, it divides collaborative governance into four main stages: starting conditions (S), leadership facilitation (F), institutional design (I), collaboration process (C) and followed governance outcomes. FWC 2022 has showed a typical example of applying stakeholder collaborative governance in environmental sustainability practices. Starting with stakeholder identification stage, the critical tournament stakeholders can be identified into internal and external groups. In the leadership facilitation stage, sustainability management system (SMS) is established for clear leadership roles, responsibilities, and governance structures. In the institutional design stage, the sustainability policy and strategy were designed as the fundamental guide of the tournament and formed the basis of the SMS and stakeholder engagement. Followed the collaboration process, stakeholder collaborative governance practices on environmental sustainability are achieved through trust building with dialogue, commitment based on a materiality assessment, shared understanding on sustainability vision and missions, collaborative behaviors and outcomes on sustainable building, low-emission solutions, waste and water management.

Discussion

Extracting insights from the case of FWC 2022, the stakeholder collaborative governance framework can be a valuable reference for future environmental sustainability efforts in mega sports events. The initial element of the framework is to identify relevant stakeholders, then build governance structure with facilitate leadership and clear rules, for achieving the collaborative governance as an iterative process of dialogue, trust, commitment, understanding factors. It is also im-

portant to note here that the realization of a collaborative stakeholder governance process cannot be achieved in the short term but requires prior planning and preparation.

DOES SPORTING GOODS MANUFACTURING INDUSTRY AGGLOMERATION HAVE ECOLOGICAL SPILLOVER EFFECT? ——A SPATIAL REGRESSION ANALYSIS BASED ON CHINA'S PROVINCIAL DATA

ZHANG, R., YAO, F., GUO, B., NIU, J., LI, X., TSENG, Y., ZHANG, C.
PEKING UNIVERSITY

Introduction

As a core sector of Chinas sports industry, the sports goods manufacturing industry accounts for over 50% of the total output, with industrial agglomeration being a notable characteristic. This paper focuses on the ecological externality of this phenomenon, aiming to leverage the industrys spatial spillover effects to promote sustainable development in the regions.

Methods

The research subject of this paper is the sports goods manufacturing industry across 30 provinces in China, from 2012 to 2016 and from 2018 to 2019 (data missing for 2017). Provincial-level industrial agglomeration is calculated using Excel 2019, while ecological efficiency is calculated using DEA-SOLVER Pro 5.0 software. Based on the STIRPAT theory, exploring spatial data analysis and spatial regression analysis were conducted using Open GeoDa 1.16 and STATA 15.0 software. The spatial Durbin model was employed to analyze the relationship between sports goods manufacturing industry agglomeration and ecological efficiency. Other explanatory variables include demographic, economic, and technological factors, while control variables encompass industrial structure, urban development, environmental governance, and opening up factors.

Results

(1) The spatial autocorrelation results indicate that ecological efficiency exhibits a "low-low" agglomeration pattern, concentrated in the Northwest China. The sports goods manufacturing industry demonstrates both "high-high" and "low-low" agglomeration patterns, with the "high-high" agglomeration distributions observed in the Southeast China. (2) The panel model results reveal an inverted U-shaped relationship between the high-level agglomeration areas and regional ecological efficiency. (3) The effect decomposition results of the spatial panel model indicate that the direct and total effects of industrial agglomeration in the sports goods manufacturing industry are significantly positive. Among the explanatory variables, the direct effects of demographic and economic variables are significantly negative, while the spillover and total effects are significantly positive, with technological variables exhibiting the opposite pattern. Within the control variables, the spillover and total effects of industrial structure, environmental governance, and urbanization variables are significantly negative, whereas the opening up variables exhibiting the opposite pattern.

Discussion

Currently, the agglomeration of China's sports goods manufacturing industry exhibits significant regional disparities and demonstrates a positive trend in ecological externalities within the region, surrounding areas, and nationwide. This trend manifests as an initial increase followed by a decrease in the impact on regional ecological efficiency, resulting from the combined effects of population, economic, technological, and other urban development factors. Future agglomeration expansion should focus on pollution control and environmental protection efforts.

11:00 - 12:15

Oral Presentations

OP-AP15 Cycling: Training Interventions and Demands

A MICROCYCLE WITH MODERATE-INTENSITY INTERVAL TRAINING IMPROVES ENDURANCE PERFORMANCE IN WELL-TRAINED CYCLISTS

SINDRE MØLMEN, K., ODDEN, I., SØRENSEN, M., RØNNESTAD, B.
INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: To organize training into shorter periods of time with specific training focuses has become increasingly common for endurance athletes in recent years. Particularly, organizing high-intensity interval training sessions in microcycles has been well-studied and found to improve endurance performance-related variables [1]. There is, however, little evidence on how efficient similar type of training strategy is when performing moderate-intensity interval training (MIT) in well-trained endurance athletes. Here, we compare the physiological effects of a seven-day MIT microcycle with a time-matched period with usual training (CON) in well-trained cyclists.

METHODS: Using a randomized crossover design, 30 male cyclists (maximal oxygen consumption (VO2max),70.5 (4.6) mL/min/kg) performed both a MIT microcycle and CON training. Sixteen and 14 of them started with the MIT microcycle and CON training, respectively. The MIT microcycle consisted of six interval sessions distributed over seven days. In con-

secutive days, except for a rest day on the 4th day, they performed interval sessions with 7x10 min, 6x12 min, 5x14 min, 7x10 min, 5x14 min, and 6x12 min work periods, with the aim of hitting 14-15 on the Borg 6-20 rating of perceived exertion (RPE) during the work intervals (equivalent to a perceived exertion of "somewhat hard" to "hard"). A six-day taper period was carried out before physiological testing. The efficacy of the MIT and CON training was measured as changes in 15-min maximal average power output (PO15min), power output at 4 mmol/L [blood lactate] (PO4mmol), mean power output achieved during the last minute of an incremental test (pVO2max), and VO2max.

RESULTS: Average RPE during work intervals in the MIT microcycle was 14.4 (0.3), which corresponded to 66.4 (4.8) % of pVO2max, 85.3 (3.3) % of maximal heart rate, and 2.8 (1.1) mmol/L [blood lactate]. The MIT microcycle led to significantly larger improvements than CON on PO4mmol (4.0 (4.4) % vs. -1.3 (3.7) %, respectively; p<0.001) and pVO2max (2.5 (4.5) % vs. -0.7 (3.9) %, respectively; p=0.007), while changes in PO15min were not statistically different between interventions (3.9 (8.3) % vs. 0.2 (6.8) %, respectively; p=0.138). VO2max tended to increase more following MIT than CON (2.0 (3.9) % vs 0.0 (3.5) %, respectively; p=0.055).

CONCLUSION: Six MIT sessions distributed over seven days followed by a taper period induced larger improvements in measures of endurance performance than a time-matched period of usual training in well-trained cyclists.

Reference: 1. Mølmen KS, Øfsteng SJ, Rønnestad BR. Block periodization of endurance training - a systematic review and meta-analysis. Open access J Sport Med. 2019;10:145–60.

REPLACING LOW INTENSITY ENDURANCE EXERCISES WITH HIGH INTENSITY MICRO-INTERVALS

MATOMÄKI, P.

UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Typically, low intensity endurance exercise (LIE) is performed as a continuous session below the first lactate threshold. However, this is not the only way to execute LIE. High intensity micro-intervals, which should not be confused with maximal sprint interval exercises, are exercises, where work phase lasts at most 15 seconds at ~100% VO2max and recovery period is at least twice as long. These intervals mimic LIE metabolically and cardiopulmonarily [1]. The energy during micro-intervals is produced aerobically using oxygen from the myoglobin stores [1, 2]. Therefore, micro-intervals are highly promising stimulus for peripheral aerobic adaptations, as well as for neuromuscular system adaptations, as muscles operates at or near 100% VO2max with minimal anaerobic component and metabolic cost.

However, little is known about the feasibility and usability of such intervals in the long-term training. The aim of the present study was to investigate whether high-level cyclists' LIE can be replaced with high intensity micro-intervals.

METHODS: In this quantitative-qualitative pilot study, three national-level cyclists (one female) progressively replaced majority of their LIE with micro-intervals for 10 weeks. They underwent a VO2max test and a 6-minute time trial before and after the intervention. To monitor the stressfulness of the training, they completed total quality recovery -scale [3] each morning. Finally, they were interviewed immediately after the intervention.

RESULTS: During the 10-week intervention, the cyclists accumulated 12.5–14.0 h (9–14% of all training time) above VO2max intensity, which accounted for 65–99% of the amount they accumulated during the entire year prior. The cyclists became accustomed to micro-intervals and reported neither cumulative fatigue nor a decrease in total quality recovery. 6-min time trial improved 12–27 W (3–7%), while there were no changes in VO2max.

CONCLUSION: A novel finding was that the extensive use of high intensity micro-intervals is a feasible method for athletes; Micro-intervals do not induce excessive fatigue, they allow athletes to accumulate a large amount of high intensity time, and they provide positive performance adaptations. However, the optimal way to include micro-intervals into training and their role in training programming still need thorough examination.

[1] Åstrand I, et al. Myohemoglobin as an Oxygen-Store in Man. Acta Physiol Scand. 1960;48(3–4):454–60.

[2] Saltin B & Essen B. Muscle glycogen, lactate, ATP, and CP in intermittent exercise. 1971

[3] Kenttä G & Hassmén P. Overtraining and Recovery A Conceptual Model. Sports Medicine. 1998;26(1):1–16.

NOVEL INSIGHT INTO THE CALCULATION OF PURE MAXIMAL GLYCOLYTIC RATE USING THREE ENERGY SYSTEM CONTRIBUTIONS

YANG, W.H., PARK, S., GEHLERT, S.

CHA UNIVERSITY

INTRODUCTION: The glycolytic system supports the metabolic energy requirements during intense exercise. The formula of maximal glycolytic rate (Mader's model) is considered the delta lactate between maximal blood lactate accumulation after a 10-15 s exercise and resting blood lactate levels are divided by the difference between the total exercise time and phosphagen system-contributed time (tPCr). However, this formula does not subtract the energy contribution of oxidative metabolism. Furthermore, tPCr is assumed in which no lactate production takes place ("fictitiously") although it is well known that lactate production occurs independently of oxygen availability under anoxic, hypoxic, and normoxic conditions. The point of –3.5% from the peak power output (tPCr –3.5%) was utilised in previous studies without providing an in-depth explanation on why the decreased 3.5% time point of the peak power output was used as tPCr. However, this method was based on an error in the early SRM cycle ergometer. Therefore, we modified the limitations of the previous formula and compared different calculations of the maximal glycolytic rate.

METHODS: Calculations of the maximal glycolytic rate were based on the differences in defining the phosphagen-contributed time and incorporating the oxidative energy system contribution. In different calculations of the maximal glycolytic rate, tPCr –3.5%, tPCr–peak (the time until peak power output using the latest SRM cycle ergometer [± 0.5-1% error]), and incorporation of the oxidative energy system contribution for pure maximal glycolytic rate using the analysis of the PCr-La–-O2 method during a 15-s maximal cycling test were used.

RESULTS: The level of maximal glycolytic rate (tPCr –3.5%) was higher than pure maximal glycolytic rate and maximal glycolytic rate (tPCr–peak) while maximal glycolytic rate (tPCr–peak) was lower than pure maximal glycolytic rate ($p < 0.0001$, respectively). A very high association between pure maximal glycolytic rate and maximal glycolytic rate (tPCr–peak) was observed ($r = 0.99$). This association was higher than the relationship between pure maximal glycolytic rate and maximal glycolytic rate (tPCr –3.5%) ($r = 0.87$).

CONCLUSION: Pure maximal glycolytic rate as a novel calculation of maximal glycolytic rate provides more detailed insights into inter-individual differences in energy and glycolytic demands than other calculations of maximal glycolytic rate (tPCr–peak and tPCr –3.5%). In particular, because oxidative and phosphagen contributions can differ remarkably between elite track cyclists, implementing those values in pure maximal glycolytic rate can establish more optimized individual responses for elite track cyclists.

HEAT SUIT TRAINING MAINTAINS THE INCREASED HAEMOGLOBIN MASS AFTER ALTITUDE TRAINING CAMP IN ELITE CYCLISTS

URIANSTAD, T., RØNNESTAD, B.R., ODDEN, I., HANSEN, J., MØLMEN, K.S., CARDINALE, D.

INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Altitude training may increase haemoglobin mass (Hbmass) and improve sea-level endurance performance in athletes [1]. As a result, training and residing at high altitudes (>2000 m above sea level) have gained popularity among endurance athletes preparing for competitions at low altitudes [2]. However, the Hbmass gained during altitude camps typically diminishes rapidly upon returning to sea level [3]. Intriguingly, prolonged heat training-induced increase in Hbmass has been shown to be maintained for three weeks by performing only three 50-minute heat suit training sessions per week in elite cyclists [4]. The present study aimed to explore whether a similar approach can maintain increased Hbmass after an altitude training camp in elite cyclists.

METHODS: Eighteen elite male cyclists, with a maximal oxygen consumption of 76.0 (4.8) mL/min/kg, completed a three-week training camp, residing and training >1890 m above sea level. In the weeks following the altitude camp, cyclists were divided into two groups: one group exercised with a heat suit that limited heat loss for 50 minutes three times a week (n=9), while the other followed their usual training routine (n=9). Heat sessions are described in detail elsewhere [4]. The total Hbmass was measured before the altitude training camp, one day after the camp, and three weeks later, i.e., after heat/usual training. Inferential statements about differences in change scores between groups were based on analyses of covariance, with baseline values defined as covariate and the post values as dependent variable.

RESULTS: The three-week altitude training camp led to an overall increase in total Hbmass of 4.1 (2.5)%. The heat suit training group maintained their Hbmass for three weeks after the altitude training camp (0.2 (1.8)%), while the group of usual training displayed a reduction (-3.3 (0.8)%) in the same time period, which corresponded to a significant difference in Hbmass changes between groups during these three weeks ($p<0.05$).

CONCLUSION: Three weekly heat suit training sessions effectively preserved Hbmass compared to usual training without heat stimulation during the three weeks following an altitude training camp.

References:

1. Bonetti and Hopkins 2009. "Sea-level exercise performance following adaptation to hypoxia: a meta-analysis."

2. Turner et al. 2019. "Altitude training in endurance running: perceptions of elite athletes and support staff."

3. Heinicke et al. 2005. "A three-week traditional altitude training increases hemoglobin mass and red cell volume in elite biathlon athletes."

4. Rønnestad et al. 2022. «Heat Training Efficiently Increases and Maintains Hemoglobin Mass and Temperate Endurance Performance in Elite Cyclists."

RACING DEMANDS FOR WINNING A GRAND TOUR: DIFFERENCES AND SIMILARITIES BETWEEN A FEMALE AND MALE WINNER

LAMBERTS, R., VAN VLEUTEN, A., DUMOULIN, T., VAN ERP, T.

STELLENBOSCH UNIVERSITY

INTRODUCTION: Professional road cycling is widely recognized as one of the most demanding sports, particularly during multi-day events such as Grand Tours. In the past decade, female professional cycling has experienced rapid growth, resulting in the introduction of two new Grand Tours, the Tour de France Femmes and the Vuelta Femenina. Despite evident disparities in the training (1) and racing habits (2) of female and male professional cyclists, less is known about the physical demands to win a Grand Tour.

METHODS: The power output of a female Grand Tour winner (Giro Rosa) and a male Grand Tour winner (Giro d'Italia) were analyzed. Mean maximal power outputs (MMP) during different stage types of the Grand Tour (e.g., time trials, flat, semi-mountainous, and mountain stages) were calculated. Additionally, relative power output (percentage of functional thresh-

old power (FTP)) was computed for both cyclists, as well as, time spent in different power zones and changes in MMP's with increasing levels of kJ burnt. A total of 64 power files were analyzed, while data was analyzed with independent t-tests and a one-way Analysis of Variance. Where needed, a Tukey post hoc tests was performed.

RESULTS: Differences in stage characteristics and absolute mean maximal power output were observed during all stage types ($p < 0.05$). However, similarities in relative power output (percentage of FTP) were found across all stage types (0.8-4.5%). Differences in percentage FTP power output were found during the first 50% of flat stages (14.7-15.1%) and the last 25% of mountain stages (9.8%). Overall, both cyclists had exceptionally high 20 to 60 minutes MMP values, reflecting their good climbing and excellent time trail capacities. Decrements in MMP's with increasing levels of kJ burnt were only observed from 30 kJ/kg in female cyclists and 45 kJ/kg in male cyclist.

CONCLUSION: This is the first study to provide insight into the racing demands of female and male cyclist, to win a Grand Tour. While expected differences were found in overall and stage characteristics, as well as absolute power output, strong similarities were found when power was expressed as a percentage of FTP power. The higher percentage of FTP power during the first half of flat stages and the last 25% of the mountain stages can likely be best explained by differences in racing tactics and potentially the climbing capacity of the two cyclists. Besides needing to be a good climber and time trial rider (high 20 to 20 MMP values (3,4)), the very late decrement of MMP's with increasing levels of kJ's burnt,5 highlights the importance of endurance and fatigue resistance in professional cyclists.

References

1. van Erp et al. Int J Sports Physiol Perform. 2020;15:534-540

2. Sanders et al. Int J Sports Physiol Perform. 2019;14:296-302

3. Mateo-March et al. Int J Sports Physiol Perform. 022;17:682-686.

4. Valenzuela et al. Int J Sports Physiol Perform. 2022;17:701-710

5. Mateo-March et al. Int J Sports Physiol Perform. 2022;17:926-931

THE BONE QUALITY OF FEMALE ELITE CYCLISTS IS CHARACTERIZED BY IMPAIRED MICROARCHITECTURE OF CORTICAL AND TRABECULAR BONE AS ASSESSED BY HIGH-RESOLUTION PERIPHERAL COMPUTED TOMOGRAPHY (HR-PQCT)

HILKENS, L., VAN DEN BERGH, J., BEVERS, M., WYERS, C., VAN LOON, L., VAN DIJK, J.W.

HAN UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Accumulating evidence indicates that many elite road-race cyclists have low areal bone mineral density (aBMD) as assessed by dual-energy X-ray absorptiometry (DXA). However, aBMD data does not provide information on bone quality, such as microstructural features of both cortical and trabecular bone, or bone strength. The present study aimed to assess aBMD, volumetric BMD (vBMD), bone microarchitecture, and bone strength in elite road-race cyclists.

METHODS: In this ongoing cross-sectional study, 20 female elite road-race cyclists (21±2 y; 59.8±6.1 kg; BMI 20.8±1.6 kg/m2) underwent DXA for the assessment of aBMD and high-resolution peripheral computed tomography (HR-pQCT) for the assessment of vBMD and bone microarchitectural parameters at the distal tibia and radius, respectively. Finite element analysis modelling was conducted to calculate bone strength. Z-scores were calculated for all outcomes, with Z-scores < -1 interpreted as low bone density or impaired bone microarchitecture. Data are presented as mean±SD and percentages.

RESULTS: With a mean Z-score of –0.3±0.9 and -0.9±1.1, low aBMD was present in 25 and 35% of the participants at the femoral neck and lumbar spine, respectively. Total vBMD of the tibia (296±39 mg/cm3) and radius (304±42 mg/cm3) was low in 40 and 45% of the participants, respectively. Low cortical vBMD was found in 35 and 40%, and low trabecular vBMD in 25 and 15% of the participants at the tibia and radius, respectively. At the tibia, 60% of the participants had a low cortical thickness (1.24±0.20 mm), 40% had low trabecular thickness (0.25±0.02 mm) and 30% had low trabecular number (1.33±0.19 trabeculae/mm). The findings at the distal radius were less pronounced, although 25% of the participants had a low cortical thickness. Calculated bone strength (failure load) was low in 20 and 15% of the participants at the tibia (8759±1522 N) and radius (3110±661 N), respectively.

CONCLUSION: Bone health of female elite road-race cyclists was characterized by low aBMD as measured by DXA, but also low vBMD as measured by HR-pQCT. The bone quality of elite road-race cyclists is particularly characterized by reduced cortical thickness and impaired trabecular microarchitecture at the tibia. Calculated bone strength was also affected, but to a lesser extent.

Oral Presentations

OP-BM01 Biomechanics I

REDEFINING MUSCULAR ACTION: 3D ARCHITECTURAL ANALYSIS REVEALS HUMAN "ADDUCTOR" MAGNUS PRIMARILY ACTING FOR HIP "EXTENSION" RATHER THAN ADDUCTION IN VIVO

TAKAHASHI, K., TOZAWA, H., KAWAMA, R., WAKAHARA, T.
DOSHISHA UNIVERSITY

INTRODUCTION: Muscle mechanical action underpinning our movements is mostly determined by its architecture (1). The muscle architecture has been extensively examined in vivo by ultrasonography (2), but its use is limited to certain small muscles because of a limited field of view (3). We still poorly understand how giant muscles in the deep part of the body form and act in living humans. By a novel 3D architectural analysis based on MRI, we examined in-vivo architecture and the potential action of the human adductor magnus (AM), one of the giant leg muscles classified as a hip adductor. We hypothesized that the primary action of AM is hip "extension" rather than adduction, considering its configuration similar to hamstrings.

METHODS: For 14 healthy young adults (9 males), thousands of muscle fascicles were automatically reconstructed over the whole AM at the hip neutral position with diffusion tensor MRI and tractography (4,5). The muscle physiological cross-sectional area, and each fascicle's line of action and moment arm length about the hip joint were determined for the medial/proximal/lateral region divided based on insertion positions. Then, the product of these parameters was calculated as an estimate of the maximal isometric torque-generating capacity (potential torque: PT). The peak torque during maximal voluntary contraction for the isometric hip extension/adduction was measured at the hip neutral and 45° flexed positions on a dynamometer. The paired t-test and linear regression analyses were performed.

RESULTS: Most AM fascicles ran parallel to the femur, showing hamstring-like orientations in 3D. The proximal and lateral regions showed comparable PTs between the hip extension and adduction. In the medial region, however, the hip extension PT was 6-fold greater than the adduction PT ($p<0.01$). Consequently, the whole AM (sum of all regions) had a greater PT for the hip extension (42±15 Nm) than adduction (29±15 Nm, $p=0.02$). The hip extension PT of the whole AM was strongly correlated with dynamometer-measured hip extension peak torque at both hip neutral and flexed positions ($r=0.71–0.87$, $p\leq0.01$), but that was not the case for the hip adduction ($r=0.42–0.59$, $p\geq0.05$).

CONCLUSION: The results clearly indicate that AM primarily acts for hip extension rather than adduction, although it has been assumed a major adductor. The AM may thus play as a strong motor rather than a stabilizer in human locomotion such as sprint running demanding forceful hip extension. The present study redefining muscular action through the in-vivo 3D architectural analysis would motivate us to rename human muscles (e.g., "extensor" magnus) and rethink their functional role, providing novel insights into proper exercise selection for effectively improving motor performance in sports and rehabilitation.

REFERENCES

1) Lieber & Friden, Muscle Nerve, 2000

2) Narici et al., J Appl Physiol, 2003

3) Franchi et al., Ultrasound Med Biol, 2018

4) Takahashi et al., J Anat, 2022

5) Takahashi et al., Med Sci Sports Exerc, 2023

EFFECT OF ECCENTRIC TRAINING AT DIFFERENT MUSCLE LENGTH ON MUSCLE-TENDON INTERACTIONS

TALLIO, T., NORDEZ, A., BIZET, B., CATTAGNI, T., DOREL, S.
NANTES UNIVERSITÉ

INTRODUCTION: Over the last 20 years, several studies showed that muscle-tendon interactions play a major role in movements (1). However, it remains unknown how the changes in muscle architecture due to training could influence these interactions. Eccentric studies have demonstrated an increase of the fascicle length following training in various muscles of the lower limb (2), and recently the benefits of training at high muscle length has been highlighted to induce more muscle adaptations, like hypertrophy or increase in fascicle length (3). Thus, the first aim of the current study is to investigate the potential change of fascicle behavior and tendon properties following an eccentric training at different muscle length. The second aim is to explore how these changes impact muscle-tendon interactions in vertical jump and running.

METHODS: 28 participants were randomised in two groups, High Length (HL) vs Short Length (SL). They performed 8 weeks (24 sessions) of eccentric training on the calf muscles at different range of motion (ROM). Measurements were made PRE and POST training. Fascicle length of the gastrocnemius medialis (GM) was measured with an ultrasound apparatus during maximal voluntary contractions (MVC) at 5 angles, eccentric contraction and through rate of force development (RFD) explosive contractions. We also estimated the stiffness of the Achilles tendon (AT) during ramp and RFD contractions. Finally, we measured the fascicle behavior of the GM during maximal vertical jumps (hopping and countermovement jump) and submaximal running.

RESULTS: We found a significant change of the fascicle length for HL group (+7%, p<0,05) during passive condition, but only before the slack length. No difference was found for the SL group. Torque increased in both groups in isometric (HL +8%, SL +13% at 0°, p<0,01) and eccentric contraction (HL +18,7%, SL +12,9%, p<0,01) but no interactions group x time were found. No significant change in fascicle length was observed during MVC, and no change in optimal length was detected in both groups. RFD did not change in both groups after training. AT Stiffness increased significantly for HL group (+29,9%, p<0,05) but not in SL group. Data from vertical jumps and running are still in processing.

CONCLUSION: No significant effects were found for fascicle-tendon interactions during maximal monoarticular contractions (RFD, MVC), suggesting that changes in muscle-tendon behavior (tendon stiffness and fascicle length) found in HL group does not impact the dynamic behavior of fascicles. We assume that these two factors offset each other's influence during contractions. Multi-joint maximal (jumps) and submaximal (running) tasks will provide a deeper understanding of the training effects on fascicle-tendon interactions.

REFERENCES:

1) Ishikawa & Komi, Exerc. Sport Sci. Rev., 2008

2) Duclay et al., Muscle and Nerve, 2009

3) Marusic et al., SJMSS, 2020

SENSITIVITY OF JUMP-LANDING MOVEMENT CHARACTERISTICS TO ACL INJURY HISTORY AND FATIGUE.

MAITÉ, C., MOHR, M., FEDEROLF, P.

UNIVERSITY OF INNSBRUCK

INTRODUCTION: Return-to-sport (RTS) assessments often involve evaluations of movement execution, e.g. in jump landings, to identify deficits in movement control and connected risks for re-injury [1]. For RTS after anterior cruciate ligament (ACL) injury, the current literature offers a plethora of kinematic variables in various jump tests that clinicians may use to guide the RTS decision [1]. To better integrate RTS movement assessments in fast-paced clinical decision-making, it may be useful to investigate the most sensitive jump test and variable combinations for detecting movement deficits. The purpose of the current study was to compare the sensitivity of three commonly used jump tests for detecting movement characteristics influenced by either an ACL injury history, a provoked fatigue status, or a combination of both.

METHODS: A total of 43 volunteers were recruited into ACL group (n=21, 11 females) and control group (n=22, 12 females). 3D motion data (Vicon, 250 Hz) were recorded during a single-leg hop (SLH), unilateral counter movement jump (uCMJ) and a unilateral cross-over hop (COH) before and after a fatigue-inducing intervention (single-leg squats and step ups). Thirteen joint angles from lower body, trunk and pelvis (50ms after initial contact) representing the landing posture were calculated through inverse kinematics in OpenSim. One combined principal component (PC) analysis was computed for all three jumps to characterize kinematic synergies. Six distinct logistic regression models (three jumps, fatigued/non-fatigued, alpha = .05) were calculated to predict ACL injury history. Three additional models predicted fatigue status. The predictors consisted of twelve PC scores.

RESULTS: In all three jump landings, the logistic regression models were able to detect an ACL injury history (Chi^2= 4.974, p<.026) but not fatigue status (Chi^2=2.165, p>.141). When predicting ACL injury history, the highest sensitivity (76%) and classification rates (77%) were achieved for SLH (p<.001) and uCMJ (p<.001) when participants were fatigued. The worst sensitivity (67%) and classification (63%) was achieved for non-fatigued COH (p=.026). The SLH and uCMJ models consistently relied on the same two PCs, which described the correlation between frontal and transverse knee, hip and trunk angles.

CONCLUSION: In our data-driven analysis, the SLH and uCMJ appear more sensitive for detecting movement characteristics related to a previous ACL injury compared to the COH. Furthermore, our results support the recommendation to include fatigued conditions during RTS tests post-ACL injury [2]. The finding that our approach could not predict fatigue status could mean that (1) fatigue effects were non-systematic or (2) the between-subject variance in PC scores blurred smaller within-subject fatigue effects. Either way, the observation of an unsuccessful prediction makes it less likely that the classification by injury history was due to chance.

[1] Kaplan, Sports Health, 2019

[2] Dingenen, Sports Med, 2017

EVALUATION OF A PERSONALIZED ASSESSMENT AND LOADING CONCEPT TO REDUCE MUSCLE-TENDON IMBALANCES

DOMROES, T., WEIDLICH, K., BOHM, S., MERSMANN, F., ARAMPATZIS, A.

HUMBOLDT-UNIVERSITÄT ZU BERLIN

INTRODUCTION: Imbalances between muscle strength and tendon stiffness can increase the mechanical demand on the tendon (i.e., tendon strain) and tendon injury risk (1). The early identification of musculotendinous imbalances and accordingly adjusted training may thus contribute to tendon injury prevention (2). Therefore, the aim of the study was to identify muscle-tendon imbalances in athletes and promote a more balanced adaptation of muscle and tendon through a personalized assessment and loading concept.

METHODS: A total of 85 athletes (37 female and 26 male adolescents (13 – 16 yrs.), 22 male adults) were assigned to a control and intervention group. We assessed knee extensor muscle strength, patellar tendon stiffness and strain during

maximum isometric contractions (MVC) at four measurement time points during a competitive season. Muscle-tendon imbalances were identified based on the individual tendon strain during MVCs (2). In the intervention group, athletes with deficits in tendon stiffness (strain ≥9%) performed exercises (3x/week) with a personalized load to reach ~5.5% tendon strain to promote tendon adaptation, athletes with deficits in muscle strength (strain ≤4.5%) trained with submaximal loads to failure to mainly promote muscle strength. Linear mixed-effects models were used to analyze time- and group-dependent developments and the influence of sex and age.

RESULTS: We found lower fluctuations of maximum tendon strain ($p = 0.016$) and a decrease in the frequency of athletes with high-level tendon strain ≥9% in the intervention group. Normalized tendon stiffness and muscle strength increased significantly over time only in the intervention group ($p < 0.001$). These increases were more pronounced in male compared to female adolescents (sex by time by group interaction; $p = 0.010$ and 0.002). In adults we found a more pronounced increase in tendon strain in the control group compared to male adolescents (age by time interaction; $p = 0.040$) paralleled by a more pronounced increase in muscle strength (age by time by group interaction; $p = 0.010$).

CONCLUSION: The reduced fluctuations of maximum patellar tendon strain over the season and the lower prevalence of highly increased maximum tendon strain in both age groups and sexes indicate that the presented personalized concept was effective in reducing muscle-tendon imbalances and has the potential to contribute to tendon injury prevention, given the increased injury risk associated with high-level tendon strain. The smaller increases in muscle strength and tendon stiffness in females may suggest sex differences in muscle and tendon adaptation, which, however, did not affect the reductions in strain fluctuations and high-level tendon strain, and thus the effectiveness of the personalized concept.

REFERENCES:

1) Mersmann et al., 2023, Sports Med – Open 9:83

2) Arampatzis et al., 2020, Front. in Physiol. 11:723

PASSIVE HAMSTRING MUSCLES RIGIDITY CHANGES ALONG THE MENSTRUAL CYCLE FOR ANGLES RELATIVE TO THE KNEE RANGE OF MOTION.

BOUVIER, J., FOURÉ, A., MARTIN, C.

UNIVERSITE CLAUDE BERNARD LYON 1

INTRODUCTION: The menstrual cycle (MC) has recently been shown to affect the risk of muscle injury (1). Muscle strain injuries are thought to appear following active muscle lengthening (2), which highly involves muscle passive mechanical properties as previously reported (3). The aim of this study was to determine the impact of the MC on the passive hamstring muscles rigidity assessed with ultrasound shear wave elastography (SWE).

METHODS: Twenty-two eumenorrheic young active females attended three identical testing sessions during their early-follicular (EF), late-follicular (LF) and mid-luteal (ML) phases, confirmed by hormonal measurements. Knee was passively extended (2°/s) by an isokinetic dynamometer from 90° to 80% of the maximal joint range of motion (RoM), for a hip angle of 70° (hip and knee fully extended = 180°). Shear wave speed (SWS) was measured using SWE in the biceps femoris long head (BF), semitendinosus (ST) and semimembranosus (SM) during passive stretches. SWS and knee joint torque were assessed every 10% of each participant's RoM and every 10° of absolute knee angle (from 90° to 80% ROM or 120° [i.e., maximal common knee angle for the entire experimental population]). Linear mixed models were used to investigate the effect of the MC phase on maximal knee RoM, knee joint torque and on each passive hamstring muscle SWS. Post-hoc analysis was conducted using Tukey HSD test when appropriate.

RESULTS: Maximal knee RoM remained consistent along the MC ($P=0.22$). The knee joint torque expressed relatively to each participant's RoM was greater during EF and LF phases than during ML phase ($P<0.001$), while it did not differ throughout the MC for absolute knee joint angles ($P=0.43$). The SWS expressed relatively to each participant's RoM was greater during the ML phase than during EF and LF phases in the BF ($P<0.01$), while it was greater during the EF and LF phases than during the ML phase in the ST ($P<0.01$). On the opposite, the SWS expressed in absolute knee joint angles did not differ along the MC ($P=0.27$, 0.07 and 0.47 for BF, ST and SM, respectively).

CONCLUSION: When rigidity was expressed in function of absolute knee angles, no difference was observed along the MC. However, for angles relative to individual RoM, BF rigidity was at its highest point during the ML phase, while the ST one was at its lowest. Interestingly, the risk of muscle injury has been shown to be greater in the ML phase and the BF is the most injured hamstring muscle (1,4). While muscle rigidity has been correlated to markers of exercise-induced muscle damage (5), the link between muscle injury occurence and a potential modulation of hamstring muscles rigidity by the MC has to be further assessed.

1) Barlow et al., Med Sci Sports Exerc, 2024; online ahead of print

2) Edouard P et al., Nat Rev Dis Primers, 2023; 9:56

3) Lacourpaille L et al., Acta Physiol, 2014; 211(1):135-46

4) Ekstrand J et al., Br J Sports Med, 2012; 46:112-17

5) Xu J et al., Eur J Sport Sci, 2019; 19:508-16

Invited Symposium

IS-PN03 Lipid droplets and mitochondria: The importance of a functional, dynamic relationship for metabolic health

LIPID DROPLET DYNAMICS IN HEALTH AND DISEASE

BARRETT, J.
LIVERPOOL JOHN MOORES UNIVERSITY

The aim of this talk is to present the current knowledge on how LD proteins respond to exercise training and their role(s) in regulating intramuscular triglyceride (IMTG) storage and utilisation during exercise. Our previous studies using immunofluorescence microscopy demonstrated that the expression of the LD-associated perilipin (PLIN) proteins are sensitive to a variety of exercise training types. Importantly, in healthy individuals at least, the expression of the PLIN proteins is closely aligned to IMTG content, and this relationship has implications for the regulation of the IMTG pool. In this context, this presentation will highlight the potential regulatory roles for the PLIN proteins in mediating IMTG storage and IMTG utilisation during exercise. This will include recent and new insights from studies employing time-course designs to reveal several important roles for the PLIN proteins contributing to the dynamic nature of LDs. Furthermore, these studies have also generated evidence that the PLIN proteins themselves are also dynamic, providing additional intrigue into the regulation of these proteins and directions for future work.

IS SKELETAL MUSCLE MITOCHONDRIAL CAPACITY IMPAIRED IN INDIVIDUALS WITH INSULIN RESISTANCE AND TYPE 2 DIABETES?

WHYTOCK, K.
LIVERPOOL JOHN MOORES UNIVERSITY

Impaired mitochondrial capacity has historically been linked to the development of insulin resistance (IR) in skeletal muscle (SkM); however this association remains controversial. Discrepancies in the literature may partially be attributed to the techniques employed to measure SkM mitochondrial capacities (enzymatic activities, ex vivo respiration, and in vivo ATP max/PCr recovery rates) and phenotypic differences (aerobic capacity, body mass index (BMI), and age) among the cohorts analyzed that are known to affect mitochondrial capacity. This talk will explore whether mitochondrial capacity is impaired in individuals with IR and T2D when confounding factors of age, BMI and aerobic capacity are accounted for and using an in-depth comprehensive suite of analyses including; in vivo PCr recovery, ex vivo mitochondrial respiration, supercomplex assembly, tricarboxylic acid (TCA) cycle intermediates, citrate synthase activity, transcriptomics and methylomics. Lastly, this talk will highlight the transcriptional and methylation profiles that underpin SkM IR that are not related to mitochondrial capacity and show whether these molecular profiles are retained in vitro in differentiated primary human skeletal muscle cells.

THE DYNAMIC INTERACTION BETWEEN MITOCHONDRIA AND LIPID DROPLETS IN HEALTH AND DISEASE.

GEMMINK, A.
MAASTRICHT UNIVERSITY

Skeletal muscle represents a tissue with high plasticity, both structurally and metabolically. Muscle can readily adapt to fluctuations in energy demand and nutrient (substrate) availability. Thus, skeletal muscle (mal)adapts to longer periods of unloading and loading, but also to dynamically adapts to microcycles in energy demand and supply. Our lab is specifically interested into the dynamics in fuel storage and oxidation in skeletal muscle, the subcellular organelles involved and their spatial (re)orientation and interaction. Thus, we have studied dynamics in lipid droplet synthesis and degradation, mitochondrial network dynamics and interaction of lipid droplets with mitochondria and vice versa. We study these phenomena in humans over the entire range of energy expenditure, i.e. in obese sedentary individuals and in elite athletes. We also link this to read-outs of metabolic health and physical fitness. To this end, we use a variety of whole-body measurements of metabolic health and performance all the way down to super resolution microscopy to image and quantify dynamic processes of (a cluster of) molecules and organelles involved in lipid droplet en mitochondrial networks. Physical exercise and nutrient intake/deprivation are strong triggers to modulate lipid droplet and mitochondrial dynamics. In the presentation we will discuss how transient energy gaps, generated by exercise or short-term food deprivation, affect mitochondrial and lipid droplet interaction and if and how these dynamics are determinants of health and performance.

Invited Symposium

IS-SH02 Intentional and unintentional doping: what is the risk of using dietary supplements?

CROSS-CONTAMINATION OF DIETARY SUPPLEMENTS: WHAT PREVENTS ATHLETES FROM UNINTENTIONALLY DOPING?

MUROFUSHI, Y.
JUNTENDO UNIVERSITY

Dietary supplement users are at an increased risk of unintentionally doping than non-users. A body of evidence has shown that due to issues with manufacturing, dietary supplements can become cross-contaminated with substances that are prohibited for use in sport. In fact, reports from the Court of Arbitration for Sport indicate that 45% of athletes who failed a drug test, were attributed to the use of a dietary supplement that had become contaminated with a prohibited substance. Despite athletes being aware of the risks associated with cross-contamination and having received education to ensure the supplements they take have been batch tested (i.e., contain no prohibited substances), athletes continue to use supplements to facilitate their performance. While evidence for the occurrence of cross-contamination is well-established, a paucity of research exists for why athletes choose to use a dietary supplement when a significant unintentional doping risk is present. To help anti-doping organisations develop more effective education interventions and target factors that prevent unintentional doping, a need exists in understanding the psychological reasons for that best protect an athlete from using a dietary supplement. In the anti-doping psychosocial science literature, a number of factors have been identified to be related to doping. Athlete's beliefs that dietary supplements are effective has consistently been shown to be related to both dietary supplement use and doping. That is, athletes that use dietary supplements are more likely to believe that they are effective and in turn, use prohibited substances. However, no research has considered whether athletes are aware that dietary supplements can be contaminated and if this in turn, influences their beliefs and use of dietary supplements. The aims of the presentation are to explain the role of dietary supplement beliefs in the decision to use performance enhancing substances, and how awareness of the risk of cross-contamination may influence the relationship between dietary supplement beliefs and use. A theoretical model will be posited before highlighting empirical cross-sectional research on the relationship between awareness of cross-contamination, dietary supplement beliefs and use. Finally, the speaker will highlight how anti-doping organisations can use results of this data to develop more effective education interventions that foster better understanding of the risks associated with dietary supplements and unintentional doping.

DIETARY SUPPLEMENT USE AND INTENTIONAL DOPING: WHAT DOES THE EVIDENCE SUGGEST?

HURST, P.
CANTERBURY CHRIST CHURCH UNIVERSITY

For over 20 years, researchers have recognised that those who use dietary supplements are more likely to use prohibited performance enhancing substances. Reasons for this are suggested to relate to athletes normalising the use of performance enhancing methods and over time, progressing to doping for equal or better performance improvements. That is, an athlete who uses a dietary supplement is suggested to become comfortable with using these substances to improve performance, normalise the practice of using performance enhancing substances, and over -time seeks out stronger and more potent substances to achieve similar or better results. However while a number of individual studies have examined the phenomena, a need exists in summarising and synthesising the extant literature to help identify the relative risk dietary supplement use has on intentional doping. To help improve precision and understanding of the risk dietary supplement use has on doping, in this presentation, the speaker will report the results of a systematic review and meta-analysis of studies examining the relationship between dietary supplement use and doping. Briefly, the speaker will highlight that from 23 studies including 8,822 athletes, dietary supplement users are over 2.5 (Odds ratio = 2.77, 95% CI = 2.10 to 3.57) times more likely to dope and have a greater intention (pooled r = 0.26, 95% CI = 0.18 to 0.34) and more favourable attitude (pooled r = 0.20, 95% CI = 0.13 to 0.28) to dope than non-users. Reasons for why dietary supplement users progress to prohibited substance use will be described and the psychosocial factors that anti-doping educators can use in their interventions to best protect dietary supplement users from doping will be explained. The speaker will also highlight the practical implications for athlete practitioners (e.g., coaches, nutritionists, physiotherapists) aiming to prevent their athletes from intentionally doping after using a dietary supplement.

FREQUENCY AND TYPES OF DIETARY SUPPLEMENTS: DO ALL SUPPLEMENTS LEAD TO UNINTENTIONAL AND INTENTIONAL DOPING?

GARCÍA-GRIMAU, E.
UNIVERSIDAD AUTÓNOMA DE MADRID

In the previous two presentations, dietary supplement use has shown to be a risk for both intentional and unintentional doping. While the research underpinning both presentations highlight the significant risk athletes may be exposing themselves to when using a dietary supplement, evidence is limited in that it does not consider the frequency and types of dietary supplements used. That is, researchers assessing the relationship between dietary supplement use and intentional doping often group all types of dietary supplement users together and do not quantify how often an athlete uses the

supplements. Arguably, an athlete using an electrolyte sports drink once to remain hydrated during a competition is less likely to dope than another using a pre-workout supplement daily to gain a competitive advantage. Understanding whether certain supplements pose a greater risk to unintentional and intentional doping is important given that prevelance of dietary supplement use is estimated at over 60% and many athletes will look to seek out ways in which they can facilitate their performance. To help athletes and practitioners identify which supplements are more likely to increase the risk of intentional and unintentional doping, a need exists in examining the relationship between frequency of use and likelihood to dope and identifying the supplements that are more likely to be cross-contaminated and cause unintentional doping. The aim of this presentation is to provide data on the frequency and types of dietary supplement used in relation to the likelihood to intentionally dope and critically review evidence of the substances that athletes may use that could lead to unintentional doping. The speaker will highlight that athletes who use ergogenic and medical supplements daily, are at an increased risk of doping intentionally than those who use sport foods and drinks sparingly. Afterwards, a comprehensive review of studies examining cross-contamination in supplements will be given, which reports multi-ingredient, pre-workout, and muscle-building supplements (e.g., protein shakes) as the greatest risk for cross-contamination, and reasons for why this occurs will be discussed. To help best protect athletes from both unintentional and intentional doping, the speaker will provide recommendations on how athletes and practitioners can recognise the risks of certain types of supplements and offer alternative methods in which they can achieve their goals.

Oral Presentations

OP-AP16 Training and Testing/Power and Strength IV

MUSCLE DAMAGE AND REPEATED BOUT EFFECT FOLLOWING A TYPICAL DOSE OF NORDIC HAMSTRINGS EXERCISE

CORATELLA, G., LONGO, S., DORLANDO, A., STERI, E., LA SPINA, O., MOCCHI, C., CÈ, E., ESPOSITO, F.
UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Nordic hamstrings exercise provides lengthening stimuli to the hamstrings with the intent to increase their resistive capacity to overstretching. While many longitudinal studies have found the effectiveness of NHE in increasing hamstrings strength and in elongating fascicles, the incorporation of NHE in the practice requires a deeper examination given the short-term effects due to the eccentric stimuli. Therefore, the present study investigated the exercises-induced muscle damage and the repeated-bout effect following a typical dose of NHE.

METHODS: Thirteen active men (mean±SD; age=25.2±2.9 years; body mass=77.5±11.3 kg; height=176.4±8.4 cm) were recruited. Hamstrings eccentric strength, muscle soreness, passive range of motion (ROM), anatomical cross-sectional area and echo-intensity of biceps femoris, semitendinosus and semimembranosus were assessed at baseline, and up to four days after the NHE bout. The repeated-bout effect was examined after four weeks by repeating the same procedures. NHE session consisted of 4 x 6 repetitions. A two-way repeated-measures ANOVA as statistical analysis.

RESULTS: After the first bout, hamstrings eccentric strength decreased and remained below the baseline up to three days (average loss: □-25%, mean Cohen's d effect size [ES] ranging from -3.88 to -2.95, $p<0.05$); muscle soreness increased two days after and remained higher up to four days (mean ES ranging from 1.30 to 1.62, $p<0.05$); passive ROM decreased up to four days (mean ES ranging from 0.64 to 1.62, $p<0.05$); anatomical cross-sectional area and echo intensity did not show any changes, both for the separate and combined muscles ($p>0.05$ for all comparisons). After the second bout, hamstrings eccentric strength decreased and remained below baseline up to one day (-22.5%, ES: -1.79, $p<0.05$); muscle soreness did not increase; passive ROM decreased up to two days (mean ES -ranging from -0.85 to -0.77); no change occurred in cross-sectional area and echo intensity.

CONCLUSION: A typical dose of NHE showed impairments in muscle function but did not affect muscle structure. The current data offer novel perspectives on incorporating NHE into the weekly routine, since defining the recovery time course after a typical NHE dose. Additionally, the recovery after the second bout is much faster. In the practice, a first bout of NHE is suggested to be included far from competitions or a congested training routine, while a second bout can be safely incorporated without any meaningful impairments in the following days.

SYNERGISTIC EFFECTS OF RESISTANCE TRAINING AT MODERATE ALTITUDE ON METABOLIC-RELATED MYOKINES: IMPLICATIONS FOR ADIPOSE TISSUE MODULATION

PEREZ REGALADO, S., LEON, J., BENAVENTE, C., BONITCH-GONGORA, J., ALMEIDA, F., PADIAL, P., DE LA FUENTE, B., GIL-GUTIERREZ, R., FERICHE, B.
UNIVERSITY OF GRANADA

INTRODUCTION: Hypobaric hypoxia (HH) exposure is characterized by an elevation of the sympathetic nervous system that could impact on metabolic-related myokines in human adipocytes, such as interleukin 15 (IL-15), involved mainly in the promotion of lipolysis (1). Additionally, resistance training (RT) programs have been associated with weight loss while preserving muscle mass. However, there are no previous studies undertaken long-term RT regimens under terrestrial HH conditions describing the molecular mechanisms linked to modulation of subcutaneous adipose tissue (SAT) thickness. In this sense, the present study aims to analyse the influence of HH exposure on SAT and circulating IL-15 response after an 8-week RT program.

METHODS: Twenty men (22.75±3.73 years; 176.4±5.93 cm; 73.01±10.97 kg) participated in an 8-week program (3 sessions/week) of a traditional hypertrophy training under intermittent terrestrial HH (2320 m) or normoxia (N, 690 m). Seventy-two hours before and after the RT program, vastus lateralis (VL) thickness and SAT were measured by ultrasound (GE-LOGICQ-E portable, UK) and blood samples were taken to analyse serum IL-15 by immunology multiplex assay (Sigma-Aldrich; Darmstadt, Germany).

RESULTS: Circulating IL-15 revealed an environmental effect following 8 weeks of RT program ($F_{1,18} = 4.399$; $p = 0.050$; $n2p = 0.196$). The pairwise comparison test revealed that HH after RT tend to be favour IL-15 increase (ES = 0.890; $p = 0.062$) compared to N. Moreover, SAT displayed a very large decrease in HH after the RT period (11.56 % vs -17.69 % in N and HH; $p < 0.001$ [ES = -1.92]) with no remarkable change in VL between conditions ($p > 0.05$).

CONCLUSION: These results evidence the effect of RT in HH on SAT and serum IL-15 with respect to the same training in N. This effect could be attributed to the IL-15 upregulation-induced muscle promotion of the fibber switching to type II and in the overall increase of lean mass ratio by the stress of the HH combined with RT. (2). Surprisingly, VL values were maintained without significant changes between conditions. Nonetheless, this outcome may not represent the entire effect on muscle growth on muscle due to a potential heterogeneous growth of the vastus quadriceps due to the orientation of the feet during squat training (3). Thus, taking all results together, it appears that the stressors factors linked to RT in HH may play a key role in the overall body composition. Further research targeting this potential non-pharmacological approach for adipose regulation is needed to determine the implication on sport performance and control of obesity-related disorders.

References

1. Duan Y, et al. 2017; PMID: 28752527.

2. Nielsen AR, et al. 2007; PMID: 17690139.

3. Murray N, Cipriani D, O'RAND D, Reed-Jones R. 2013; PMID: 27293497.

A COMPARISON OF FLYWHEEL CLUSTER SET TRAINING AND TRADITIONAL CLUSTER SET RESISTANCE TRAINING OVER 8-WEEKS ON ATHLETIC PERFORMANCE IN TEAM SPORT ATHLETES.

RYAN, S., RAMIREZ-CAMPILLO, R., BROWNE, D., MOODY, J., BYRNE, P.J.

SOUTH EAST TECHNOLOGICAL UNIVERSITY CARLOW

INTRODUCTION: The correlation between effective resistance training programmes and success in team sports is widely agreed upon due to the physical demands placed upon athletes. As performance demands increase, the implementation of innovative resistance training strategies ensue. Cluster training has gained popularity, through its use of "intra-set" rest periods, proven to benefit training volume, power outputs and fatigue accumulation. Although, to date there is a scarcity of research integrating the cluster model during flywheel (FW) training. Thus, the purpose of this study was to compare the effect of flywheel cluster set training (FWC) and traditional cluster set resistance training (TDC) on athletic performance in team sport athletes.

METHODS: Seventy-six amateur male field sport athletes participated in this study during the pre-season phase of their training calendar. Participants were randomly allocated into one of three groups; FWC, TDC or a control (CON) group. All participants underwent pre and post intervention testing for 20m linear sprints, countermovement jumps (CMJ), 5-10-5 change of direction (COD) and 3RM lower body strength. During the 8- week intervention, both FWC and TDC groups performed two sessions per week, consisting of 4 sets of 9 repetitions using quarter-squats and Romanian deadlifts. Intra-set rest durations of 45 seconds were allocated between cluster blocks [1]. The FWC group used the 0.050kg.m2 inertial load, while the TDC group used 70% of their predetermined 1RM for the initial 4-weeks, followed by increasing the load to 75% for the final 4-weeks. The CON group were instructed to performed pitch sessions only.

RESULTS: Both cluster training groups reported similar group x time interactions with significant improvements between pre and post testing results in all performance exercises. The Hex-bar deadlift reported improvements ($p < 0.05$) in lower body 3RM strength in the FWC group (ES = 0.40, PC = 6.91%) and for the TDC group (ES = 0.38, PC = 7.06%). Moreover, improvements in sprint performance ($p < 0.001$) were reported in both 5m (FWC- 3.14%, TDC- 2.62%) and 20m linear sprint speed (FWC- 1.89%, TDC- 1.04%). While ES indicated that COD saw the largest increase in performance (FWC- 0.93- 1.12, TDC- 0.96- 0.98). Furthermore, COD reported significant improvements ($p < 0.05$) on both right and left lateral turns (FWC- 5.64- 6.55%, TDC- 5.39- 6.05%). Lastly, the CON group reported trivial changes throughout all tests post intervention.

CONCLUSION: This is the first study to compare a flywheel cluster training block to a traditional barbell cluster training block. The similarity of results and increases to performance parameters indicate the usability of both training methods. These findings should encourage coaches and sport science practitioners to utilize both training methods within resistance training programmes to increase field sport athlete performance.

INTENSITY OF SIX ECCENTRIC CONTRACTIONS PERFORMED 5 DAYS A WEEK FOR 4 WEEKS TO INCREASE MUSCLE STRENGTH AND VOLUME

NOSAKA, K., YOSHIDA, R.1, MURAKAMI, Y.2, KASAHARA, K.2, SATO, S.3, NAKAMURA, M.4

EDITH COWAN UNIVERSITY, 1 MANIWA ORTHOPEDICS CLINIC, 2 NIIGATA UNIVERSITY OF HEALTH AND WELFARE, 3 MATSU-MURA GENERAL HOSPITAL, 4 NISHI KYUSHU UNIVERSITY

INTRODUCTION: We reported that one 3-s maximal eccentric contraction of the elbow flexors performed on an isokinetic dynamometer 5 days a week for 4 weeks increased maximal voluntary isometric (MVC-ISO), concentric (MVC-CON), and eccentric contraction (MVC-ECC) torque of the elbow flexors by 10.2±6.4%, 12.8±9.6% and 12.2±7.8%, respectively [Sato et al. Scand J Med Sci Sports. 32:833-43, 2022]. However, these effects were not produced by one 3-s maximal isometric nor concentric contraction in the same format. Our other study showed that daily six maximal eccentric contractions that were performed on an isokinetic dynamometer 5 days a week for 4 weeks increased MVC-ISO (9.3±5.5%), MVC-CON (11.1±7.4%), and MVC-ECC torque of the elbow flexors (13.5±11.5%), and muscle thickness (MT) of biceps brachii and brachialis (10.4±4.4%) [Yoshida et al. Scand J Med Sci Sports. 32:1602-14, 2022.]. To perform maximal eccentric contraction(s), a specific device such as an isokinetic dynamometer is necessary, which is difficult to be accessed practically. The present study examined whether the muscle strength and MT would still be increased when a dumbbell was used with the training intensity of six eccentric contractions being reduced to 2/3 or 1/3 of the peak MVC-ECC torque.

METHODS: Thirty-six healthy young (19-24 y) adults who had not performed resistance training were placed to three groups (n=12/group): 2/3MVC or 1/3MVC that performed the six eccentric contractions with a dumbbell set at 2/3 or 1/3 MVC-ECC load 5 days a week or control group that did not perform any training for 4 weeks. Changes in MVC-ISO, MVC-CON, MVC-ECC torque of the elbow flexors, and MT before and after the 4-week period were compared among the groups and with the group of the previous study [Yoshida et al. Scand J Med Sci Sports. 2022.] in which six maximal eccentric contractions were performed 5 days a week for 4 weeks (MVC group; n=12) by two-way repeated measured ANOVA.

RESULTS: All participants reported to the laboratory to perform the training without any missing sessions. The control and 1/3MVC groups showed no significant changes in any measures. Significant ($p<0.05$) increases in MVC-ISO (10.3±11.4%), MVC-CON (10.9±9.5%), and MVC-ECC (9.3±8.8%) torque and MT (10.1±9.2%) were observed for the 2/3MVC group. When comparing the 2/3 MVC and MVC groups, no significant differences in the changes in the measures were found. This may be due to that the dumbbell set at 2/3 of MVC-ECC torque was close to the MVC-ECC at elbow extended angles.

CONCLUSION: These results suggest that submaximal-intensity at 2/3 MVC-ECC is still effective for the six maximal eccentric contractions to increase muscle strength and MT, and the "submaximal" intensity using a dumbbell produced the same effects as those by maximal intensity protocol using an isokinetic dynamometer. The present study together with the previous studies show potent effects of daily small volume eccentric contractions on muscle adaptations, which could be used in practice.

Oral Presentations

OP-PN16 Hypoxia II

EFFECT OF ACUTE NORMOBARIC HYPOXIA ON WHOLE-BODY FAT OXIDATION KINETICS AT MATCHED RELATIVE INTENSITIES COMPARED TO NORMOXIA: INTENSITY MATTERS!

GARCIA, J., ALLENDER, P.1, BROCHERIE, F.2, MALATESTA, D.1

1 UNIVERSITY OF LAUSANNE, SWITZERLAND, 2 FRENCH INSTITUTE OF SPORT , FRANCE

INTRODUCTION: The heterogeneity of the effects of acute hypoxia on substrate oxidation during exercise matched for relative intensity compared with normoxia (N) has been previously reported [1]. While fat oxidation kinetics over a wide range of intensities in N has already been well described [2, 3], the homologous kinetics in normobaric hypoxia (NH) and its comparison at identical relative intensities with N are unknown. Therefore, this study aimed to investigate the effect of acute NH vs. N on whole-body fat oxidation kinetics at identical relative intensities during a submaximal graded cycling test.

METHODS: Thirteen active men (24.9±3.0 yrs) performed i) two maximal incremental cycling tests to determine maximal oxygen uptake (VO2max) in either NH [hypoxic chamber; inspired fraction of oxygen (FiO2) = 12.7%, ~4000 m] or N [FiO2 = 20.7%, ~375 m], and ii) two submaximal graded cycling tests to assess whole-body fat oxidation in each condition, using indirect calorimetry after an overnight fast and 20-min acclimation to NH. A sinusoidal model was used to characterize, with three independent parameters (dilatation, symmetry and translation), the whole-body fat oxidation kinetics and to determine Fatmax [i.e., the intensity eliciting the maximal fat oxidation (MFO)] in both conditions [2].

RESULTS: VO2max was significantly lower (50.4±5.3 vs. 61.5±7.5 ml/kg/min, $p<0.001$) and Fatmax was significantly higher (63.9±6.7 vs. 57.7±4.3 %VO2max, $p<0.001$) in NH vs. N. MFO (0.66±0.22 vs. 0.49±0.12 g/min, $p=0.005$) and whole-body fat oxidation rates for exercise intensities ranging from 50 to 85% VO2max ($p<0.019$) were significantly higher in NH vs. N. The mean kinetics in NH was characterized by a significantly greater dilatation (widening of the curve, $p=0.01$) with no significant difference for symmetry ($p=0.17$) and translation ($p=0.79$) vs. N.

CONCLUSION: Whole-body fat oxidation kinetics differed between normobaric hypoxia and normoxia when compared at the same relative exercise intensities, with greater dilatation, MFO, Fatmax and fat oxidation rates during moderate- and high-intensity exercises in normobaric hypoxia. Exercise intensity may thus play a central role in the effect of hypoxia on fat oxidation, confirming previous findings involving carbohydrate intake [4]. For the same relative moderate- to high-intensity exercise, the greater reliance on fat oxidation in normobaric hypoxia vs. normoxia seems consistent with the increased oxidation of plasma non-esterified fatty acids, representing a more important part of total fat oxidation during moderate- to high-intensity exercise. The present findings support that acute exposure to normobaric hypoxia vs. normoxia after overnight fasting enhances the metabolic pathways of fat oxidation during moderate- to high-intensity exercise.

REFERENCES:

[1] Griffiths, J Int Soc Sports Nutr, 2019

[2] Cheneviere, Med Sci Sports Exerc, 2009

[3] Jeukendrup and Wallis, Int J Sports Med, 2005

[4] O'Hara et al., Physiol Rep, 2017

EFFECT OF ACUTE NORMOBARIC HYPOXIA ON COGNITIVE PERFORMANCE AND CEREBRAL OXYGENATION IN YOUNG HEALTHY SUBJECTS

FAUCHER, C., MATHE, N., SAULNIER, P.J., MAQUA, A., THEUROT, D., BOULARES, A., GIMENES, M., DUGUE, B., PICHON, A., DUPUY, O.

UNIVERSITY OF POITIERS - CHU POITIERS

INTRODUCTION: The association between cerebral oxygen level and cognitive function is extensively documented in the normal oxygen range. However, the heterogeneity in protocols designed to investigate the impact of hypoxia-induced changes in cognitive function prevents definitive conclusions regarding underlying mechanisms of cognitive performance. In this study, we aimed to assess the effect of acute normobaric hypoxic conditions on cognitive functions and cerebral oxygenation.

METHODS: We enrolled healthy participants aged 18 to 30 in a crossover study to explore the effects of 4 simulated altitudes on executive function. These altitudes included normoxia at sea level (SL; FiO2: 21%), low hypoxia (1600 m altitude; FiO2:17.2%), moderate hypoxia (3000 m altitude; FiO2:14.4%), and high hypoxia (4100 m altitude; FiO2:12.5%). Executive function was assessed using 4 standardized cognitive tasks: Stroop task, N-Back, Corsi blocks, and Go/No-Go. The sequence of cognitive tasks and altitude conditions were randomized. Peripheral oxygen saturation (SpO2) and heart rate (HR) were continuously monitored. Cerebral oxygenation was measured using near-infrared spectroscopy during each condition. Changes in the tissue saturation index (ΔTSI%), total hemoglobin (ΔtHb), deoxyhemoglobin (ΔHHb), and oxyhemoglobin (ΔO2Hb) were defined as the difference between each hypoxia level and the normoxia resting state. Perceived exertion after each task was assessed using the DP15 rating scale.

RESULTS: In 23 participants (22.2±2.8 years; 11 females and 12 males), SpO2 decreased with increasing hypoxia dose, and each condition was different from the others ($p<0.001$). There was a significant association between perceived exertion level after the Stroop task and hypoxic level ($p=0.003$) but not after the other 3 cognitive tasks ($p=0.098$ to 0.977). The hypoxia was only statistically associated with accuracy during the Stroop task (the higher the hypoxia, the higher the mean error rate during the task; $p=0.039$) but not with other tasks. No significant change in tissue saturation and total hemoglobin (ΔTSI% and (ΔtHb) were found. However, there was a statistically significant increase in deoxyhemoglobin values (ΔHHb) and a significant decrease in oxyhemoglobin (ΔO2Hb) for every cognitive task with the severity of hypoxia.

CONCLUSION: In summary, our findings suggest that only severe acute normobaric hypoxia impacts executive functions in young healthy subjects. This modest effect may be partially due to compensatory mechanisms operating at the cerebral oxygen extraction level. Nevertheless, participants reported a progressively increased in the perception of task difficulty under all progressive hypoxia levels during every demanding task suggesting a larger cognitive cost.

COMPARISON OF NORMOBARIC HYPOXIA STRATEGIES ON STRENGTH PERFORMANCE

JIMÉNEZ, J.A., FERICHE, B., PÉREZ-REGALADO, S., BENAVENTE, C., PADIAL, P., GARCÍA RODRÍGUEZ, S., TIMÓN, R.

UNIVERSITY OF EXTREMADURA

INTRODUCTION: Acute exercise under hypoxic conditions induces a drop in blood oxygen levels (hypoxemia) and impact in continuous oxygen supply to tissues (1). Terrestrial altitude presents a logistical challenge. For this reason, certain research endeavours to replicate high-altitude scenarios within normobaric hypoxia (NH) (2). However, one of the main concerns in using NH systems is the accumulation of CO2 levels and increased temperature and humidity inside the tent resulting from athletes' exhalation (3). Therefore, combining reduced oxygen availability and increased environmental stressors could affect performance (4). The present study aims to analyse the effects of a resistance training (RT) period under two different NH environment emplacements on strength development.

METHODS: Nineteen men (22,16 ± 2,94 years; 176,79 ± 7,47 cm; 76,32 ± 11,00 kg) participated in an 8-week- hypertrophy RT program (3 sessions /week) under systemic moderate NH (FiO2 = 15,9%) in a tent (8 m2; 50 l/min/persona) or in a room (60 m2; 900 l/min/persona). Before and after the program, one repetition maximum (1RM) in back squat and bench press exercises were evaluated. Maximal blood lactate and rating of perceived exertion (RPE min25) were also measured after the programs first and last sessions. Environmental CO2 was monitored during the RT sessions.

RESULTS: The values of change in CO2 concentration from the beginning to the end of the session were significantly higher in the tent (4947,70 ± 1918,84 ppm) compared with the room (550,31 ± 405,40 ppm). 1RM increased in both groups ($p < 0.05$), with no differences between groups ($p > 0.05$). No differences were found in the RPE and lactate between conditions ($p > 0.05$).

CONCLUSION: Results reveal a strength development after a RT period in NH regardless of the environmental additional stressors. However, such a higher CO2 concentration measured in the NH tent could lead to a greater physiological strain during exercise, impacting the normal functioning of organic systems not evaluated in this study. Therefore, the type of equipment used must be considered when conducting NH training.

References:

1. Billaut F., et al. PLoS ONE. 2013;8: e77297.

2. Coppel J., et al. Extrem Physiol Med. 2015;4(1).

3. Vasquez-Bonilla AA., et al. J Clin Med. 2021; 22;10(21):4879.

4. Girard O., et al Front. Sports Act. Living. 2020; 2:26.

Funding: This research was funded by the Spanish Ministry of Science, Innovation and Universities under grant number PGC2018-097388-B-I00 and by the Andalusian FEDER Operational Program under grants number A-SEJ-246-UGR18 & B-CTS-374-UGR20.

ADDING A SUSTAINED ATTENTION TASK TO A PHYSICALLY DEMANDING CYCLING EXERCISE EXACERBATES NEUROMUSCULAR FATIGUE AND IMPAIRS COGNITIVE PERFORMANCE IN BOTH NORMOXIA AND HYPOXIA.

GOEPP, T., HAYES, M., DI DOMENICO, H., HOT, P., RUPP, T.

UNIVERSITÉ SAVOIE MONT BLANC

INTRODUCTION: Both cognitive motor dual-tasks (CMDT) protocols and hypoxic environments have been associated to significant impairments on cognitive and physical performances. We aimed to determine the effects of hypoxia on cognitive performance and neuromuscular fatigue during a highly physically demanding CMDT.

METHODS: Fifteen young adults randomly participated in a separated task session in normoxia (CTLEX, CTLCOG) and in CMDT sessions in normoxia (DTNOR) and hypoxia (DTHYP). The physical exercise consisted of 20 min cycling at an "hard" perceived effort, and the cognitive task consisted of 15 min sustained attention to response time task (SART). Concurrent psycho-physiological measurements included: quadriceps neuromuscular fatigue (peripheral/central components from femoral nerve electrostimulation), prefrontal cortex (PFC) oxygenation by near-infrared spectroscopy, and perception of effort.

RESULTS: SART performance significantly decreased in DTNOR (-15.7±15.6%, $P<0.01$) and DTHYP (-26.2±16.0%, $P<0.01$) compared to CTLCOG (-1.0±17.7%, $P=0.61$). Peripheral fatigue similarly increased across conditions, whereas the ability of the central nervous system to activate the working muscles was impaired similarly in DTNOR (-6.1±5.9%, $P<0.001$) and DTHYP (-5.4±7.3%, $P<0.001$) compared to CTLEX (-1.1±0.2%, $P=0.52$). Exercise-induced perception of effort increased in DTHYP (+1.1±0.2, $P<0.001$) and in DTNOR (+0.7±0.2, $P=0.001$), while CTLEX remained unchanged (+0.4±0.2, $P=0.42$). This was correlated with cognitive impairments in both normoxia ($r=0.64$, $P=0.01$) and hypoxia ($r=0.53$, $P<0.05$). PFC deoxygenation was more pronounced in DTHYP compared to DTNOR (-6.9±1.7%, $P<0.001$) and CTLEX (-7.6±1.7%, $P<0.001$).

CONCLUSION: In conclusion, performing a sustained attention task together with physically challenging whole-body exercise promotes central neuromuscular fatigue and impairs cognitive accuracy; the latter is particularly noticeable when the CMDT is performed in hypoxia.

EFFECT OF STRENUOUS EXERCISE SESSION UNDER HYPOXIA ON SLEEP QUALITY IN YOUNG MALES.

MATSUDO, H., GOTO, K.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: Sleep is an indispensable activity to maintain health. Insufficient sleep duration or decreased sleep quality has been associated with an increased risk of injuries and augmented inflammation (Milewski et al., 2014). Previous research has revealed that sleep quality tends to be decreased during sleep in hypoxia compared with sleep in normoxia (Heinzer et al., 2016). However, typical type of "living low, training high" procedure involves exercise in hypoxia (< 2h) and sleep in normoxia. Therefore, further investigations need to clarify how high-intensity exercise under hypoxia affects sleep quality. The present study was designed to clarify the effect of strenuous exercise session under hypoxia on sleep-related physiological responses in young

METHODS: Ten healthy active males(20.3±0.4year, 172.7±1.8cm, 65.29±2.1kg) were recruited. They performed 3 conditions on different days, (1)exercise in hypoxia (Hypoxia; FiO2:14.5%), (2) exercise in normoxia (Normoxia; FiO2:20.9%), and (3)rest (Rest; without exercise). The exercise consisted of 30min pedaling exercise (the load was set as 3% of body weight) followed by repeated sprint exercise [(6s maximal pedaling with 30s rest periods between sprints×6session×2set), the load was set as 7.5% body weight]. During exercise session (16:30~17:30) HR, SpO2, and RPE were evaluated. During subsequent sleep (24:00~7:00) sleep architecture (EEG), skin temperature, and autonomic nerve activity(HF, LF/HF) were further evaluated.

RESULTS: During exercise, SpO2 was significantly lower in Hypoxia (85±0.3%) than in Normoxia (97±0.1%) and Rest (98±0.1%, P<0.05). HR was significantly higher in Hypoxia (144±1 bpm) and Normoxia (138±2 bpm) than in Rest (66±0.4 bpm, P<0.05), with no significant differences between Hypoxia and Normoxia. During 7 hours of sleep, autonomic nerve activity (HF, LF/HF) did not differ significantly among three conditions. Moreover, total sleep time, sleep efficiency, and sleep latency did not differ significantly among three conditions. However, sleep latency of slow wave sleep (SWS; stage 3) was significantly longer in Hypoxia (18.2±11.7 min) than in Normoxia (9.0±0.8 min) and Rest (7.2±1 min, P<0.05).

CONCLUSION: Although strenuous exercise session under hypoxia did not affect sleep efficiency, it significantly delayed the onset of the SWS, which may be potentially negative for sleep quality.

REFERENCE:

• Milewski, M. D., Skaggs, D. L., Bishop, G. A., Pace, J. L., Ibrahim, D. A., Wren, T. A., & Barzdukas, A. (2014). Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. Journal of Pediatric Orthopedics, 34(2), 129–133.

• Heinzer, R., Saugy, J. J., Rupp, T., Tobback, N., Faiss, R., Bourdillon, N., Rubio, J. H., & Millet, G. P. (2016). Comparison of Sleep Disorders between Real and Simulated 3,450-m Altitude. Sleep, 39(8), 1517–1523.

Oral Presentations

OP-BM05 Neuromuscular Physiology II

ALL SEX DIFFERENCES IN FORCE-VELOCITY RELATIONSHIP AND RATE OF FORCE DEVELOPMENT DISAPPEAR AFTER NORMALISING FOR MAXIMAL FORCE

SALVAGGIO, F., BRUSTIO, P., PINTORE, A., GROSSIO L., CALCAGNO, E., RAINOLDI, A., SAMOZINO, L., BOCCIA G.
UNIVERSITY OF TURIN

INTRODUCTION: Force-velocity (FV) relationship is characterised by dynamic force production capacities at high (V0) and low (F0) velocities, and then maximal power (Pmax). The rate of force development (RFD) represents a key measure determining the capacity to produce force quickly in isometric conditions starting from a relaxed state. When the FV relationship is obtained from average force and velocity over the movement, RFD could be an underlying factor of force production capacities at high velocity (V0, Boccia et al. 2024). This study aims to analyse comprehensively the variations in FV relationship and RFD parameters between sexes, notably to test the likely association between differences in both RFD and V0.

METHODS: Single-leg knee extensors were tested under isometric and dynamic conditions in 53 healthy subjects (38% female). The protocol included two 5s maximal isometric voluntary contractions (MVC), 15 isometric burst-like contractions (at least 70% of MVC) and dynamic incremental-load knee extensions from the minimum load (i.e., 2.5 kg) up to the individual maximal load. Force and velocity were measured to calculate individual FV relationships using a hyperbolic model. Electromyographic signals were recorded using two 64-electrodes matrices placed on the vastus lateralis and the rectus femoris muscles. The root mean square (RMS) calculated during isometric and dynamic contractions was normalised to the RMS during the MVC.

RESULTS: FV relationships were well fitted by hyperbolic regression (r^2 from 0.983 to 0.993). Independent samples t-test revealed significant sex differences (p<.001) in favour of males in isometric testing for RFD measured at 50 ms (effect size [ES]= 1.2), 100 ms (ES=2.1) and 150 ms (ES=2.4), peak RFD (ES=2.0), MVC (ES=2.1). However, after normalising all the parameters for MVC, the sex differences disappeared. Regarding FV parameters F0 (ES=0.9), Pmax (ES=1.0), and force at Pmax (ES=1.9) were greater in males (p<.001), while V0 was similar between sexes. Again, when normalising the force parameters (i.e. F0 and force at Pmax) for MVC, the sex differences disappeared. Similarly, the normalised EMG signals of both muscles showed no sex differences.

CONCLUSION: Moderate to large sex differences were observed in favour of males in several parameters, including the RFD at 50ms, 100ms and 150ms, MVC, peak RFD, F0, maximal power and force at maximal power. However, after the normalisation of all the parameters mentioned above to MVC, those differences were no longer observed, suggesting that the maximal strength may explain most of the sex differences in rapid isometric and dynamic force production, without any differences in V0 between sexes.

REFERENCES:

Boccia et al., ECSS, 2024, The rate of force development as a determinant of maximal theoretical velocity in the force-velocity relationship.

AGE-RELATED DIFFERENCES IN MOTOR UNIT DISCHARGE RATE AS A FUNCTION OF CONTRACTION INTENSITY

CONNELLY, C.D., VALENCIC, T., THOMASON, H., PIASECKI, M., PEARCEY, G., FOLLAND, J., ŠKARABOT, J.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Older adults undergo alterations in the neuromuscular system ultimately leading to reduced muscle force generating capacity. The force exerted by a muscle is controlled by motor unit (MU) recruitment and discharge rate, with

the latter having been shown to decrease with advancing age. However, less is known about MU discharge rate modulation with increased contraction intensity in aged compared to younger individuals with alterations in motoneuron structural integrity, ionotropic synaptic input, and neuromodulation indicating potentially greater age-related effects at higher contraction intensities. Therefore, we aimed to examine tibialis anterior (TA) MU discharge rate modulation across a wide range of contraction intensities in older compared to young adults.

METHODS: Fourteen young (6 female; 24±5 years) and 14 older adults (6 female; 71±4 years) matched for physical activity levels (3938 [2723, 6661] vs. 3431 [2068, 4795] MET.min/week, p=0.57) performed isometric dorsiflexion contractions both of a trapezoidal (10 s hold phase) and triangular shape (10 s ascending/descending phase) at 30%, 50% and 70% of maximum voluntary force (MVF). Multichannel electromyography signals were recorded from TA with a 64-channel array and were decomposed using Convolution Kernel Compensation algorithm into MU spike trains. From MU spike trains identified during trapezoidal contractions mean discharge rate during the hold phase was calculated. The MU spike trains during triangular contractions were smoothed with support vector regression, followed by the calculation of the onset-offset hysteresis of pairs of MUs (ΔF) to estimate the magnitude of persistent inward currents. Linear mixed effects models were used to determine if MU properties were predicted by age, contraction intensity and their interaction with MU recruitment threshold as a covariate.

RESULTS: Dorsiflexion MVF was not significantly different between young and older adults (322 [278, 366] vs. 262 [222, 302] N; p=0.06). There was a significant interaction between age and contraction intensity for MU discharge rate (p=0.006). However, post hoc testing did not indicate any differences at individual contractions intensities (30% MVF: 14.5 [13.0, 16.0] vs. 12.7 [11.2, 14.1] pps, p=0.49; 50% MVF: 19.4 [17.9, 20.9] vs. 18.0 [16.5, 19.4] pps, p=0.71; 70% MVF: 26.0 [24.5, 27.5] vs. 25.3 [23.9, 26.8] pps; p=0.99). A significant age by contraction intensity interaction was also noted for ΔF (p<0.001), with greater ΔF noted for young compared to older adults at 70% (6.3 [5.7, 7.0] vs. 4.5 [3.8, 5.2] pps, p=0.006), but not 50% (5.8 [5.1, 6.4] vs. 4.4 [3.7, 5.1] pps, p=0.077) or 30% MVF (4.8 [4.1, 5.5] vs. 4.1 [3.4, 4.8] pps, p=0.6).

CONCLUSION: These findings demonstrate that MU discharge properties are differentially modulated from low to high contraction intensities between young and older individuals in the TA, suggesting alterations in the gain modulation of aged motoneurons.

EFFECTS OF 14 DAYS OF STEPS REDUCTION ON NEUROMUSCULAR FUNCTION AND FATIGABILITY IN YOUNG ADULTS

GATTI, M., COLOSIO, M., PADDEU, S., MARCIANO, A., SAZZI, C., BROCCA, L., PORCELLI, S., PELLEGRINO, M., CANEPARI, M., BOTTINELLI, R.

UNIVERSITÀ DEGLI STUDI DI PAVIA

INTRODUCTION: Physical inactivity (PI) is a critical issue for our society and is linked to increased risk of adverse health outcomes [1]. Disuse models used to simulate physiological consequences of PI, such as bedrest or lower limb suspension, showed muscle wasting and neuromuscular function (NMF) impairments in young adults [2,3]. After steps reduction (SR) interventions, a less invasive model of PI, mild muscle atrophy and controversial impairments in muscle force have been reported [4]. To date, no studies have fully explored NMF and fatigability changes after SR in young adults. This work aimed to assess in-vivo and ex-vivo muscle contractile proprieties and performance fatigability after 14 days of SR in healthy young adults.

METHODS: We recruited 30 (n=16 women) young healthy, normally active, subjects that underwent to 14 days of SR to 1500 steps/day. They were tested before (T1) and after SR (T2). In each time point, participants performed 80 maximal-velocity isotonic concentric knee extension (KE) contractions (1 every 3s) with a load equivalent to 30% of the maximal voluntary isometric contraction (MVIC) torque. Mechanical power output (Pw) of each contraction was calculated. Before (PRE) and immediately after (POST) the fatiguing exercise, KE MVIC was performed. During MVIC interpolated twitch technique was used to investigate voluntary activation (VA). A set of 100Hz doublets (Db100) and single (St) transcutaneous electrical stimulations were also delivered through the femoral nerve on relaxed muscle. Finally, specific isometric force (P0/CSA) and maximal velocity (V0) were determined from skinned single muscle fibers samples from vastus lateralis.

RESULTS: Overall daily steps were reduced by 82%. KE MVIC torque significantly decreased from T1 (149.7□50.0 Nm) to T2 (126.8□47.9 N m; p<.01). SR did not affected VA, St and Db100 torque. Initial Pw was lower T2 (2.97□0.83 W/Kg) compared to T1 (3.27□0.81 W/kg; p<.01). In POST, Pw and MVIC torque loss did not show any intervention effect. P0/CSA didn't change in type 1 fibers, but a significant decrease in type 2 was found (103□50 and 77□36 kN*m2 in T1 and T2, respectively; p<.05). Moreover, V0 increased only for type 1 fibers (from 0.12□0.09 to 0.23□0.14 L/s; p<.05).

CONCLUSION: In healthy young adults, mild reduction in physical activity like SR, caused a significant decrease in force production and mechanical Pw of KE, without affecting fatigability. Classical hallmarks of disuse [5] as reduction in type 2 fibers specific force and increase in type 1 fibers' maximal velocity were found. This suggest that after SR, neuromuscular changes of knee extensors could be, at least in part, related to changes in contractile properties, although no changes were observed by electrical stimulated contractions. Thus, low mechanical load imposed for two weeks is sufficient to cause relevant functional impairments at skeletal muscle level.

ECCENTRIC-ONLY RESISTANCE TRAINING TO CHRONICALLY DECREASE PASSIVE STIFFNESS OF THE HAMSTRING MUSCLE

KAWAMA, R., TAKAHASHI, K., IKIFUNE, H., TOZAWA, H., OBATA, T., ITO, R., HOJO, T., WAKAHARA, T.
DOSHISHA UNIVERSITY

INTRODUCTION: Resistance training is effective in increasing muscular strength and size, but may be empirically believed to increase passive muscle stiffness, potentially increasing the risk of musculoskeletal injuries [1]. Meanwhile, we have recently shown that the passive stiffness of a specific hamstring muscle (semimembranosus [SM]) acutely decreases after a session of eccentric-only stiff-leg deadlift using a combination of long muscle lengths and a long duration (LL [2]). Passive muscle stiffness was reported to chronically decrease after static stretching at moderate to high weekly frequencies (three to six sessions per week [3]). Thus, the present study tested the hypothesis that passive stiffness of the hamstring muscle chronically decreases when eccentric-only resistance training with LL is performed, especially at a relatively high weekly frequency.

METHODS: Thirty-six healthy young males were randomly assigned into two training groups (W2 and W3, n = 12 in each group) and a control group (CON, n = 12). The participants in both training groups performed three sets of 10 repetitions of eccentric-only stiff-leg deadlift at 60–70% of body weight, 50–100% of maximal exercise range of motion with 5 s per repetition for 10 weeks (two and three sessions per week in W2 and W3, respectively). Before and after the intervention period, shear moduli of the biceps femoris long head, semitendinosus, and SM were measured using shear wave elastography. Additionally, maximal voluntary isometric torque of knee flexion and volumes of the biarticular hamstring muscles were measured with a dynamometer and MRI, respectively. For these variables, non-parametric tests were performed.

RESULTS: In W3, the shear modulus of SM (–11.4% [median value]) significantly decreased after the intervention period, but that of the biceps femoris long head (0.6%) or semitendinosus (4.6%) did not change. There were no significant changes in the shear moduli of the biarticular hamstring muscles in W2 or CON. The maximal voluntary isometric torque (20.3% and 26.2%, respectively) and SM volume (5.7% and 7.4%, respectively) significantly increased in W2 and W3.

CONCLUSION: The present study is the first to show that passive muscle stiffness chronically decreases when eccentric-only resistance training with LL is performed, especially at a higher weekly frequency. Moreover, the previous [2] and present studies suggest that an acute decrease in the passive muscle stiffness induced by resistance exercise corresponds to a training-induced chronic decrease in the stiffness. The present findings provide new insights into the current understanding of the training-induced adaptive plasticity of passive muscle stiffness. Our training modality may be a time-efficient strategy for increasing muscular strength and size while minimizing the risk of musculoskeletal injuries.

REFERENCES:

1. Kumagai et al. Med Sci Sports Exerc, 2019

2. Kawama et al., Eur J Appl Physiol, 2023

3. Takeuchi et al. Scand J Med Sci Sports, 2023

ADAPTATION OF THE HUMAN RETICULOSPINAL TRACT IN UNTRAINED PARTICIPANTS TO A 6-WEEK ISOMETRIC RESISTANCE TRAINING INTERVENTION.

ATKINSON, E., ANSDELL, P., GOODALL, S., HOWATSON, G., ŠKARABOT, J., THOMAS, K.
NORTHUMBRIA UNIVERSITY

INTRODUCTION: Introduction. Neural adaptations to resistance training in humans have focused on the corticospinal tract (CST), with equivocal results [1]. Non-human primate research has highlighted the reticulospinal tract (RST) as a site of adaptation to resistance training [2], however, longitudinal observations in humans have yet to be performed. This study examined the possible time-course of adaptations within descending motor tracts over a 6-week resistance training intervention.

METHODS: Methods. Twenty-eight participants (age: 31 ± 7 years) were randomly assigned into training and control groups, consisting of fourteen in the control group (age: 31 ± 5 years) and fourteen in the training group (age: 31 ± 8 years). The training group's isometric resistance training intervention was 4 sets of 8 repetitions at 80% maximal voluntary contraction (MVC) of their dominant elbow flexor, occurring twice weekly for 6-weeks and 24–48h apart. Neuromuscular assessments were performed at baseline and end of weeks 1, 2, 3 and 6, with evoked responses recorded at 10% MVC with surface electromyography. Short-interval cortical inhibition (SICI), intra-cortical facilitation (ICF), supra-spinal input (V-wave) assessed cortical function, while motor evoked potentials (MEP) assessed CST excitability. RST excitability was indirectly inferred from responses to cervico-medullary stimulations (CMEPCON) and transcranial magnetic stimulation (TMSCON), paired with a conditioning startling auditory stimuli of ≥ 110 dB, either 80 ms (CMEPCON) or 50 ms (TMSCON) apart[3]. The StartReact protocol [4], also assessed RST function through reaction time responses to visual (VRT), auditory (VART), and startling auditory stimuli (VASRT), quantified through the calculations of RST Gain and auditory – startle response time difference (ARSRΔ).

RESULTS: Results. Training group elbow flexor strength increased compared to controls (14 ± 7% vs 1 ± 5%, $p < 0.001$). For measures of RST function, no interaction effect for CMEPCON responses ($p = 0.54$), TMSCON ($p = 0.56$), or for quantification of StartReact through RST Gain ($p = 0.15$) and ARSRΔ ($p = 0.29$) following the intervention were found. For cortical and CST function, there were also no interaction effects for SICI, ICF, V-Wave or MEP responses ($p \geq 0.09$).

CONCLUSION: Conclusion. While elbow flexor strength increased, indirect measures of RST function did not show evidence of RST adaptation following the isometric resistance training intervention, despite no cortical or CST adaptations. Therefore, this data shows that the RST does not appear to facilitate strength increases following isometric resistance training.

1) Siddique et al., Sports Med, 2020

2) Glover et al., J neurosci, 2020

3) Furubyashi et al., Clin Neurophysiol, 2000

4) Baker et al., J Neurosci, 2017

Oral Presentations

OP-AP03 Training and Testing

DRIBBLE LIKE ROBBEN: WHAT DETERMINES SUCCESSFULNESS IN 1-VS-1 ACTIONS IN ELITE SOCCER?

OONK, G.A., KEMPE, M., BUURKE, T.J.W., LEMMINK, K.A.P.M.

UNIVERSITY OF GRONINGEN

INTRODUCTION: Competitive interactions are an important phenomenon in most team and individual sports. However, research on competitive interactions is mainly conducted in controlled laboratory-based experiments, which raises the question of generalizability towards more dynamic environments in team sports. While studies in rugby and futsal investigated 1-vs-1 actions in training settings, they did not relate their findings to the successfulness of the actions. We seek to close this gap by studying 1-vs-1 actions in competition. Therefore, using a large-scale observation design, this study aims to identify determinants of successful 1-vs-1 actions in male elite soccer.

METHODS: 1-vs-1 actions from 43 Dutch Eredivisie matches were manually selected and labelled on successfulness by three raters. Using tracking data, 24 variables of the 1-vs-1 actions were obtained, divided into three categories: individual (e.g. velocity of the defender), interaction (e.g. relative velocity between the attacker and the defender), and environmental (e.g. the location on the pitch of the action). Multivariate analysis was used to show which (category of) variables discriminated between successful and unsuccessful 1-vs-1 actions.

RESULTS: In total 734 1-vs-1 actions were selected (Fleiss kappa = 0.76) of which 356 were successful and 378 unsuccessful (Fleiss kappa = 0.89). A MANOVA showed a main effect for successfulness (Wilks $\Lambda = 0.881$, $F(23, 710) = 4.178$, $p < 0.001$). Post-hoc analysis with a Bonferroni correction identified five individual variables that differed between successful and unsuccessful 1-vs-1 actions ($p<0.03$): the minimal distance between the attacker and the defender, the minimal distance between the ball and the defender, the variation in the distance between the attacker and the ball, the pressure on the attacker, and the median directional change of the attacker during the action. All five were variables that related to the interaction between the attacker and his environment, while variables for the individual and environment show no significant results.

CONCLUSION: In conclusion, only the variables that were related to the interaction between the attacker and the defenders discriminated between successful and unsuccessful 1-vs-1 actions. These findings can be directly applied to talent identification and scouting in team sports. Although it is often thought that individual speed and acceleration are important for successful 1-vs-1 actions, the results show that the interaction between the attacker and the environment is more decisive for successfulness in 1-vs-1 actions than individual variables. Specifically, the successful 1-vs-1 actions differentiated from unsuccessful ones by showing less pressure exerted on the attacker during the action, a higher degree of ball control by the attacker, and a more direct approach during the action.

MUSCLE TYPOLOGY OF YOUTH TRACK-AND-FIELD ATHLETES PREDICTS THEIR ADULT PERFORMANCE: A PROSPECTIVE STUDY

VANDECAUTER, J., VAN VOSSEL, K., VAN DE CASTEELE, F., DERAVE, W., LIEVENS, E.

GHENT UNIVERSITY

INTRODUCTION: Current talent identification programs struggle to successfully identify track-and-field talents at a younger age, mainly because of poor relation between youth and senior performances [1]. Instead, stable biological and performance-related factors, such as muscle fiber type composition (MFTC), may hold promise for more robust predictions. Fast and slow muscle fibers possess distinct characteristics and their ratio is discipline-dependent in elite track-and-field athletes [2]. With the advent of non-invasive techniques, the assessment of MFTC is no longer restricted to muscle biopsies, enabling its use in talented youth [3]. Therefore, the aim of this longitudinal prospective study is to investigate whether MFTC measured at a younger age, is a good predictor for later track-and-field performance.

METHODS: Between 2010 and 2019, we included 64 talented youth athletes that were allowed into selective track-and field elite sport schools (age = 15.7 ± 1.3 years, range 12 to 18 years). Their MFTC was non-invasively estimated in the gastrocnemius muscle using 3T proton magnetic resonance spectroscopy of the fast-twitch metabolite carnosine. Youth athletes' MFTC was compared to a discipline-specific elite athlete benchmark population (n = 87, ≥ 1050 IAAF points). A categorical approach was used to assign youth athletes as 'match' if their MFTC was within the range (mean ± 1 SD) of the

elite athletes for their discipline, otherwise appointed as 'mismatch'. The personal best IAAF-score was analyzed as performance parameter, with a follow-up period of 3 to 12 years after the muscle scan. Independent sample t-tests were used with significance set at $p \leq 0.05$.

RESULTS: The highest IAAF-score was obtained 3.4 ± 2.4 years after the scan. Two-thirds of the athletes were already training for a discipline matching their MFTC, indicating the importance of the coaches' eye. Nevertheless, one-third was still misclassified. The 'match' athletes achieved a significantly higher IAAF-score (987 ± 110 vs 915 ± 93 points, $p = 0.011$) compared to 'mismatch' athletes, indicating a better later performance if MFTC at youth level matches with the MFTC of the elite benchmark for their discipline. Of all the matching athletes, 36% achieved an all-time best score above 1050 points, i.e. reaching international standards, compared to only 9% with a mismatching MFTC ($p = 0.022$).

CONCLUSION: This study shows for the first time that youth track-and-field athletes who train for a discipline that is deemed optimal based on their MFTC, perform better at adult age. Therefore, the non-invasive measurement of MFTC can be seen as a new and valuable element in talent identification, identifying the ideal discipline for youth athletes around the age of 15 to 16 years. This is likely expandable to other sports, like cycling, where discipline specialization depends on MFTC.

References:

[1] Barth et al. (2023). Sports Medicine.

[2] Costill et al. (1976). Journal of Applied Physiology.

[3] Baguet et al. (2011). PLOS ONE.

DURABILITY OF SPEED-TIME AND POWER-TIME RELATIONSHIP PARAMETERS DURING OVER-GROUND RUNNING IN A TEAM SPORTS SIMULATION

VASSALLO, C., GRIGGS, A., GRAY, A., KILDUFF, L.P., JENKINS, D., WALDRON, M.

SWANSEA UNIVERSITY

INTRODUCTION: Parameters of the speed- or power-time relationship, such as critical speed (CS) and D-prime (D') or critical power (CP) and W-prime (W') enable non-invasive evaluation of physiological capacities, which can be used to model the 'balance' of W (W'BAL) during intermittent exercise [1]. However, their deterioration during prolonged exercise, described as 'durability' [2], may lead to inaccuracies in W'BAL modelling. This study evaluated i) changes in speed- or power-time parameters during team sport simulations and ii) the relationships between work done in the severe-intensity domain (SID) and the magnitude of change in parameters.

METHODS: Twenty participants consented to take part in four testing visits. Familiarisation and baseline assessments of overground running 3-min tests (3MT) were conducted, with a global positioning system used to measure the speed-time relationship and mechanical work determined via energetic modelling, from which CP (W) and W' (kJ) were calculated. Subsequent visits comprised a 40-min (one-half) or 80-min (full-match) rugby league movement simulation protocol, each followed by the 3MT (40-3MT and 80-3MT). The SID distance (m) >CS and work (kJ) >CP were calculated from each simulation. A repeated measures ANOVA analysed changes in parameters across baseline, 40-3MT and 80-3MT, with post-hoc comparisons where appropriate. Linear regression was used to explain the variance in power-time parameter changes based on SID work. The relationships between baseline parameters and durability were analysed with Pearson's coefficients. Means±SD are presented.

RESULTS: There were no differences (P>0.05) in CS or CP across simulation stages; however, D' and W' deteriorated at each simulation stage and were lowest after the 80-3MT (94±37 m, 19±8 kJ, respectively) compared to baseline (142±50 m, 28±12 kJ, respectively; P<0.001). The SID work explained 41.0% (P=0.01) variance in the W' reductions between baseline 3MT and 80-3MT. There was no relationship between baseline CP or CS and the reduction in W' after 80 min (P=>0.05), but there was an inverse relationship between baseline W' and the reduction in W' after 40 min (r=-0.69; P=0.001) and 80 min (r=-0.76; P=<0.001).

CONCLUSION: These results demonstrate the magnitude and time-course of D' and W' reductions after half- and full-match simulations, whilst highlighting the maintenance of CS and CP. The W-prime reductions tended to be highest among those with higher baseline W' values but were unrelated to CP or CS. The maintenance of CS and CP parameters across protocols was unanticipated, which adds complexity to the understanding of the interdependency between CP and W' or CS and D' parameters. These findings have implications for the accurate modelling of W'BAL during prolonged intermittent running and offer preliminary data to support the future adjustment of models to account for progressive exercise-induced reductions in baseline speed- or power-time parameters.

1. Skiba & Clarke (2021) 2. Maunder et al. (2021)

PREDICTIVE ACCURACY OF RAPID WEIGHT LOSS, SEX DIFFERENCES, AND TEST-RETEST RELIABILITY OF HYDRATION BIOMARKERS FOLLOWING ACUTE PASSIVE DEHYDRATION

DOHERTY, C., FORTINGTON, L., BARLEY, O.

EDITH COWAN UNIVERSITY

INTRODUCTION: Combat sports athletes undergo pre-competition body mass (BM) assessments to check compliance with their chosen weight class. In pursuit of a competitive edge, athletes often resort to rapid weight loss (RWL) practices before weigh-ins, despite associated health risks, and rare fatalities. Some organisations have introduced hydration testing, such

as urine-specific gravity (USG) tests, to mitigate these risks, but the accuracy and reliability of hydration biomarkers in this context remain unclear. Therefore, this study aimed to investigate the predictive accuracy of RWL for explaining biomarker changes, and assess sex differences, while also examining biomarker reliability across two passive dehydration trials.

METHODS: Fifteen male (age: 26.3 ± 3.5 years, BM: 76 ± 7 kg) and fifteen female (age: 28.8 ± 6.4 years, BM: 63 ± 7 kg) combat sports athletes aimed to lose 4% of their BM via infrared sauna (46°C [±0.8]°C and 35% [±3%] relative humidity), on two separate occasions (10.9 ± 5.6 days apart). Biomarkers were collected pre- and post-dehydration and included serum, tear, and urine osmolality (Sosm, Tosm, Uosm), haematocrit (Hct), and USG. Linear regression assessed the predictive accuracy of RWL, and sex differences in biomarker change scores (Δ), the intra-class correlation coefficient (ICC 2,1) measured reliability, and the accuracy of post-USG (≥1.020) was evaluated based on post-Sosm (≥295/301 mOsm/kg) cut-offs.

RESULTS: Male RWL was significantly greater than that of females across both trials (3.44% ± 0.60% vs. 2.53% ± 0.43%, $p < .001$). RWL poorly predicted all biomarker change scores, with the best explanatory power for HctΔ ($R2 = 0.22$, $\beta = 1$, $p = 0.009$). When controlling for RWL, sex (ref male) had a significant effect in explaining HctΔ ($R2 = 0.39$, $\beta = 0.8$, $p = .032$) and SosmΔ ($R2 = 0.25$, $\beta = -3.3$, $p = .005$), but not for urinary or tear measures. Reliability ranged from poor to good; TosmΔ performed worst (ICC = 0.06, $p = 0.37$), while HctΔ showed the best reliability (ICC = 0.61, $p < 0.001$). Post-USG based on a post-Sosm cutoff of 295 mOsm/kg, had an 80% true negative rate (TNR) and a 62% true positive rate (TPR), with 35% false negatives and 2% false positives. Adjusting the Sosm cutoff to 301 mOsm/kg, the TNR decreased to 52%, while the TPR increased to 83%, with 5% false negatives and 33% false positives.

CONCLUSION: All biomarkers displayed considerable variation over both sessions. While RWL displayed the strongest predictive accuracy for blood measures, it only accounted for <25% of biomarker variation. A sex difference in blood biomarker change was observed, with females having a 0.8% lower HctΔ and a 3.3 mOsm/kg greater SosmΔ when controlling for RWL. Overall, the biomarkers were unreliable, and post-USG misclassified almost 4 out of every 10 dehydrated athletes. RWL of ~3.0% did not accurately explain changes in hydration biomarkers, and therefore these measures cannot be recommended for regulatory use in combat sports.

MODELLING THE RELATIONSHIP BETWEEN REPETITIONS LEFT IN RESERVE AND MOVEMENT VELOCITY: A VALID METHOD FOR RESISTANCE TRAINING MONITORING AND PRESCRIPTION, AND FATIGUE MANAGEMENT

JUKIC, I., PRNJAK, K., HELMS, E., MCGUIGAN, M.R.

AUCKLAND UNIVERSITY OF TECHNOLOGY; ABERTAY UNIVERSITY

INTRODUCTION: In resistance training (RT), establishing a relationship between repetitions left in reserve and the mean absolute velocity (RIR-velocity relationship) could allow for objective monitoring, prescription, and real-time adjustment of the training load and set volume. Therefore, we examined the goodness of fit and predictive validity of general and individual RIR-velocity relationships in the free-weight back squat exercise. Moreover, we investigated whether sex, training status and history, personality traits, and different modelling strategies also affect the goodness of fit and the validity of these relationships.

METHODS: Fifty-one resistance-trained people (15 females and 36 males; 18 to 40 years of age) with a wide range of strength levels, training experience, and different training histories were recruited and they performed a one-repetition maximum (1RM) test, and two repetitions to failure (RTF) tests 72 hours apart. RTF sessions were performed with 70, 80, and 90% of 1RM with 10 minutes of rest between sets. The training history and RT practices were examined via questionnaires while the 50-item International Personality Item Pool Big Five Personality Inventory was used to assess stable personality traits via Qualtrics software. Linear and generalised linear mixed-effects models were used to examine 1) factors influencing the goodness of fit of individual RIR-velocity relationships; and 2) the predictive validity of both general and individual RIR-velocity relationships and the factors affecting the validity of these models.

RESULTS: We found a greater goodness of fit of individual RIR-velocity relationships ($R2 = 0.91$-0.97; residual standard error [RSE] = 0.35-1.38) compared to general RIR-velocity relationships ($R2 = 0.45$-0.57; RSE = 1.14-3.47). Individual, but not general RIR-velocity relationships established in the first testing session yielded acceptable predictive validity of RIR (mean error < 2 repetitions) in the subsequent testing session, regardless of the load used. Sex, training status and history, and personality traits did not significantly affect the goodness of fit of general and individual RIR-velocity relationships or their prediction validity (all $p < 0.05$), suggesting the potential generalisability of those findings among resistance-trained populations. Similar results were obtained when both general and individual RIR-velocity relationships were averaged across the loads; this suggests that an individual RIR-velocity relationship covering a range of loads can be used to monitor and prescribe RT with acceptable accuracy.

CONCLUSION: Establishing RIR-velocity relationships enables precise load prescriptions based on daily readiness and provides real-time and accurate insight into individuals proximity to failure during RT. This enhanced understanding could empower sport scientists and coaches to exert greater control over the physiological stimuli applied during RT, potentially fostering more targeted and effective training adaptations.

Oral Presentations

OP-PN14 Nutrition VI

NUTRITION CULTURE IN ENGLISH PREMIER LEAGUE FOOTBALL: A BOURDIEUSIAN ANALYSIS

FOO, W.L., TESTER, E., CLOSE, G.L., CRONIN, C.J., MORTON, J.P.
LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: In 2020, the Union of European Football Associations (UEFA) published evidence based nutritional guidelines for elite football (1), reflecting the growing recognition of the role of nutrition in supporting football performance. In practice, however, players do not readily meet these guidelines (2). While behaviour change models have explored enablers and barriers to nutritional adherence (3), the cultural factors influencing players' nutritional habits also warrant investigation. Through the lens of Bourdieu Theory (4), this study aimed to explore players' perceptions of the nutrition culture within the professional football environment.

METHODS: An interpretivist paradigm, which emphasizes that reality is subjective and socially constructed, underpins this study. Accordingly, face-to-face semi structured interviews were conducted with purposively sampled male footballers from the English Premier League (EPL) (5 British, 5 Migrant; mean age: 26 ± 6; mean EPL appearances: 106 ± 129). Questions were open-ended to maximise contribution. Data were abductively analysed using thematic analysis (5). Bourdieu theory which includes habitus (acquired disposition and behaviour), capitals (economic, e.g. resources; social, e.g. status), field (arena of social practice) and doxa (taken-for-granted beliefs) informed interviews and analysis

RESULTS: This study revealed five key themes: (1) Habitus, shaped by familial, ethnic and religious backgrounds, influences footballers' dietary habits; (2) Via social capital, managers, teammates and online influences, significantly impact footballers' dietary practices; (3) The rise of football clubs' and players' economic capitals spurred advancements in nutrition provision; (4) An unequal distribution of economic capitals has led to hierarchical practice in the performance nutrition field with personalized nutrition being somewhat enacted at the higher levels, and (5) Body composition measurement is a 'doxic' practice in professional football that warrants challenge.

CONCLUSION: Data showed that the habitual nutritional practices of professional players is influenced by cultural factors associated with their personal upbringing and the context of the specific club in question (e.g. economic resources and/or social capital exerted by managers). Additionally, the field of performance nutrition within professional football is influenced by stakeholder doxic beliefs surrounding the perceived optimal body composition of players, where managers also exert social capital. Practically, these data clearly demonstrate the necessity for player and stakeholder education programmes that seek to equip individuals with both knowledge and practical skillsets to ensure the successful translation of science to practice.

REFERENCES:

1) Collins et al., Br J Sports Med, 2021

2) Danielik et al., Int J Environ Res Public Health, 2022

3) Bentley et al. Psychol Sport Exerc, 2021

4) Bourdieu, London, Routledge, 1984

5) Sparkes & Smith, Routledge/Taylor & Francis Group, 2014

POSTPRANDIAL GLUCOSE AND APPETITE RESPONSES TO DIFFERENT FOOD INTAKE SEQUENCES IN RECREATIONALLY ACTIVE ADULTS

GIRO, R.1,2, TEIXEIRA, V.H.1, REBELO, P.2, BORGES, N.1, BRITO, J.2
1 FACULTY OF NUTRITION AND FOOD SCIENCES, UNIVERSITY OF PORTO 2 PORTUGAL FOOTBALL SCHOOL, PORTUGUESE FOOTBALL FEDERATION

INTRODUCTION: Food intake sequence can impact postprandial glucose (PPG) concentrations in patients with diabetes and healthy individuals. Lower PPG rises and dips are associated with decreased subsequent hunger and energy intake. However, no studies to date have targeted athletes or recreationally active individuals, despite their high carbohydrate (CHO) requirements and the role of CHO on metabolic health and exercise performance. Therefore, this study aimed to evaluate the acute effects of food intake sequence on PPG and appetite perceptions in recreationally active adults.

METHODS: In a randomized crossover counterbalanced design, 10 healthy recreationally active individuals (5 men, 5 women; 22–41 yrs; 21.8±2.5 kg/m2; 4.7±3.1 h/week of exercise) consumed an identical, isocaloric meal in either of two intake sequences: CHO-first or CHO-last. Orange juice, white bread with jam and banana were consumed before or after a high-protein yoghurt and almonds over 15 min. The test-meal was high in CHO (1.59±0.11 g/kg), moderate in protein (0.44±0.03 g/kg), low in fat (0.16±0.01 g/kg) and low in fibre (5.9–6.8 g). Finger-prick capillary blood glucose and appetite ratings on 100-mm visual analogue scales were measured at baseline, 15, 30, 45, 60, 90, 120 and 180 min after the start of the meal. Friedman test with Bonferroni post-hoc was performed to explore differences between food intake sequences over time. Paired t and Wilcoxon signed-rank tests were used to compare time series summary statistics [total area under the curve (tAUC), incremental AUC (iAUC), peak and time to peak]. Spearman rho assessed partial correlations controlling for condition, time, sex, and order effects.

RESULTS: Participants were normal glucose tolerant [4.8±0.5 mmol/L of fasting blood glucose (<5.6 mmol/L) and 6.1±0.8 mmol/L of 2-h PPG during a 75-g oral glucose tolerance test (<7.8 mmol/L)]. Baseline and PPG concentrations were not different between food intake sequences (pairwise comparisons, peak, time to peak, tAUC, iAUC x 120 and 180 min, p>0.05). Desire to eat something salty was greater after consumption of the CHO-first vs. the CHO-last meal pattern (iAUC: 1428 [263–3403] vs. 3876 [780–6881] mm x 120 min, p<0.05). Blood glucose was moderately positively correlated (p<0.001) with satiety (rs=0.577), fullness (rs=0.583), desire to eat something salty (rs=0.457) and savoury (rs=0.522); moderately negatively correlated (p<0.001) with hunger (rs=-0.561) and prospective food consumption (rs=-0.615); poorly positively correlated with desire to eat something sweet (rs=0.385; p<0.001), and very poorly positively correlated with desire to eat something fatty (rs=0.169; p<0.05).

CONCLUSION: Blood glucose was associated with appetite perceptions in healthy, recreationally active individuals. Food intake sequence influenced the desire for specific food types in the hours after a meal. Further research is warranted on the effects of eating order on the health and performance of recreationally active and athletic populations.

DIETARY INTERVENTION FOR A HEALTHY GUT MICROBIOTA DID NOT ALTER PERFORMANCE IN EQUINE ATHLETES

VASSEUR, M., GRIMM, P.2, JULLIAND, S.2, LANGEVIN, N.3, LEPERS, R.1

1.INSERM U1093 CAPS, 2.LABTOFIELD, 3.ECURIE HUNTER VALLEY

INTRODUCTION: Intake of high-starch diets is a strategy for equine athletes to support energetic demand and accelerate muscle glycogen repletion after exercise. However, this strategy induces a shift in gut microbiota composition and acidosis, reducing fiber (cellulose, hemicellulose) digestion, short-chain fatty acids (SCFA) production and absorption. The predominant SCFA, acetate, is an energy substrate for muscles lowering glucose mobilization and inducing less acid production than glucose. We recently demonstrated on equine athletes that fibrolytic efficiency of gut microbiota was associated with improved aerobic capacities. The aim of the present study was to test the hypothesis that replacing a high-starch diet (HS) with a high-fiber diet (HF) would benefit fibrolytic activity of equine gut microbiota and subsequently exercise performance.

METHODS: French Trotters regularly trained (n=21, 2.0±0.1yrs, 447±33kg) fed HS diet (starch: 1495g/day, neutral detergent fibers (NDF): 5151g/day) were included in a longitudinal test. An in vitro fermentation test was performed from fresh fecal samples during 48h to assess the fibrolytic capacity of the fecal microbiota (fibers disappearance and gas production). SCFA concentration and pH were measured in the feces. Maximal oxygen uptake (VO2peak) was determined with an incremental discontinuous test until maximal aerobic speed. Blood samples were taken at rest, immediately after the test, and after 20 minutes of recovery to measure acetate, glucose, lactate, and non-esterified fatty acids concentrations. After basal measurements, 10 horses were fed an isocaloric and isoprotein HF diet (starch: 732g/day, NDF: 5789g/day) for 4 weeks, and the 11 others remained on the HS diet. Measurements were repeated after the 4 weeks. ANCOVA analysis, with basal values as covariate and Tukey post-hoc adjustment was performed to evaluate the impact of diet on each parameter.

RESULTS: Higher fecal pH was observed in HF (p<0.001), probably due to differences in SCFA concentration (HS: 87.7 mmol/L, HF: 65.8 mmol/L, p=0.005). In parallel, acetate proportion was higher in HF (p=0.01), while propionate proportion was lower (p<0.001). In vitro parameters did not vary between groups nor did blood metabolites (p>0.2). VO2peak (HS: 114 ml/min/kg, HF: 109 ml/min/kg, p=0.5) and maximal speed (HS: 12.2 m/s, HF: 12.5 m/s, p=0.2) did not differ between groups.

CONCLUSION: These results confirm that replacing HS diet with a HF diet reduces gut acidosis. SCFA absorption was probably greater in HF diet, as a lower fecal concentration was observed, although this was not confirmed by blood parameters. The alteration in fecal SCFA proportions suggests a shift toward an improvement in fibrolytic activity, even if fibrolytic efficiency measured in vitro was not modified by the diet as it was assumed. This could explain why respiratory parameters and aerobic performance were not significantly affected by the diet. A greater contrast between diets seems necessary to alter performance.

Oral Presentations

OP-MH02 Sports Medicine

INVESTIGATING THE IMPACT OF EXERCISE ON RIGHT VENTRICLE FUNCTIONAL RESERVE IN ELITE ADOLESCENT FOOTBALLERS USING STRESS ECHOCARDIOGRAPHY

BERRYMAN, B., DOROBANTU, D.M., FRIEDBERG, M.K., PIELES, G.E., WILLIAMS, C.A.

UNIVERSITY OF EXETER

INTRODUCTION: The athletes right ventricle (RV) undergoes remodelling secondary to training, characterised by enlarged end-diastolic volume and augmented myocardial reserve, allowing for increased cardiac output during exercise. Global RV function is determined mainly by transverse and longitudinal function, with transverse proposed to have a greater contribution to global function[1], and this could be of importance during physical activity. This study investigated the rela-

tionship between RV function components and exercise intensity in adolescent athletes. It was hypothesised that RV transverse function would increase more than longitudinal function during exercise.

METHODS: A total of 30 elite male adolescent footballers (mean age 14.9 ± 1.0 y) underwent combined cardiopulmonary exercise test (CPET) and stress echocardiography. Fractional area change (FAC – global function), tricuspid annular plane systolic excursion (TAPSE – longitudinal function) and fractional septal free-wall distance (F-SFD – transverse function) [1] were measured at rest, 0 W, then 50 W increments during exercise. Exercise steps were classified by intensity domain based on the gas exchange threshold (GET) in low (50 W), moderate (below the GET) and high (above the GET). Changes in CPET parameters, RV function and RV cardiac reserve (relative difference in RV function to rest) were analysed using linear mixed models.

RESULTS: All mean RV function parameters increased from rest to high intensity (FAC: 41 vs. 62.3%, TAPSE: 25 vs 33.5 mm, F-SFD: 20.8 vs 41.4%, p<0.001 for all). Transverse function reserve at high intensity exercise was significantly higher than longitudinal function reserve (mean F-SFD reserve: 126.9%, 95% CI [89.8-164.1] vs TAPSE reserve: 38.4%, 95% CI [27.6-49.3], p<0.05). Mean FAC reserve at high intensity was 54.1%, 95% CI [45.2-63.1]. The absolute difference between TAPSE and F-SFD reserve increased from low to high intensity exercise (p<0.05), while the TAPSE to F-SFD ratio decreased (p<0.05). FAC, TAPSE and F-SFD all demonstrated linear relationships with HR, VO2 and O2 pulse (p<0.05), FAC demonstrated the strongest relationship with each parameter.

CONCLUSION: As hypothesised, transverse function increased more than longitudinal function during exercise, but FAC correlated best with oxygen uptake. These findings reflect the complex, three-dimensional nature of RV function augmentation in response to exercise. Therefore, assessing only TAPSE and FAC, as commonly conducted in practice, does not fully characterise the global RV exercise response in athletes. A multi-parametric approach should be used, including transverse function reserve.

References

[1] Kind, T, et al., Right ventricular ejection fraction is better reflected by transverse rather than longitudinal wall motion in pulmonary hypertension, J of Cardiovascular Magnetic Resonance, 2010, 12, p.1-11.

NOVEL IMPLICATION OF GENOMIC LOCI WITHIN ITGB2, COL5A1 AND VEGFA COLLECTIVELY ASSOCIATING WITH ANTERIOR LIGAMENT RUPTURE SUSCEPTIBILITY IN LARGE COHORT FROM SOUTH AFRICA, POLAND, SWEDEN AND AUSTRALIA

SEPTEMBER, A., DLAMINI, S.B., SAUNDERS, C.J., CIESZCZYK, P., FICEK, K., HÄGER, C.K., STATTIN, E., NILSSON, K.G., EYNON, N., FELLER, J., TIROSH, O., BOPE, C.D., CHIMUSA, E.R., COLLINS, M.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Independently, genetic loci within genes ITGB2 (beta 2 subunit of integrin), COL5A1 (alpha 1 chain of type V collagen) and VEGFA1 (vascular endothelial growth factor A) have been associated with rupture susceptibility of the anterior cruciate ligament (ACL-R). These genes have diverse functions including cell-cell communication, maintaining structural integrity and regulating new blood vessel formation which are all integral to ligament tissue integrity. The aim of the study was to identify key genetic loci which collectively maybe relevant to maintaining extracellular matrix tissue integrity of the ligament.

METHODS: A genetic association was conducted for a combined cohort recruited from Australia, Poland, Sweden, and South Africa. Participants analysed in this study included uninjured controls CON=584; participants with ACL ruptures ACL-R=731 and a sub-group with non-contact mechanism of ACL ruptures NON=425. Participants were genotyped for ITGB2 (rs2230528 C/T); COL5A1 (rs12722 C/T) and VEGFA (rs699947 C/A, rs2010963 G/C) polymorphisms. Statistical analyses were conducted using the programming environment R. Inferred allele combinations were constructed as a proxy for potential gene-gene interactions using genotype data. Statistical significance was accepted when $p < 0.05$, and the false discovery rate (FDR) procedure was used to adjust for multiple comparisons.

RESULTS: Significant distributions were noted for combinations between ITGB2 (rs2230528 C/T); COL5A1 (rs12722 C/T) and VEGFA (rs699947 C/A, rs2010963 G/C). The C-C-A-G combination was overrepresented in the CON (19%) compared to the ACL-R (ACL-14: 5%, p=1.x10-4; OR:0.93; 95% CI: 0.61-1.41) group and ACL-NON (ACL-NON: 14%, p=0.002; OR:0.96; 95% CI: 0.61-1.51) subgroup. The C-T-C-C combination was overrepresented in the CON (13%) compared to the ACL-R (ACL-R:10 %, p=0.023; OR:0.76; 95% CI: 0.46-1.26) group and ACL-NON (ACL-NON: 10%, p=0.003; OR:1.11; 95% CI: 0.63-1.79) subgroup. Similar findings were found when males and females were analysed separately.

CONCLUSION: The novel associations highlight key genetic loci which in combination are associated with ACL ruptures susceptibility in a large cohort. In addition, the diversity of the gene functions in this risk model highlight the collective contribution towards maintaining tissue integrity.

THE VEGFA AND KDR GENES ARE ASSOCIATED WITH BILATERAL OR MULTIPLE CHRONIC ACHILLES TENDON INJURIES

COLLINS, M., BRAZIER, C.D., MKUMBUZI, N.S., SEPTEMBER, A.V., LANGUETTE, M.J.N.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Chronic Achilles tendinopathy (AT) is prevalent in athletes, specifically in sports with a large running component. It presents as swelling, impaired lower limb function and pain. Although the mechanisms are unclear, current theories implicate structural changes and neovascularisation in AT. Vascular endothelial growth factor (VEGF) and its receptor referred to as kinase domain receptor (KDR) are key regulators of neovascularisation and can be associated with

pain. Polymorphisms within the VEGFA and KDR genes have previously been associated with musculoskeletal soft tissue injuries. The primary aim of this study was to identify whether VEGF and KDR polymorphisms were associated with (i) the severity of AT, (ii) AT ultrasound findings and (iii) self-reported measurements of Achilles tendon pain using multidimensional pain scales.

METHODS: 185 recreational athletes with clinically confirmed AT were recruited from Cape Town, South Africa. The injured and uninjured Achilles tendons were examined using conventional grayscale ultrasound. Tendinopathy pain was rated by completing the VISA-A, Short-form McGill Pain Questionnaire (sf- MPQ), and Short-form Brief Pain Inventory (sf-BPI) questionnaires. 194 asymptomatic healthy appropriately matched individuals with no history of tendon injuries were also recruited for this study. Participants were genotyped for VEGFA (rs699947, C/A; rs2010963, G/A) and KDR (rs2071559, G/C; rs1870377, T/A).

RESULTS: The VEGFA rs699947 CC genotype was significantly associated with decreased risk of bilateral AT, while the A-G VEGFA inferred haplotype constructed from rs699947 and rs2010963 was associated with increased risk of bilateral AT. The KDR rs2071559 AA genotype was significantly associated with increased risk of a history of multiple (two or more) AT, while the G-T and A-A KDR inferred haplotypes constructed from rs2071559 and rs1870377 were associated with decreased risk and increased risk of multiple and/or bilateral AT, respectively. The C-G and A-A VEGFA rs699947 and KDR rs2071559 allele-allele interactions were significantly associated with decreased and increased risk of bilateral or multiple injuries respectively. There were no significant differences in the diameters or the relative number of abnormal ultrasound findings of the injured and uninjured Achilles tendons between the VEGFA and KDR genotype groups. Finally, there were also no significant differences in VISA-A, sf-MPQ and sf-BPI scores, as well the sub-scale scores between the genotype groups.

CONCLUSION: The novel findings of this study implicate the VEGF and KDR genes, and by implication the potential biological role of the angiogenesis signalling pathway, with bilateral and/or multiple Achilles tendinopathy risk. The investigated variants within these genes however were not associated with tendon diameters, the relative number of abnormal ultrasound findings or self-reported Achilles tendon pain measured using multidimensional pain scales.

RELATIONSHIP BETWEEN LOWER EXTREMITY MUSCLE ARCHITECTURE AND KNEE STRENGTH IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTED MALES

EMIRZEOGLU, M., AYAZOGLU, M.A., ONER, K., AYNACI, O.

KARADENIZ TECHNICAL UNIVERSITY

INTRODUCTION: There is a known deficit in the structural and functional properties of knee-related muscles in individuals who undergo anterior cruciate ligament reconstruction. However, there is insufficient evidence regarding the relationships between these properties. The objective of this study was to investigate the correlation between the architectural features of the six lower extremity muscles and the strength of the knee flexor and extensor muscles in patients who had undergone anterior cruciate ligament reconstruction using hamstring autograft.

METHODS: The study included 33 male participants (age: 24.06±4.37 years, height: 175.55±6.43 cm, weight: 77.88±10.81 kg, time after reconstruction: 14.55±6.21 months). Ultrasonography was used to assess the architectural characteristics of the vastus lateralis (VL), rectus femoris (RF), tibialis anterior (TA), biceps femoris longus (BFL), gastrocnemius medialis (GM), and gastrocnemius lateralis (GL). Muscle strength for knee flexion and extension was evaluated using an Isomed 2000 isokinetic dynamometer in concentric mode at 60 and 180°/s. All assessments were conducted on both the injured and uninjured limbs. The data was analyzed using Pearson and Spearman tests in the SPSS program.

RESULTS: On the injured limb, a significant relationship was found between the VL thickness and peak torque extension at 60°/s (r=0.387; p=0.046). Similarly, there were significant relationships between GM thickness and peak torque extension (r=0.430; p=0.016), peak work extension (r=0.486; p=0.006), peak torque flexion/extension (r=-0.418; p=0.019), peak work flexion/extension (r=-0.457; p=0.010), peak work extension/weight (r=0.360, p=0.047) and total work extension (r=0.437, p=0.014). There was no significant relationship between muscle architectural characteristics and muscle strength parameters at 180°/s (p>0.05). According to the analysis of the differences between the limbs, there was a significant relationship between peak work flexion/extension at 60°/s and thickness of the RF and BFL (r=-0.414, p=0.036; r=-0.406, p=0.026, respectively). There was a significant relationship between GM thickness and peak torque flexion/extension at 60 and 180°/s (r=-0.381, p=0.034; r=-0.411, p=0.022, respectively). Similarly, there were significant relationships between TA thickness and peak torque flexion/extension (r=-0.514, p=0.005; r=-0.585, p=0.001, respectively) and peak work flexion/extension (r=-0.484, p=0.009; r=-0.554, p=0.002, respectively) at 60 and 180°/s.

CONCLUSION: The muscle strengths of the knee flexors and extensors in anterior cruciate ligament reconstructed males are related to the architectural characteristics of these muscle groups, as well as the GM and TA. Therefore, postoperative rehabilitation should take a holistic approach to the muscles of the lower extremity.

Oral Presentations

OP-PN17 Thermoregulation I

COMBINED EFFECTS OF PRE-COOLING AND IN-PLAY COOLING BREAKS USING ICE TOWELS AND COLD DRINKS DURING FOOTBALL MATCHES IN WARM CONDITIONS.

SCHWARZ, E., DUFFIELD, R., ALANIS, A., OLIVEIRA, C., DUARTE MUÑOZ, M., ALANIS, M., LARA, A., COSTA, J., FREEZE, A., MEYER, T.

SAARLAND UNIVERSITY

INTRODUCTION: Playing in hot environmental temperatures is a growing concern for sporting and football organisations worldwide. Therefore, to support player health and minimise performance deterioration during football in the heat, strategies, including cooling procedures and breaks in play, have been proposed; however, investigations in field settings remain scarce (Gouttebarge et al., 2023).

METHODS: In total, 22 male academy soccer players (age 17 ± 0.8 y) participated in two matches in warm conditions (25.5 ± 2 °C WBGT) and received a cooling intervention (COOL) or a control condition (CON) in a randomised cross-over design. COOL consisted of cold towels (6-9 °C) and cold drinks (5 °C) for 10min of pre-cooling prior to the warmup, 10min before the kick-off, 10min at halftime and for an additional 3min during cooling breaks at 25min into each half. The CON received a placebo drink (17 °C) and no cooling at the same time frames. Core body temperature (Tcore), heart rate (HR), match running performance via gobal positioning system (GPS), sweat loss and fluid intake, rating-of-fatigue (RoF), rating of perceived exertion (RPE), thermal sensation (TS) and perceptions regarding likeability and performance benefits were measured throughout the match-day.

RESULTS: Players reached a maximum Tcore of 39.2 ± 0.5 °C in COOL, which did not differ from CON (39.1 °C ± 0.5 °C; $p \geq 0.05$). Further, there were no differences between conditions for Tcore, HR, GPS, RoF or RPE ($p \geq 0.05$), but TS was lower in COOL during respective breaks ($p < 0.05$). Players sweated significantly less in COOL than in CON (2.5 ± 0.5 L vs 2.9 ± 0.6 L) but made up for that by increasing fluid intake (COOL: 1.2 ± 0.3 L; CON: 1.4 ± 0.3 L). Further, players rated the cold towels and cold drinks better than the placebo drinks ($p < 0.05$) and perceived more benefits from COOL than CON ($p < 0.05$).

CONCLUSION: No physiological or performance benefits were observed for the cooling intervention other than the reduced sweat rate. Given the observed warm but not hot environmental conditions, heat strain remained moderate for both groups and may have impacted the effectiveness of the cooling strategy. Nevertheless, the 3min cooling breaks seemed to attenuate the continuous rise in Tcore described in matches without breaks (Mohr et al., 2011). Future observations are needed to investigate the potential benefits of this strategy in hotter temperatures.

Gouttebarge V et al. 2023. Protective guidelines and mitigation strategies for hot conditions in professional football: starting 11 Hot Tips for consideration. BMJ Open Sport Exerc, 9, doi:10.1136/bmjsem-2023-001608

Mohr M et al. 2012. Physiological Responses and Physical Performance during Football in the Heat. PLoS ONE, 7(6), doi:10.1371/journal.pone.0039202

EXPLORING THE DEPENDENCY OF INFORMATIONAL TRANSFER BETWEEN CORE OR SKIN TEMPERATURES AND SUDOMOTOR ACTIVITY AMONG HEALTHY PARTICIPANTS OF VARYING THERMOREGULATORY CONTROL

WALDRON, M., PEEL, J., PAGE, J., SCOTT, G., HEFFERNAN, S., TALLENT, J., JEFFRIES, O.

SWANSEA UNIVERSITY, UK; NEWCASTLE UNIVERSITY, UK; UNIVERSITY OF ESSEX, UK.

INTRODUCTION: During hyperthermia, integration of afferent input from central and peripheral thermoreceptors initiates efferent sympathetic signals to activate sweat glands in pulsatile bursts. In this feedback system, core temperature (Tcore) is the primary controlled variable, with skin temperature (Tskin) providing 'auxiliary' dynamic feedback [1]. However, the connectivity of efferent signalling between Tcore, Tskin and sweating, as well as the synchrony of sweating between skin sites, across individuals of varying thermoregulatory control has not been investigated. Therefore, we evaluated i) connectivity between Tcore, Tskin and local eccrine sweating of the arm and chest during passive heating and ii) the temporal synchrony of arm and chest sweating.

METHODS: Thirteen participants completed 90 min passive heating, twice, across one-week (38±0°C, relative humidity 56±2%). Local sweat rates were continuously measured on the ventral forearm and chest, alongside Tcore (rectal) and mean Tskin (chest, arm and leg). Changes in Tcore across the protocol and thermosensitivity (Tcore change at sweat onset) were measured to determine thermoregulatory control of the sample. Transfer entropy (TE) was used to quantify information flow between Tcore, Tskin and all sweating sites, with higher values demonstrating greater connectivity. Relationships between thermoregulatory control measures and TE were evaluated using repeated measures correlations. Cross-correlation was used to assess sweating synchrony across the two sites. Paired t-tests assessed differences between TE values. Data are means±SD.

RESULTS: The TE for Tcore-arm (0.007±0.005 bits) and Tcore-chest (0.009±0.010) was lower ($P < 0.01$ and $P < 0.01$) than Tskin-arm (0.019±0.014 bits) and Tskin-chest (0.022±0.015 bits), respectively, denoting higher information flow from the skin to sweating sites. There were no differences between arm and chest Tskin TE values ($P = 0.31$). Both Tskin-arm TE and Tskin-chest TE were inversely related to the Tcore increases ($r = -0.56$ and -0.57, respectively) and thermosensitivity values

(r= -0.37 & -0.46, respectively), while Tcore TE values were unrelated (P>0.05). Cross-correlation analysis revealed no time-lag between chest and arm site peak relationships, which were strongly correlated (r=0.98±0.03).

CONCLUSION: The notion of Tskin as a dynamic auxiliary feedback mechanism [1] is supported, with reliance upon informational flow between Tskin and sweating of the arm and chest to maintain control of Tcore, which has relatively less TE to sweating sites. Individuals with smaller increases in Tcore and faster sweating onset possessed greater connectivity between Tskin and sweating sites. The temporal correspondence confirms the assumed synchrony between sweating sites, indicating that the pattern of this informational flow is likely to be similar across anatomical locations. These findings may inform future passive assessments of thermoeffector feedback loops.

References

1. Romanovsky, 2014, Acta Physiol.

UNALTERED INTESTINAL FATTY ACID BINDING PROTEIN (IFABP), CYTOKINE AND CHEMOKINE RESPONSES TO PROLONGED PASSIVE HYPERTHERMIA IN HEALTHY HUMANS

GIBSON, O., LAITANO, O., WATANABE, K., GONZÁLEZ-ALONSO, J.

BRUNEL UNIVERSITY LONDON

INTRODUCTION: Hyperthermia, whether passive or exertional, can cause small intestine epithelial injury. Epithelial injury can elevate gastrointestinal permeability, facilitate endotoxin translocation and an inflammatory cytokine/chemokine response which are contributory factors in heat illness (Garcia et al., 2022). Exercise-heat stress causes epithelial injury as quantified by changes in intestinal fatty acid binding protein (iFABP) (Walter, et al., 2021a), and a greater inflammatory response relative to normothermic exercise (Garcia et al., 2022). Responses during passive hyperthermia of equivalent magnitudes to exercise-heat stress have yet to be clearly described (Walter et al., 2021b). This experiment aimed to quantify the changes in iFABP, and cytokine/chemokine responses during prolonged passive hyperthermia. It was hypothesised that passive hyperthermia would increase iFABP and cytokine/chemokine concentrations.

METHODS: In a counterbalanced order, eight young, healthy males visited the lab on four occasions to undertake 3 h of rest (CON); 3 h of one leg heating (OLH); 3 h of two legs heating (TLH); and 2.5 h of whole-body heating (WBH). Heating was applied via a water perfused garment circulating 50°C water. Core (Tcore) and thigh muscle temperature (Tm) were measured continuously, with the concentration of iFABP and selected cytokines and chemokines (EGF, Eotaxin, FGF-2, FLT-3L, Fractalkine, G-CSF, GM-CSF, GRO, IFN-α2, IFN-γ, IL-6, IL-10, IL-12p40, MCP-3, MDC, sCD40L, TGF-α, TNFα, VEGFα) quantified periodically. Regional (Leg, arm and head) and systemic haemodynamics (cardiac output) were measured by echocardiography and Doppler ultrasound to quantify torso blood flow.

RESULTS: Tcore and Tm increased from baseline in OLH (+0.4 ± 0.2°C, +3.4 ± 1.2°C), TLH (+0.7 ± 0.2°C, +3.4 ± 1.3°C) and WBH (+2.3 ± 0.4°C, +6.0 ± 1.7°C) respectively ($p < 0.05$), but were unchanged in CON. Torso blood flow increased ($p < 0.05$) from baseline in OLH (+0.26 ± 0.51 L.min-1), TLH (+0.47 ± 0.60 L.min-1) and WBH (+3.24 ± 1.43 L.min-1), but was also unchanged in CON. Cardiac output increased in OLH (+2.1 ± 0.6 L.min-1), TLH (+3.4 ± 0.7 L.min-1), and WBH (+7.3 ± 1.0 L.min-1) vs CON respectively ($p < 0.05$). Circulating iFABP, and all chemokine/cytokines were unchanged from baseline ($p > 0.05$) in CON, OLH, TLH or WBH.

CONCLUSION: These data identify that iFABP and circulating cytokine and chemokine concentrations do not significantly increase during prolonged local and systemic passive heating. This finding questions the independent effect of hyperthermia on circulating markers of gastrointestinal permeability and subsequent inflammation in healthy humans.

References

Garcia, C. K., et al., (2022). Exertional heat stroke: pathophysiology and risk factors. BMJ medicine, 1(1):e000239

Walter, E., (2021a). Eur. J. Appl. Physiol., 121(4), 1179-1187

Walter, E., (2021b). Physiol. Rep., 9(16), e14945

HOT WATER IMMERSION PROTOCOL WITH AN OLDER POPULATION: A PILOT STUDY

COLE, E., JACKSON, K., DONNAN, K.J., SIMPSON, A.J., GARRETT, A.T.

UNIVERSITY OF HULL

INTRODUCTION: Hot water immersion (HWI) is being explored as a practicable and accessible method of heat acclimation for the general population. However, there are questions as to the applicability of these protocols in relation to people's tolerance, affective responses and safety. This research aimed to identify practical insights into more accessible heat acclimation methods for an ageing population (45-75 years) by comparing the efficacy a potentially more tolerable Arms Out method (thereby reducing the submerged surface area), against an "Arms In" submersion protocol.

METHODS: Employing a randomised experimental cross-over design, nine healthy highly trained adults (7 males, 2 females; aged 52±6 years) participated. Participants first engaged in a 6-min walk test to establish fitness levels, followed by two 45-min controlled HWI trials ('Arms In' and 'Arms Out') in a hot tub (40°C) located in an environmental chamber (21°C, 45% relative humidity). The 'Arms In' condition required participants to be submerged up to the base of the neck, whereas 'Arms Out' required participants to be submerged up to mid sternum, with their arms exposed on the side of the hot tub. Physiological measurements included heart rate, mean skin temperature, and mean rectal temperature. Perceptual measures included thermal sensation, thermal comfort, affective valence, and the 32-item Brunel Mood Scale. Each

measurement was recorded at baseline then every 5-mins, except the Brunel Mood Scale which was taken at baseline and at 15-min intervals.

RESULTS: All participants completed both trials. The 'Arms In' immersion protocol induced a significant rise in core temperature from 20-mins ($p<0.05$), with all participants experiencing a ≥1°C increase by 35-mins. 'Arms Out' also showed a significant rise in core temperature across the protocol, however it was significantly lower than 'Arms In'. Mean temperature change from baseline to end point for 'Arms In' was 1.64±0.55°C ($p>0.05$) vs 0.54±0.33°C ($p>0.05$) for 'Arms Out'. Participants, however, reported significantly higher discomfort with 'Arms In'. This was shown in increased mean values for thermal comfort ($p<0.05$), affective valence ($p<0.05$) and elevated values for tension on the Brunel Mood Scale ($p<0.05$).

CONCLUSION: These findings highlight the need to consider perceptual tolerance alongside efficacy of HWI protocols to develop practical heat acclimation methods for the general population that will both be utilised (i.e., are less unpleasant) and induce adequate physiological adaptations. The 'Arms In' method utilised shows the potential effectiveness of HWI to induce sufficient physiological strain for heat acclimation method, however the perceptual tolerance of such protocols is important to consider. A protocol that encompasses the subjective discomfort felt against the physiological stress needed to achieve adaptations should be the avenue for further study.

IMPACT OF AIRFLOW ON THERMOREGULATION AND HEAT STORAGE DURING EXERCISE IN EXTREME HOT ENVIRONMENTS

AGER, L., JEFFRIES, O.
NEWCASTLE UNIVERSITY

INTRODUCTION: Convective airflow facilitates human thermoregulation in ambient temperatures (Tamb) typically below skin temperature (Tsk) (~35°C) during exercise and at rest. In higher temperatures, as typified during extreme heat wave scenarios, it is unclear how convective airflow exceeding Tsk may impact the maintenance of body core temperature during exercise. The aim of this study was to examine conductive airflow in extreme temperatures to aid our understanding of thermal, cardiovascular and perceptual strain during exercise.

METHODS: Thirteen trained, non-heat acclimated males [age 30±6 years; body mass 73.3±7.8 kg; height 181.4±5.1 cm; peak oxygen uptake 61.5±5.1 ml kg-1 min-1; peak power output (PPO) 412±36 W] completed four separate 30-min cycling bouts at 50% PPO in four differing environmental conditions: 37°C and 45°C each with (37F, 45F) and without (37NF, 45NF) dual fan-assisted airflow (~3 m.s-1). Cardiovascular measures of rectal core temperature (Tc), mean Tsk, heart rate (HR) and oxygen consumption were recorded continuously. Perceptual measures of Relative Perceived Exertion and Thermal Sensation were recorded every 3-min. Whole Body Sweat Loss (WBSL) was estimated from pre vs post body mass. A two-way repeated measures ANOVA was performed to identify differences between trials. Statistical significance was set at $P<0.05$.

RESULTS: Tc was different between conditions ($P = 0.022$), changed with time ($P<0.001$) and showed an interaction effect ($P<0.001$). During the latter stages of exercise, we observed the change from baseline in 37NF was 15% greater than 37F, and 45NF was 12.5% greater than 47F. WBSL was different between conditions ($P<0.001$), being greater with respect to Tamb in 45NF vs 37NF (+33%, P=0.007) and 45F vs 37F (+35%, $P = 0.008$). However, WBSL did not differ (<6% difference) in similar Tamb irrespective of fan, between 37NF vs 37F ($P = 0.752$) and 45NF vs 45F ($P = 0.752$). Cardiovascular strain indicated by HR differed by condition ($P = 0.001$), temporally ($P<0.001$), and showed an interaction effect ($P<0.001$). Mean HR was greater during 37NF vs 37F (+7 bpm, $P = 0.07$), however this difference was not evident in higher temperatures 45NF vs 45F (+4 bpm, $P = 0.150$). HR was greater during 45NF vs 37NF (+10 bpm, $P<0.001$) and 45F vs 37F (+13 bpm, $P<0.001$).

CONCLUSION: Convective airflow during exercise in 37°C Tamb reduced thermal, cardio and perceptual strain. In more extreme temperatures where Tamb exceed Tsk (Tamb 45°C), airflow did not result in greater heat storage and instead amplified heat loss. Interestingly these differences were not supported by changes in WBSL. Our data suggests that even at higher Tamb, the addition of airflow promotes evaporative potential and sweat efficiency sufficiently to offset the increase in dry heat transfer gain. In conditions of low humidly (30%) our findings provide clear evidence for the use of conductive airflow during exercise to improve thermal tolerance and mitigate heat illness risk in extreme temperatures up to 45°C.

Oral Presentations

OP-AP14 Olympic Sports: Rowing/Kayaking/Climbing

SKELETAL MUSCLE DETERMINANTS OF ROWING PERFORMANCE

BELLINGER, P., ROBERTS, L., MORRIS, K., DERAVE, W., LIEVENS, E., KENNEDY, B., CHARLES, J., WACKWITZ, T., MCGILL, A., DUHIG, S.
GRIFFITH UNIVERSITY

INTRODUCTION: Elite rowers present with diverse physiological profiles (van der Zwaard et al. 2018; Fukuda et al. 2011; Alföldi et al. 2021) which may be due to, in part, variation in the underpinning muscle characteristics, such as muscle

oxidative capacity, architecture, volume, typology and strength. Nonetheless, the extent to which these muscle characteristics explain rowing performance has not been determined in a systematic manner previously. In this study, we aimed to identify the skeletal muscle determinants of rowing performance and pacing in elite rowers.

METHODS: 22 well-trained rowers (13 male) completed a 7-stage incremental rowing ergometer test to determine rowing economy, the lactate threshold, lactate turn point and VO2peak. The final stage of the incremental test was a maximal effort, representing a 4-min time-trial and was recorded as the criterion dependent variable (i.e., 4 min TT). We also expressed the relative distance that was covered in each minute of the 4 min TT to investigate pacing strategy. Rowers also completed a series of strength and power assessments including loaded and unloaded squat jumps, an isometric mid-thigh pull and 1-repetition maximum (RM) pull up and 3-RM leg press. Rowers underwent an assessment of body composition by dual-energy x-ray absorptiometry, magnetic resonance imaging of their thigh to determine volumes of the major hip- and knee-spanning muscle functional groups and diffusion tensor imaging to estimate muscle fascicle lengths, pennation angles and physiological cross-sectional area of the vastus lateralis (VL). Carnosine content was quantified by proton magnetic resonance spectroscopy in the soleus and expressed as a Z-score to estimate muscle typology. Data were analysed using multiple stepwise regression analysis.

RESULTS: The majority of rowers had negative Z-score values (17/22; Z-score = -0.44 ± 0.85), indicative of a greater estimated proportion of type I fibres, with similar variation in both male and female rowers. Male rowers had greater normalized knee extensor muscle volume (19.2 cm3·kg−1) compared to female rowers (16.8 cm3·kg−1), while VL fascicle lengths were similar. When controlling for lean body mass and sex, muscle fascicle length in the VL, VO2peak and isometric mid-thigh pull peak force explained 82% of the variation in final stage of the incremental test (i.e., 4 min TT). Muscle typology was the only muscle characteristic that explained variation in pacing strategy, whereby rowers with a higher Z-scores (i.e., greater estimated proportion of type II fibres) started the 4 min TT more conservatively but covered a greater relative distance during the second half.

CONCLUSION: In the context our study, these findings indicate that rowers should focus on increasing VL fascicle length, isometric mid-thigh pull strength and aerobic power. Muscle typology was associated with preferential pacing strategies and could be used to inform optimal boat crew pairings to maximise pacing and performance.

PHYSIOLOGICAL RESPONSE FOR ELITE ROWERS IN A 4-WEEKS TRAINING CAMP AT ALTITUDE 2100 METERS

CHAN, Y.Y., TAI, C.H., LO, K.K., CHAN, L.H., LO, W.K., HUANG, Z., WU, J.
HONG KONG SPORTS INSTITUTE

INTRODUCTION: Rowing events are typically raced over 2000m, which last for 5.5-7 mins [1]. A number of studies indicated that rowing performances were dependent on energy systems, with 70-80% contributed by aerobic metabolism and 20-30% derived from anaerobic metabolism [2,3]. Therefore, it is common for rowing athletes to who live in sea level to train at moderate altitude, in order to improve their endurance performance [4]. In this study, the physiological response of elite rowing athletes who took part at a 4-weeks altitude training camp at altitude 2100 meters were investigated.

METHODS: Twenty-seven elite rowing athletes from the Hong Kong Rowing Squad participate in this study (18 male,9 female, age 22.4±3.8). All subjects normally live at sea-level and participated a 4-weeks altitude training camp at altitude 2100 meters. Physiological parameters including hemoglobin (Hb) and body weight were monitored throughout the camp. Incremental test with rowing ergometer (Model D, Concept 2, USA) consists of seven stages of 1km were repeated at 7 days pre-camp, the 16th day during the camp, and 3 days post-camp. 30 mins rowing ergometer training at 22 spm were carried out every week to assess the performance of the rowers during the camp. A repeated measures ANOVA was used to detect changes between different time points of the parameters, effect sizes expressed as partial eta-squared ($\eta 2$). Significance was set at $P<0.05$.

RESULTS: Mean Hb was 14.0±0.9, 15.4±1.0, 15.3±0.9, 15.4±0.9, 15.2±1.1 g/dl for pre-camp, and week 1-4 respectively. Significant differences were found between pre-camp and week 1-4 ($P=0.00$, $\eta 2=0.44$). Mean body weight was 70.95±8.46, 70.4±8.5, 70±8.59 and 69.66±8.44 kg for week 1-4 respectively. Significant differences were found between week 1 to 4 ($P=0.00$, $\eta 2=0.21$). Mean power at anaerobic threshold of incremental rowing ergometer test were 250.0±47.6, 246.5±50.7 and 273.2±52.4 W for pre-camp, during-camp and post-camp respectively. Significant differences were found between pre-camp and post-camp ($P=0.00$, $\eta 2=0.50$). Mean power of 30 mins rowing ergometer training at 22 spm were 197.3±39.8, 203.5±42.0, 200.2±41.1 and 203.1±43.4 W for week 1-4 respectively. Significant differences were found between week 1 to 4 ($P=0.01$, $\eta 2=0.18$).

CONCLUSION: Hb increases significantly by 10.1% since the first week of the altitude camp when compared with pre-camp baseline. A trend of body weight decreases for a total of 1.7% throughout the camp. The anaerobic threshold power of incremental test have been increased by 9.3% throughout the camp. The 30 mins rowing ergometer training power were the lowest at week 1 of the camp, then increased by 3.0% from week 1 to week 4. In summary, Hb and anaerobic threshold power increases, with body weight decreased by taking part in the altitude camp, while 30 mins ergometer power increased from week 2 of the camp.

1. Steinacker (1993) 2. Ingham et al. (2002) 3. Stevens et al. (2015) 4. Burtscher et al. (2018)

ANAEROBIC POWER AS A DETERMINANT OF PERFORMANCE IN ELITE KAYAKING: THE INTERPLAY BETWEEN AEROBIC CAPACITY AND LACTATE ACCUMULATION

MIKA, T., SEKERA, J., BOLEK, E., NOVAKOVA, M.
CASRI, PRAGUE

INTRODUCTION: Performance in elite kayaking is influenced by a complex interplay between aerobic and anaerobic physiological capacities. This study focused on the specific roles of anaerobic power, demonstrated by peak power (PP) and mean power (MP), in relation to blood lactate concentration and aerobic capacity, measured by VO2max. Kayakers competing at national (Nat) and international (Int) level were assessed.

METHODS: A cross-sectional analysis was conducted on 25 male elite kayakers (23 years ± 4 years) stratified into performance levels. Athletes underwent a spiroergometric test to determine VO2max and a Wingate test to measure anaerobic power (PP and MP). Lactate levels were obtained at the seventh minute post-exercise. Descriptive statistics, normality distribution Shapiro Wilk test and for homogeneity of variance Levenes test, Pearson correlation, T- test for independent variables and regression analyses were used to identify key performance determinants.

RESULTS: A comparative analysis of kayaking performance metrics revealed that international-level kayakers (Int) demonstrated significantly higher Peak Power (PP), with mean values of 10.43 W/kg, compared to 9.69 W/kg for national-level athletes (Nat) (t-statistic: -2.83, p-value: 0.0096). Mean Power (MP) also tended to be higher in the international group, averaging 7.71 W/kg, in contrast to 7.36 W/kg for the national group, though this difference did not reach statistical significance (t-statistic: -1.40, p-value: 0.1746). No significant differences were observed in Maximal Oxygen Uptake (VO2max), with the international group averaging 59.48 ml/min/kg and the national group 61.70 ml/min/kg (t-statistic: 0.76, p-value: 0.4595). Lactic Acid Maximum (LA max) levels were slightly higher for international competitors, averaging 12.21 mmol/L, compared to 11.38 mmol/L for their national counterparts (t-statistic: -0.90, p-value: 0.3786). Moreover, a significant correlation was found between MP and lactate ($r = 0.57$, p-value: 0.0028), and a negative correlation was observed between lactate levels and VO2max ($r = -0.66$, $p < 0.05$). These findings underscore the importance of anaerobic power in the high-performance profile.

CONCLUSION: Our findings suggest that while aerobic capacity provides a fundamental foundation for kayaking performance, the ability to generate and sustain high-intensity anaerobic power, as evidenced by higher peak power and post-exercise lactate levels, is a more significant determinant of success at the highest competitive levels. These insights underscore the importance of tailored training programs that focus on enhancing anaerobic power outputs to improve performance among elite kayakers.

THE RELATIONSHIP BETWEEN STRENGTH, BODY COMPOSITION AND 500 M SPRINT KAYAK PERFORMANCE

KLITGAARD, K., DE ZEE, M., KRISTIANSEN, M.
AALBORG UNIVERSITY

INTRODUCTION: Kayaking, as a dynamic sport, demands a blend of strength, power, and endurance [1]. A range of physiological and biomechanical factors, such as body composition, muscle strength, stroke rate, stroke force, and paddling technique, shape sprint performance in kayaking [2]. However, past research has often isolated individual aspects of kayak sprint performance, overlooking the intricate interplay among these variables. Furthermore, past research has been centered around short distances (≤200m) and 1000m. With more disciplines in the Olympic program being centered around the 500m event/distance, a greater understanding of the strength demands of 500m performance is needed. This study investigates the relationship between body composition, strength, and performance in kayaking over a 500m distance.

METHODS: 30 trained female (6) and male (24) kayakers were recruited with a mean age of 20.69 ± 5.27 years, body mass of 80.14 kg ± 9.62, and height of 1.79 ± 0.07 m. They performed a 500 m on-water kayak test with a standing start. During this test, the following variables were recorded: paddle force (E-kayak, AP-Lab), footrest force, and kayak velocity. On a different day, 1RM tests were carried out in the bench press, bench pull, pull up, and a specific kayak strength measured on a custom-made single-arm machine (3). Body composition was measured on a DEXA scanner (GE Lunar iDXA). A partial least squares regression analysis model was used to assess the relationship between the independent variables and the dependent variable (on-water kayak test).

RESULTS: The regression model revealed notable relationships between 1RM strength variables(Bench-pull, Bench-press and Pull-ups), total lean mass, torso, and arm lean mass, along with paddle forces, as evidenced by their high VIP (Variable Importance in Projection) values ranging from 1.162 to 1.307. Furthermore, the same variables showed a solid relationship to 500m performance when looking at loadings, with values ranging from 0.252 to 0.285.

CONCLUSION: The high VIP value and loading values suggest that these variables are important predictors of the outcome. 1RM strength variables(Bench-pull, Bench-press, and Pull-ups), total lean mass, torso and arm lean mass, and paddle forces are the best predictors of 500m on-water kayak performance. A wider array of factors appears to affect the 500m sprint than the 200m sprint, where 1RM strength emerges as the most significant predictor of performance.

[1]Michael JS, Rooney KB, Smith R. The metabolic demands of kayaking: a review 2008;7:1–7.

[2]Michael JS, Smith R, Rooney KB. Determinants of kayak paddling performance 2009;8:167–79.

[3] Klitgaard, K. K., Adler, A. T., & de Zee, M. (2021, November). A Modified Single Arm Machine-A Brief Report. In 13th Annual Meeting of the Danish Society of Biomechanics.

QUANTIFYING CLIMBING ENDURANCE: ANALYSIS OF INTERMITTENT ISOMETRIC FOREARM MUSCLES' CONTRACTIONS ACROSS VARIED HOLD DEPTHS

EXEL, J., LEDROIT, C., MUSIL, C., GÁSPARI, A., BACA, A., KAINZ, H.
UNIVERSITY OF VIENNA

INTRODUCTION: Isometric finger endurance is key for climbing performance [1, 2] and methods for estimating forearm muscles' aerobic capacity is an important tool to optimize training organization. Previous work has proposed a method for determining this capacity, based on percentages of maximal voluntary isometric contractions of the forearms and fixed hold depth [3]. However, climbing often present variety of holds sizes, shapes, and depths to challenge climbers' skill abilities while performing and understanding the relationship between climbers' tolerance to exercise in different hold depths is still unknown. A first step towards that is determining an assessment protocol that can exhibit a real change in performance instead of a change consistent with the measurement error. Thus, the aim of this study was to assess the consistency of the force measurements in the test-retest of an intermittent exercise of isometric body-weight dead hangs to exhaustion performed in 4 different hold depth.

METHODS: Twenty climbers (28.7□7.2 years, 175.9□7.9 cm height, 67.7□9.9 kg weight, 21.4□1.6 IRCRA scale climbing ability level) visited the lab in four occasions for testing, with a minimum interval of 48 hours between sessions. The test consisted of intermittent isometric dead hangs to exhaustion, with a 7:3 s work:relief ratio in one of the 2 pairs of holds with different depths: 10 - 30 mm, and 15 - 20 mm. The sequence of hold pairs was assigned randomly for the 1st and 2nd sessions, and repeated in the retest. An instrumented hang board, with adjustable hold depths and 2D strain gauge sensors, captured applied force (N), time-to-exhaustion (TTE), and total work (TW).

RESULTS: The average vertical force and TTE for both sessions was 320±0.1 N - 24.5±2.1 s for 10 mm, 326±0.6 N – 55.5±2.2 s for 15 mm, 377±1.6 N – 109.7±0.05 s for 20 mm, and 331±0.5 N - 158±16.9 s for 30 mm. Interclass Correlation Coefficient (ICC average [95% CI]) showed good to excellent consistency for all depths across sessions (10 mm, 15 mm, 20 mm and 30 mm, considering force (0.92[0.80-0.97], 0.99[0.99-0.99], 0.98[0.97-0.99], 0.99[0.98-0.99], respectively), TTE (0.77[0.41-0.91], 0.93[0.84-0.97], 0.92[0.80-0.97], 0.91[0.76- 0.96], respectively), and TW (0.81[0.40-0.94], 0.94[0.82-0.9], 0.90[0.70-0.96], 0.91[0.74-0.97], respectively).

CONCLUSION: These results show a potential of this protocol to be used in future investigations to unveil the relationship between steady state work rate of the forearm muscles during isometric contractions and hold depths. This is an important initial step towards understanding the effects of different hold depths in climbers' maximum work that the forearm muscles can maintain for an extended duration without fatigue (critical force [CF]) and characterizing the energy store component which is depleted above CP, first proposed by [3].

[1] https://doi.org/10.1016/j.jesf.2019.04.002

[2] https://doi.org/10.2478/hukin-2018-0057

[3] https://doi.org/10.1123/ijspp.2018-0809

Oral Presentations

OP-MH24 Cardiovascular diseases and exercise

CARDIOPROTECTION INDUCED BY INTRADIALYTIC EXERCISE IN AN OPEN-LABEL, PROSPECTIVE RANDOMIZED TRIAL: A REGIONAL WALL MOTION ANALYSIS AND CLINICAL DETERMINANTS

MAUFRAIS, C., JOSSE, M., PATRIER, L., ISNARD, M., GRANDPERRIN, A., TURC-BARON, C., NOTTIN, S., CRISTOL, J.P., OBERT, P.
AVIGNON UNIVERSITY

INTRODUCTION: Cardiovascular diseases are present in more than 50% of patients with End-Stage Kidney Disease (ESKD). Hemodialysis (HD) is a life-saving treatment but it also induces LV regional wall motion abnormalities (RWMAs) that leads to LV systolic dysfunction due to a transient myocardial ischemia, a phenomenon well-known as myocardial stunning. Such repetitive ischemic insults are widely recognized to be important in the pathogenesis of cardiac failure and contribute to the excess cardiovascular mortality in this population. Therapeutic strategies to mitigate cardiovascular disorders associated with HD are therefore mandatory. Acute intradialytic exercise (IDE) has the exciting potential to be cardioprotective in patients with ESKD. However, studies analyzing its effect on myocardial stunning are scarce, and include a small number of patients and some methodological bias. We aimed to explore 1) the impact of IDE on the regional occurrence of RWMAs in a large cohort of exercise-naïve subjects receiving HD and 2) the benefits of the cardioprotection induced by IDE according to the clinical characteristics of patients.

METHODS: In this prospective, open-label, two-center randomized crossover trial, 72 stable patients performed 2 HD sessions in a random order: a standard HD (HD-CONT) and a session incorporating 30min of aerobic exercise (HD-EX). Echocardiography was performed immediately before HD (T0) and at peak stress of HD (i.e. 30 min before HD ending, Tpeak) during each session. An 18-segment model was used to identify RWMAs, defined as a 20% reduction in longitudinal strain at Tpeak compared to T0. Myocardial stunning was confirmed for patients who developed at least 2 RWMAs at Tpeak.

RESULTS: IDE significantly reduced the number of RWMAs during HD-EX compared to HD-CONT (estimated difference: 1.1segment, 95%CI: 0.33/1.90, p=0.009). There was a base-to-apex benefits gradient of IDE with the greatest reduction in RWMAs observed at the apex during HD-EX when compared to HD-CONT. Overweight patients had a decrease in RWMAs during HD-EX compared to HD-CONT (HD-CONT: 7.1±3segments, HD-EX: 5.3±3segments; p<0.001) whereas we observed no significant difference for normoponderal patients (HD-CONT: 6.5±3.5segments, HD-EX: 6.2±3.5segments; p=0.99).

CONCLUSION: We confirm that IDE limits the myocardial stunning induced by HD. Using a regional analysis for the first time in the literature, we exposed a reduction in the number of RWMAs occurring during HD-EX compared to a standard session with greater benefits observed at the apical level. The most relevant clinical characteristic related to the decreased myocardial stunning induced by IDE was the ponderal status of patients. Overweight individuals presented a greater decrease in RWMAs compared to normoponderal patients.

Further studies are needed to fully elucidate the mechanisms underlying the benefits of IDE on the regional myocardial function and better identify the clinical factors that determine the degree of cardioprotection.

KEEP HYPERTENSION "OUTDOOR" FROM YOUR CARDIOVASCULAR HEALTH

PAPALE, O., FESTINO, E., DI ROCCO, F., FUSCO, A., CORTIS, C.

UNIVERSITY OF CASSINO AND LAZIO MERIDIONALE

INTRODUCTION: Hypertension is the primary risk factor for global mortality. Physical activity (PA) has been established as an effective treatment for hypertension, leading to reductions in Systolic BP (sBP), a response known as Post-Exercise Hypotension (PEH). Although gym-based exercise is the most common form of PA, there has been a growing trend towards outdoor activities. Considering the limited research on its benefits, this study aims to compare the sBP response and the PEH following indoor (laboratory) and outdoor activities.

METHODS: 11 subjects (age:24.3±1.1 years; BMI: 23.5±2.6 kg/m2) completed an outdoor activities on a selected hike and participated in a laboratory-based treadmill test, incorporating both uphill and downhill walking. During the laboratory test, subjects self-selected their speed to replicate their pace from the outdoor activities. The initial 2-min stage was set at 0% grade. The grade then increased by 2% at each 2-min stage during the uphill phase until subjects reached 95% of their estimated maximum heart rate (HRmax) or volitional fatigue, followed by a decrease of 2% at each 2-min stage during the downhill phase until it returned to 0% grade. During both sessions, sBP was measured 15-min before (PRE) and 30-min after (POST). Means (M) and standard deviations of PRE and POST sBP, along with PEH (difference between PRE and POST sBP measurements), were determined. Repeated measures mixed models assessed the effects on sBP, treating subjects as a random effect and measurement times (PRE and POST) as fixed effects. Paired t-tests compared PEH between field and laboratory settings, with statistical significance set at p<0.05.

RESULTS: Significant reductions were observed in the field session (length: ~3800m, max slope: 19%, M slope: 5.3%, M duration: 41:86min, M HRmax: 84%) between PRE (127.8 ± 7.8 mmHg) and POST (110.2 ± 8.6 mmHg) sBP measurements, resulting in a PEH of 17.6±6.7mmHg (p<0.001), and in the laboratory session (length: ~2800m, max slope: 25%, M slope: 8.1%, M duration: 40:00min, M HRmax: 92%) between PRE (124.5±8.6mmHg) and POST (106.1±6.4mmHg) sBP measurements, resulting in a PEH of 18.4±10.7mmHg (p<0.001). No significant (p=0.80) differences in PEH (M difference: 0.9 ± 11.3 mmHg) were found between the sessions.

CONCLUSION: Our findings align with the existing literature, confirming the positive effect of PA on reducing BP. These results suggest that the beneficial effects of PA on sBP could be replicated, and potentially even enhanced, by exercising in outdoor environments. This enhancement is linked to subjects achieving a lower internal load during outdoor activities, suggesting a stronger cardiovascular protective effect, even with similar exercise characteristics. Outdoor activities replicate traditional PA benefits and provide a potentially more sustainable and beneficial approach to improving overall health by reducing cardiovascular stress.

IS IT MORE TIRING TO CARRY OUT RESUSCITATION PROCEDURES WITH THE PATIENTS BED AT A HEIGHT OF 80 CM OR 42 CM?

MORGADO, J.P., BHUDARALLY, M.1, FEBRA, C.2, ATALAIA, T.3, PEREIRA, H.1,2, GUERRA, J.3, PALMEIRA, A.1, ALEIXO, P.1

1- CIDEFES -UNIVERSIDADE LUSÓFONA 2- HOSPITAL DA LUZ, LISBOA, PORTUGAL 3- ESCOLA SUPERIOR DE SAÚDE DA CRUZ VERMELHA PORTUGUESA LISBOA, PORTUGAL

INTRODUCTION: The guidelines of the American Heart Association and the European Resuscitation Council (ERC) (Perkins et al., 2021) for improving Cardiopulmonary Resuscitation (CPR) procedures applied to cases of cardiopulmonary arrest have recently been updated. During these procedures, chest compressions (CT) are essential to maintain continuous blood supply to the heart and brain (Chi et al., 2008). Depending on the clinical scenario, a resuscitator can perform CPR kneeling (patient on the floor outside the hospital setting) or standing (with or without a stool, with the patient on a bed in an emergency unit).

Kinematic analysis of the resuscitated patient in two situations with different bed heights (63 cm and 37 cm) revealed that there were no differences in the compression forces and their depths (Chi et al., 2008) compared. On the other hand, another study (Parent-Nichols et al., 2021) also analysed the effects of bed height on the resuscitators kinematics during standing CPR.

According to the ERC guidelines, the resuscitator who performs CT should be resuscitated at least every 2 minutes. If there is fatigue and/or less effective CT, the resuscitator should be surrendered earlier.

Our purpose was to compare the physiological impact of a Cardiopulmonary Resuscitation protocol performed with the patient on beds of different heights: 80 cm and 42 cm.

METHODS: Four certified female first aid trainers with more than 5 years experience (46.0 ± 7.48 years; height 163.1 ± 3.57 cm; 80.0 ± 4.82 kg) carried out a CPR protocol of 5 periods of chest compressions interspersed with 2 minutes of recovery in 2 scenarios with different bed heights: 80 cm (H80) and 42 cm (H42). Heart rate (HR) was monitored throughout the protocol and lactatemia was analysed during the recovery periods.

Nonparametric Wilcoxon test for related samples was used to compare mean values of H80 and H42. Statistical significance was set at $p<0.050$.

RESULTS: There was a tendency towards higher average values in response to H80 compared to H42 for blood lactate (H80: 4.81±1.97; H42: 2.93±0.67; p=0.068), HRTCavg (H80: 129.5±17.1; H42: 116.8±17.1; p=0.068), HRTCmax (H80: 139.9±19.1 ; H42: 126.3±20.4; p=0.068), FCCTmin (H80: 106.6 ±15.7; H42: 99.0±14.1; p=0.273) e HRRec (H80: 113.9±20.2; H42: 105.7±17.1; p=0.465).

CONCLUSION: Higher patient bed heights (80 cm) seem to induce more resuscitator fatigue in CPR processes than lower heights (42 cm), considering the physiological indicators of lactatemia and mean and maximum exertional HR and recovery HR.

Physiological characterisation of effort and recovery will be great tools for deepening knowledge about optimising processes during CPR.

Fitness level may be a factor to determine chest compression duration and the levels of physical function, muscle strength, mass and morphology tend to decline with ageing. Future studies may adress the impact of an exercise intervention programme on the CC efficiency and induced fatigue in first aiders.

ENDURANCE WALKING TEST: VALIDATION OF A SIMPLE AND REPRODUCIBLE METHOD TO MEASURE EFFECTS OF REHABILITATION IN CARDIORESPIRATORY PATIENTS.

LE PORCHOU, L., CHEHERE, B., SOULET, A., PAGLIA, O., SIMON, B., GIROUX-METGES, M.A., MANSOURATI, J.
UNIVERSITÉ DE BREST - CHU DE BREST - ORPHY EA 4324

INTRODUCTION: Exercise tests are routinely used to assess the evolution of exercise tolerance following a rehabilitation in patients with cardiopulmonary diseases. Among all these tests, it was previously reported that walking endurance time (the time a person is able to walk at a constant, personalized intensity) is the most sensitive endurance parameter to assess the effects of rehabilitation. Difficulty lies in the feasibility of the method: it must be quick to set up for care teams and should last less than 10 minutes. The reference method (Endurance Shuttle Walk Test [ESWT]) is time-consuming as the walking speed is determined following two Incremental Shuttle Walk Test (ISWT). In this study, we propose a walking endurance test using the average speed measured during the 6-minute walk test (6MWT) which is already performed routinely and less time-consuming. The aims of this study are (1) to compare the walking speed and the feasibility of the two methods: ESWT using the two ISWT (SWTISWT) versus ESWT using the 6MWT (SWT6MWT), (2) to compare the cardiorespiratory adaptations during the tests and (3) to assess the reproducibility and learning effect of the SWT6MWT.

METHODS: Forty-four patients (age: 64 ± 10 years) with heart failure (n=16, Left Ventricle Ejection Fraction: 41 ± 10 %) or chronic obstructive pulmonary disease (n=28, Forced Expiratory Volume in the 1st second: 53 ± 14 %predicted) were recruited from Brest University Hospital and underwent 4 visits over a 4-week period:

- Visit 1: two 6MWT,
- Visit 2: two ISWT and one ESWT using the ISWT (SWTISWT),
- Visits 3 and 4: two ESWT using the 6MWT (SWT6MWT).

For each test, endurance time, heart rate (HR), respiratory rate (RR), tidal volume (VT), minute ventilation (VE), pulse oxygen saturation (SpO2), dyspnea and fatigue (modified Borg scale) were assessed.

RESULTS: (1) The SWT6MWT showed a higher speed when compared to SWTISWT (5.1 ± 1.1 vs. 4.3 ± 0.7 km.h-1, respectively; $p<0.001$); a smaller duration (263 ± 196 vs. 995 ± 338 sec, respectively; $p<0.001$) and a higher proportion of patients with endurance time under 10 minutes (71% vs. 19%, respectively; $p<0.001$).

(2) The SWT6MWT showed a higher SpO2 when compared to SWTISWT (92 ± 4 % vs. 90 ± 5 %, respectively; p=0.006); a higher RR (32 ± 6 vs. 30 ± 5 cycles.min-1, respectively; p=0.017) and a higher dyspnea score (5 ± 1 vs. 4 ± 1, respectively; p=0.002).

(3) The four SWT6MWT, whether separated by recovery time (30 minutes) or several days, were not significantly different (p=0.820).

CONCLUSION: Using the 6MWT to personalize the endurance test intensity can be achieved for cardiorespiratory patients. The SWT6MWT seems to be a quick to set up and a feasible method with a higher proportion of patients having an endurance time under 10 minutes that of SWTISWT. The higher speed of SWT6MWT compared to SWTISWT means a higher RR and dyspnea score but also allows patients to desaturate less during their test. Finally, the SWT6MWT is a reproducible method with no learning effect.

ENDOTHELIAL FUNCTION: A COMPLEX ASSOCIATION WITH CARDIOVASCULAR RISK FACTORS, SLEEP QUALITY AND CARDIORESPIRATORY CAPACITY IN PATIENTS WITH ACUTE CORONARY SYNDROME.

HBAIEB, M.A., CHARFEDDINE, S., HAMMOUDA, O., DRISS, T., BOSQUET, L., ABID, L.
UNIVERSITY OF POITIERS

INTRODUCTION: It is widely acknowledged that normal endothelial function plays a pivotal role in conferring cardioprotective effects against ischemia-reperfusion (IR) injury following acute myocardial infarction treated by a primary percutaneous coronary intervention (PCI), thereby mitigating oxidative stress and limiting infarct size. However, endothelial dysfunction has been extensively documented in patients with cardiovascular (CV) risk factors .This study proposes a novel perspective, positing that endothelial dysfunction could be intricately linked not only with traditional CV risk factors, but also it can be associated with poor sleep quality.Consequently, this interplay might significantly contribute to the attenuation of exercise capacity.

The aim of this study was to assess endothelial function following acute myocardial infarction (AMI) treated with a PCI and investigate the link between endothelial function, CV risk factors, sleep quality and exercise capacity. Furthermore, Additionally, the study aimed to determine if endothelial function could serve as a predictive factor for future major adverse acute cardiac events (MAACE) following AMI.

METHODS: Sixty-three patients with AMI (56.21 ± 7.6 years) volunteered to participate in this study, . Endothelial function was assessed using the Endothelium Quality Index (EQI) . Sleep quality was evaluated using both actigraphy and the PSQI (Pittsburgh Sleep Quality Index) questionnaire. Exercise capacity was quantified through the 6-minute walking test (6mwt).

RESULTS: Endothelial dysfunction (ED) was evident, as indicated by an EQI of 1.4 ± 0.7. Furthermore, ED was notably influenced by CV risk factors such as low physical activity level, age, and smoking. A significant correlation was found between EQI and both sleep efficiency ($r = 0.340$; $p = 0.006$) and PSQI score ($r = -0.533$; $p < 0.001$). Additionally, a strong association was observed between endothelial function and the results of the 6mwt ($r = 0.291$; $p = 0.021$). Furthermore, during a follow up period (near 4 months) following PCI, MAACE were observed in patients with severe endothelial dysfunction only.

CONCLUSION: In summary, this inquiry shows potential in revealing a complex interplay among impaired endothelial function, CV risk factors, sleep quality, and cardiorespiratory capacity during post-myocardial infarction recovery. Findings of this study may emphasize the importance of enhancing sleep quality and advocating for an active lifestyle as modifiable elements to enhance endothelial function, which can be regarded as a prognostic tool subsequent to AMI, ultimately contributing to improved clinical outcomes

Oral Presentations

OP-MH17 Physiotherapy/Knee

PATELLOFEMORAL PAIN IN YOUNG GYMNASTS

STEINBERG, N., ELBAZ, L., BAR-SELA, S., DAR, G., NEMET, D., ELIAKIM, A.
LEVINSKY-WINGATE ACADEMIC COLLEGE

INTRODUCTION: Patellofemoral pain (PFP) is prevalent in high impact athletes. In gymnastics, intensive physical activity, including the repetition of extreme movements apply loads and strains to the lower extremities. The combination of high-impact forces and long practice hours along pubertal development increased the concerns for PFP in competitive young gymnasts. Our aims were to investigate the prevalence of PFP in rhythmic, acrobatic and artistic gymnasts; and to look at the relation between PFP and anatomical features (such as maturation, joints ROM, bone strength and muscle strength) in young gymnasts from those three different disciplines.

METHODS: Data was collected via screening of 274 (aged 11.8±1.9 years) rhythmic, acrobatic and artistic compatetive gymnasts. They were asked to complete the Tanner questionnaire and to report their date of birth and menarche status. Each gymnast was assessed for anthropometrics, bone strength, muscle-strength (ankle plantar-flexors/dorsiflexors, knee extensors/flexors and hip abductors/adductors), hypermobility (using the Beighton 9-Point Test) and joints range of motion (ROM) (passive ankle dorsi flexion/plantarflexion, active hip extension, hip abduction, anterior split, posterior split and active trunk extension). Each gymnast underwent a physical examination conducted by the same physical therapist (specializes in sports medicine) for PFP.

RESULTS: 21.5% of the gymnasts had PFP, with significantly higher prevalence among artistic gymnasts (33.3%) compared to rhythmic gymnasts (21.4%) and acrobatic gymnasts (10.0%) ($p=.008$). No significant differences were found in age, menarche status and pubertal stages of gymnasts with and with no-PFP ($p>.05$). Univariate ANOVA showed discipline X PFP interaction for h/week of training this year ($F(2, 267)=3.647$, $p=0.027$). Logistic regressions showed that increased h/week of training last year (OR=1.062) and reduced muscle-strength [knee extensors (OR=0.853) and hip abductors (OR=0.673)] were significantly associated with PFP.

CONCLUSION: The prevalence of PFP was high, especially among artistic gymnasts. Impact of training and reduced knee and hip muscle strength were associated with PFP in young gymnasts. The knowledge acquired from this study can be utilized by all those involved in gymnastics, as a means of designing injury-prevention programs and for modifying train-

ing programs for gymnasts' specific body structures and current developmental stages. This combined with an increased understanding of factors related to injuries can help reduce musculoskeletal injuries among young female gymnasts.

ACTIVE PHYSIOTHERAPY IS SUPERIOR THAN PASSIVE PHYSIOTHERAPY FOR PATIENTS WITH CHRONIC KNEE PAIN: A 12-MONTH FOLLOW-UP OF A RANDOMIZED TRIAL

CUI, X., ZHAO, P., GUO, X., WANG, J., HAN, T., ZHOU, X., YAN, Q.
CHINA INSTITUTE OF SPORT SCINENCE

INTRODUCTION: Knee pain disrupts daily life, and functional impairments contribute to neuromuscular imbalance, a key factor in musculoskeletal pain. Effective treatment of chronic pain requires understanding the intricate interplay between systems and structures, transitioning from a singular structural focus to addressing functional impairments. Active physiotherapy (AP) adopts a patient-centered approach, using active movements to integrate sensory-motor information for functional recovery and pain relief. Passive physiotherapy (PP) involves direct therapist intervention and passive treatment. However, research on the therapeutic potential of AP and PP for chronic musculoskeletal pain is limited. This study aimed to determine whether AP is superior to PP in improving knee function over a 12-month follow-up period in patients with knee pain.

METHODS: 87 patients with symptomatic and radiographically confirmed knee pain were randomly assigned to either 3 months of Active Physiotherapy (AP) (n=44) or Passive Physiotherapy (PP) (n=43). The AP protocol integrated Mulligan Mobilization (MWM), active myofascial release technique, therapeutic exercises, with a focus on muscle balance, neuromuscular control, and coordination. The PP protocol consisted of physical agents therapy (such as laser therapy, microwave therapy, ultrasound therapy, and so on) and passive manual therapy. The primary outcome was the change from baseline in the Knee Injury and Osteoarthritis Outcome Score-4 domain version (KOOS4). Key secondary outcomes included pain intensity (VAS), quality of life (SF-36), and functional performances (40-meter fast walk and 6-minute walk test), measured at different intervals. Intention-to-treat and per-protocol analyses was performed. Linear mixed-model analysis was utilized.

RESULTS: Over a 12-month follow-up period, knee function improved in the AP by 20.5 ± 13.5 and in the PP by 14.2 ± 12.5. The overall between-group difference was 6.2 points (97.5% CI, 1.8 to 10.7; P = 0.007). The mean difference of the VAS was -5.3 mm (95% CI, -8.7 to -1.8; P=0.003), favoring AP. No difference between groups was observed in SF-36. AP group exhibited substantial improvements in all functional performance variables compared to the PP group (P < 0.05). Adverse events: 4 in AP, 7 in PP, with additional knee pain outpatient visits most frequent (2 in AP, 6 in PP).

CONCLUSION: Active physiotherapy demonstrates superiority in improving function and alleviating pain in patients with knee pain. These findings underscore the considerable therapeutic value of active physiotherapy for chronic knee pain treatment.

PAIN WITHOUT GAIN? ASSESSING PAIN PERCEPTION AND JUMP HEIGHT AFTER ACTIVE AND PASSIVE FOAM ROLLING: A CROSSOVER RANDOMIZED CONTROLLED TRIAL

HEINKE, L.N., JAVANMARDI, S., ZEMKE, J., RAPPELT, L., KNICKER, A., FREIWALD, J., NIEDERER, D., BAUMGART, C.
UNIVERSITY OF WUPPERTAL

INTRODUCTION: In the last decade, foam rolling (FR) gained popularity as a pre-exercise tool, improving range of motion and performance [1]. However, the specific effects of active (AFR) and passive (PFR) FR remain unclear. This study aims to explore how AFR and PFR affect pain perception and jumping performance.

METHODS: In a crossover RCT, 20 participants (10 men and 10 women) underwent both AFR and PFR sessions on their anterior thigh and calf muscles on two separate days. Prior to each treatment, participants engaged in a 5-minute warm-up on a stationary bicycle. Afterwards, each leg was treated twice for 3 minutes. Vertical force during AFR was measured with a force plate, and a custom constant-pressure rolling device was used for PFR, with pressure individualized to 32.1 ± 1.5% of body weight [2]. Countermovement jump (CMJ) performance was assessed before and after warm-up, and post-FR treatment. Pain perception, using the visual analog scale (VAS), was evaluated for both AFR and PFR during treatments. Two-factor (treatment x time) rANOVA`s using statistical parametric mapping (SPM) were employed to compare body weight-normalized vertical force data for the CMJs. SPM analyses were executed in Python using the open-source package spm1d, and further statistical analyses were calculated using R 4.2.2.

RESULTS: Jumping performance showed a moderate, but not statistically significant group × time interaction effect (p = .078, ηp2 = .126). Pairwise comparison indicated a small reduction from POST1 to POST2 for both AFR (27.2 ± 6.1 cm to 25.9 ± 5.7 cm; SMD = .225) and PFR (27.1 ± 5.9 cm to 25.1 ± 5.5 cm; SMD = .343). Furthermore, at POST2, a trivial difference was observed between AFR and PFR (SMD = .145). The rANOVA`s of SPM showed no interaction effects. AFR and PFR rolling pressure analysis revealed statistically significant higher forces on the thigh in AFR (291.0 ± 74.3 N) compared to PFR (223.7 ± 35.1 N) (SMD = .822). Pain perception was significantly higher in PFR (6.1 ± 2.1) compared to AFR (3.9 ± 2.4) (SMD = .975).

CONCLUSION: Both rolling conditions reduced the jumping performance. Surprisingly, participants rated PFR more painful than AFR, despite AFR applying substantially higher pressure. Speculatively, the non-contracted musculature in PFR may allow greater modulation of muscle and tissue stiffness, contributing to more pronounced negative effects on performance. It is noteworthy that in both conditions, the applied pressure could be twice as high as typically used in occlusion studies [3]. A concern for practical application is that, when comparing AFR and PFR, even higher mechanical pressure in

AFR does not lead to increased pain perception compared to PFR. Adverse effects on connective tissue, nerves, blood vessels, and bones should be critically considered if both treatments are improperly used.

[1] Wiewelhove et al., Front Physiol, 2019

[2] Baumgart et al., Sports (Basel), 2019

[3] Abe et al., J Appl Physiol (1985), 2006

INPATIENT VERSUS OUTPATIENT REHABILITATION FOLLOWING TOTAL KNEE ARTHROPLASTY

MAU-MÖLLER, A., EL-AARID, N., BEHRENS, M., STÖCKEL, T., BERGSCHMIDT, P., BADER, R., TOHTZ, S., MITTELMEIER, W., JACKSTEIT, R.

UNIVERSITY OF ROSTOCK

INTRODUCTION: Studies on the effectiveness of inpatient and outpatient orthopaedic rehabilitation have not yet differentiated their analyses with respect to certain orthopaedic diseases. This is the first study on the effectiveness of both rehabilitation programmes in a specific orthopaedic population (total knee arthroplasty [TKA] patients) with a focus on functional motor performance.

METHODS: Forty-two patients were allocated to a 3-week inpatient (n = 26) or outpatient (n = 16) rehabilitation program. Measurements were performed 1 day before discharge from the hospital (pre-test) and 3 months after TKA (post-test). Outcome measures included physical activity over a period of 7 days, i.e. number of steps (primary outcome variable) and number of sit-to-stand transitions. Secondary outcomes included knee pain, knee joint swelling, active and passive maximal knee flexion and maximal knee extension range of motion, timed up and go performance, stair climbing performance, joint position sense at 30° and 50° of knee flexion, gait performance and long-term memory representation of the gait.

RESULTS: The outpatient group performed a higher number of steps (mean difference: 14840; 95% CI: 6844 to 22835; $P < 0.001$) and sit-to-stand-transitions (74; -11 to 158; $p = 0.086$) during the first 7 days of rehabilitation. They also showed a lower error during the knee joint repositioning test at 30° (-7.7°; -12.4° to 3.2°; $p < 0.001$) and 50° (-5.5°; -10.0° to 1.0°; $p < 0.010$) of knee flexion and better stair climbing performance (-6.1s; -12.3s to 0.1s; $p = 0.004$) at post-test.

Correlation analyses between the functional outcome measures revealed moderate and strong positive relationships between the number of steps and sit-to-stand transitions ($r = 0.48$; $p = 0.003$) and between stair climbing and timed up and go performance ($r = 0.68$; $p < 0.001$).

CONCLUSION: The outpatient rehabilitation group showed (i) significantly higher physical activity during the first 7 days of rehabilitation, (ii) better proprioceptive accuracy and stair climbing performance 3 months after TKA, (iii) no significant group-differences in pain, swelling, range of motion, timed up and go performance, gait performance or long-term memory representation of the gait and (iv) correlations between functional outcome measures.

The associations between functional measures are not surprising, but – together with the finding of higher physical activity and better motor performance during and following outpatient rehabilitation – the present study underlines the relevance of physical activity for regaining and/or retaining motor performance in the early postoperative phase following TKA. Our findings suggest that, besides standard physiotherapy, everyday physical activity should be promoted during inpatient rehabilitation. Thus, outpatient rehabilitation is a suitable alternative for patients who can be treated in either an inpatient or an outpatient setting.

UPHILL TREADMILL RUNNING AND JOINT MOBILIZATION IMPROVE DYNAMIC STABILITY AND ANKLE DORSIFLEXION RANGE OF MOTION IN YOUNG ADULTS WITH CHRONIC ANKLE INSTABILITY: A FOUR-ARM RANDOMIZED CONTROLLED TRIAL

LAO, Y.

TSINGHUA UNIVERSITY

INTRODUCTION: The objective of this trial was to observe the effect of uphill treadmill running and the combined effect of uphill running plus ankle joint mobilizations on subjective feeling of instability, dynamic postural control and ankle dorsiflexion range of motion in young adults with chronic ankle instability(CAI).

METHODS: A randomized, four-arm, pretest-posttest design was implemented. After screening, a total of 76 CAI patients were randomly allocated among four groups: the combined uphill running and joint mobilization group(URJM), the uphill running alone group(UR), the joint mobilization alone group(JM), and the control group. Participants in the URJM group and UR group received 20 minutes per session, three treadmill training sessions per week throughout a 4-week program. Ankle joint mobilizations were provided three sessions a week for 4 weeks for the participants in the URJM group and JM group. The outcome measures included the Cumberland Ankle Instability Tool (CAIT) assessing subjective feeling of instability; the Y-balance test (YBT) in anterior, posteromedial (PM), and posterolateral (PL) directions assessing dynamic postural control; the weight-bearing lunge test and non-weight-bearing ankle dorsiflexion degree in half circle goniometer (NWBG) assessing ankle dorsiflexion range of motion. Linear mixed models were used to test differences between groups, with baseline outcome values serving as a covariate for adjustment. The effect size (Cohen's d) will be calculated to evaluate the magnitude of difference among groups.

RESULTS: There were statistically significant effects after isolated UR, JM or URJM on CAIT compared with the control group($p<0.01$). All the mean difference and the lower 95% CI were greater than the minimal clinically significant difference

of CAIT(3 scores), supporting the clinical efficacy. For the outcomes of dynamic postural control, there were statistically significant effects after isolated UR, JM or URJM on YBT-PM and YBT-PL compared with the control group($p<0.01$). For ankle dorsiflexion range of motion, participants in URJM group had a significantly greater improvement in NWBG than those in UR($p=0.021$), JM($p=0.028$) and the control group($p=0.000$).

CONCLUSION: A 4-week uphill treadmill running program can improve the subjective feeling of instability and dynamic postural control in young adults with CAI. Compared to uphill running alone or joint mobilization alone, their combined application can better improve non-weight-bearing ankle dorsiflexion range of motion. This effect may help improve inadequate ankle dorsiflexion preceding heel strike, a known risk factor for ankle sprains in CAI individuals. Clinical implications: The uphill running program mentioned in this study is a form of exercise therapy that can be autonomously undertaken by CAI patients. Clinicians and physical therapists may consider incorporating uphill running into the rehabilitation protocols for CAI patients.

Oral Presentations

OP-SH19 Physical Education and Pedagogics/Teachers

"FEELING SAFE" WHILE TEACHING GYMNASTICS IN PHYSICAL EDUCATION CLASSES? A QUALITATIVE EXPLORATION OF CHALLENGING FACTORS

ROHLEDER, J., UNGEHEUER, A., SCHAEFER, J., VOGT, T.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Although gymnastics is named as an essential movement domain within western Physical Education (PE) curricula, research indicates too little relative teaching time compared to other movement domains [1]. Approaching German circumstances and possible causes (e.g., in university PE teacher studies), this study aims to explore challenging factors perceived by German PE teachers regarding the teaching of gymnastics classes.

METHODS: Using a literature-based interview guide, semi-structured interviews of six PE teachers and trainee teachers (age: 40.0±18.7 years, female: one, male: five) with different professional and gymnastics-specific experiences were recorded. Qualitative content analyses served for combined deductive and inductive category coding by two coders using MAXQDA. Based on deductively detected main categories (MC; i.e., framework, teaching, apparatus, spotting, and safety), subcategories were inductively identified revealing a substantial inter-coder agreement (Krippendorff's alpha: 0.80) [2].

RESULTS: Identified subcategories assigned to MC-framework comprised time, stock of equipment, class size, staff shortage and curriculum. MC-teaching included methodology, pupils' and teachers' prerequisites, conscientiousness, uncertainty, risk-taking, pupils' motivation as well as teaching content material. MC-apparatus covered the apparatus setup and defects, whereas the statements concerning MC-spotting addressed the application of spotting by pupils and teachers as well as the teaching of spotting skills. MC-safety differentiated the subcategories injury risk and prevention as well as apparatus handling.

DISCUSSION: According to Robinson et al. (2020), insufficient time which was mostly associated with apparatus setup was mentioned most frequently as a main challenge caused by the school-related framework. Regarding gymnastics-specific teaching at school, the findings indicate a lack of basic organisational knowledge concerning the structure of a gymnastics class. This is with respect to declining motor skills of children [3]. Furthermore, the trusting involvement of pupils in setting up the apparatus and spotting gymnastics movements challenges the duty of supervision as a sole teacher. With this, teachers' uncertainties when applying spotting techniques are less about the technical implementation, but more in the fear of getting reproached for encroaching behaviour.

CONCLUSION: The present findings motivate to steadily rethink those challenging factors that contemporary university teaching can address. Intending a mixed-method approach, further research aims to survey the practical relevance of current gymnastics-specific PE teacher studies at German universities based on the present study's preliminary findings.

REFERENCES:

[1] Robinson, D. B., et al. (2020). DOI: 10.1080/25742981.2020.1715232

[2] Artstein, R., & Poesio, M. (2008). DOI: 10.1162/coli.07-034-R2

[3] Tester, G. et al. (2014). DOI: 10.4236/ape.2014.43.01

WEB-BASED INTERVENTION PROGRAM TO FOSTER NEED-SUPPORTIVE BEHAVIORS IN PHYSICAL EDUCATION TEACHERS AND PARENTS: A CLUSTER-RANDOMIZED CONTROLLED STUDY TO SUPPORT STUDENTS' PA-RELATED OUTCOMES

MEERITS, P.R., TILGA, H., KOKA, A.
UNIVERSITY OF TARTU

INTRODUCTION

The global trends of insufficient physical activity (PA) levels among children and adolescents underscore the imperative to identify ways to encourage their PA behavior. Both parents and teachers play a crucial role in shaping the health behaviors of children. Therefore, we developed and tested two online need-supportive interventions based on self-

determination theory, for parents and physical education (PE) teachers. The interventions consist of video lectures about need-supportive techniques that parents and PE teachers can use when interacting with children to support their intrinsic motivation towards leisure-time PA.

METHODS

We recruited 115 children (Mage = 12.47 ± 0.68, boys = 55, girls = 60) and one parent for each child. Students were cluster-randomized by school into four study groups (PE teacher training; parent training; combined PE teacher and parent trainings; control). Respective of the group, PE teachers and parents were assigned to either participate in a 4-week need-supportive intervention program or continue teaching and parenting as usual. Children completed questionnaires on psychological measures and self-reported PA pre-intervention, post-intervention, and one month after the intervention. Repeated measures ANOVAs were conducted to test the unique and combined effects of the interventions.

RESULTS

Students in the combined study group showed significantly higher perceived autonomy support from parents at one-month follow-up compared to students in either intervention alone and the control group. Contrary to expectations, the combined study group also demonstrated significantly higher perceived controlling behavior from teacher and external regulation in PE classes at one-month follow-up.

As the effect of these interventions may be moderated by the baseline PA level, we conducted additional analyses to examine whether the interventions were more effective for the sub-group of students with relatively low levels of PA at baseline. Results showed that combined study group demonstrated significantly higher levels of intrinsic motivation in PE, and perceived autonomy and competence support from parents at one-month follow-up compared to students in either intervention alone and the control group. Students in both PE teacher and parent alone intervention groups demonstrated a decline in perceived controlling behavior from PE teacher compared to the control and combined study groups at one-month follow-up.

DISCUSSION

When PE teachers and parents are involved simultaneously in supporting children's psychological needs, the children feel more autonomy support from their parents at follow-ups. Furthermore, results indicated that these interventions may be more beneficial for children who have lower PA levels at the outset.

Future research should replicate the interventions with a larger number of participants. Also, future intervention studies are advised to select children who are currently especially low in PA.

INCLUSION IN PHYSICAL EDUCATION TEACHER TRAINING PROGRAMMES - RECORDING THE ATTITUDES AND SELF-EFFICACY EXPECTATIONS OF PROSPECTIVE PHYSICAL EDUCATION TEACHERS WITH REGARD TO INCLUSION IN SCHOOLS

DESAIVE, C., KEYE, I.

HUMAN SCIENCES

Introduction

Pro-inclusive attitudes and inclusion-related self-efficacy expectations are important prerequisites for the implementation of inclusive Physical Education and are considered determinants of success for the implementation of inclusive schooling for pupils. Targeted support in this regard should already be provided during university teacher training (Willems & Meyer 2019). As Caprara et al. (2006) showed, positive attitudes and self-efficacy expectations of teachers have a positive influence on pupils learning success. Following on from this, the present study records and analyses the inclusion-related attitudes and self-efficacy expectations of Physical Education Teacher Trainees at Otto von Guericke University Magdeburg.

Method

In this Analysis n=70 (m= 46, f= 24) Physical Education Teacher Students were included. The students age is from 18 to 24 years. The survey was conducted using the SACIE-R "Sentiments, Attitudes and Concerns about Inclusive Education - Revised" with 15 items and the TEIP "Teacher Efficacy for Inclusive Practice" with 18 items.

Results

No significant difference was found between the Bachelors and Masters students in the overall analysis of the results (p=.39). The mean value comparison of the genders also revealed no significant difference in the SACIE-R (p= .91), nor in the comparison of the results of the survey using the TEIP questionnaire (p= .59). In the subscale "Concerns about the implementation of inclusive teaching", a significant difference was found between the Bachelors and Masters degree programmes (p=.02, d= 0.5).

Discussion

The subscale Concerns (concerns regarding the implementation of inclusive teaching) shows a significant difference between Bachelor and Master students. The results show that Bachelor students are more likely to have concerns about inclusion in schools and inclusive Physical Education. Students state that they hardly have the necessary knowledge and skills to teach in Physical Education to learners with disabilities. Physical Education Teacher Students also rate their skills in designing individualised learning tasks for learners with disabilities as rather mediocre. A stronger integration of inclusive learning opportunities and courses in teacher training programmes is therefore becoming increasingly important.

References

Willems, A. S., & Meyer, K. (2019). What role influence factors before and during the study programme play in student teachers beliefs about school inclusion? In T. Ehmke, P. Kuhl, & M. Pietsch (Eds.), Teachers. Education. Shaping. Contributions to empirical research in teacher education (pp. 71-84). Beltz Juventa.

Caprara, G. V., Barbaranelli, C., Steca, P. & Malone, P. S. (2006). Teachers self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: a study at the school level. Journal of School Psychology, 44(6), S. 473-490.

PHYSICAL EDUCATION COOPERATING TEACHERS AND THEIR UNDERSTANDING OF MENTORING PRESERVICE TEACHERS

AMORIM, C., RIBEIRO-SILVA, E.
UNIVERSITY OF COIMBRA

Introduction

Preservice teachers (PSTs) spend time in real classrooms during school placement to familiarise themselves with the intricate requirements of their future careers. Numerous academic works emphasise the importance of the cooperating teacher (CT) during the school placement, and PSTs' professional identities are shaped by their interaction and support from the CT (Izadinia, 2016). PSTs are required to learn about a range of topics and elements related to the teaching profession from CTs. This study aimed to comprehend how CTs perceive their role as mentors and how it affected and contributed to PSTs' identity formation.

Methods

Seven CTs with 22 to 40 years of experience teaching physical education participated in this qualitative study. Semi-structured interviews were conducted to collect data, and the questions centred on mentoring. The CTs were given preference in terms of time and location for the interviews. The interviews were audio recorded and manually transcribed with all personally identifiable information removed to protect the participants' privacy. We performed thematic content analysis and to identify trends in the data, we conducted a comparative horizontal analysis. Categories driven by the data were: PST role, PST characteristics, pros and cons of mentoring, PST strengths and weaknesses, PST teacher identity and professional relationships.

Results and discussion

CTs understand that PSTs should start their school placement by being available for a year of learning and want to mentor PSTs who are predisposed to it. CTs value PSTs with commitment to the school placement and availability to learn, which were also seen as strengths. The disparity in training and lack of personal investment in their formation process were seen as weaknesses. The role of CT is seen as positive for its challenge and keeping up to date. The negative side of mentoring relates to the amount of work that CTs must do. CTs believe that PSTs have good preparation in didactic-pedagogical knowledge but not in the different sports. Half of the participants believe that PSTs develop a teacher identity throughout the school placement and the rest believe that it depends on the person and their previous experiences. Despite some conflicts that sometimes arise, CTs maintain a friendly and professional relationship with their mentees.

Conclusion

This study set out to study the role of the CT as a socialisation agent. We understand that CTs place a strong humanistic focus on the personal development of the PSTs in addition to acquiring essential teaching skills. If we desire a certain socialisation, we must also value these CTs and CTs perceptions of their own mentoring should be made clear.

References

Izadinia, M. (2016). Preservice teachers' professional identity development and the role of mentor teachers. International Journal of Mentoring and Coaching in Education, 5(2), 127–143. https://doi.org/10.1108/IJMCE-01-2016-0004

13:15 - 14:30

Invited Symposium

IS-AP02 Machine learning in sports – Not everything that glitters is gold! - sponsored by adidas

DOES THIS MAKE SENSE? ASSESSING MACHINE LEARNING APPLICATIONS FOR SPORT RELATED USE-CASES

HECKSTEDEN, A.
UNIVERSITÄT INNSBRUCK

Today, machine learning is self-evident part of many life domains. Impressive performance in some areas together with objectivity and scalability may lead to the impression that data-driven approaches are generally superior to other ways of generating knowledge and competence (e.g. "normal" statistics or experience- based learning). This apparent edge is particularly attractive in competitive sport where "AI" based applications have become pervasive. While understanding and evaluating technical details is beyond the reach for most sport scientists and practitioners, it is possible to gauge the potential suitability of machine learning for a specific use-case and critically scrutinize performance claims. To begin with, it is important to keep in mind that the performance of data driven approaches relies (among other things) on two critical

requirements: (i) Large amounts of precedents (many previous cases to learn from) and (ii) An informative - not just large - set of explanatory variables (that is, the explanatory variables jointly explain most of the outcome). Only if these requirements are met, one can hope to identify regularities that generalize beyond the training data. Note that neither a vast panel of explanatory variables (as e.g. in "omics" approaches), nor a sophisticated, highly-flexible machine learning algorithm (e.g. a deep neural network), nor a large number of repeated measurements (e.g. from wearables) can make up for a limited number of precedents. Therefore, in many sport-related use-cases, a misfit between the model complexity required for useful performance and the number of available precedents ("data scarcity") poses hard limits to the performance of data-driven approaches. Why is this "hard" limitation is not recognized more generally? Arguably, challenges of unambiguously verifying model performance play a major role. First and foremost, complex an / or probabilistic outcomes (e.g. recovery need or injury occurrence), which are common in sport, do not allow for a direct comparison of model output with the (later) observed ground truth. Moreover, model performance may differ dramatically between training set, cross-validation, out-of-sample, and out-of-population validation. While successful practical application requires model performance with new cases, data scarcity increases the risk of spuriously high performance on the training data ("overfitting"). Therefore, verified out-of-sample performance is crucial for sports practice and should always be reported / requested. Moreover, consciously scrutinizing the plausibility of claimed performance based on the predictability of the outcome, the set of explanatory variables and common sense remains important (e.g. near perfect prediction of contact injuries in team sports based on GPS data alone). This talk will illustrate the above considerations based on practical examples and provide suggestions for fitting machine learning approaches to sport-related use-cases

UNDERSTANDING PARAMETER INFERENCE VERSUS PREDICTIVE INFERENCE WHEN APPLYING MACHINE LEARNING MODELS

REIN, R.
GERMAN SPORT UNIVERSITY COLOGNE

Standard statistical practices in sports science research typically involve the estimation of unobservable model parameters based on a specific data model. Subsequently, inferences usually connected to a hypothesis testing framework about model parameters are performed to identify data generating processes and possible causal relationships. In general, linear model approaches instantiated for example through Analysis of Variance type of analyses represent the majority of analysis approaches across sports science disciplines. Accordingly, model driven hypotheses tests using a frequentist theoretical approaches form the main epistemological framework to interpret research results and assess their importance. However, with the increasing application of machine learning approaches (ML) to sports science data this approach is overly restrictive and may also lead to erroneous procedures. First, a distinction must be made between an inferential approach and a decision-making approach according to the aim of research project. ML approaches are typically much more suitable when researchers are interested in building a decision-making procedure as their strengths lie in prediction results and less on parameter inferences. ML methods therefore usually require a different approach to the analysis of the data and the interpretation and assessment of the model as many of these models act as black-boxes in contrast to standard linear models. Practices common under an inferential framework like variable selection may not only be unnecessary but may actually deteriorate performance even when less important variables are deleted. In turn, when using black-box algorithm approaches model interpretability necessarily becomes less important compared to predictive accuracy. Focusing more strongly on predictive properties has thereby the benefit of being often of direct interest to practitioners. A practitioner may not have much interest in what has been found for a specific sample but rather would like to know what would happen if new observables would be collected based on their specific sample of athletes. As the prediction error and more general model accuracy become more central for the assessment of a chosen analysis procedures like cross-validation, model stability, and model comparison and concepts like bias-variance trade-off and overfitting become much more important compared to traditional goodness-of-fit tests and parameter inferences. Unfortunately, knowledge and best-practices about these procedures and their specific requirements are not commonly taught at sports science institutions which at best hampers the application of ML to sports science data and at worst leads to erroneous applications. Thus, when adopting more algorithm centered machine learning in contrast to traditional model centered approaches different requirements have to be met by the researchers to ensure that their conclusions are truly supported by their data.

THE DATA SCIENTIST AND THE COACH: A LONG LASTING MARRIAGE IF DONE RIGHT

KEMPE, M.
UNIVERSITY OF GRONINGEN

Using Machine Learning (ML) to synthesize the vast amount of data enabling coaches, trainers, and support staff to make educated decisions might be the most influential use in sports practice. By now, a professional sports team monitors their athletes extensively, recoding variables of training prescription and performance (external load), as well as the physiological and mental strains of these training sessions (internal load). Next to that, they also perform regular performance testing and record individual variables like age, injury history, growth spurt, etc. The complexity and possible interactions of these variables are hard to grasp which is why Robertson made the argument to install decision support systems to create recommendations for practitioners based on "historical" data [1] using ML. Such a system creates simplified variables and/ or visualization by synthesizing various information to make better-informed decisions. Especially in terms of athlete monitoring and injury prevention, different approaches were introduced in the last decade to serve this purpose. A recent review found eleven studies that used different data sources and ML algorithms to predict injuries [2].While the quality of

the implementation of the ML algorithms in these papers was good compared to earlier reviews in this field [3], the overall quality of the evidence just ranked from very low to moderate. While seeming accurate, these approaches aren't endorsed by practitioners. Therefore, this talk will give recommendations to design an approach that is helpful, useful and accepted by coaches and the supporting staff using ML. The outline is given by an example of a use case of Dutch National Short track team, applying a readiness to perform prediction to adapt daily training prescriptions. To enable more sport scientist to apply such an approach and facilitate reproducibility, appropriate reporting as well as data and code sharing should be stimulated. This means open science principles, as highlighted by Bullock et al. [4], should be stimulated in these publications. This includes using reporting guidelines like TRIPOD and adhering to FAIR data principles. Thus, this talk will give an outline on how to setup an ML project for practical implementation in a way that could also serve as a blue-print for other sport scientist.

[1] Robertson, P.S.: Man & machine: Adaptive tools for the contemporary performance analyst. J. Sports Sci. 00, 1–9 (2020). https://doi.org/10.1080/02640414.2020.1774143.

[2] Van Eetvelde, H., Mendonça, L.D., Ley, C., Seil, R., Tischer, T.: Machine learning methods in sport injury prediction and prevention: a systematic review. J. Exp. Orthop. 8, (2021). https://doi.org/10.1186/s40634-021-00346-x.

Invited Symposium

IS-MH08 Moving Forward! Advancements in Physical Activity, Exercise and Eating Disorders

BODY SYSTEMS AND BIOPHYSIOLOGICAL ADVANCEMENTS IN EDS

FERNANDEZ DEL VALLE, M.

UNIVERSIDAD DE OVIEDO

Eating disorders impact all systems of the body. Among them, the nervous system is the most studied in EDs with neurobiology being one main area receiving extensive attention. Historically, brain function has been examined through cerebrospinal fluid samples. However, over the past decades, in vivo brain imaging has made possible the study of the structure, composition, activity, and biological function of the brain and food-related behaviors. Beyond neurobiology, scattered research has exposed significant biophysiological alterations at multiple levels in EDs like altered body composition, dysbiosis of the gut microbiota, epigenetic changes, or impaired inflammatory and metabolic responses. An individual who engages in maladaptive movement during an ED exacerbates dysfunction of all body systems and, as a consequence, undermines treatment efforts by reducing the probability of full recovery. Adapted exercise unfolds as a crucial tool to modulate several of these alterations, however, clinical teams lack of resources to help them manage maladaptive movement (a critical ED symptom). In addition of having a better understanding of these alterations and the degree to which body systems affected, a deeper knowledge of the impact of movement (maladaptive and healthy) could aid medical teams, exercise professionals and patients. It is of great importance, therefore, to look at EDs from a more complex perspective that includes the biophysiological component. This talk will provide an overview of the main neurobiological alterations in EDs. Following, we will offer a comprehensive view of the bio-physiology and body systems affected on these disorders including areas of interest such as muscle, fat and bone tissue, microbiota, epigenetics, or inflammation. In addition, this talk will also seek to clarify the connections between the biophysiological alterations and the modulatory potential of healthy movement in EDs.

COMPULSIVE EXERCISE: UNDERSTANDING EXERCISE OBSESSIONS AND COMPULSIONS

SOLFRID, B.

UNIVERSITY OF SOUTH-EASTERN NORWAY

Difficult relationships with movement have long plagued the field of eating disorders (EDs). Starting in the 19th century, clinicians and researchers have documented such behavior in their patients and attempted to term this phenomenon and determine a corresponding conceptualization. Unfortunately, a consensus has yet to be reached on how to conceptualize difficult relationships with movement. In part, this is due to the lack of knowledge and understanding about both the complexity cognitions and behaviors. Recent advancements have identified exercise obsessions without compulsions across various population, making the cognitions about exercise relevant also for the sedentary persons. This adds to the complexity of how to identify and manage complicated relationships with movement across populations (i.e., athletes, persons diagnosed with EDs or persons experiencing disordered eating). This is of particular importance because up to 80% of patients engage in maladaptive movement over the course of their EDs. Further yet, individuals with and without EDs can experience facets of maladaptive movement. In this presentation, we will give an update on recent advancements in the conceptualization of compulsive exercise and present the term "maladaptive (bodily) movement", which reflects both quantitative and qualitative aspects. We will also explore their presentation across populations and activity types (i.e., incidental physical activity, exercise, and sports). Finally, we will outline how the qualitative facets of maladaptive movement can present in the non-ED population and present the implications for the general population. Together, this presentation will offer knowledge on different aspects and conceptualizations of maladaptive movement. It will provide information on the tools and instruments used to identify and manage such behavior in both athletic and clinical populations.

THE SAFE EXERCISE AT EVERY STAGE (SEES) GUIDELINE, UPDATES, AND IMPLEMENTATION

QUESNEL, D.
UNIVERSITY OF TORONTO

Eating disorders (EDs) are a group of mental health disorders that cause serious harm to both physical and psychological health and well-being. Although treatment advancements have been made, ED outcomes are often less than ideal as high levels of drop-out, partial responses to available therapies, and elevated relapse rates characterize ED patients. A factor that has been known to interfere with ED treatment and recovery is maladaptive movement, which reflects quantitative and qualitative features of one's relationship with activity across modalities (i.e., incidental activity, sport, exercise). Engaging in maladaptive movement before, during and after ED treatment can aggravate negative treatment outcomes. However, clinicians don't feel they have the knowledge and tools to address this transdiagnostic ED symptom. Further complicating this arena is the incidence of EDs and maladaptive movement in athlete populations. For athletes, their careers, financial wellbeing, education, and identity often rely on their ability to perform in the sport. However, the incidence of an ED and maladaptive movement can make sports engagement difficult, if not impossible, for some. It leaves coaches and clinicians with the difficult task of helping athletes return to their sport if achievable. The Safe Exercise at Every Stage (SEES) and Safe Exercise at Every Stage- Athlete (SEES-A) guidelines were developed to support clinicians and exercise professionals in managing movement during treatment for an eating disorder. Since 2019, the SEES guidelines have garnered international recognition and helped private and public ED treatment programs enhance how they address movement with their clients. Clinician training based on the SEES guideline demonstrated the ability to improve clinician self-efficacy in addressing maladaptive movement during treatment. The SEES team has continued to remain up to date with the current literature and integrated it into the SEES and SEES-A guidelines. This talk will provide an overview of the SEES and SEES-A guideline and how they have been updated over the last five years. We will continue by guiding health professionals through step-by-step instruction on using the guidelines in clinical practice with athletes and the general population. Finally, an open discussion will engage participants in reviewing any questions or difficulties they have had in navigating maladaptive movement in EDs within research and clinical contexts.

Oral Presentations

OP-PN18 Fatigue I

CAN MUSCLE FATIGUE OR PEDALING TECHNIQUE EXPLAIN THE VO2 SLOW COMPONENT DURING CYCLING?

MACDOUGALL, K., ABOODARDA, S., WESTERGARD, P., MACINTOSH, B.
UNIVERSITY OF CALGARY

INTRODUCTION: During constant power cycling in the heavy and severe domains, the steady-state VO2 is delayed or prevented due to the VO2 slow component (SC). The rising oxygen uptake has been assumed to represent a progressive loss of muscle efficiency, resulting primarily from skeletal muscle fatigue, however evidence for a causal relationship is equivocal. Notably, it has also been demonstrated that alterations in pedaling technique may occur during fatiguing cycling exercise. If these alterations impair cycling efficiency, this could represent a moderating factor between the development of fatigue and the increase in oxygen cost observed with the SC. However, little is known about the existence of pedaling technique adjustments during fatiguing cycling exercise in association with the SC. Therefore, the purpose of this study was to explore the association between the VO2 SC and skeletal muscle fatigue, and the impact that changes in pedaling technique may have on the development of the VO2 SC.

METHODS: Eleven participants completed an incremental exercise test to determine lactate threshold, followed by constant power trials to exhaustion at 10% above lactate threshold (power output 194 ± 55W). Utilizing femoral nerve stimulation and instrumented pedals, muscle fatigue was assessed, along with oxygen uptake, quadriceps oxygenation, electromyography (EMG), and pedal force components. To explore the temporal relationship between muscle fatigue and the appearance of the SC, Pearson's correlation coefficient was calculated between the relative reductions in twitch force across the first 2.5 min of exercise and the time of onset of the SC. To explore the association between the SC and alterations in pedaling technique, repeated measures correlations between physiological and mechanical variables were estimated at both a group and individual level.

RESULTS: There was no significant correlation between the time of onset of the VO2 SC and initial reductions in twitch force ($r = -0.076$, $p = 0.852$). At a group level, the SC (387 ± 172 ml/min at peak) was significantly correlated with quadriceps twitch force ($r = -0.48$, $p < 0.001$), root mean square EMG ($r = 0.18$, $p = 0.016$), and muscle oxygenation ($r = -0.50$, $p < 0.001$), as well as with pedaling mechanical variables such as peak total downstroke force ($r = -0.16$, $p = 0.022$), minimum total upstroke force ($r = -0.15$, $p = 0.029$), and upstroke index of effectiveness ($r = 0.18$, $p = 0.012$). However, there was large interindividual variability for all these correlations. At an individual level, repeated measures correlations between twitch force and the SC ranged from -0.03 to -0.87, while correlations between the SC and some pedaling mechanical variables were seen to be as high as 0.80 for some individuals.

CONCLUSION: From the heterogeneity of the data, we question a direct causal link between fatigue and the SC, and suggest that alterations in pedaling technique may also be a factor in its development.

THE MAGNITUDE OF PERFORMANCE AND PERCEIVED FATIGABILITY IS DEPENDENT ON INTENSITY AND EXERCISED MUSCLE MASS

ABOODARDA, J., ABOODARDA, S.J., ZHANG, J., MACINNIS, M.J., IANNETTA, D.
UNIVERSITY OF CALGARY

INTRODUCTION: The extent of performance and perceived fatigability varies based on the volume of exercised muscle mass (1,2). However, no study to date has explored this effect across the entire intensity spectrum. Accordingly, this study aims to investigate alterations in muscle contractile function, central voluntary activation and perceived responses to single-leg (SL) and double-leg (DL) cycling tasks performed within four intensity domains.

METHODS: Eleven males (29±4 years) performed SL and DL cycling to task failure in the moderate (MOD), heavy (HVY), severe (SVR), and extreme (EXT) intensity domains, as characterized by gas exchange threshold, respiratory compensation point, and maximal aerobic capacity from a DL ramp incremental test. SL cycling was performed at 60% of the power output corresponding to DL trials. Voluntary and evoked contractions, including 5s MVC of the dominant knee extensors combined with superimposed 100 Hz doublets (Db100) and resting Db100, 10 Hz doublets (Db10), and single twitch electrical stimuli of the femoral nerve were performed at baseline, immediately upon task failure, and following 1, 4, and 8 min of recovery. Perceived fatigue, leg pain, dyspnea, and effort were collected during trials. Two-way repeated measures ANOVAs with Bonferroni post hoc examined 2 modes × 4 timepoints within each domain.

RESULTS: Time to task failure was similar between SL and DL cycling in all domains. MVC declined more following SL in SVR (SL vs. DL: -41±12% vs. -31±15%; P=0.036) and HVY domains (-42±16% vs. -30±18%; P=0.011). Also, peak twitch force declined more following SL at SVR (-49±13% vs. -40±7%; P=0.048) and HVY domains (-31±12% vs. -22±10%; P=0.007). Voluntary activation declined more following SL than DL at HVY (-20±15% vs. -9±10%; P=0.008). Dyspnea was greater following DL at HVY (7±3 vs. 6±3; P=0.031), SVR (8±2 vs. 6±2; P=0.001), and EXT domains (7±2 vs. 5±2; P=0.025), whereas ratings of fatigue, pain, and effort were similar between exercise modes.

CONCLUSION: These findings suggest that metabolic perturbations within smaller muscle mass exercise (e.g., SL vs. DL cycling) can result in greater impairments in muscle contractile function within the SVR and HVY domains. However, the impairment in muscle function may be exacerbated for DL cycling within the MOD domain. Also, except for greater dyspnea, perceived responses between exercised muscle masses did not show any difference between domains. Collectively, these findings indicate that the modulatory effect of muscle mass on the extent of performance and perceived fatigability is exercise intensity-dependent.

1. Rossman et al., 2012, Acta Physiol

2. Zhang et al., 2021, AJP-Regul Integr Comp Physiol

THE EFFECTS OF HYDROGEN GAS ON REPEATED SPRINT PERFORMANCE IN HEALTHY ACTIVE ADULTS—A RANDOMIZED CONTROLLED CROSSOVER TRIAL

CHEN, W.T., LIN, W.C., HSU, T.C., YOU, W.T., WU, C.L.
NATIONAL CHUNG HSING UNIVERSITY

INTRODUCTION: Molecular hydrogen has been suggested to have antioxidation and anti-inflammatory properties which may serve as ergogenic aids for sport and exercise performance. Studies have investigated the potential effects of molecular hydrogen, mainly given as hydrogen-rich water, on endurance performance and muscle damage. However, little has been known in terms of the effects of inhaling hydrogen gas on high intensity intermittent exercise (HIIE). Thus, the purpose of current study was to explore the potential effects of acute inhalation of hydrogen gas on high intensity repeated sprint performance.

METHODS: Fourteen healthy active males (age:22.9±5.4yrs, height:177.8±6.3cm, weight:70.5±8kg) were recruited to participate in this randomized, double-blinded, placebo-controlled, crossover study. Subjects were randomized to inhale either hydrogen gas (H2) (gas generation rate was 1.5L/min, containing 70% hydrogen and 30% oxygen) or normal gas (placebo, ambient air) for 30 mins (including a 10-min warm up), before performing the HIIE test. They were asked to return to the laboratory, after a 7-day washout period, to inhale the other gas in a crossover fashion. The HIIE test, conducting after gas inhalation, comprised 15x6s all-out repeated sprints (20s active recovery between sprints) on a cycle ergometer, and the work load was fixed at 9% of body weight. Blood samples were collected at baseline, pre-test and post-test to analyze blood lactate and arterialized venous blood gas. Rate of perceive exertion (RPE) were recorded at the end of the test. Peak power (PP), mean power (MP), minimum power (MinP), work done (WD), cadence (rpm), fatigue index (FI) and decrement score (Sdec) were recorded during the test. Data were analyzed by using repeated measures ANOVA, and were presented as mean±SD.

RESULTS: Significant group by time interactions were found in venous blood partial pressure of oxygen (PO2) (p=.012), partial pressure of carbon dioxide (PCO2) (p=.012), total carbon dioxide content (tCO2) (p=.013), base excess (BE) (p=.016), bicarbonate (HCO3) (p=.013) and standard bicarbonate (stHCO3) (p=.022), but not in pH and blood lactate. Furthermore, blood BE (-9±2.8 vs. -10.6±2.9 mmol/L, p<.05) and stHCO3 (17.2±2 vs. 16.1±2 mmol/L, p<.05) concentrations were both found higher at post-test in the H2 trial, which corresponded to the trend of lower variations in BE (p<.05), HCO3 (p<.01) and stHCO3 (p<.05) while performing the HIIE in the H2 trial. As for the sprint performance, no significant differences were observed in PP, MP, MinP, WD, rpm, FI, Sdec and RPE between trials.

CONCLUSION: The results suggested that pre-exercise acute inhalation of H2 might facilitate a more effective buffering system in blood, which might be explained by the relatively moderate variations in BE and HCO3 during exercise. However, the enhanced magnitude of buffering capacity was not able to alter blood pH and lactate production, which, taken together, resulted in trivial effects on the repeated sprint performance.

THE LINK BETWEEN SLEEP, MENTAL FATIGUE AND CAFFEINE USE: EVIDENCE FROM A RANDOMIZED CROSSOVER TRIAL FEATURING OVER 90 PARTICIPANTS

HABAY, J., EZZY, Q., ARENALES ARAUZ, Y.L., PATTYN, N., VAN CUTSEM, J., ROELANDS, B.

VRIJE UNIVERSITEIT BRUSSEL , ROYAL MILITARY ACADEMY , RESEARCH FOUNDATION FLANDERS

INTRODUCTION: Both sleep and mental fatigue (MF) influence cognitive and physical performance [1, 2]. However, while they are theorized to share similar effects and mechanisms, not much is known about the link between sleep and MF variables. Moreover, caffeine is said to influence both states, but no research has yet included caffeine use as a confounding variable.

METHODS: Ninety-nine healthy individuals (54 male, 32.7 ± 8.7 y, 175.1 ± 9.9 cm, 70.0 ± 11.7 kg, 48.4 ± 9.4 ml/min.kg) were included in this randomized crossover trial. Participants visited the lab three times (familiarization, intervention (INT) and control (CON)) and were required to either perform a 45 min Stroop task (INT) or watch a documentary (CON). The level of MF was quantified using a visual analogue scale (MVAS). A GoNoGo task (cognitive performance) and cycling time trial (physical performance) were used to quantify the behavioral effects of MF. Sleep variables included quality, quantity, chronotype and sleepiness. Caffeine use was measured using the revised caffeine consumption questionnaire. A one way ANCOVA and regression analyses were used to explore the links between all variables.

RESULTS: There was a significant rise in MF as evidenced by MVAS values (MF = 69.0 ± 18.5 AU; CON = 26.4 ± 17.6 AU; $p<0.001$; $d = 1.9$). MF negatively impacted Go reaction time (MF = 382.4 ± 33.3 ms; CON = 369.5 ± 32.2 ms; $p <0.001$; $d = 0.6$), Go accuracy (MF = 98.1 ± 1.6%; CON = 98.7 ± 1.2%; $p<0.001$; $d = 0.4$), and NoGo accuracy (MF = 88.1 ± 9.8 %; CON = 91.2 ± 7.4%; $p < 0.001$; $d = 0.4$). Distance in the time trial showed a trend to significance (MF = 12.6 ± 1.8 km; CON = 12.7 ± 1.7 km; $p = 0.078$; ES = 0.2). The one way ANCOVA showed no influence of chronotype on MF variables. Moreover, only two regression models showed a significant link between MF and sleep, with an increase in MVAS leading to an increase in sleepiness ($p = 0.040$; Adj. $R2 = 0.03$), and a decrease in sleep quality leading to a worsening of reaction time ($p = 0.035$; Adj. $R2 = 0.04$). Two variables (sleep quantity ($p = 0.099$; Adj. $R2 = 0.02$) and sleepiness ($p = 0.120$; Adj. $R2 = 0.02$)) showed a trend to significance, with an worsening of both leading to a higher effect of MF on time trial distance. Caffeine usage had no influence on the performed analyses.

CONCLUSION: The results of the present study show almost no relationship between sleep, MF and caffeine variables. Possible explanations for the lack of relationship are specific differences in physiological mechanisms and the limited variability of sleep data. Therefore, future research is necessary to gain further insights into sleep, MF and their internal connections.

1. Habay J, et al. Interindividual Variability in Mental Fatigue-Related Impairments in Endurance Performance: A Systematic Review and Multiple Meta-regression. Sports Medicine - Open. 2023;9(1).

2. Craven J, et al. Effects of Acute Sleep Loss on Physical Performance: A Systematic and Meta-Analytical Review. Sports Medicine. 2022;52(11):2669-90.

EFFECT OF MUSCLE DAMAGE ON EFFICIENCY AND THE CARIOPULMONARY RESPONSES TO CYCLING

BROWNSTEIN, C., HORNER, D., JEFFRIES, O.

NEWCASTLE UNIVERSITY

INTRODUCTION: The effect of eccentric exercise-induced muscle damage (EIMD) on cycling efficiency are unclear. While some studies report a reduction in economy during cycling with EIMD (Marcora et al. 2008), others report no change (Twist et al. 2009). This study assessed the effect of EIMD on gross and delta efficiency and the cardiopulmonary responses to cycling.

METHODS: 21 recreational athletes performed 3 × 5 minute stages of cycling at 70%, 90% and 110% of the gas exchange threshold (GET) under control conditions (Control) and 24 h following a bout of damaging eccentric exercise (Damage). Efficiency, cardiopulmonary and vastus lateralis electromyographic responses, as well as rate of perceived exertion (RPE) were assessed during the last 2 minute of each stage. Damage was assessed via changes in knee extensor maximal voluntary contraction (MVC) and potentiated twitch responses (Qtw,pot). A reliability control was also performed to assess the reliability of gross and delta efficiency, in order to assess whether any change in these measures as a result of muscle damage was beyond typical error.

RESULTS: EIMD resulted in a reduction in MVC and Qtw,pot of ~25%. A 0.5-0.6% absolute reduction in gross efficiency across all work rates was found for Damage relative to Control ($p < 0.001$). However, there was no change in delta efficiency ($p = 0.513$). Concurrently, root-mean-squared EMG was 5-6% higher during Damage than Control, with RPE also higher for Damage ($p < 0.001$). Regarding the cardiopulmonary responses, an intensity-dependent increase in ventilation was found with Damage at 90% and 110%, but not 70% GET. Similarly, an increase in ventilatory equivalents for oxygen and carbon dioxide were intensity-dependent, and were only increased during Damage at 110% GET. The reliability analysis showed good to excellent reliability of gross efficiency (ICCs 0.89-0.96 across work rates), and poor reliability for delta efficiency (ICC = 0.24).

CONCLUSION: These results demonstrate the EIMD reduces gross efficiency. The concurrently higher vastus lateralis EMG activity indicates that reductions in muscle efficiency were likely responsible, at least in part, for reductions in gross efficiency. However, delta efficiency was unchanged, which could relate to its poor reliability hindering the ability to detect change. The study also demonstrates intensity-dependent hyperventilation when cycling with EIMD, which might relate to the higher central command, as indicated by the higher EMG and RPE. These results provide new insight into the effects of EIMD on the physiological responses to cycling.

Marcora et al. (2008, Am J Physiol Regul Integr Comp Physiol)

Twist et al. (2009, Eur J Appl Physiol)

Invited Symposium

IS-BM03 Reticulospinal functioning, its measurement and adaptation to resistance training

AN INTRODUCTION TO THE RETICULOSPINAL TRACT: ANATOMY, FUNCTION AND MEASUREMENT

KIDGELL, D.

MONASH UNIVERSITY

The lecture explores the anatomy and function of the corticospinal and reticulospinal tracts, and it discusses the application of transcranial magnetic stimulation (TMS) and other neurophysiological methods for the activation of neurons within each tract. Additionally, the lecture provides a concise overview of potential measurements that can be conducted in both human subjects and non-human primates. It also includes a discussion of the current methodological limitations, along with a cautionary note. Associate Professor Kidgell draws from the ongoing and as-yet-unpublished research conducted in his laboratory, as well as prior studies conducted by other research groups. Relevance: The lecture enhances comprehension of the reticulospinal tract, elucidating its anatomical location and function in relation to the more widely recognized corticospinal tract. It also probes the mechanisms through which the reticulospinal tract exerts its influence during muscle contraction. Furthermore, this lecture serves as a foundational precursor to the subsequent two lectures. Target audience: Primary interests will be from biomechanists and neurophysiologists, with secondary interests from physiologists and physiotherapists.

RETICULOSPINAL TRACT FUNCTIONING AND ADAPTATION IN NON-HUMAN PRIMATES

WALKER, S.

NEWCASTLE UNIVERSITY

This lecture covers the ground-breaking discoveries on reticulospinal tract functioning from the lab of Prof. Stuart Baker. Dr Walker will disseminate recent findings from strength training studies in non-human primates led by first author Dr. Isabel Glover. Here, he presents data recorded from muscles, primary motor cortex and the reticular formation in chronically implanted monkeys performing different strength contractions. These results provide proof-of-concept for human studies. Dr. Walker will also briefly outline possible future applications of the knowledge gained from this research. Relevance: Currently, the most convincing evidence of reticulospinal contribution to high force production and adaptation to resistance training is derived from Dr. Glover's research. Her papers are integral to focused interest on this topic. Dr. Walker's lecture will bring this work into greater attention within the field of exercise science, whereas the primary notoriety is within neuroscience currently. This lecture leads to a natural progression into lecture 3, where humans are studied using various non-invasive measurement techniques. Target audience: Primarily neurophysiologists, as well as medical science fields (such as neurologists and physiotherapists).

RETICULOSPINAL ADAPTATION THROUGH STRENGTH TRAINING IN HUMANS

HU, N.

UNIVERSITY OF JYVÄSKYLÄ

Strength training, as the primary exercise mode for increasing force production capacity, is a keen focus of this lecture. Dr. Hu provides evidence of enhanced reticulospinal functioning from chronic strength training. The lecture presents a possible (non-invasive) measurement battery to examine reticulospinal functioning and adaptation in humans, drawing on recent experience of Dr. Hu and her collaborators who have shaped these test protocols. Relevance: Evidence of reticulospinal facilitation and adaptation in humans is presented, where methodological honing, as well as current limitations are discussed. This lecture primarily consists of unpublished and/or recently published data. Dr. Hu shares the latest research findings from the lab of Dr. Walker, which will encourage future randomized controlled trials to be performed. Target audience: Primarily biomechanists and neurophysiologists. However, attendance is expected from physiotherapy, strength and conditioning, and training and testing.

Oral Presentations

OP-MH01 Exercise for older adults I

STICKING TO IT: HIGH ADHERENCE LEVELS AND ENHANCED CARDIORESPIRATORY FITNESS IN OLDER ADULTS PERFORMING HOME-BASED HIIT

FOSSTVEIT, S., BERNTSEN, S.1, FERON, J.2, JOYCE, K.E.2, IVARSSON, A.3, SEGAERT, K.2, LUCAS, S.J.E.2, LOHNE-SEILER, H.1
1. UNIVERSITY OF AGDER, 2. UNIVERSITY OF BIRMINGHAM, 3. HALMSTAD UNIVERSITY

INTRODUCTION: Cardiorespiratory fitness (CRF), a strong predictor of overall health and longevity, typically declines with age, increasing the risk of chronic diseases in older adults.1 Home-based high-intensity interval training (HIIT) potentially offers a practical and accessible method to improve CRF. However, objectively measured adherence levels and subsequent effectiveness of home-based HIIT in older populations remain underexplored.2,3 Therefore, this study aimed to investigate adherence to a six-month home-based HIIT intervention in older adults, as well as assessing associations between various adherence metrics and the resultant changes in peak oxygen consumption (VO2peak).

METHODS: 233 healthy older adults (60-84 years, 54% female) were randomised to six-month, thrice-weekly home-based HIIT (one circuit and two interval sessions) or a passive control group. Exercise sessions were monitored with a Polar watch and logbook for objective and subjective data, respectively, and guided by a personal coach. Adherence was assessed using frequency, intensity, and duration data, and was quantified using a novel method involving metabolic equivalents (METs).4 For each metric, adherence was expressed as percentage completion relative to what was planned. VO2peak was assessed using a modified Balke treadmill protocol to volitional exhaustion. General linear regression models (GLMs) assessed between-group differences in post-intervention VO2peak, with baseline VO2peak, age, sex, and country as covariates, and group as a fixed factor. For adherence-VO2peak associations, GLMs were used with age, sex, and country as covariates.

RESULTS: The HIIT group achieved an average total of 11116±5455 MET-min (122% of the planned exercise volume). Participants completed 2.6±0.6 sessions per week (86% of planned) and spent 10.3±5.2 min per session at ≥80% of HRpeak (98% of planned), with an average session duration of 39.9±11.8 min (135% of planned). Between-group differences were observed in the pre-to-post intervention change in VO2peak (1.8 [1.2;2.3] mL/kg/min; effect size: 0.35). There was a positive association between adherence to frequency and intensity and percentage improvements in VO2peak (β=0.1 [0.0;0.2]; β=0.04 [0.00;0.07], respectively), but not duration or total MET-mins.

CONCLUSION: The findings indicate that older adults can successfully adhere to and benefit from a home-based HIIT program, achieving clinically meaningful improvements in CRF over six months. Notably, while adherence levels are crucial in designing effective exercise interventions for this demographic, the findings indicate that exceeding prescribed exercise volumes does not necessarily lead to superior enhancements in CRF.

References:

1. Kaminsky et al. Progress in cardiovascular diseases. 2019.

2. Gray et al. British Journal of Sports Medicine. 2016.

3. Stork et al. Health psychology review. 2017.

4. Nilsen et al. Medicine and science in sports and exercise. 2018.

(www.fab-study.com)

IMPROVED SLEEP IN OLDER ADULTS THROUGH PHYSICAL ACTIVITY AND POTENTIAL UNDERLYING MECHANISMS

SCHERRER, S., EGGER, S., WICK, A., LIU, X., XIN, L., RASCH, B., LAUBER, B., TAUBE, W.
UNIVERSITY OF FRIBOURG

INTRODUCTION: Around 50% of individuals aged 60 and older experience sleep problems, and current insomnia treatments are difficult to access or have adverse effects [1]. Thus, there is urgent need for alternatives. Gamma-aminobutyric acid (GABA)-mediated inhibition is crucial for sleep [2] and older adults exhibit lower GABA levels [3]. Interestingly, balance training has been shown to enhance GABA-mediated inhibition [4]. Thus, we hypothesised that balance training would improve sleep quality in older adults.

METHODS: 60 volunteers (64-81 years old) were randomly assigned to a three-month balance intervention (> 30 sessions; BT), a three-month strength intervention (> 30 sessions; ST) or a control group, following their daily routines (CON). Before and after the three-month period, subjective sleep quality was evaluated with the Pittsburgh Sleep Quality Questionnaire (PSQI). Sleep efficiency was recorded with polysomnography (PSG) at the participant's home. During an afternoon nap in the laboratory, short- interval intracortical inhibition (SICI), a measure of the activity of GABAergic inhibitory interneurons in the motor cortex, was assessed. GABA and lactate levels in the motor cortex were determined with magnetic resonance spectroscopy. Linear mixed-effects models (LME), followed by Bonferroni-corrected paired t- tests and cohen's d effect sizes with 95% confidence intervals were calculated.

RESULTS: LME indicated a significant time effect for PSQI scores (p=.016). BT improved subjective sleep quality by -1.35 score points (d=0.58, 95% CI [0.06, 1.09], p=.046), with no change in ST (p=1) and CON (p=1). Improved sleep scores in BT

showed a trend towards a strong correlation with increased SICI at sleep onset (r =-0.59, p=.073). Furthermore, a time effect on GABA levels was revealed (p=.025). BT increased GABA levels by 22% (d=0.97, 95% CI [0.40, 1.55], p=.009), while ST (p=1) and CON (p=1) showed no change. Sleep efficiency demonstrated a significant interaction effect of group and time (p=.006): BT (p=.353) and CON (p=1) did not change significantly while ST increased sleep efficiency by 7% (d=0.71, 95% CI [0.22, 1.21], p=.022). Additionally, ST revealed a significant decrease in brain lactate level (p=.02).

CONCLUSION: Older adults showed improved subjective sleep quality along with increased GABA levels after BT. Moreover, increased GABAergic inhibition at sleep onset was associated with improved sleep scores. These findings support the idea that BT counteracts hyperarousal in the elderly brain [5]. The observed decrease in brain lactate, a biomarker of sleep [6], suggests that ST improves sleep efficiency by improving lactate metabolism, as previously shown in animal models [7].

1. Patel, D. et al., J Clin Sleep Med, 2018.

2. Saper, C.B. et al., Nature, 2005.

3. Cuypers, K. et al., Aging (Albany NY), 2018.

4. Taube, W. et al., Eur J Neurosc, 2020.

5. Riemann, D. et al., Sleep Med Rev, 2010.

6. Naylor, E. et al., Sleep, 2012.

7. Carroll, C.M. et al., bioRxiv, 2022.

PREDICTIVE MODELING OF ADVERSE HEALTH EVENTS AND CONDITIONS USING MACHINE LEARNING: A 6-YEAR LONGITUDINAL CLUSTER ANALYSIS IN THE TOLEDO STUDY FOR HEALTHY AGING

GARCIA-AGUIRRE, M.1,2,3, BALTASAR-FERNANDEZ, I.1,2,3,4, ALCAZAR, J.1,2,3, GUADALUPE-GRAU, A.1,2,3, GALEANO, J.5, ALFARO-ACHA, A.2,3,6, ARA, I.1,2,3, RODRIGUEZ-MAÑAS, L.2,7, ALEGRE, L.M.1,2,3, GARCIA-GARCIA, F.J.2,3,6

1. GENUD TOLEDO RESEARCH GROUP. FACULTY OF SPORTS SCIENCES. UNIVERSITY OF CASTILLA-LA MANCHA, TOLEDO, SPAIN. 2. CIBER ON FRAILTY AND HEALTHY AGING (CIBERFES), INSTITUTO DE SALUD CARLOS III, MADRID, SPAIN. 3. INSTITUTO DE INVESTIGACIÓN SANITARIA DE CASTILLA LA MANCHA (IDISCAM). TOLEDO, SPAIN. 4. FACULTY OF HEALTH SCIENCES. UNIVERSITY OF CASTILLA-LA MANCHA, TALAVERA DE LA REINA, SPAIN. 5. COMPLEX SYSTEMS GROUP, UNIVERSIDAD POLITÉCNICA DE MADRID, SPAIN 6. GERIATRICS DEPARTMENT, HOSPITAL UNIVERSITARIO DE TOLEDO, TOLEDO, SPAIN 7. GERIATRICS DEPARTMENT, GETAFE UNIVERSITY HOSPITAL, GETAFE, SPAIN

INTRODUCTION: Aging constitutes a multifaceted and inevitable process characterized by a gradual decline in physiological functions and an escalation in health risks. Despite a significant increase in life expectancy, the achievement of healthy aging has not kept pace accordingly. This emphasizes the importance of identifying biomarkers associated with healthy aging. Thus, this study aimed 1) to cluster the study population into healthy and unhealthy aging by using machine learning methodologies, 2) to identify straightforward predictive variables for these clusters, and 3) to analyze the relationship between clusters indicative of unhealthy aging and adverse health events and conditions.

METHODS: A prospective cohort study that included 1852 older adults (>65 years) from the Toledo Study for Healthy Aging. A total of 366 variables (including physical, cognitive, and biochemical outcomes among others) were assessed using machine learning k-means clustering. Gradient boosting, area under the curve (AUC) values, and classification accuracy (CA) were used to evaluate the predictive capacity of healthy and unhealthy aging clusters. Logistic regression analyses adjusted for age, educational level, and comorbidities were used to assess the relationship between the healthy and unhealthy aging clusters and the risk of experiencing cognitive impairment, frailty, hospitalizations, and all-cause mortality over the subsequent 6 years.

RESULTS: Two clusters of healthy (C1) and unhealthy aging (C2) were identified in both men (C1= 243; C2= 565) and women (C1= 342; C2= 702). Among the 366 variables tested, relative sit-to-stand power, loss of memory in the last two years, and habitual gait speed collectively exhibited excellent predictive capacity for healthy and unhealthy aging in both older men and women according to the AUC values (0.850 in men and 0.875 in women) and CA (0.819 in men and 0.792 in women). After 6 years of follow-up, older adults in the unhealthy aging cluster exhibited a higher risk of experiencing cognitive impairment [OR (95%CI) = 4.7 (1.8, 12.3) in men and 2.9 (1.3, 6.3) in women], frailty [OR (95%CI) = 2.8 (1.2, 6.8) in men and 7.1 (3.3, 15.4) in women], hospitalizations [OR (95%CI) = 1.8 (1.2, 2.6) in men and 2.0 (1.4 , 2.8) in women] and all-cause mortality [OR (95%CI) = 2.0 (1.4, 2.9) in men and 2.2 (1.5, 3.1) in women] compared to those older individuals in the healthy aging cluster.

CONCLUSION: The machine-learning method identified that relative sit-to-stand power, memory loss, and habitual gait speed were strong predictors of healthy and unhealthy aging in older adults. Those older people within the unhealthy aging cluster exhibited a 2 to 7 times higher likelihood of experiencing an adverse event or condition compared to those in the healthy aging cluster after 6 years of follow-up, emphasizing the importance of assessing and monitoring these variables to ensure healthy aging.

PHYSICAL ACTIVITY SHIFTS SIX MONTHS AFTER A SEVERE FALL – MODERATING FACTORS IN OLDER ADULTS

SCHMIDT, L., STUCKENSCHNEIDER, T., KWIECIEN, R., ZIESCHANG, T.

GERIATRIC MEDICINE

INTRODUCTION: Severe falls among older individuals are a common cause of emergency department (ED) visits, often leading to long-term consequences that impact functional independence. Little is known about the characteristics of individuals who suffer functional decline after such falls, however, a reduced physical activity (PA) may serve as an early warning sign. To date, PA has mostly been investigated in older adults with a fall cross-sectionally. Thus, little is known about which moderators e.g., age, sex, cognitive function, and depressive symptoms, influence changes in PA and to what extent. Therefore, this study aims to investigate the association between clinically relevant moderators and changes in PA in older adults, who experienced a severe fall.

METHODS: Participants were recruited from the SeFallED study following up on individuals aged 60 years or older, who presented to the ED after a severe fall without hospital admission [1]. Moderating factors were collected as part of a home-based geriatric assessment within 4 weeks after a fall (T1) and included: age, sex, BMI, cognitive function, depressive symptoms, concerns about falling, falls in the preceding 12 months, type of initial fall i.e., unrecovered or recovered, lower extremity function, gait speed, and hand grip strength. Participants' activity was quantified by assessing sedentary time using a three-axial accelerometer (activPAL4, PAL Technologies Ltd., Glasgow, UK), worn for 7 consecutive days, at T1 and 6 months after the initial fall (T2). Association of moderating factors with changes in PA were calculated using Linear Mixed Model (LMM) in R (R Core Team, 2023 Version 4.3.2, 2023-10-31).

RESULTS: The study enrolled 335 participants, among whom, so far, 208 individuals (mean age 75.6; 60–98 years; 134 females) contributed valid datasets up to a 6-month follow-up period, further data pending as follow-up continues. Preliminary results of LMM revealed a significant time effect for sedentary time with an increase of 150.1 minutes between T1 and T2 (95% CI: 111.3–188.9, $p<0.001$). Each fall in the preceding 12 months was significantly associated with an increase of 13.0 minutes in sedentary time (95% CI: 3.9 – 22.2, $p=0.005$).

CONCLUSION: Preliminary findings indicate that a decline in PA six months after a severe fall associates with the frequency of falls during the 12 months preceding the ED visit. Hence, this emphasizes the importance of enquiring falls in the ED in individuals seeking care post-fall, as it could signal potential long-term adverse outcomes. Considering the emerging healthcare challenge, posed by falls and their consequences, it is crucial to optimize risk assessments. The assessment should be realistically feasible and sufficiently sensitive to enable the implementation of tailored interventions for those with the most pressing needs – identifying prior falls may help.

1. Stuckenschneider T, et al: Sentinel fall presenting to the emergency department (SeFallED) - protocol. BMC Geriatr 2022, 22(1):594.

Oral Presentations

OP-PN03 Nutrition III

THE EFFECT OF ORAL TAURINE SUPPLEMENTATION ON THERMOREGULATORY AND CARDIOMETABOLIC RESPONSES TO PASSIVE HEAT EXPOSURE

PEEL J.S., MCNARRY, M.A., HEFFERNAN, S.M., NEVOLA, V.R., KILDUFF, L.P., COATES, K., DUDLEY, E., THOMAS, A., WALDRON, M.

SWANSEA UNIVERSITY

INTRODUCTION: In hot or humid environments, there is a reduced capacity for dry or evaporative cooling, which can result in uncompensable heat stress and rises in core temperature (Tcore) [1]. Cardiovascular adjustments (e.g. elevated heart rate, cardiac output and peripheral vasodilation) attempt to meet heat loss demands by facilitating greater skin blood flow (SkBF) and occur in parallel to increases in sudomotor function [2]. An individual's ability to thermoregulate (i.e. enhanced vasodilation and eccrine sweating) and, consequently, tolerate such conditions, can be chronically or acutely modified [3]. Taurine supplementation enhances sweating onset and rate during exercise in the heat [4] and induces greater peripheral arterial vasodilation [5], but its potential role in thermoregulation at rest has not been evaluated. The current study aimed to determine the effect of oral taurine supplementation on sweating, vascular, cardiometabolic and Tcore responses during 90 min passive heat exposure.

METHODS: Thirteen, healthy, euhydrated, non-heat acclimated female (n = 2) and male (n = 11) participants (26 ± 5 years, 79.3 ± 9.6 kg) completed a 90 min passive heating protocol (38.4 ± 0.4°C, relative humidity 55.9 ± 1.9%), following eight-days of oral taurine supplementation (50 mg/kg of body mass) or placebo in a double-blind, randomised, cross-over design. Whole-body sweat loss (WBSL), local sweat rate (LSR), SkBF, cutaneous vascular conductance (CVC), brachial artery diameter and blood flow, mean arterial pressure (MAP), parameters of cardiac function, pulmonary gas exchange and Tcore were assessed. Relative % SkBF and brachial artery vasodilation (V%) were analysed during- and post-isometric handgrip exercise, respectively, at three timepoints (20, 50 and 80 min). Plasma taurine concentrations were determined from post-supplementation blood samples.

RESULTS: Oral taurine supplementation increased WBSL by 16.2% ($p < 0.049$), leg LSR by 26.6% ($p = 0.011$), SkBF by 19.3% ($p = 0.016$) and CVC by 9.3% ($p = 0.027$) compared to placebo. Post-isometric handgrip brachial artery (8.0 vs 5.8%; $p = 0.002$) and SkBF (6.3 vs 4.6%; $p = 0.020$) V% were greater in the taurine condition; however, no differences in resting brachial artery diameter and blood flow, MAP, cardiometabolic parameters or Tcore were observed ($p > 0.05$). Plasma taurine bioavailability was increased in taurine vs placebo (258 ± 55 vs 74 ± 26 μM).

CONCLUSION: Oral taurine supplementation influenced aspects of thermoregulation during passive heat exposure, with enhanced sweating and cutaneous vasodilatory responses, without affecting other parameters of cardiometabolic function. These findings have potential implications for individuals at risk of heat stress in environmental conditions that permit dry and evaporative heat dissipation.

REFERENCES:

1. Cramer & Jay, 2016, Auton Neurosci.

2. Crandall & Wilson, 2015, Compr Physiol.

3. Periard et al., 2021, Physiol Rev.

4. Page et al., 2019, Eur J Sport Sci.

5. Sun et al., 2016, Hypertens.

EFFECTS OF RESISTANCE-BASED TRAINING AND POLYPHENOL SUPPLEMENTATION ON MITOCHONDRIAL BIOENERGETICS AND REACTIVE OXYGEN SPECIES PRODUCTION IN INDIVIDUALS AT THE ONSET OF AGING.

FLENSTED-JENSEN, M., WEINREICH, C.M., KLEIS-OLSEN, A.S., HANSEN, F., SKYGGELUND, N.S., PII, J.R., KARLSEN, A., DELA, F.

UNIVERSITY OF COPENHAGEN

INTRODUCTION: Aging entails a gradual deterioration in physical capabilities and cellular functions, including impaired mitochondrial function and heightened oxidative stress. Resistance training (RT) mitigates a decline in physical function, yet its impact on oxidative stress and mitochondrial function is unknown. Polyphenols (PP) possess antioxidant properties and can bolster mitochondrial biogenesis, but their effects in the elderly are relatively uncharted. This double-blinded RCT examines the individual and combined influences of RT and PP supplementation on muscle performance, oxidative stress, and mitochondrial respiration, with the hypothesis that mitochondrial respiratory capacity and H2O2 emission will increase and decrease, respectively, with an enhanced effect of combined RT and PP supplementation.

METHODS: 40 men and women (55-70 yrs) were randomized to ingest a PP supplement (700 mg/day) or placebo daily for one month (loading period). Then a 12-week supervised RT-based program (x3/wk), while continuing either PP or placebo (PLB), was carried out. Anthropometrics, muscle power and strength were measured at the study start, after loading and after RT. Muscle biopsies were obtained before and after RT, and analyzed for mitochondrial respiratory capacity (MRC) and H2O2 emission (Oroboros 2k). Here we report preliminary results of the RT (n=16 as one group regardless of PP or PLB) as unblinding will be done in June when the last subject is finished. Statistical analysis of MRC and H2O2 emission is done by two-way RM ANOVA, and other outcomes by a paired t-test.

RESULTS: RT led to increased leg maximal voluntary contraction strength (159±50 vs 178±53 Nm; $P < 0.001$), handgrip strength (39.1±12.2 vs 42.1±3.5 kg; $P < 0.01$) and sit-to-stand test reps (14.5±3 vs 16.8±3.4 reps; $P = 0.0001$), with a tendency towards higher VO2max (2382±429 vs 2464±470 ml O2/min; $P = 0.08$). Mitochondrial H2O2 emission decreased (main effect; $P < 0.05$) and MRC increased (main effect; $P = 0.02$) with RT. Lean mass was only significantly increased with RT in the male (n=9) participants (59.7±4.5 vs 60.9±4.8 kg; $P = 0.005$) with no significant change for the women (n=7)($P = 0.29$).

CONCLUSION: These results imply that resistance-based training can improve mitochondrial bioenergetics and attenuate oxidative stress by increasing respiratory capacity and lowering mitochondrial reactive oxygen species production in individuals at the onset of aging. This is of particular importance in this population, as aging is associated with impaired mitochondrial function and increased oxidative stress, which may be linked to the development of several age-related diseases. The effect of PP supplementation awaits the unblinding.

CARBOHYDRATE BUT NOT NIACIN INGESTION SUPPRESSES EXERCISE INDUCED AMPK SIGNALLING

BRADSHAW, L., MORENO CABAÑAS, A., SPELLANZON, B., BUNIAM, J., MALLINSON, J., TZINTAS, K., WAHLIN, J.P., BETTS, J.A., KOUMANOV, F., GONZALEZ, J.T.

UNIVERSITY OF BATH

INTRODUCTION: AMP-activated protein kinase (AMPK) is an important regulator of adaptations to endurance exercise. Training with low carbohydrate availability can increase AMPK activation (Bartlett, Hawley and Morton, 2015), but whether increased AMPK activation is due to low carbohydrate availability per se or due to concurrent increases in fatty acid availability/oxidation is unclear. The aim of this study was to assess the independent effects of carbohydrate and fatty acid availability on exercise-induced skeletal muscle AMPK activation.

METHODS: Eight active males cycled on three occasions for 1 hour at 95% of lactate threshold 1 with ingestion of either carbohydrate (CARB), niacin (NIACIN), or placebo (FAST) in a crossover design (11±6-day washout). After baseline breath, blood and muscle samples, participants consumed a drink (1.6 g/kg maltodextrin or placebo) and tablets (10 mg/kg niacin or placebo). Following 1 hour of rest participants cycled with further carbohydrate (0.8 g/kg/hr maltodextrin), niacin (10

mg/kg/hr) or placebo and blood and expired breath samples were collected every 15 minutes. Following exercise, a further muscle sample was obtained. Plasma was analysed for NEFA concentrations, and muscle for glycogen concentrations using the hexokinase method. Muscle protein content and phosphorylation status was assessed by semi-quantitative western blotting and expressed as the fold-change from pre- to post-exercise. Normality of data were checked by visual inspection of residuals. Differences between CARB vs FAST and CARB vs NIACIN were analysed by paired t-tests.

RESULTS: Fat oxidation was lower in CARB vs. FAST (13±8 g vs. 22±9 g, p=0.003) but there was no significant difference between CARB vs. NIACIN (15±8 g, p=0.59). There was no evidence for differences in glycogen use with CARB (58±56 mmol/kgDM) vs FAST (97±56 mmol/kgDM, p=0.27). However, muscle glycogen use with NIACIN (142±76 mmol/kgDM) was higher than CARB (p=0.01). ACCSer79 phosphorylation status (ratio p-ACC to total-ACC) was decreased with CARB (1.6±1.8 fold) vs. both FAST (2.1±2.1 fold, p=0.04) and NIACIN (2.0±0.8 fold, p = 0.02). AktSer473 phosphorylation (ratio p-Akt to total-Akt) was increased with CARB (1.7±0.6 fold) vs. FAST (1.0±0.4 fold, p<0.01), but the difference between CARB vs. NIACIN (1.7±0.6 fold) was not statistically significant (p=0.08).

CONCLUSION: These data suggest that augmented glycogen use during exercise with niacin use increases skeletal muscle AMPK signalling independent from circulating fatty acid concentrations. Therefore, low carbohydrate availability may be more important than fatty acid availability for AMPK induced adaptations to exercise.

References:

Bartlett JD, Hawley JA, Morton JP. Carbohydrate availability and exercise training adaptation: too much of a good thing? Eur J Sport Sci. 2015;15(1):3-12. doi: 10.1080/17461391.2014.920926.

INGESTION OF AN ANTI-LIPOLYTIC DRUG ALTERS WHOLE-BODY SUBSTRATE UTILISATION DURING BRISK WALKING EXERCISE IN OBESE INDIVIDUALS, BUT DOES NOT ALTER MUSCLE DIACYLGLYCEROL AND CERAMIDE CONCENTRATIONS

BARRETT, J.S.1, BENNETT, S.2, FORTIS, H.O.1, CUTHBERTSON, D.J.3, OWENS, D.J.1, STRAUSS, J.A.1, WAGENMAKERS, A.J.M.1, SHEPHERD, S.O.1

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Exercise increases turnover of muscle lipid pool and enhances storage of fatty acids as intramuscular triglycerides (IMTG) in healthy individuals. Obese individuals have lower rates of IMTG turnover leading to the accumulation of diacylglycerols (DAGs) and ceramides (Cer) and insulin resistance. Anti-lipolytic drug ingestion prior to exercise reduces plasma free fatty acid (FFA) concentrations and increases IMTG use. This study investigated whether plasma FFA suppression during and following exercise leads to alterations in fibre type and subcellular-specific IMTG use and muscle Cer and DAG species in obese individuals.

METHODS: In a repeated measures crossover design, ten obese (BMI >30 kg.m-2) sedentary individuals (7 M/3 F, 46 □ 10 y) performed two separate 45-min treadmill walking trials at 45% VO2max followed by 3 h recovery. For one trial, participants ingested the anti-lipolytic drug, Acipimox (250 mg), 1 h before and again immediately post-exercise. During the other trial nothing was ingested. Muscle samples were obtained at baseline, immediately post-exercise, and 3-hours post-exercise. Muscle samples were analysed by liquid chromatography tandem mass spectrometry for lipids (n=10), and transmission electron microscopy (TEM) for IMTG content (n=4). Data were analysed using a two-way ANOVA.

RESULTS: Plasma FFA concentrations were lower in the Acipimox trial compared to control (P<0.05). Mean carbohydrate oxidation rates measured by indirect calorimetry during exercise were greater in the Acipimox trial (1.21□0.46 g.min-1) compared to the control trial (1.01□0.38 g.min-1; P=0.002) and mean fat oxidation rates were greater in the control trial (0.38□0.10 g.min-1) compared to the Acipimox trial (0.28□0.07 g.min-1; P=0.009). Total muscle DAG or ceramide concentrations did not change during exercise or during recovery (P=0.34). The concentration of glucosylceramides (GluCer) 24:0 and 24:1 increased immediately following exercise in both conditions. Total lactosylceramide (LacCer) concentrations were significantly increased by exercise, as were LacCer species 20:0, 22:0 and 24:0, with no differences between conditions. Notably, exercise-induced increases in concentration of LacCer species appeared to be sustained following 3 h of recovery. Initial data demonstrates that Acipimox ingestion reduced intermyofibrillar IMTG content~ 30% from pre- to post-exercise compared to control.

CONCLUSION: Ingestion of an anti-lipolytic drug suppressed plasma FFA concentrations and altered whole-body substrate utilisation during 45-min of brisk walking in obese individuals. Although no changes in Cer were observed, we speculate that both the rate of synthesis and degradation of Cer and GluCer is increased by exercise, resulting in greater formation of LacCer. Ongoing TEM analysis to measure subcellular lipid droplet content and morphology will reveal whether increased flux through the de novo ceramide synthesis pathway is coupled to IMTG turnover.

CARBOHYDRATE PROVIDED IN DRINKS COMPARED TO GELS BETTER MAINTAINS HYDRATION STATUS AND ENDURANCE CYCLING PERFORMANCE IN THE HEAT DESPITE AD-LIBITUM WATER AVAILABILITY

REYNOLDS, K., MARKEY, K., HILLIER, Y., MEARS, S.A., JAMES, L.J.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Exogenous carbohydrate intake is recommended during exercise >60 min, with the format of delivery (i.e. gel vs drink vs bar etc.) not influencing the efficacy of the carbohydrate supplementation in temperate environments. During exercise in warm/hot environments, increased glycogen use, reduced gut blood flow and elevated sweat rates may make the format of carbohydrate delivery more important, particularly as there may be greater need to integrate fluid and

fuel strategies. Therefore, this study examined the effect of providing carbohydrate either in a gel or drink format on cycling endurance performance, gastrointestinal (GI) and fluid balance responses in a warm environment.

METHODS: Ten trained cyclists/triathletes (two females; 26 ± 6 y; 57 ± 9 ml/kg/min; 11 ± 4 h/week endurance training) completed VO2peak (22°C), full familiarisation and two experimental trials in 32°C. Trials involved 120 min at ~50% Wpeak (preload) and a ~15 min time trial (TT). Carbohydrate was provided every 20 min (72 g/h) either in the form of a DRINK (900 mL water/h males; 600 mL water/h females) or a GEL (12.4 mL water/h). In addition, water was available to consume ad libitum during the preload in both trials. Expired breath samples were collected at 60 and 120 min, with venous blood collected and GI symptoms measured at 0, 60, 120 min and post-TT. Plasma osmolality and volume, as well as concentrations of glucose, lactate, insulin, sCD14 and IFABP were measured in blood samples.

RESULTS: TT performance was faster in DRINK (848 ± 82 s vs 896 ± 121 s; P=0.027). There were no between-trial differences for GI temperature (Preload mean: GEL 37.90 ± 0.32°C; DRINK 37.80 ± 0.44°C; P=0.424), heart rate (Preload mean: GEL 145 ± 12 beats/min; DRINK 139 ± 11 beats/min P≥0.091), RPE (P=0.472), carbohydrate oxidation (P=0.313), GI comfort (P=0.664), or plasma concentrations of glucose (P=0.929), lactate (P=0.801), insulin (P=0.583), sCD14 (P=0.682) or IFABP (P=0.289). Sweat rate was not different between trials (P=0.651), but total fluid intake was higher in DRINK (2619 ± 720 mL vs 1363 ± 783 mL; P<0.001), despite higher ad-libitum water intake in GEL (1334 ± 783 mL vs 646 ± 606 mL; P=0.012). Thus, pre and post-TT hypohydration (pre-TT: GEL -1.0 ± 0.7%; DRINK 0.3 ± 0.9%; P=0.012; post-TT: GEL -1.7 ± 0.7%; DRINK -0.5 ± 0.8%; P=0.001) and plasma osmolality (pre-TT: GEL 292 ± 4 mOsmol/kg; DRINK 285 ± 5 mOsmol/kg; P=<0.001; post-TT: GEL 300 ± 4 mOsmol/kg; DRINK 293 ± 4 mOsmol/kg; P=<0.001) were higher in GEL.

CONCLUSION: During prolonged cycling in a warm environment carbohydrate provided in a drink format improved performance compared to carbohydrate provided in a gel. This was likely caused by the better maintenance of hydration status in the drink trial. This study demonstrates that, unlike during exercise in temperate environments, peri-exercise carbohydrate supplement format for endurance exercise (at least for cycling) might be an important factor in warm/hot environments.

Oral Presentations

OP-BM28 Applied Biomechanics

ACL RUPTURES IN COMPETITIVE SKIERS: BICEPS FEMORIS FASCICLE LENGTHS AND PENNATION ANGLES OF THE INJURED AND NON-INJURED LIMB SEVERAL YEARS FOLLOWING SURGERY

TILP, M., SCHRETTNER, A., KONRAD, A., KRUSE, A., FISCHER, J., MANIEU, J., HABERSACK, A.

UNIVERSITY GRAZ

INTRODUCTION: Even years following ACL surgeries, hamstrings show reduced muscle activity and strength which are risk factors for relapsing injuries. A recent meta-analysis by Sherman et al. (2021) additionally reported structural changes like reduced muscular volume, cross-sectional area, and muscle length. Only one study (Timmins et al. 2016) investigated possible differences in fascicle lengths of the biceps femoris between ACL-injured and non-injured limbs of athletes. Estimates based on extrapolating visible parts of fascicles from ultrasound images revealed reduced total fascicle lengths and increased pennation angles in ACL-injured legs of rugby players. As the extrapolation of visible fascicles to obtain fascicle length is problematic (Franchi et al., 2021), the aim of the study was to compare fascicle lengths and pennation angles of the biceps femoris between ACL-injured and non-injured limbs of athletes by using extended field of view (EFOV) ultrasound to overcome this shortcoming.

METHODS: Eight competitive skiers (2 males, 22.0 years, 173.6 +/- 5.7 cm, 69.6, +/- 6.7 kg) with a previous ACL surgery (4.1 +/- 3.4 years ago) gave their written confirmed consent to participate in the study. Biceps femoris fascicle lengths and pennation angles to the intermediate aponeurosis were measured in the ACL-injured and non-injured limb in a resting position using EFOV ultrasound (Aixplorer, Supersonic Imaging). Due to not normally distributed data, Wilcoxon tests were applied to test for possible differences between the ACL-injured and non-injured limb.

RESULTS: Pilot data analyses revealed no significant differences in biceps femoris fascicle architecture between the ACL-injured and the non-injured limb. Fascicle lengths were 9.71+/-2.47 cm for the ACL-injured and 9.68 +/- 1.30 cm (p=0.67) for the non-injured leg. Pennation angles were 8.03 +/- 1.92° for the ACL-injured and 10.65 +/- 0.53° (p=0.06) for the non-injured leg.

CONCLUSION: Four years following the ACL surgery, biceps femoris fascicle lengths and pennation angles were not significantly different between the ACL-injured and non-injured limb in competitive skiers. This result is in contrast to previous research that reported shorter fascicle lengths and greater pennation angles 3.5 years following an ACL surgery in rugby players (Timmins et al. 2016). Differences could be due to ultrasound fascicle measurement technique (Franchi et al., 2021) but also due to surgery technique, rehabilitation procedures, and/or participants characteristics. We recommend that future research should incorporate advanced 3D techniques and homogenous and stratified participant groups based on sex and surgical technique to thoroughly investigate potential structural alterations in fascicle architecture post-ACL surgery and their relation to functional deficits.

REFERENCES: 1) Sherman et al., Sports Med, 2021. 2) Timmins et al., Med Sci Sports Exerc, 2016. 3) Franchi et al., Med Sci Sports Exerc, 2019

SKIING CHARACTERISTICS ANALYSIS OF CROSS-COUNTRY SKIING SKATING TECHNIQUE USING KINEMATIC GNSS

UDA, S., MIYAMOTO, N., NAKANO, H., TAKEDA, M.
DOSHISHA UNIVERSITY

INTRODUCTION: In cross-country skiing, competitions, sub-techniques exist in both classical and skating styles. The most appropriate sub-techniques are selected according to the gradient of the track, snow conditions, skiing velocity, or the athletes own physical fitness, such as muscle power. Classification of sub-techniques throughout the course could enhance performance analysis of the athletes, in turn, improve training plan for individual athlete. In this study, we used a high-precision kinematic global navigation satellite system (GNSS) (sampling frequency 100 Hz) to identify sub-technique in skating and clarify the characteristics of each sub-technique such as velocity, cycle length, cycle frequency, and gradient used.

METHODS: Two subjects, an adult male skier and a junior high school male skier, were analyzed during a skating style time trial for 4.2 km. GNSS was attached to the skier's head. Three-dimensional positional data of latitude, longitude, and altitude of the head during the time trial were acquired from a GNSS, and identification was made based on the difference in waveform patterns of vertical and horizontal movements of the head for each sub-technique. The sub-techniques of skating were classified into four categories: V1, V2, V2a, and Turn, and waveform patterns other than the four were classified as others. The applied skiing technique, skiing velocity, and cycle time and cycle length, gradient used for each technique were analyzed using the GNSS data. Motion data during trial was taken by Go pro video camera (Go pro, Hero 9) followed by snow mobile (ski-doo), which was used to confirm match ratio (%Match) with GNSS data.

RESULTS: The %Match was high: 96.6% for V1, 98.2% for V2, 97.5% for V2a, 95.7% for Turn, and 97.1% in total. The percentage of each sub-technique used for all techniques was 25.8% for V1, 46.5% for V2, 14.3% for V2a, 13.3% for Turn 0.1% for others. The averages of skiing velocity, cycle time, cycle length, and gradient used for each sub-technique were calculated: for skiing velocity, V1: 4.05 m/sec, V2: 4.51 m/sec, V2a: 4.98 m/sec, and Turn: 5.01 m/sec; for cycle time, V1: 1.18 sec, V2: 1.09 sec, V2a: 1.41 sec, and Turn: 1.11 sec.; in cycle length, V1: 4.79 m, V2: 4.91 m, V2a: 7.10 m, and Turn: 5.55 m, in gradient used, V1: 2.71 degrees, V2: 1.01 degrees, V2a: -0.98 degrees, and Turn: -0.41 degrees.

CONCLUSION: Based on the results of our study, it is suggested that a high-precision kinematic GNSS can be applied for discriminate sub-technique and clarify the usage characteristics of each sub-technique such as velocity, cycle length, cycle frequency, and slope used during a skating style XCS race.

COMPARISON OF BIOMECHANICAL CHARACTERISTICS BETWEEN SPRINTERS AUTOREGULATORY SQUAT TRAINING AND TRADITIONAL SQUAT TRAINING

MEI, T., ZHANG, X., LI, J., LI, L.
BEIJING SPORT UNIVERSITY

INTRODUCTION: Autoregulatory Training (ART) can adjust training loads based on athletes training status. It includes Velocity Based Training (VBT) and Repetition in Reserve (RIR) based on subjective perception of fatigue (Rating of Perceived Exertion, RPE). However, there is limited research on the mechanical characteristics of these two methods. This study aimed to compare and analyze the biomechanical characteristics of sprinters in a single free squat training session using traditional Percentage-Based Training (PBT), RIR, and VBT, aiming to provide an individualized training load regulation protocol for sprinters.

METHODS: 18 male sprinters were recruited, and a randomized crossover experimental design was used for 3 randomized crossover squat training sessions (PBT, RIR, and VBT). Under an 80% 1RM load, the PBT group completed 5 sets of 5 repetitions each, the RIR group completed 5 sets of 5 repetitions each, with the load for the next set adjusted based on subjective feedback from the subjects, and the VBT group completed 5 sets of training, stopping each set when the speed decreased to 80% of the mean speed. Linear position sensors (Tendo) were used to collect mechanical indices (including Mean velocity (MV), Mean force (MF), Mean power (MP), Mean work (MW), Peak velocity (PV), Peak force (PF), Peak power (PP), Total work (TW), Mean load (ML), Mean repetitions (Reps), Total time under load (TUT), and Total time under load (sTUT)) and subjective perception (RPE) during the squat training. Performing data analysis using one-way analysis of variance (ANOVA).

RESULTS: (1) The VBT group had the fastest Mean velocity (MV) (PBT, VBT, and RIR MV: 0.53±0.05m/s, 0.58±0.05m/s, and 0.55±0.04m/s, respectively, $p<0.05$). The Peak velocity (PV) of the VBT and RIR groups was significantly faster than that of the PBT group (PBT, VBT, and RIR PV: 0.91±0.06m/s, 1.00±0.06m/s, and 0.97±0.06m/s, respectively, $p<0.05$). The Mean power (MP) of the VBT and RIR groups was significantly higher than that of the PBT group (PBT, VBT, and RIR MP: 729.39±61.23w, 800.72±82.64w, and 797.67±83.03w, respectively, $p<0.05$). The Repetitions (Reps) of the VBT group were lower than those of the PBT and RIR groups (PBT, VBT, and RIR Reps: 25.00±0.00, 24.06±0.73, and 25.00±0.00, respectively, $p<0.01$). No significant differences were found in other measurements among the three training groups. (2) There were no significant differences among the three groups in CTUT, but sTUT showed significant differences (PBT, VBT, and RIR sTUT: 61.41±2.74s, 54.68±2.04s, and 59.87±2.19s, respectively, $p<0.01$). (3) Compared to the PBT group, the RPE was lower in the VBT and RIR groups (PBT, VBT, and RIR RPE: 8.00±0.77, 7.44±0.51, and 7.72±0.67, respectively, $p<0.05$).

CONCLUSION: VBT and RIR demonstrated faster speed, greater power output, and lower subjective perception in a single free squat training session compared to traditional PBT. Additionally, their effects on time indices were different from PBT.

THE RELATIONSHIP BETWEEN FULLY TETHERED SWIMMING FORCE AND THE ESTIMATED MAXIMUM LOAD FROM SWIMMING LOAD-VELOCITY PROFILING

GONJO, T., LJØDAL, I., OLSTAD, B.H.

HERIOT-WATT UNIVERSITY

INTRODUCTION: Load-velocity profiling has been used to estimate the maximum swimming velocity (V0) and maximum load the swimmer can withstand (L0). Theoretically, L0 should be closely related to the fully tethered swimming force (Gonjo et al., 2021), which is an indicator of the ability to generate the propulsive force. However, this assumption has never been tested. Therefore, the aim of the present study was to investigate the relationship between L0 and the fully tethered swimming force.

METHODS: Thirteen male front crawl swimmers (19.14±2.46 years old, 1.838 ±0.072 m in height, 77.96±9.59 kg in body mass, and 652.31±117.66 World Aquatics point) performed a set of sprint semi-tethered swimming protocol consisting of three 25 m trials with three external loads, as well as three 10-second fully tethered swimming trials, in front crawl. Both semi-tethered swimming and fully tethered swimming sets were conducted with 1080 Sprint (1080 Motion, Lidingö, Sweden). The resistance load was set to 30 kg for fully tethered swimming trials. As this load was much higher than the typical estimated maximum load (about 22 kg) in front crawl swimming (Gonjo et al., 2021), this setting was deemed appropriate for the fully tethered swimming condition. In the fully tethered swimming trials, the first 2-3 seconds contained slight forward movement, presumably due to the large momentum from push-off. Therefore, this initial phase was excluded from the analysis. After trimming the data, the mean force value (FT) of the three fully tethered swimming outcomes was used for further analysis. L0 was estimated using the load-velocity profiling method, as described in Gonjo et al. (2021). The normality of data was checked using the Shapiro-Wilk test and confirmed for both L0 and FT. Therefore, the person's correlation coefficient was used to assess the relationship between the two variables with alpha = 0.05.

RESULTS: There was a significant correlation between L0 and FT (r=0.727, p=0.005). The inter-participant mean of FT was 155.77±27.49 N. When normalising this variable with the body mass, the inter-participant mean value was 1.99±0.19 N/kg, which was close to male competitive swimmers' data presented in a previous study which reported FT of 133.2±16.8 N with 70.4±6.3 kg body mass (Loturco et al., 2016).

CONCLUSION: In conclusion, L0 and FT are strongly related, which suggests that L0 is an indicator of a swimmer's ability to generate the propulsive force.

REFERENCES:

Gonjo T, Njøs N, Eriksrud O and Olstad BH (2021) The Relationship Between Selected Load-Velocity Profile Parameters and 50 m Front Crawl Swimming Performance. Front. Physiol. 12:625411. doi: 10.3389/fphys.2021.625411

Loturco I, Barbosa AC, Nocentini RK, Pereira LA, Kobal R, Kitamura K, Abad CC, Figueiredo P, Nakamura FY. A Correlational Analysis of Tethered Swimming, Swim Sprint Performance and Dry-land Power Assessments. Int J Sports Med. 2016 Mar;37(3):211-8. doi: 10.1055/s-0035-1559694. Epub 2015 Dec 15. PMID: 26669251.

Oral Presentations

OP-AP20 Sleep

SLEEP HABITS OF YOUNG FOOTBALL PLAYERS: CAN THE WEEKEND OFF HELP CATCH UP FROM SLEEP DEBT?

BARREIRA, J., BRITO, J.2, NAKAMURA, F.1, FIGUEIREDO, P.3,4,2

1: CIDESD, UNIVERSITY OF MAIA, PORTUGAL 2: PORTUGAL FOOTBALL SCHOOL-FPF, PORTUGAL 3: UNITED ARAB EMIRATES UNIVERSITY, UAE 4: CIDESD, VILA REAL, PORTUGAL

INTRODUCTION: Sleep is essential for the health and well-being of all individuals. However, the younger population appears more vulnerable to short sleep durations, most likely due to a combination of biological, psychosocial, and societal pressures that come together and compete with one another affecting sleep [1]. Thus, it is common for teenagers to adjust their sleep schedules during the weekends to "catch up" on their sleep debt from weekdays [2, 3]; however, this might not be possible for young football players since they play official matches on the weekends during the competitive period.

METHODS: Twenty-three highly trained young football players (mean ± SD; age: 17.3 ± 0.6 yrs) from the same U19 team were recruited. Sleep was objectively monitored using actigraphy devices for eight weeks, comprising two types of microcycles: normal (i.e., with an official match on the weekend) and off (i.e., with a weekend off, without matches). Linear mixed models were used to analyze the differences in sleep variables between microcycle type (normal vs. off) and night-type (weekday vs. weekend). Significance was set at $p<0.05$. Effect sizes from post-hoc analysis were calculated using Cohen's d (d).

RESULTS: Throughout the eight weeks, average total time in bed (TIB) was 505.1 ± 65.3 min, total sleep time (TST) 399.0 ± 63.7 min, sleep efficiency 78.9 ± 7.9%, and wake after sleep onset 98.3 ± 41.4 min. Average bedtime was at 23:48 ±

01:03, and wake-up at 08:18 ± 01:24. Eighteen (80%) players slept less than 7h on weekdays, independent of microcycle type. Sixteen (70%) players slept less than 7h on regular weekends, and seven (30%) players on off weekends.

A significant (p<.05) main effect of the microcycle type, night of the week, and an interaction between both were verified for TIB, TST, bedtime, and wake-up time, indicating that weekend sleep adjustments were dependent of playing a match or not. Weekends off presented higher TIB (+35.8 min, p=.0001, d= .32) and TST (+33.6 min, p<0.0001, d=.33), and later bedtimes and wake-up times (+48 min, p<.0001, d=.43; and +01.06h, p<.0001, d=.60; respectively) compared with regular weekends with a match. Similar TIB and TST were observed between weekday and weekend-nights of normal microcycles.

CONCLUSION: Young football players adopted a compensatory sleep behavior on weekends without competitive matches. Despite this behavior, it is questionable whether the observed increase in TST is sufficient to compensate weekdays sleep debt. Also, considering the importance of maintaining a regular sleep schedule, it is arguable whether this behavior is healthy, given the regular changes on sleep schedules between weekday and weekend nights.

Funding: This work was supported by the Portuguese Foundation for Science and Technology [2022.09446.BD] and [UIDB04045/2020].

REFERENCES:

1. Carskadon, M.A.: Pediatric Clinics of North America (2011)

2. Bartel, K.A. et al., Sleep Med Rev. (2015).

3. Fox, J.L. et al., Sports Med. (2020)

DO TRAINING LOADS OR MICROCYCLE DAYS INFLUENCE SLEEP PATTERNS? AN OBSERVATIONAL STUDY WITH YOUNG MALE FOOTBALL PLAYERS

CUNHA, L., BRITO, J.2, LASTELLA, M.3, FIGUEIREDO, P.4,5

1.CIDESD, UNIVERSITY OF MAIA, PORTUGAL; 2.PORTUGAL FOOTBALL SCHOOL, FPF, PORTUGAL; 3.CENTRAL QUEENSLAND UNIVERSITY, AUSTRALIA ; 4.UNITED ARAB EMIRATES UNIVERSITY, UAE; 5.CIDESD, VILA REAL, PORTUGAL

INTRODUCTION: Training loads and daily schedules are referred to as relevant sports factors that influence athletes sleep [1]. Yet, data examining training loads or daily schedules in young football players is scarce. Therefore, this study aimed to describe the sleep habits and needs of young football players, analyzing the differences between microcycle days and the influence of training/matches workloads.

METHODS: The study included 60 young male football players with a mean age of 16.3 ± 1.4 years old. For two weeks, the players wore a 3-axial accelerometer during sleep, filled out sleep diaries, and answered the question "how many hours of sleep do you need to feel rested?". A difference of 1h or more between sleep needs and sleep duration was considered sleep deficit [2]. Training/matches external workloads were monitored using 10-hz GPS devices. Linear mixed models were used to examine the differences between sleep duration and sleep efficiency between training (TD), match (MD), and rest days (RD). Within-subjects correlations were tested between sleep duration, sleep efficiency and training/matches external workload metrics (total distance, high-speed running distance, and sprinting distance).

RESULTS: : On average, players obtained 8.1 ± 1.5 hours of sleep duration, had a sleep efficiency of 83 ± 7% and reported needing 8.8 ± 0.9 hours of sleep. Twenty-seven athletes (45%) slept less than 8 hours per night, thirty-six (60%) had a sleep efficiency below 85%, and fifteen (30%) had a sleep deficit. Regarding the differences on sleep between microcycle days, players slept 8.0 ± 1.5 hours and had 83 ± 7% sleep efficiency on training days, 7.6 ± 1.5 hours and 83 ± 9% on match days, and 8.5 ± 1.3 hours and 84 ± 6% on rest days. There was a trivial main effect for microcycle days on sleep duration (F=3.1, p=0.04, ηp2= 0.009), but not on sleep efficiency (p=0.78). No associations were found between sleep duration/efficiency and external workload metrics (p>0.05).

CONCLUSION: The results of this study revealed that one-third of the players presented a sleep deficit, and two-thirds had a sleep efficiency below 85%. It appears there were trivial to no differences between the microcycle days on sleep duration and sleep efficiency. Also, external training/match workloads throughout the microcycle were unrelated to sleep duration and efficiency

References:

1. Walsh, N.P. et al., British journal of sports medicine, (2020).

2. Sargent et al., Int J Sports Physiol Perform, (2021).

Funding: This work was supported by the Portuguese Foundation for Science and Technology [UI/BD/151482/2021 and UIDB04045/2020].

HIGH LEVELS OF POST-SLEEP FATIGUE AND POOR SLEEP QUALITY ARE ASSOCIATED WITH INSUFFICIENT SLEEP IN FOOTBALL PLAYERS

FIGUEIREDO, P.1,2,3, CUNHA, L.2, BARREIRA, J.2, NAKAMURA, F.Y.2, LASTELLA, M.4, BRITO, J.3, MARQUES, E.A.5,2

1: UNITED ARAB EMIRATES UNIVERSITY, UAE, 2: CIDESD, PORTUGAL, 3: PORTUGAL FOOTBALL SCHOOL-FPF, PORTUGAL, 4: CENTRAL QUEENSLAND UNIVERSITY, AUSTRALIA, 5: UNIVERSITY OF KALBA, UAE

INTRODUCTION: Sleep is recognised as an essential component of athletic performance and recovery. Research on the sleep requirements of football players is scarce (1,2), revealing that athletes typically obtain less sleep than their self-

assessed needs. This highlights a need to research how daily objective sleep data, factors related to training demands and sleep patterns impact sleep. This study aimed to compare the self-assessed sleep needs of football players with daily objective measures of sleep duration and to explore the relationship between daily fatigue, external workloads and sleep habits with sleep insufficiency.

METHODS: For 2 weeks, 72 football players (19 females; 19.5 ± 4.4 years old) wore an accelerometer to measure sleep duration and efficiency and reported daily pre- and post-sleep perceived fatigue and sleep quality using a Likert scale (1: very, very low/poor; to 7: very, very high/good). Total distance during training/matches (external workloads) was measured using GPS devices. The players answered the question, "how many hours of sleep do you need to feel rested?". A daily sleep index was calculated by subtracting sleep duration from individual self-assessed sleep needs. A difference of 1 hour or more indicated insufficient sleep (1). Sleep quality index was measured using the Pittsburgh Sleep Quality Index (PSQI), daytime sleepiness with the Epworth Sleepiness Score, and chronotype with the Morningness-Eveningness Questionnaire. Differences between sleep needs and sleep duration were analyzed using a linear mixed model. A generalized mixed-effects regression tree was applied using the daily sleep index (sufficient sleep vs insufficient sleep) as the outcome variable.

RESULTS: Players reported an average subjective sleep need of 8.4 (min-max: 6-11) hours and slept an average sleep duration of 8.2 (min-max: 5.5-10.3) hours ($p < 0.001$). The prevalence of insufficient sleep was 25% (157 out of 619 recorded nights), with 48 (67%) of players having at least one night of insufficient sleep. The generalized mixed-effects regression tree revealed daily post-sleep fatigue and sleep quality (PSQI) as the significant factors associated with daily sleep insufficiency. Also, those with high to very, very high daily post-sleep fatigue (> 5) had a higher prevalence of insufficient sleep than those with average to very, very low daily post-sleep fatigue (≤ 5). Among those with average to very, very low post-sleep fatigue (≤ 5), having poor sleep quality (PSQI >5) was associated with a higher prevalence of insufficient sleep.

CONCLUSION: Daily post-sleep fatigue and sleep quality (PSQI) were selected as explanatory variables of daily sleep insufficiency. These results highlight that monitoring post-sleep fatigue can be used to track athletes obtaining insufficient sleep, which can negatively affect performance, recovery, and health.

ACKNOWLEDGEMENTS:

FCT project UIDB04045/2020

REFERENCES:

1. Sargent et al., Int J Sports Physiol Perform, 2021

2. Figueiredo et al., 28th ECSS, 2023

ENHANCING SLEEP QUALITY IN PROFESSIONAL RUGBY PLAYERS: ASSESSMENT AND INTERVENTION

GOLDBERG, M., BOUTIN, A., COHN, J., MICHEL, V., STAUFFER, E., DEBARNOT, U.
UNIVERSITÉ LYON 1

INTRODUCTION: Sleep is a crucial factor in recovery and must be integrated into athletes training plans for optimal performance and well-being1. Although professional athletes are advised to sleep for a minimum of 8 hours1, many experience shorter sleep durations or exhibit poor sleep efficiency, especially after matches or hard training cycles2,3. Recent sleep tracking observations in athletes suggest that sleep quality is altered, yet this emerging field of research requires comprehensive assessments, including objective and subjective sleep outputs. To improve sleep quality, sleep interventions have been recently tested with various modalities, including among others, sleep hygiene education and sleep strategies. Importantly, combinations of sleep interventions have been shown to improve sleep quality in young elite athletes 3,4. Therefore, across match weeks, this ecological study aimed to identify good and poor sleepers within a professional male rugby team, using both objective and subjective assessments, and to evaluate the effects of sleep interventions, including sleep hygiene education and strategies.

METHODS: Forty-three male professional rugby players from national French rugby union were evaluated during two tracking and intervention match weeks using objective and subjective assessments (i.e., actimeter and Hooper questionnaire). During the first tracking week, we assessed the wake-sleep cycle of athletes who maintained their daily habits. Then, two sleep experts reported the results from the tracking phase in a group setting context and offered an educational session on sleep hygiene (30 min). Sleep experts further taught them how to practice relaxation strategies (15 min), which they could implement as needed during the post-intervention week.

RESULTS: Our findings revealed that 65 % of players were considered bad sleepers. Subjective sleep quality improved between the tracking and the intervention weeks ($p = 0.002$, $\eta 2 = 0.22$). A significant effect of the sleep hygiene intervention was also found on bedtime ($p = 0.005$, $\eta 2 = 0.19$), which occurred earlier during the intervention week (23:25 ± 00:38 vs. 23:43 ± 00:44 during tracking). A trend towards significant increases in objective (actimetric) sleep quantity was also observed (421.3 min during tracking week vs. 433.4 min during intervention week; $p = 0.07$, $\eta 2 = 0.08$).

CONCLUSION: The first main finding revealed that a majority of professional rugby players did not sleep sufficiently, which extends previously reported results from different sports1,2,3,4. The second main finding demonstrated that sleep interventions improved sleep quality and quantity. This study offers a simple and accessible method for evaluating sleep status in team sports athletes, while providing feedback to optimize and enhance sleep quality and quantity.

1Walsh et al., 2021 2Leduc et al., 2020 3Vachon et al., 2023 4Pasquier et al. 2023

POSITIVE SLEEP OUTCOMES ASSOCIATED WITH INCREASED MORNING AND DAYTIME LIGHT EXPOSURE IN ELITE TEAM SPORT ATHLETES

STEVENSON, S., SUPPIAH, H., RUDDY, J., MURPHY, S., DRILLER, M.
LA TROBE UNIVERSITY

INTRODUCTION: Light exposure techniques have been recommended to combat sleep issues caused by disruption to circadian regularity in the athletic population, although no studies have measured light exposure and sleep outcomes in an elite athlete setting.

METHODS: A total of 17 professional male Australian Football athletes (age ± SD: 22 ± 3 years) wore a wrist actigraph to measure sleep parameters, and a wearable light sensor to measure melanopic equivalent daylight illuminance (mEDI, in lux) for 14 days. Participants completed three sleep questionnaires at the end of the data collection period and completed wellbeing surveys 6 times. The Sleep Regularity Index (SRI) for each player was also calculated from actigraphy data. Light exposure data were organised into three different timeframes; morning (wake time + 2 hours), daytime (end of morning to 6 pm), and evening (2 hours leading up to bedtime) for analysis.

RESULTS: Higher morning light was associated with significantly ($p < 0.01$) greater total sleep time ($r = 0.26$). Higher daytime light exposure was associated with higher subjective sleep quality ($r = 0.48$, $p < 0.05$). Higher evening light exposure was associated with higher ASSQ global scores ($r = 0.52$, $p < 0.05$), and lower sleep efficiency ($r = -0.25$, $p < 0.01$). There were no other significant correlations between light exposure and sleep or wellbeing measures ($p > 0.05$).

CONCLUSION: Higher morning and daylight exposure levels were associated with various positive objective and subjective sleep measures in professional team sport athletes, supporting the need for education on optimising light exposure to improve circadian function, sleep, and health.

Oral Presentations

OP-PN31 Physiology/Mixed Session II

CARDIORESPIRATORY AND NEUROMUSCULAR RESPONSES TO SINGLE-LEG ECCENTRIC CYCLING: EFFECT OF PEDAL CADENCE AND BLOOD FLOW RESTRICTION

DUFOUR, S.P.1, MAVROPALIAS, G.2,3, SCOTT, B.R.3, HASELER, L.4, NOSAKA, K.3
1 UNIV STRASBOURG, FRANCE 2 EDITH COWAN UNIV, AUSTRALIA 3 MURDOCH UNIV, AUSTRALIA 4 CURTIN UNIV, AUSTRALIA

INTRODUCTION: Eccentric (ECC) cycling allows greater mechanical load to be achieved despite lower metabolic demand [1] and induces different acute cardiorespiratory and neuromuscular responses than those observed during conventional concentric (CON) cycling [2-3]. The present study aimed to determine how pedal cadence and blood flow restriction (BFR) to the exercising limb affect acute cardiorespiratory, vascular and neuromuscular responses to ECC cycling.

METHODS: Healthy males (n=10, 38±10y, BMI 24.0±2.5) completed 4 sessions over 4-wk. The first two sessions were used to familiarize the participants to procedures including single leg (SL) ECC cycling, maximal voluntary knee extensor isometric strength (MVC) and microvascular function tests (MVF) based on vastus lateralis (VL) oxygenation response to 5-min arterial occlusion/reperfusion. In addition, SL-CON cycling sprint power for 10-s at 20- and 60-rpm were measured. The following two visits consisted of 15 bouts of 40-s SL-ECC cycling at 25% SL-CON sprint power, with 20-s passive cycling recovery. One leg cycled with BFR (60% of arterial occlusion pressure) while the other cycled without (non-BFR). Cardiorespiratory function (indirect calorimetry and telemetry), VL oxygenation (near infra-red spectroscopy) and electromyographic activity (EMG) were continuously recorded. Blood lactate (BL), MVC and MVF were assessed before and after exercise. Two-way repeated measures ANOVAs were performed to test for cadence and BFR effects on the measures. All data are expressed as mean ± SD and a significant level was set at $p<0.05$.

RESULTS: Mean power output was higher ($p<0.001$) at 60- (133±23W) than 20-rpm (57±11W) without difference between BFR and non-BFR conditions. Oxygen uptake (+58%), heart rate (HR, +15%), pulmonary ventilation (+28%) and breathing rate (BR, +25%) were greater during exercise at 60-rpm than 20-rpm ($p<0.05$). VE (+20%) and BR (+13%) were higher ($p<0.05$) in the BFR than non-BFR condition, while HR tended to be higher (+6%, $p=0.066$) with BFR than non-BFR. VL oxygenation was 6% lower at 60- than 20-rpm and also reduced by 16% in BFR compared to non-BFR condition (cadence effect $p<0.01$, BFR effect $p<0.001$). Post-exercise BL was not significantly altered by cadence but was 38% higher ($p<0.05$) in the BFR than non-BFR condition. There was no significant cadence nor BFR effects on EMG activity, MVC and MVF tests.

CONCLUSION: These data suggest greater acute cardiorespiratory and muscle metabolic challenges when ECC cycling is performed at faster pedal cadence with BFR. Therefore, combining faster pedal cadence and BFR might be a useful strategy to enhance cardiorespiratory and muscle metabolic training stimuli for future chronic studies exploring the functional benefits of ECC cycling in clinical and athletic populations.

1. Dufour et al. Am J Physiol Regul Integr Comp Physiol. 2007

2. Barreto et al. J Sports Med Phys Fitness. 2023

3. Isner-Horobeti et al. Sports Med. 2013

SD was supported by a grant from Region Grand Est, France

RELATIONSHIP BETWEEN HEART RATE KINETICS IN THE MODERATE INTENSITY DOMAIN OF EXERCISE WITH RESTING HEART RATE VARIABILITY IN NORMAL WEIGHT PERSONS AND PERSONS WITH GRADE I OBESITY

ACEITUNO PINTO, H., CANO-CAPPELLACCI, M., OPAZO-DÍAZ, E., YUMHA, M.J., AMADOR, P.
UNIVERSIDAD DE CHILE

INTRODUCTION: Recently, it has been reported in young, trained males and males with obesity that in the moderate intensity domain of exercise, heart rate (HR) kinetics exhibit a slow component, distinct from oxygen uptake, which reaches a steady state at intensities below ventilatory threshold 1 (VT1). The functional significance of the slow component in at moderate intensity is unclear. The autonomous nervous system (ANS) is known to be the principal modulator of HR during exercise. Therefore, the aim of this study is to establish the relationship between HR variability, representing the ANS, and the HR kinetics in moderate intensity domain in normal weight persons and persons with grade 1 obesity.

METHODS: Sixteen persons with grade I obesity (OB) of 27 ± 4 years old and sixteen age-matched normal weight persons (NW) were recruited. All volunteers visited the laboratory on two non-consecutive days. On the first day, resting HR variability was measured, and an incremental test was conducted to determine VT1. HR variability assessment involved calculation of low frequency (LF), very low frequency (VLF) and high frequency (HF) power and the ratio LF/HF. On second day, subjects performed three transitions from unloaded cycling to 70% of the load associated with VT1. HR was measured during each transition. HR kinetics were determined for each participant following the procedure described by Zuccarelli et al. (2018). One of three possible models: mono-exponential, biexponential, and exponential+linear) were fitted to the HR data. The frequency of each model in each group was compared using chi-squared analysis. Comparisons between groups were made using the Mann-Whitney test, and Spearmans test was used to establish correlations between variables. Statistical significance for all tests was set at $p \leq 0.05$.

Zuccarelli, L. et al. (2018). Comparison between Slow Components of HR and V&O2 Kinetics. Medicine & Science in Sports & Exercise, 50(8), 1649–1

RESULTS: In the OB group, the frequency of HR kinetics with mono-exponential, biexponential, and exponential+linear models was 2, 10, and 4, respectively, whereas in NW group was 2, 12, and 2, respectively, with no significant differences in frequency between groups ($p = 0.65$). Significant differences between NW and OB groups were found in baseline HR ($p = 0.018$) and time delay ($p = 0.001$). Significant correlations were observed in the OB group between baseline heart rate and LF (Rho = -0.51) and LF/HF (Rho = -0.46). In the other hand, in the NW group, significant correlations were observed between fundamental HR and LF (Rho = 0.42) and VLF (Rho = 0.47).

CONCLUSION: NW and OB persons exhibit similar HR responses to constant load moderate exercise, and not all subjects exhibit the HR slow component. Parameters of heart rate variability are related differently with heart rate kinetics parameters in OB and NW groups. Further studies could focus on identifying factors that determine the type of heart rate response to moderate exercise intensity.

VITAMIN D SUFFICIENCY IS ASSOCIATED WITH BETTER VASCULAR IMPROVEMENTS AFTER HIGH INTENSITY INTERVAL TRAINING IN HEALTHY ADULT MALES

CHEN, L.Y., WANG, C.W., CHEN, L.A., HE, C.S.
NATIONAL CHUNG CHENG UNIVERSITY

INTRODUCTION: Cardiovascular disease (CVD) stands as a primary contributor to global mortality. Arterial stiffness has been established as an independent risk factor for both CVD and mortality. Peripheral pulse wave velocity (pPWV) serves as an indicator of arterial stiffness and represents a significant risk factor for CVD. Previous research has demonstrated an association between vitamin D deficiency and arterial stiffness (1). Prior study has indicated that high intensity interval training (HIIT) can effectively improve arterial stiffness (2). However, the impact of HIIT training on individuals with different levels of vitamin D remains unclear. The primary objective of this study was to compare different vitamin D status on vascular function following two weeks HIIT in healthy adults.

METHODS: Forty-three adult males were divided into the 25(OH)D sufficient group (n=29, vitamin D≧50 nmol/L) and deficient group (n=14, vitamin D <50 nmol/L). The maximal graded exercise was performed using on upright bikes an incremental cycling test to exhaustion. The training intervention consisted of two weeks of high intensity cycling training, five days/week, consisting of 10 × 1 min bouts at 90% of HRpeak with 1 min rests. The pPWV and blood pressure (BP) were measured at baseline, on the mid-training, and post-training. The pPWV and BP variables were subjected to a two-way analysis of variance (ANOVA). Subsequent to identifying significant interaction and main effects, post hoc comparisons were conducted using t-test analysis. Changes in mean arterial pressure (MAP) and pPWV during HIIT were assessed using the area under the curve (AUC) method based on the trapezoidal rule, followed by a t-test on AUC values between groups. The accepted level of significance was set at $p < 0.05$.

RESULTS: Baseline characteristics showed no significant differences, except for vitamin D concentrations. Both the vitamin D sufficient and deficient groups exhibited a significant reduction in pPWV ($p < 0.05$). The vitamin D sufficient group showed a significant lower systolic BP at post-HIIT compared with deficient group (116.17 ± 11.39 vs 120.25 ± 11.22 mmHg). The sufficient group demonstrated a significant reduction in systolic BP at post-HIIT compared to baseline (122.59 ± 13.65 vs 116.17 ± 11.39 mmHg). In addition, AUC for both pPWV and MAP in vitamin D sufficient group was significantly smaller

than deficient group ($p < 0.05$). There were no significant changes in systolic BP between the baseline and post-HIIT training in the vitamin D deficient group ($p > 0.05$).

CONCLUSION: In this study, we found that adults with 25(OH)D sufficiency have a better vascular function improvement after two weeks of HIIT. People with sufficient vitamin D status may experience better vascular vasodilation and blood pressure reduction during each high-intensity training session.

1. Chen, L. Y., et al. Nutrients, 14(15), 3074. (2022)

2. Hasegawa, N., et al. Med Sci Sports Exerc 50(6), 1177-1185. (2018)

SKELETAL MUSCLE SIGNATURE OF ELITE MASTER ENDURANCE RUNNER WITH THALASSEMIA – A CASE STUDY

STRELECKY, M., SEDLIAK, M., BERISHA, G., ORESKÁ, L., BUZGO, G., CERNÁCKOVÁ, A., OKULIAROVA, M., ZEMAN, M., KERN, H., ZAMPIERI, S., PIETRANGELO, L., PROTASI, F.

FACULTY OF PHYSICAL EDUCATION AND SPORTS COMENIUS UNIVERSITY

INTRODUCTION: Thalassemia is a type of inherited hemoglobinopathy resulting in reduced ability to produce haemoglobin. Depending on a type of thalassemia, endurance performance may be negatively affected but there is lack of evidence in master athletes. We had a unique opportunity to examine not only performance and blood parameters but also skeletal muscle characteristics of an elite male master marathon runner who placed second at the World championship in the age category 75-79 years and won all the World Marathon Majors between 2013 and 2019.

METHODS: A 79-year-old Caucasian male (body height 168.2 cm, body mass 59.5 kg, BMI 21 kg/m2) with hereditary form β-thalassemia voluntarily participated in this study. The data were collected throughout the 3 weeks. During the first week, maximal isometric voluntary contraction (MVC) of the knee extensors and incremental laboratory exercise test to on a bicycle ergometer for VO2max were performed. During the second week, the subject was instructed to maintain his habitual daily activities. During the third week on Tuesday, the subject underwent a blood sampling procedure and muscle biopsy for histological analyses. All data were compared to earlier results from our laboratory.

RESULTS: As expected, blood count showed abnormalities in hemoglobin values (106 g/l, reference range (r.r.) 135-172 g/l), haematocrit (0.33% r.r. 0.42-0.52%), MCV (64.2 fl, r.r. 84-98) and MCH (20.7 pg r.r. 28-34), Serum iron concentration, its binding capacity, ferritin, and transferrin were within the normal range. Histology - the individual´s mean myofiber diameter values (58.60 ± 13.92 μm) very similar to that observed in young adult, and higher in comparison to that observed in aged-matched sedentary elderlies. The two type-groupings refer to reinnervation events and circulating levels of C-terminal agrin fragment as a biomarker of neuromuscular junction destabilization was lower than in aged matched sedentary elderlies (5623 pg/ml vs 6350,7 pg/ml). Electron microscopy - the high mitochondria number (more than doubled if compared to sedentary seniors of the same age) was not accompanied by a parallel marked increase in their volume and a small average size of these organelles is reported. Taken together these factors suggests that possibly mitochondria are undergoing active fission processes. In bilateral knee extension and flexion, the MVC values were 138.2 Nm and 34.91 Nm/kg, respectively. The predicted VO2max value was 44.3 ml/kg/min.

CONCLUSION: Despite the thalassemia and impaired parameters of blood count, the performance and muscle tissue quantitative and qualitative measures were well preserved in the elite master marathon runner. Moreover, analysed muscle tissue was in several aspects more similar to young men than to the subjects' age-matched sedentary counterparts.

The study was supported by the Slovak Research and Development Agency (grant no. APVV-21-0164).

EXERCISE MODE INFLUENCES THE ACUTE EXPRESSION OF GILZ WITHIN SKELETAL MUSCLE

PAUL, S., DONATH, L., HOPPSTAEDTER, J., HECKSTEDEN, A.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: The glucocorticoid induced leucin zipper (GILZ) is a protein originally described as an anti-inflammatory regulator of gene expression in lymphatic tissue (1). Since then, expression of GILZ has been identified in a variety of tissues. This includes skeletal muscle where it has anti-myogenic effects and mediates the well-known muscle-related side effects of glucocorticoids but also of statins (1). Interestingly, recent evidence suggests that GILZ expression is also regulated by physical exercise with muscular, as opposed to cardiocirculatory strain, being the decisive factor (2). To verify these seminal findings, we performed a retrospective analysis of datasets from acute exercise trials published in Gene Expression Omnibus (GEO).

METHODS: We conducted a systematic search of the GEO repository for gene expression studies reporting the acute effects of either endurance, conventional resistance, or eccentric resistance exercise. Gene expressional data was required to be quantified either via micro array or high throughput sequencing techniques. Only studies on healthy adults were eligible. Additionally, muscle biopsies must have been obtained acutely (3-6h) post exercise. Within-trial robust scaling of raw data was used to account for variation between trials. ANOVA and post hoc testing were used to compare changes in GILZ expression from pre- to post-exercise between groups.

RESULTS: A total of 14 studies and 258 subjects (213 male; 45 female) could be included into the analysis. Activity level ranged from sedentary to endurance trained, and the age of examined individuals ranged from 18 to 90 years (35.2 ± 2.8 [mean ± SD]). Eccentric exercise resulted in the greatest downregulation of GILZ (- 0.56 ± 0.92 [AU]), closely followed by

resistance exercise (- 0.46 ± 1.07 [AU]), and little change in GILZ expression was observed with endurance exercise (- 0.1 ± 0.93 [AU]).

CONCLUSION: Our results support the hypotheses that mechanical strain is a key mediator of training induced changes in GILZ expression. It is noteworthy that this result has been obtained despite the substantial differences in age, level of habitual exercise, and exercise dose across studies.

1. Hoppstaedter J, Valbuena Perez JV, Linnenberger R, et al. The glucocorticoid-induced leucine zipper mediates statin-induced muscle damage. FASEB J. 2020;34(3):4684-4701. doi:10.1096/fj.201902557RRR

2. Hecksteden A, Hoppstaedter J, Bizjak DA, et al. Effects of acute exercise and training status on glucocorticoid-induced leucine zipper (GILZ) expression in human skeletal muscle. J Sci Med Sport. 2023;26(12):707-710. doi:10.1016/j.jsams.2023.10.007

Oral Presentations

OP-SH02 Psychology

A QUALITATIVE STUDY OF RETIRED FEMALE ATHLETES LIVED EXPERIENCES PERTAINING TO COACHING PRACTICES AND THEIR RECOMMENDATIONS FOR FEMALE-SPECIFIC COACH EDUCATION PROGRAMS

AUSLAND, Å., TORSTVEIT, M.K., IVARSSON, A., KNIGHT, C.J., SOLSTAD, B.E.

UNIVERSITY OF AGDER

Introduction: Sports coaching is a pivotal factor in the development and success of athletes, yet a noticeable knowledge gap in coach education programs specifically tailored for coaching of female athletes still exists. This qualitative study explored the lived experiences of retired elite female athletes to inform the development of female-specific coach education programs. By delving into the perspectives of these elite athletes, the purpose of the present study was to identify areas for improvement in coaching practices and content for future coach education programs.

Methods: In-depth interviews were conducted with retired elite female athletes (n=8) representing diverse sporting backgrounds, including both team and individual sports. All participants had represented Norway at the elite level in their sports, respectively, including the Olympic Games and World Championships. These interviews explored athletes lived experiences, preferences, and recommendations pertaining to coaching practices and the needs of female-specific coach education programs. Reflexive thematic analysis was used to analyse the collected data.

Results: The interviews revealed several recurring themes concerning coaching of female athletes. Notably, athletes emphasized the importance of coaches understanding of the biological, psychological, and social (biopsychosocial) needs of female athletes. Specifically, biological aspects of injuries and the menstrual cycle was underpinned by their own experiences as well as experiences of peer athletes that did not make it to the elite level. Effective communication also emerged as a key aspect of coaching, with athletes highlighting the significance of coaches who actively listened and responded to their needs. Furthermore, there was a consensus among the athletes regarding the necessity for coach education programs to be tailored specifically to the requirements of coaching female athletes. The interviews also provided more nuanced insights into the attributes of exemplary coaches as well as areas where coaching practices could be further improved.

Discussion: The findings underscore the critical need for coach education programs that are addressing the distinct coaching needs of female athletes. By incorporating insights from retired elite athletes, such as the importance of understanding females' biopsychosocial needs, future coach education programs can better prepare coaches to support and empower this overlooked group of athletes. Addressing these key areas for improvement will not only benefit individual coaches, but also contribute to the overall athletic participation, development, and performances of female athletes in sports.

Conclusion:These lived experiences of retired female athletes provide valuable insights for establishing the needs of coaches who are coaching female athletes, thereby providing important steps toward developing a biopsychosocial coach education program for improved coaching of female athletes.

SHELTER ME FROM THE STORM: AN ATTACHMENT PERSPECTIVE ON INDIVIDUALS' RELATIONSHIP WITH THEIR SPORTING ACTIVITIES.

WILLEGERS, M., WOODMAN, T.

BANGOR UNIVERSITY

Objective: We aimed to develop and validate new attachment scales to explore the degree to which individuals use their attachment to sporting activities to compensate for insecure attachments in close interpersonal relationships – the Compensatory Hypothesis.

Design: At present, there is no scale that captures the support that human-nonhuman attachments provide according to Bowlbys notion of an attachment and exploratory behavioural system. In Study 1 we developed such a scale to test the Compensatory Hypothesis in Study 2.

Methods: We sampled 286 participants through online surveys (Facebook, Instagram). In Study 1, we used Bayesian Structural Equation Modelling in Mplus to analyse the model fit of the four-factor Relationship Attachment Support Scale (RASS; safe haven, secure base, proximity maintenance, and separation distress) and the six-factor Relationship Exploratory Support Scale (RESS; security in exploration, emotion regulation, personal reflection, development, self-expression, and self-esteem). In Study 2, we used PROCESS to explore the degree to which individuals use their attachment to sporting activities to compensate for insecure attachments in interpersonal relationships – the Compensatory Hypothesis.

Results: We found excellent model fit (ppp >.05, factor-loading >.4) and psychometric properties for the RASS and RESS across both activity and interpersonal relationships. In Study 2, we used these scales to test the Compensatory Hypothesis. Moderation analysis revealed that the emotion regulation transfer benefits of individuals activity attachments significantly (p <.05, R2 = .03 - .1) reduced the negative relationship between insecure interpersonal attachment and wellbeing.

Conclusion: These results provide valuable insight into the emotion regulation role of activity attachments for individuals who suffer from insecure interpersonal attachments and the broader application of the RASS and RESS.

A MULTI-STAGED INVESTIGATION OF FEARS OF COMPASSION IN COMPETITIVE SPORTS

MICHALCZYK, M., ZHANG, S., MCEWAN, K., SHEFFIELD, D.

UNIVERSITY OF DERBY

Background: To date, research has demonstrated the wide benefits of compassionate minds in sports, such as adaptive psychophysiological responses to stress, greater mental well-being, and superior coping under challenging performance scenarios. However, barriers still exist when incorporating compassion in competitive sports (e.g. fear of losing personal standards), which requires further research attention. As such, we aimed to gain an in-depth understanding of fears of compassion in athletes and its manifestations in sports by adopting a multi-staged investigation consisting of focus groups and 1-1 interviews.

Method: We recruited 18 competitive athletes (Mean age = 23.3, SD = 2,8; 44.4 % of male) and assigned them randomly to one of the three initial focus groups (i.e., the exploratory stage). We then conducted 1-1 semi-structured interviews (i.e., the confirmatory stage) with each participant. Reflexive thematic analysis (RTA) was performed to understand the fears of compassion in sports.

Results: We identified 3 main themes with 2 subthemes for each main theme. Theme 1 unveiled the context-specific nature of fears of self-compassion in competitive sports, with two emerging subthemes namely compassion during sports performance and compassion as an 'aftermath'. Theme 2 reflected the social dynamics of fears of compassion, with two emerging subthemes namely fear of giving compassion and fear of receiving compassion. Theme 3 uncovered the impact of sports cultures on fears of compassion, with two emerging subthemes namely team sport culture and individual sport culture.

Discussion: Fears of self-compassion in competitive sports appeared to be context-specific. Athletes tended not to use compassion during performance but would likely adopt it afterwards as there is 'no time' to think about adopting a self-compassionate mind during performance. Fears of giving compassion to other athletes appeared to be dependent on the extent to which they know the person(s) and their skill level. More specifically, athletes said they are keen to offer compassion to athletes they know well, however are fearful of giving compassion to athletes with a 'higher rank' than them. Similarly, the extent to which one feared receiving compassion from others appeared to depend on the 'source' or 'origin' of compassion. That is, athletes reported a greater level of acceptance and lower level of fear when they received compassion from coaches compared to their teammates. Lastly, fears of compassion were perceived differently in individual vs team sports due to the varied challenges and cultures that offer unique fears.

Conclusion: Fears of compassion in competitive sports are context-specific and rooted in the social dynamic in sports and performance settings. Perhaps a state fears of compassion in sports scale is needed for a more comprehensive assessment of such fears to inform assessment, monitoring, and evaluation processes when implementing compassion in sports.

EFFECTIVENESS OF MOTIVATIONAL STRATEGIES IN A 12-WEEK SUPERVISED EXERCISE PROGRAM ON PHYSICAL AND WELL-BEING OUTCOMES IN OLDER ADULTS: PRELIMINARY FINDINGS FROM THE PRO-TRAINING PROJECT

GÓMEZ-REDONDO, P.1,2,3, MARTÍNEZ-DE-QUEL, O.6,7, VALENZUELA, P.4,5, MORENO-MANZANARO, D.1,2,3, CEREZO ARROYO, M.1,2,3, ALEGRE, L.1,2,3, GUADALUPE GRAU, A.1,2,3, ARA, I.1,2,3, MAÑAS, A.1,2,3,8,9

1 GENUD TOLEDO RESEARCH GROUP, FACULTY OF SPORTS SCIENCES, UNIVERSITY OF CASTILLA-LA MANCHA, TOLEDO, SPAIN. 2 CIBER ON FRAILTY AND HEALTHY AGING, INSTITUTO DE SALUD CARLOS III, MADRID, SPAIN. 3 INSTITUTO DE INVESTIGACIÓN SANITARIA DE CASTILLA-LA MANCHA (IDISCAM), JUNTA DE COMUNIDADES DE CASTILLA-LA MANCHA (JCCM), SPAIN. 4 PHYSICAL ACTIVITY AND HEALTH RESEARCH GROUP (PAHERG), RESEARCH INSTITUTE OF HOSPITAL 12 DE OCTUBRE (IMAS12), MADRID, SPAIN. 5 DEPARTMENT OF SYSTEMS BIOLOGY, UNIVERSITY OF ALCALÁ, MADRID, SPAIN. 6 DIDACTICS OF LANGUAGES, ARTS AND PHYSICAL EDUCATION DEPARTMENT, FACULTY OF EDUCATION, COMPLUTENSE UNIVERSITY OF MADRID, 28040 MADRID, SPAIN. 7 FACULTY OF SCIENCES FOR PHYSICAL ACTIVITY AND SPORT (INEF), POLYTECHNIC UNIVERSITY OF MADRID, 28040 MADRID, SPAIN. 8 CENTER UCM-ISCIII FOR HUMAN EVOLUTION AND BEHAVIOR, 28029 MADRID, SPAIN 9 DIDACTICS OF LANGUAGES, ARTS AND PHYSICAL EDUCATION DEPARTMENT, FACULTY OF EDUCATION, COMPLUTENSE UNIVERSITY OF MADRID, 28040 MADRID, SPAIN

INTRODUCTION: Integrating motivational strategies within exercise programs may enhance physical and well-being outcomes in older adults (1), although their actual effectiveness remains unclear. This study aimed to analyze the effect of motivational strategies during a supervised exercise program on physical and well-being outcomes in individuals aged 60-75 years.

METHODS: This work is part of the PRO-Training project (NCT05619250). A sample of 72 participants (69.1 ± 4.2 years old) was randomly allocated into 3 groups: 1-Control, 2-Supervised exercise without motivational intervention (SUP), 3- Supervised exercise with motivational intervention (SUP+). Over 12 weeks, supervised groups engaged in a multicomponent exercise program 3 times per week, while the control group maintained their usual lifestyle. Motivational intervention was based on the self-determination theory, including strategies such as phone calls, interactive workshops, motivational messages, informative infographics, and videos. Physical outcomes included upper-body (30-seconds biceps curl test) and lower-body (5-repetition [5-STS] and 30-second [30-STS] sit-to-stand tests) strength. Well-being involved health-related quality of life assessed using the visual analog scale (EQ-VAS). Outcomes were assessed at baseline and after 12 weeks. Statistical analyses included multivariate analysis of variance and Bonferroni post-hoc tests for parametric variables, and Kruskal-Wallis for nonparametric variables. Results are change from baseline, presented as mean ± SD change.

RESULTS: Significant benefits were observed for SUP+ (2.6 ± 1.6 repetitions, p=0.013) and SUP (1.9 ± 2.6 repetitions, p=0.013) compared to the control group (-0.4 ± 2.5 repetitions) in the biceps curl test. Although no significant differences were found between SUP+ and SUP for any outcome, additional benefits were observed for SUP+ -but not SUP- over the control group for 5-STS (-1.6 ± 1.2 vs. -0.6 ± 0.7 seconds, respectively, p=0.05), 30-STS (3.4 ± 3.1 vs. 1.4 ± 2.4 repetitions, respectively, p=0.021), and EQ-VAS (6.6 ± 13.3 vs. -4.1 ± 16.3 scores, respectively, p=0.035).

CONCLUSION: Motivational strategies appear to maximize the benefits on health-related quality of life and muscle strength during a 12-week supervised training program in older adults. However, further research with larger sample sizes is warranted to confirm these findings.

REFERENCES:

(1) Marcos-Pardo, P. J., Martínez-Rodríguez, A., & Gil-Arias, A. (2018). Impact of a motivational resistance-training programme on adherence and body composition in the elderly. Scientific Reports, 8(1), 1370.

A COMPARATIVE STUDY OF GOAL ORIENTATIONS, SELF-DETERMINED MOTIVATION, NEEDS SATISFACTION, AND COACH-ATHLETE RELATIONSHIP QUALITY BETWEEN ADOLESCENT ATHLETES WHO DISCONTINUED PARTICIPATION AND THOSE WH

LIU, Z., NEVILLE, R.D.

UNIVERSITY COLLEGE DUBLIN

Background. Numerous systematic reviews have reported a link between adolescent athletes' intentions to continue or drop out of competitive sports and factors such as goal orientations, levels of self-determined motivation, satisfaction of basic needs, and their relationship with their coach. However, there remains limited evidence regarding the differences in means for these crucial psychosocial factors between adolescent athletes who have discontinued participation in competitive sports and those who remain active, thus constituting the primary aim of this study.

Methods. A cross-sectional research design was applied. 78 athletes (mean age 22.6 ± 0.8, 42% female) were recruited from an international Rugby Football Union database in Ireland and responded to an online questionnaire administered through Microsoft Forms. The measures employed in this study have demonstrated acceptable reliability and validity in previously published investigations. Data were analysed using multivariate analysis of variance in SPSS Version 27. Differences between groups were standardised to a Cohen's d value and the resulting effect sizes were evaluated using the following scale: <0.2, slight; 0.2 to <0.6, small; 0.6 to <1.2, moderate; ≥1.2, large. The level of evidence for each effect was assessed by interpreting the uncertainty and range of values within its 95% confidence interval (CI).

Results. The final sample consisted of 65 athletes who continued participating in rugby and 13 who discontinued. There was clear evidence that the mean value representing commitment with one's coach was lower for athletes who continued compared to those who dropped out (Cohen's d, -0.63, 95%CI, -1.22 to -0.33). Further, there was some evidence that the

mean value representing amotivation was higher for athletes who continued to drop out (0.47, -0.13 to 1.07). There was some evidence that complementarity with one's coach was lower for athletes who continued (-0.43, -1.03 to 0.17). Differences between athletes who continued and those who dropped out in closeness with their coach, task-related and ego-related goal orientations, and each of the three facets of basic needs satisfaction (i.e., the need for autonomy, competence, and relatedness) had 95%CIs that were too wide to provide useful evidence.

Interpretation. Consistent with theoretical predictions, our findings provide some evidence of a difference in the degree of self-determined motivation between athletes who continued and those who had dropped out, with the latter reporting higher levels of amotivation. Somewhat diverging from theoretical expectations, our study revealed that commitment to and complementarity with ones coach were lower among athletes who continued. This suggests that dropout among the athletes in this sample might be attributed directly to changes in coaching personnel and the opportunity to engage in competitive rugby elsewhere under the guidance of a specific coach (e.g., in another country).

Oral Presentations

OP-AP19 Swimming

POSTPONING EARLY MORNING TRAINING FOR SWIMMERS – THE EFFECT ON SLEEP, PERFORMANCE AND FATIGUE

BRANDTS, M., SKORSKI, S., MEYER, T.

SAARLAND UNIVERSITY

INTRODUCTION: Previous research has shown that swimmers sleep less prior to early morning training compared to a rest day (Sargent et al., 2014). Whether sleep can be extended by postponing the early morning training has not been investigated thus far. Moreover, it is unclear which effect this might have on performance and perceived fatigue. Therefore, the aim of the current study was to assess the effect of postponed morning training on sleep, performance and perceived fatigue in swimmers.

METHODS: Employing a randomized cross-over design, this study involved twenty-seven national level youth swimmers (13F, 14M; age: 16 ± 1 y) participating in two 8-day training camps. For the duration of the camp, training commenced at 7 a.m. (early training: ET) or at 9 a.m. (late training: LT). Sleep was measured daily using the ActiGraph wGT3X-BT (ActiGraph LLC, Pensacola, FL, USA) alongside a sleep diary. Perceived fatigue was recorded daily using the Short Recovery and Stress Scale for Sport. Performance assessments, comprising 100 m and 800 m all-out tests, were conducted at the start (Pre) and end (Post) of each training camp. The effect of postponed early morning training on sleep duration and perceived fatigue was analyzed using multilevel linear modeling, while performance outcomes were assessed using a two-way analysis of variance (ANOVA).

RESULTS: Sleep duration was significantly greater in ET compared to LT. (ET: 6.9 ± 0.7 h vs. LT: 7.9 ± 0.7 h; mean difference (md): 1.0 ± 1.7 h; $P < 0.001$; $\eta 2p = 0.27$). No significant intervention x training camp interaction effect was observed for 100 m performance ($F(1,20) = 0.72$; $P = 0.41$; $\eta 2p < 0.01$) or 800 m performance (F-(1,20) = 0.02; $P = 0.88$; $\eta 2p < 0.01$). However, perceived stress was significantly lower (ET: 3.4 ± 1.0; LT: 2.5 ± 0.9; med: -0.9 ± 2.5; $P < 0.001$; $\eta 2p = 0.13$) and perceived recovery significantly higher (ET: 2.7 ± 0.8; LT: 2.9 ± 0.7 ; md: 0.2 ± 2.0; $P = 0.027$; $\eta 2p = 0.01$) in LT compared to ET.

CONCLUSION: Postponing early morning training by 2 hrs is associated with extended total sleep time and improved perceived fatigue, but does not have an acute effect on performance. However, it could be speculated that extending sleep might be important in the long-term, considering the importance of perceived fatigue and sleep loss in the development of functional overreaching (Hausswirth et al., 2014).

References:

Hausswirth, C., Louis, J., Aubry, A., Bonnet, G., Duffield, R., & Le Meur, Y. (2014). Evidence of Disturbed Sleep and Increased Illness in Overreached Endurance Athletes. Medicine & Science in Sports & Exercise, 46(5), 1036-1045. https://doi.org/10.1249/mss.0000000000000177

Sargent, C., Halson, S., & Roach, G. D. (2014). Sleep or swim? Early-morning training severely restricts the amount of sleep obtained by elite swimmers. European Journal of Sport Science, 14(sup1), S310-S315. https://doi.org/10.1080/17461391.2012.696711

STRENGTH TRAINING AND CONDITIONING LEADING TO A WORLD RECORD AT THE 2023 FUKUOKA WORLD CHAMPIONSHIPS: A CASE STUDY OF HAIYANG QIN

SHU, Y., CHENG, Y.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: This study investigates the influence of strength training and conditioning on specialized swimming techniques, focusing on Haiyang Qin, an elite Chinese male breaststroke swimmer. Spanning from 2022 to 2023, a critical period in Haiyangs career, it examines the interplay between his physical training, rhythmic training, and physiological adaptations. The aim was to elucidate how these factors synergistically contributed to his success in winning gold medals in the 50m, 100m, and 200m breaststroke events, thereby offering valuable insights into competitive swimming training.

METHODS: The study employed the following methods: (1) Training session analysis: A comprehensive examination of both aquatic and land-based training regimens, including specific swimming training and perceived exertion ratings (RPE) reported by coaches and athletes, along with monitoring of blood biochemical markers. (2) Functional testing and morphological changes: Regular assessments were carried out to evaluate morphological indicators and physical capabilities such as power and strength (Vertical Jump and Pull-up Test), speed (30 Metre Sprint Test), coordination (Y-Balance Test) and endurance (3 km Run Test). (3) Competition technical analysis: A systematic comparison was made of Haiyang Qins technical performance at the Fukuoka Championships with his previous results, with a focus on biomechanical changes and performance enhancements.

RESULTS: (1) High-intensity land-based training sessions (RPE: 8.4±0.9) exhibited a significant correlation with physiological markers such as testosterone levels. Additionally, significant changes in morphology were observed, particularly in chest circumference (101cm to 107cm) and weight (84kg to 93kg). (2) Increases in strength, core stability, agility, and power output led to significant improvements in Vertical Jump and Y-Balance Tests. (3) Specific-swimming performance showed significant enhancements, including a 7.1% increase in stroke rate in the 100m event and a 3.8% increase in stroke length in the 200m event during the Fukuoka Championships.

CONCLUSION: The findings indicate that a multi-approach strength training and conditioning program enhances the athletic physique, lower limb strength, and coordination. These improvements played a vital role in Haiyang Qins technical adjustments, resulting in his outstanding performance at the Fukuoka World Championships. The study highlights the potential benefits of a multi-approach physical training program for swimmers, providing valuable insights for coaches and athletes.

THE RELATIONSHIP BETWEEN TRUNK STRENGTH AND TURN TIME IN 400 M FREESTYLE FOR SWIMMING ATHLETES

ZHONG, J., GAO, H., ZHANG, C., WANG, D.
SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Turn time (TT) plays a crucial role in competitive swimming performance. Its proportion in freestyle races spanning from 100 m to 1500 m ranges between 19.69% and 36.87% [1]. The longer the distance is, the more important TT. Of which, 400 m freestyle requires athletes to have both speed and endurance, and a large number of turns can be analysed. Rotation is the main phase of the turn in swimming. It involves entire body movement around the transverse and longitudinal axes [2]. This necessitates engagement of the trunk muscles to facilitate swift and smooth rotations. Therefore, this study aimed to investigate the correlation between trunk strength and TT in 400 m freestyle among swimming athletes.

METHODS: Thirteen regional swimming athletes (8 males: 18.63 y, 185.75 cm, 75.88 kg and 5 females: 16.6 y, 169.2 cm, 55.7 kg), whose average best records were 91.71% (male) and 86.86% (female) of the world records respectively, participated in the 400 m freestyle test. Data include total TT, single 15 m-turn (5 m-in: the time from 5 m to wall contact; plus 10 m-out: the time of 10 m after wall contact) in 7 turns for each participant. Trunk strength was assessed during flexion and extension using an isokinetic dynamometer (IsoMed-2000) at speeds of 60°/s and 180°/s, and bilateral trunk rotation was measured at speeds of 90°/s and 150°/s. Pearson correlations were computed between TT parameters and trunk isokinetic peak torque (PT).

RESULTS: Pearson correlation showed significant negative correlations between total TT and trunk flexion ($r = -0.61$, $P = 0.027$) and extension ($r = -0.575$, $P = 0.04$) PT at 60°/s respectively. Similarly, strong to very strong correlations were observed for trunk rotation at 90°/s and 150°/s (left: $r = -0.737 \sim -0.77$, $P = 0.002 \sim 0.004$; right: $r = -0.659 \sim -0.686$, $P = 0.01 \sim 0.014$). Besides, the correlations from the first turn to the last turn gradually increased every single 15 m-turn, significantly in flexion 60°/s (from $r = -0.56$ to -0.639), left rotation 90°/s and 150°/s (from $r = -0.646$ to -0.8), and right rotation 90°/s and 150°/s (from $r = -0.547$ to -0.782). The higher correlation of left than right side may be caused by the habit of each participant's rotation. After splitting the TT to 5 m-in and 10 m-out, the total 5 m-in time was negatively correlated with bilateral rotation in both 90°/s and 150°/s ($r = -0.56 \sim -0.644$, $P = 0.018 \sim 0.046$). However, the total 10 m-out time was correlated with flexion (60°/s and 180°/s), extension (60°/s), and bilateral rotation in both 90°/s and 150°/s ($r = -0.601 \sim -0.806$, $P = 0.003 \sim 0.001$).

CONCLUSION: The findings suggest that (1) trunk flexion, extension, and bilateral rotation strength are strongly correlated with TT; (2) the higher correlation of left than right may be caused by habitual turning direction; (3) this correlation may strengthen as the distance increases; (4) the correlations were higher in 10 m-out phases than 5 m-in phases.

REFERENCE: [1] Polach et al. 2021. [2] Puel et al. 2023.

ADVANCING ARTISTIC SWIMMING BIOMECHANICS AND OFFICIATING THROUGH MEDIAPIPE-BASED ANALYSIS OF THE BALLET LEG TECHNIQUE.

EDRISS, S., CAPRIOLI, L., BONAIUTO, V., ANNINO, G.
TOR VERGATA UNIVERSITY

INTRODUCTION: In certain sports, such as Artistic Swimming (AS), the evaluation of player performance and the assessment of penalties are linked to the jury. This requires players to execute their routines within the lateral purview of the referees. In addition, deviations from specific AS techniques contribute to point deductions through penalties. Prompt and precise deviation monitoring is an important requirement. Such monitoring aids coaches in strategic planning during the training sessions, and guides referees to monitor this matter. However, technology benefits in AS are generally limited,

and decisions were principally made by on-site judges who observed the performances live. This study introduces a marker-less Python-based MediaPipe system to recognize body elements, focusing on the Ballet Leg technique to measure deviations and assess swimmers biomechanics. In this technique, the deviation is defined as a leg angle that is either more or less than 90°, indicating whether the leg is oriented vertically or not relative to the horizontal plane, and more degree deviations, reduce more points. The scoring scale in penalty measurement of one leg execution is that the deviation up to 15 degrees reduces 0.2 points, between 15 to 30 degrees reduces 0.5 points, and over 30 degrees deducts 1 point. Validation involves comparing results with the suggested method via Kinovea software (Version 0.9.5, USA) in 2D AutoCAD 2019 (Autodesk, Inc.) as the gold standard method in this project.

METHODS: Twenty AS athletes, with an average age of 15±2 and over 3 years of experience, executed a Ballet Leg technique during training sessions. Two GoPro9 recordings, positioned 2 meters laterally from the swimmers at the pool edge with one camera placed 30 cm under and the other 25 cm above the water surface, captured the swimmers performance. The peak performance deviation was measured using MediaPipe, Kinovea, and 2D AutoCAD. The data similarity was measured by analyzing deviation angles between the two software and the gold standard by calculating the correlations using Orange3 Software.

RESULTS: The statistical analysis revealed strong correlations between the measurements obtained using MediaPipe and the gold standard (Pearson correlation coefficient = 0.92, RMSE = 2.3). Plus, the comparison of Kinovea with the gold standard demonstrated an even higher correlation (Pearson correlation coefficient = 0.99) and a notably lower RMSE score (0.6), indicating a high level of accuracy in the Kinovea kinematic measurements.

CONCLUSION: The results obtained through MediaPipe demonstrate similarity with the gold standard, establishing its capability to evaluate AS techniques including Ballet Leg. Particularly, its real-time and offline deviation calculation capabilities surpass the limitations of manual alternatives like Kinovea. While technology usage is limited in official AS officiating, coaches can get the benefits of MediaPipe to access accurate biomechanics-designed data and receive quick and precise feedback.

A STUDY ON THE ABILITY TRANSFER OF CHINESE SWIMMERS IN SINGLE MIDDLE AND SHORT DISTANCE EVENTS

SHANG, M., CHENG, Y.
BEIJING SPORT UNIVERSITY

INTRODUCTION: According to statistics, the number of medals in the four strokes of 50m, 100m and 200m accounts for 77% of the medals at the World Championships. Swimmers usually excel in 1-2 of these distances, and outstanding swimmers are able to achieve all-around development by excelling in 3 distances. However, it is rare for top swimmers to achieve excellence in a single event at 50m, 100m and 200m distances and win medals in all of them. At the 2023 World Championships, Chinas breaststroke swimmer Qin Haiyang achieved a historic achievement in the 50m, 100m and 200m breaststroke events, creating a trio of titles. At the same World Championships, Kaylee McKeown dominated the backstroke events, winning all three titles. These achievements highlight the fact that competing and excelling in multiple events has become a new competitive trend. This study delves into the migration of Chinese swimmers ability to compete in a single short- and middle-distance event, and promotes multi-event participation and multidimensional skill enhancement in swimmers, which is believed to enhance the overall competitiveness and depth of talent in the sport.

METHODS: The search results were analyzed on China Knowledge and Google Scholar using the keywords "swimming ability", "transfer learning" and "multisport development", combined with interviews with Chinese swimming team coaches and researchers. The results were analyzed.

RESULTS: During the period 2016-2023, two Olympic Games and four World Championships were held. In the 2016 Rio Olympics, there were six champion-cum-athletes; in the 2017 Budapest World Championships, there were 12 champion-cum-athletes; in the 2019 Gwangju World Championships, there were 13 champion-cum-athletes; in the 2021 Tokyo Olympics, there were 14 champion-cum-athletes; in the 2022 Budapest World Championships, there were 17 at the 2022 World Championships in Budapest; and 17 at the 2023 World Championships in Fukuoka. As of February 2024, there are 17 times in the history of the World Championships in the 50-100-200 meters can achieve both medals, of which the number of athletes in the 2019 and 2023 World Championships in the 50-100-200 meters at the same time to win medals are three, which reflects that in recent years the swimming world of the ability of athletes to participate in multiple events in the level of training to obtain a greater improvement. In particular, Chinas Luo Xuejuan, Zhang Yufei and Qin Haiyang were among the 17 people mentioned above. In terms of strokes, there are 6 breaststroke, 4 freestyle, 3 backstroke and 1 butterfly, reflecting that breaststroke is easier to migrate in ability. 2023 World Championships at the same time, there are 2 people at the same time to take the small event Grand Crown.

CONCLUSION: The study of kinematic characteristics, departure and stroke kinetics characteristics, energy metabolism characteristics, and specialized fitness characteristics of short- and middle-distance swimmers is the key to solving the synergistic develop

Oral Presentations

OP-AP18 Sprint Training

DOES THE SELECTION OF RESISTANCE FOR LIGHT LOAD RESISTANCE RUNNING TRAINING NEED TO BE PERSONALIZED

GUO, Q., YUAN, T.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Resistance running(RS) is widely recognized as the most commonly used and effective method to enhance speed performance and overcome speed barriers in sprint training. Some studies have employed body mass (bm) as a benchmark, revealing that varying percentages of body mass as resistance yield different training effects. For instance, 12.5%bm RS enhances high-speed acceleration phases. Another study utilized 10%bm, 30%bm, and 50%bm for resistance running training, suggesting that faster and stronger athletes may require relatively heavier resistance to attain their training goals. This study investigates resistance ranging from 1% to 10%bm, aiming to determine if athletes with different physical characteristics benefit from personalized resistance for achieving specific training goals within this range.

METHODS: Twenty-nine elite track and field athletes participated in this study, comprising 18 male and 11 female athletes. All athletes underwent the same warm-up procedure, followed by a squat 1RM test and a 30m sprint test without resistance （T-133 timing system，eliga，china）on the same day. Within one week of the initial test, the athletes engaged in resistance running training（T120-sprint training device，eliga，china）. The resistance was set between 1%-10% of the athletes body weight(bw), and the 30m times were recorded, above test excluding reaction time. Linear regression analysis was conducted using SPSS software to assess the impact of gender, weight, and relative strength (squat 1RM/body weight) on the rate of speed decline.

RESULTS: The average time for the 30m sprint without resistance was recorded at 3.835 seconds, with a standard deviation of 0.123 seconds. The average relative strength was measured at 2.100, with a standard deviation of 0.251, and the average rate of speed decline was found to be 15.37%, with a standard deviation of 3.613%. For female athletes, the average 30m sprint time was 4.087 seconds, with a standard deviation of 0.133 seconds; the average relative strength was 1.818, with a standard deviation of 0.217; and the average rate of speed decline was 21.281%, with a standard deviation of 6.679%.Linear regression analysis revealed that resistance as a percentage of body weight, within the range of 1%-10% (B=1.635, $p<0.01$), and gender (B=0.079, $p<0.01$) significantly influenced the rate of speed decline. However, relative strength (B=-0.048, p=0.144) and the finish time for the sprint without resistance (B=-0.110, p=0.074) did not show a significant effect on the rate of speed decline.

CONCLUSION: The findings of this study indicate that in resistance running training, when the load is below 10% of body weight (bw), the trend of speed decline is roughly similar across athletes of different strength levels as resistance increases. However, gender and the amount of load are significant factors affecting the rate of speed decline, with female athletes experiencing a slightly higher rate of decline compared to male athletes. This suggests that when des

THE EFFECTS OF COMBINED RESISTED AND MAXIMUM VELOCITY SPRINT TRAINING ON THE SPRINT PERFORMANCE OF TEAM SPORT PLAYERS

WARD, C., Ó CATHÁIN, C., NÍ CHÉILLEACHAIR, N., KELLY, D.T.

TECHNOLOGICAL UNIVERSITY OF THE SHANNON, ATHLONE, IRELAND.

INTRODUCTION: The development of acceleration and maximum velocity (MV) sprint performance are key goals for field-based invasion team sport (FITS) coaches. Resisted sprint training (RST) has been shown to be an effective method for improving acceleration performance when using a broad range of loading magnitudes [1], yet there are concerns regarding the potential of 'very heavy' loaded RST to negatively impact MV performance [2]. Alternatively, flying sprints are used by coaches when targeting MV improvements [3]. However, no research has investigated the efficacy of a concurrent RST and maximum velocity sprint training (MVST) protocol. This study aimed to determine the effectiveness of a combined RST and MVST approach on the in-season acceleration and maximum velocity performance of FITS players.

METHODS: Elite level, male hurling players were assigned to an experimental group (EG) (n=21) or a control group (n=19). In addition to their regular training, the EG performed two sessions (1 x RST, 1 x MVST) per week for 8 weeks, while the control group performed unresisted sprinting (5-20m repetition distance range). RST was performed with a 50% Vdec load and a constant repetition distance of 15m, while MVST consisted of 8-12m flying sprints with a 25m build-up phase. Sprint, strength, and jump performance were measured at 1-week pre and post intervention.

RESULTS: The EG displayed significant small within-group (pre to post) improvements in 5m (d = 0.57) and 10m (d = 0.44) split times, and MV (d = 0.35), while a significant moderate increase in SLJ performance (d = 0.89) was also found. A significant decrease in reactive strength (d = 0.42) and increase in relative strength (d = 0.53) were detected for the CG. Finally, there were significant time effects for first step flight time (FT) (p = 0.004) last step FT (p = 0.035), and the 10-20 m split time (p = 0.018).

CONCLUSION: Performing a weekly combination of very-heavy RST and MVST across an 8-week in-season training block can yield improvements in both early acceleration and MV sprint performance. Additionally, study findings dampen previ-

ous concerns regarding the potentially negative impact of heavy-loaded RST on MV. Our study highlights the utility of this RST (using 8 sleds) and MVST approach within FITS settings, integrated prior to collective in-season sports training using a short 20-minute time slot.

RELATIONSHIPS BETWEEN LOWER LIMB MUSCLE VOLUME, MUSCLE STRENGTH AND SPRINT PERFORMANCE IN ELITE ATHLETES

GIROUX, C.1, MACCHI, R.1, PIECUCH, L.2, HEGYI, A.3,4, HOLLVILLE, E.1, MATEUS, D.2, FORNASIER- SANTOS, C.1, SLAWINSKI, J.1, MORIN, J.B.5, LACOURPAILLE, L.4, COUTURIER, A.1, NORDEZ, A.4, RABITA, G.1, GUILHEM, G.1

1. FRENCH INSTITUTE OF SPORT, SEP, EA 7370, PARIS, FRANCE 2. ÉCOLE CENTRALE NANTES, LS2N, UMR CNRS 6004, NANTES, FRANCE 3. HUNGARIAN UNIVERSITY OF SPORTS SCIENCE, BUDAPEST, HUNGARY 4. NANTES UNIVERSITÉ, MIP, UR 4334, NANTES, FRANCE 5. LIBM, JEAN-MONNET UNIVERSITY, SAINT-ETIENNE, FRANCE

INTRODUCTION: High-speed running is fundamental to perform in various sports. Muscle morphological (volume) and functional characteristics (strength) are recognized to be associated with sprint performance [1,2] and seem to influence sprint force-power-velocity (FPV) relationship [3]. This study aimed to identify the relationships between sprint maximal velocity (Vmax), theoretical maximal power (Pmax) and force (F0) derived from the sprint FVP profiles, and lower limb muscle characteristics including volume inferred from automatized MRI scans segmentation in elite athletes.

METHODS: Seventy-two athletes (33 women, 39 men, age: 24.3 ± 3.3 years, height: 1.77 ± 0.09 m, mass: 74.2 ± 12.9 kg) of rugby 7, track and field, and bobsleigh performed two 40-m sprints. Vmax and FVP relationship were assessed using radar-based velocity measurements. F0 and Pmax were calculated from the FPV relationship. Maximal isometric (MVC) and eccentric (ECC) torque, and rate of torque development (RTD) were assessed during hip, knee and ankle extension and flexion (except for ankle).

The volume of 18 lower limb muscles including gluteus, quadriceps, hamstrings and adductors groups was automatically extracted from Magnetic Resonance imaging (MRI) using Deep Learning method [4] for 24 athletes (14 women and 10 men).

Multiple linear regressions (Forward method) were conducted to identify significant predictors of Pmax, F0 and Vmax (dependant variables) from the functional characteristics and then the 18 muscle volumes (independent variables).

RESULTS: Vmax exhibited significant correlations with the volume of the vastus intermedius (VI), gluteus minimus (Gmin), biceps femoris short head (BFsh) and semitendinosus (ST) muscles ($r2 = 0.62$, $P < 0.05$). Pmax showed significant correlations with VI, BFsh, gluteus maximus (Gmax) and ST volumes ($r2 = 0.70$, $P < 0.05$) whereas F0 showed significant correlations with VI and Gmax volume ($r2 = 0.58$, $P < 0.05$).

Furthermore, Vmax was significantly correlated with plantar flexor RTD and hip flexor MVC ($r2 = 0.20$, $P < 0.05$) whereas Pmax and F0 were both significantly correlated with plantar flexor RTD and knee flexor MVC ($r2 = 0.18$ and $r2 = 0.13$, respectively, $P < 0.05$).

CONCLUSION: This study shows that a significant part of sprint performance variability could be explained by hip flexors and knee extensors muscle volume. Joint strength testing seems also to partly explain sprint performance. Hip extensor and knee flexor muscles could be targeted in training programs to maximize sprint performance. While these findings are consistent with previous studies [1,5,6], they suggest to further explore the relationship between muscle morphology, functional capacity and sprint performance, particularly for thigh muscles.

REFERENCES:

1.Miller et al., 2021, MSSE

2.Bellinger et al., 2020, MSSE

3.Rabita et al., 2015, Scand J Med Sci Sports

4.Piecuch et al., 2023, in Shape in Medical Imaging

5.Takahashi et al., 2021, PlosOne

6.Takahashi et al., 2024, Sport Biomech

EFFECTS OF LOW-VOLUME COURT-BASED SPRINT INTERVAL TRAINING ON AEROBIC CAPACITY AND SPORT-SPECIFIC ENDURANCE PERFORMANCE IN COMPETITIVE TENNIS PLAYERS

LIU, H.1,2, YANG, W.1, LI, Q.1,2, POON, E.T.3, HO, I.M.K.4,5, LIU, H.1, BAO, D.1, GUO, Y.1, LI, Y.1

1 BEIJING SPORT UNIVERSITY;2 UNIVERSITY OF LIMERICK; 3 THE CHINESE UNIVERSITY OF HONG KONG;4 TECHNOLOGICAL AND HIGHER EDUCATION INSTITUTE OF HONG KONG;5 ASIAN ACADEMY FOR SPORTS AND FITNESS PROFESSIONALS;

INTRODUCTION: Sprint interval training (SIT) is a potent exercise strategy to enhance athletes aerobic capacity in a time-efficient manner. The purpose of this study was to examine the effect of a low-volume court-based SIT program on aerobic capacity and sport-specific endurance performance for competitive tennis players.

METHODS: Sixteen competitive collegiate tennis players were randomly assigned to the SIT (court-based repeated-sprint training) and traditional endurance training (ET; 45-min continuous treadmill running) groups for a 6-week intervention (3 sessions/week). The maximal oxygen uptake (VO2max), minute ventilation at peak exercise (VEmax), ventilatory anaerobic threshold in percentage of VO2max (VT/VO2), and elimination rate of blood lactate (BLAer) were assessed, whereas the

Yo-Yo Intermittent Recovery Test Level 2 (YoYo-IR2) and the tennis-specific HIT&TURN test were conducted at baseline and after the intervention.

RESULTS: Both SIT and ET showed significant improvements in VO2max ($p < 0.01$) with moderate effect sizes (ES=0.64 and 0.98, respectively), as well as in VEmax ($p < 0.01$) with small effect sizes (ES=0.23 and 0.21, respectively), and VT/VO2 ($p < 0.01$) with large effect sizes (ES=2.37 and 3.85, respectively). The BLAer improved significantly in SIT (ES=1.03; $p < 0.05$) whereas no significant changes occurred in ET. The magnitude-based decision showed a clear and superior improvement in both YoYo-IR2 (ES=0.69) and HIT&TURN (ES=1.72) tests in SIT than ET.

CONCLUSION: Compared with traditional ET, court-based SIT can be a time-efficient strategy to improve aerobic capacity and tennis-specific endurance without requiring specialized equipment for competitive tennis players.

COMBINATION OF WEIGHT REDUCTION AND HYPOXIA ON PSYCHOPHYSIOLOGICAL RESPONSES TO A HIGH-INTENSITY EXERCISE IN ATHLETES: PRELIMINARY DATA

CHAMBION-DIAZ, M., PIALOUX, V., BILLAUT, F.

UNIVERSITÉ CLAUDE BERNARD LYON 1, LYON, FRANCE & UNIVERSITÉ LAVAL, QUÉBEC, CANADA

INTRODUCTION: The AlterG treadmill allows weight reduction during running, which lowers mechanical stress. This tool therefore has great potential applications in return from injuries and to maximize training benefits under lower mechanical stress in healthy athletes. However, there is no strong evidence regarding the beneficial effect of AlterG running on athlete's physical performance. Moreover, reducing mechanical load might potentially decrease physiological stress and subsequent adaptations. Hypoxia is well known to increase metabolic stress and may thus offer a countermeasure to optimize the benefits from weightless running in varied training scenarios. To date, there is no study examining physiological responses to such training strategy. The aim of this study is to verify the feasibility of combining running with body weight reduction and hypoxia during high-intensity interval exercise, and characterize the psychophysiological responses to such exercise-environment combination.

METHODS: Twenty-two participants volunteered for the project, but only three (2 men, 1 woman, age:24.6 years, height:168.3cm, weight:66.7kg, VO2max:62ml/min/kg) completed the protocol to date. Participants completed a high-intensity interval training (HIIT) session on an AlterG treadmill in the following 5 experimental conditions in randomized order: normoxia at 100% body weight (BW); normoxia at 80% BW; normoxia at 60% BW; hypoxia ($FIO2 = 14\%$) at 80% BW; hypoxia at 60% BW. The HIIT session included 3 sets of 8 repetitions of 30 seconds of effort performed at 110% of the maximum aerobic speed, interspersed with 30 seconds of passive recovery. During the session, heart rate (HR), pulse arterial O2 saturation (SaO2), muscle deoxyhemoglobin (HHb) concentration and rate of perceived exertion (RPE) were continuously recorded. Blood lactate concentration was measured post-session.

RESULTS: Weight reduction by AlterG increased SaO2 by 3% and reduced both HR by 27bpm and RPE by 2.4 points compared to control ($p<0.05$). When hypoxia was added, SaO2 was reduced by 9 to 13% compared to the 3 other conditions in normoxia with varied weights. HR was lower in all conditions compared to control ($p<0.05$). RPE was higher in hypoxia by 1 point compared to the 2 other conditions in normoxia and weight reduction ($p<0.05$). Hypoxia increased [HHb] by 21 mmol compared to the 2 other conditions in normoxia and weight reduction ($p<0.05$). There was no significant difference in [lactate] at the end of the effort across conditions ($p=0.08$).

CONCLUSION: These preliminary data suggest that mechanical load and hypoxia differently modulate psychophysiological responses to high-intensity exercise in a different way. Further analyses will allow us to confirm these initial observations and to ascertain whether biological sex mediates these phenotypic responses.

Oral Presentations

OP-MH26 Exercise and peripheral artery disease

EFFECTS OF ARM-CRANK EXERCISE ON CARDIOVASCULAR FUNCTION IN PATIENTS WITH PERIPHERAL ARTERY DISEASE: A RANDOMISED CONTROLLED TRIAL

CUCATO, G., WILHELM, E.1, KANEGUSUKU, H.2, WOLOSKER, N.2, CORREIA, M.A.3, RITTI-DIAS, R.M.3

1-NORTHUMBRIA UNIVERSITY, UK; 2-HOSPITAL ISRAELITA ALBERT EINSTEIN, BRAZIL; 3-UNIVERSIDADE NOVE DE JULHO, BRAZIL.

INTRODUCTION: Arm-crank exercise training (ACT) is an alternative exercise modality for patients with peripheral artery disease (PAD) due to the attenuation of pain symptoms during the exercise and the benefits on functional capacity. However, the benefits of ACT on cardiovascular function in PAD are unknown.

METHODS: This is a three-armed randomised, prospective, single-blind data collection, single-centre study. Forty-two patients of both sexes were randomised into 3 intervention groups: ACT, (N=14, age=69±7 years) walking training (WT, N=15, age=68±7 years), and the control group (CO, n=13, age=65±8 years). The ACT and WT performed 2 supervised sessions/week for 12 weeks, 15 to 10 sets of 2 to 5 minutes at 13 to 15 score on the Borg scale. Patients in the CO attended meetings twice a week for 12 weeks with the research team. During these meetings, they engaged in manual tasks using materials, cultural programs, cooking classes, and home care without any exercise components. Before and after 12

weeks of interventions, cardiovascular parameters [office, ambulatory and central blood pressure, heart rate variability (high frequency/low frequency)], and arterial stiffness (pulse wave velocity) were obtained. We performed generalised estimating equations and a post hoc pairwise comparison using the Bonferroni correction for multiple comparisons. A level of significance (α)<0.05 was assumed in this study. All data are expressed as mean±SD.

RESULTS: Compared to baseline, office systolic (ACT =-7.5±18.2; WT=-6.2±14.6 and CO=-7.0±8.8 mm Hg), office diastolic (ACT=-4.0±7.9; WT=-5.0±7.0 and CO=-4.5±4.5 mm Hg), central systolic (ACT =-8.3±18.6; WT=-8.5±18.2; and CO=-11.2±15.9) and central diastolic blood pressure (ACT=-5.5±8.6; WT=-4.5±7.7; and CO=-5.0±10.4) decreased significantly post-intervention in all groups (time effect p<0.05). In contrast, compared to baseline, there were no changes in all groups for pulse wave velocity (ACT=0.2±0.8; WT=-0.6±2.8 and CO=-0.5±2.3 m/s), high frequency/low frequency (ACT=-0.0±0.6; WT=0.1±0.7 and CO=-0.0±0.7), 24 hours systolic (ACT=-4.8±14.4; WT=1.2±5.3 and CO=-1.1±4.8 mm Hg), 24 hours diastolic (ACT=-4.1±7.0; WT=-2.9±4.6 and CO=-3.4±7.0 mm Hg), and 24 hours mean blood pressure (ACT=-4.4±9.1; WT=2.4±4.3; and CO=-2.7±7.9 mm Hg), all P>0.05

CONCLUSION: In PAD patients, ACT promotes similar cardiovascular benefits to WT and CO groups. Consequently, ACT can be integrated into broader PAD management strategies to reduce cardiovascular risk in these patients.

IMPACT OF ATHEROSCLEROTIC LOWER LIMB PERIPHERAL ARTERY DISEASE ON THE RISK OF CAROTID PLAQUE INSTABILITY: EFFECT OF PHYSICAL FITNESS LEVEL.

RIVOIRE, E., MURA, M., JOSSET, L., DEHINA-KHENNICHE, A., MILLON, A., LONG, A., PIALOUX, V.

HÔPITAL CARDIOLOGIQUE LOUIS PRADEL

INTRODUCTION: Lower extremities peripheral arterial disease (LE-PAD) associated with carotid atherosclerotic plaques increases the risk of ischemic events. Atherosclerotic patients with both LE-PAD and carotid plaque are at higher risk of unstable plaques1, which may be due, in part, to an increased level of chronic systemic low-grade inflammation. This may thereby place these individuals at a greater risk of stroke1, with more severe atherosclerotic damage2 and limitations to walking3 as compared to patients with only carotid plaque. Benefits of regular physical activity (PA) on morbidity, mortality and long-term quality of life were previously demonstrated in LE-PAD patients. Objective: Evaluate the effect of LE-PAD and PA on the risk of carotid plaque instability.

METHODS: In this study, patients with carotid plaque with a stenosis >50% were divided in two groups: LE-PAD (+) and LE-PAD (-), according to ankle brachial index (ABI) or history of revascularization. Characterization of carotid plaque instability was evaluated by magnetic resonance imaging (MRI). PA and sedentary behavior were assessed by questionnaires and physical fitness by quadriceps strength and 6-minutes Walking Test (6-MWT).

RESULTS: Fifty-two patients were included in this study (30 and 22 in LE-PAD (+) and (-) groups respectively). In LE-PAD (+) group the non-physically active patients (<1600 MET.min/weeks) and sedentary patients (>8h/day) had higher intraplaque haemorrhage (IPH) compared to physically active (p=.017) and non-sedentary patients (p=.06) respectively. Whereas these differences were not observed in LE-PAD (-) group. In the LE-PAD (-) group, 6-MWT distance was higher in the physically active patients compared to the non-physically active one (p<.00.1). On the contrary, there was no difference in 6-MWT distance between active and non-physically active subjects in the LE-PAD (+) group, suggesting that LE-PAD likely inhibits the impact of PA on the walking distance capacity.

CONCLUSION: Patients with carotid plaques and LE-PAD may represent a subgroup at higher risk of cardiovascular-related complications, with greater plaque instability. However, increased PA and reduced sedentary behavior may limit these risks.

Conclusion: In the long term, systematic evaluation of lower limb vasculature by ABI measurement and completion of personalized PA may be beneficial for LE-PAD patients with carotid plaques.

CUTANEOUS BLOOD FLOW MODULATES ASSESSMENTS OF MUSCLE OXYGENATIONS: COMPARISONS OF CONTINUOUS-WAVE AND TIME-RESOLVED NEAR-INFRARED SPECTROSCOPY

KUNIMASA, Y., AMANO, T.1, OKUSHIMA, D.2, KOGA, S.3

1 NIIGATA UNIVERSITY, NIIGATA, JAPAN; 2 NAGAOKA UNIVERSITY OF TECHNOLOGY, NIIGATA, JAPAN, 3 KOBE DESIGN UNIVERSITY, HYOGO, JAPAN

INTRODUCTION: Near-infrared spectroscopy (NIRS) is a non-invasive technique to assess skeletal muscle oxygenation during exercise. Studies suggested that changes in skin blood flow (SkBF) would alter tissue oxygenations assessed by a conventional continuous-wave NIRS (CW-NIRS) which evaluates relative changes in muscle oxygenations (Buono et al. 2005; Koga et al. 2015). The time-resolved NIRS (TRS-NIRS), which can assess absolute changes in tissue oxygenations, has been suggested to be less influenced by the increases in SKBF, but not entirely insensitive (Koga et al. 2015). For both CW-NIRS and TRS-NIRS, eliminating potential changes in SkBF during the assessment of muscle oxygenations may improve physiological interpretation. We therefore investigated how a transdermal administration of adrenaline to induce sustained cutaneous vasoconstriction alters the assessment of muscle oxy- and deoxygenations during passive heating.

METHODS: Eleven healthy males received 0.1% adrenaline into the medial gastrocnemius muscle using transdermal iontophoresis (0.5 mA, 20 min) to stimulate alpha adrenaline receptors inducing sustained cutaneous vasoconstrictions. After the normothermic baseline recording, participants were passively heated by wearing a water perfusion suit (47 °C) with concomitant elevations of ambient temperature to 35 °C for 60 minutes. SkBF, muscle oxy- and deoxygenation of hemoglogin+ myoglobin (Oxy [Hb+Mb] and deoxy [Hb+Mb]), total [Hb+Mb], and optical factors (path length: PL, scattering

coefficient: SC, and absorption coefficient: AC) were assessed at the site with and without (control) adrenaline treatments. Rectal and skin temperatures were assessed to evaluate the magnitude of heat stress.

RESULTS: Heat stress elevated skin temperature by approximately 4 °C (P<0.001) while the elevation was small in rectal temperature (by 0.1 °C, P<0.01). Administration of adrenaline attenuates baseline SkBF by half (51%) of the control site. Cutaneous vasodilation was significantly suppressed at the adrenaline-treated site during heat stress as the changes were 4- and 2-fold from baseline at control and adrenaline treatment sites, respectively (both p<0.001). Heat stress increased CW-NIRS-derived oxy [Hb+Mb] and total [Hb+Mb] at both control and adrenaline-treated sites but this was only seen at the control for the assessment of TRS-NIRS (all P<0.05). TRS-NIRS-derived deoxy [Hb+Mb] at the control site was decreased by the heating (P<0.01), but not at the site with adrenaline treatments.

CONCLUSION: The reduced SkBF by the adrenaline treatment abolished heat stress-mediated muscle oxygenations assessed by TRS-NIRS but it remains sensitive to the response assessed by CW-NIRS. These results suggest that cutaneous adrenaline treatment (or any other equivalent intervention to reduce SkBF) is important to interpret NIRS-derived muscle oxygenations when significant cutaneous vasodilation is expected. Notably, this treatment is more effective for assessing muscle oxygenations using TRS-NIRS.

Oral Presentations

OP-MH23 Sports Medicine and Orthopaedics II

IGF-1 ALTERED THE REMODELLING CAPACITY OF TENDON CONSTRUCTS INDEPENDENTLY OF THE POST-EXERCISE SYSTEMIC ENVIRONMENT

GIANNOPOULOS, A., PAPADOPETRAKI, A., MAGNUSSON, S.P., PHILIPPOU, A., BACKMAN, L.B., SVENSSON, R.B.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Tendinopathies are characterised by an imbalance between extracellular matrix (ECM) production and degradation, leading to dysfunctional tendons. Exercise is considered the gold standard for managing tendinopathies. Further, exercise induces an anabolic environment with the accumulation of growth factors in the circulation, among them IGF-1 which is a fundamental factor for tendon remodelling. Additionally, it has been shown that injections with IGF-1 cause upregulation of protein and collagen synthesis in human tendons. Hence, we hypothesised that the exercise-induced biochemical environment would have an additive effect on IGF-1 bioactivity to matrix remodelling of human engineered tendons.

METHODS: Serum was isolated from blood samples (N=7 participants) that were collected within 10 minutes after a bout of exercise until exhaustion, on a cycle ergometer. Human tendon constructs were cultured with 10% human serum in the culture media for one week. Serum from each participant used separately for the following groups: Pre- (Pre-Ex+IGF-1) and post-exercise serum (Post-Ex+IGF-1) supplemented with IGF-1 (IGF-1), pre- (Pre-Ex) and post-exercise (Post-Ex) serum without IGF-1. Enzyme-linked immunosorbent assays were used to evaluate procollagen type I carboxy-terminal propeptide (PICP), extracellular matrix metalloproteinase inducer (EMPRIN) and matrix metalloproteinase-2 (MMP-2) proteins in the culture media that collected from the whole cultured period after the addition of human serum. Confocal microscopy was used to image whole mount constructs stained with collagen hybridizing peptide (CHP) to evaluate collagen degradation.

RESULTS: The CHP intensity did not reveal any differences between the conditions. PICP concentration revealed a 40.8% increase at pre-Ex+IGF-1 relative to the Pre-Ex (p=0,0016) group and 34.7 % in the Post-Ex+IGF-1 relative to the Post-Ex (p<0,0075) group. IGF-1 administration significantly enhanced EMMPRIN concentration (p<0.0001), which was increased by 18.7% at Pre-Ex+IGF-1 compared to Pre-Ex (p=0.0068), and 27,5% at Post-Ex+IGF-1 compared Post-Ex (p<0.0001) groups, with significant contribution of the exercise effect (p=0.0124). MMP-2 concentration was upregulated with the administration of IGF-1 (p=0.0010) and was 7.5% higher in the Pre-Ex+IGF-1 relative to the Pre-Ex (p=0.0120) group, and 6.4% higher in the Post-Ex+IGF-1 relative to the Post-Ex (p=0.0320) group.

CONCLUSION: Contrary to our hypothesis, the above results revealed that IGF-1 can regulate the ECM remodelling independently of the post-exercise environment. A combined effect of exercise and IGF-1 treatment was demonstrated in EMMPRIN secretion, indicating the involvement of MMP-mediated signalling pathways, providing a potential link between exercise and tendon remodelling.

HIGH ACCURACY OF THE A NEW DIGITAL INSOLE SYSTEM (WALKINSENSE) FOR THE MEASUREMENT OF SPATIOTEMPORAL PARAMETERS AT DIFFERENT SPEED CONDITIONS

ECKELT, M., FAYAD, J., SCHURMANS, G., BACKES, A., MEYER, T., GRIMM, B., MOUTON, C., SEIL, B., MALISOUX, L.
LUXEMBOURG INSTITUTE OF HEALTH

INTRODUCTION: The evaluation of spatiotemporal parameters during walking is helpful to detect abnormal gait or to quantify improvement resulting from interventions, in particular during rehabilitation in patients with orthopaedic conditions. For now, these measurements are mainly limited to laboratory testing. Gait monitoring of the patients in their natural environment during daily life activities would provide highly relevant information to clinicians. This study aims to assess the

validity of a new digital health solution, the WalkinSense system, which consists of pressure-sensitive insoles combined with inertial measurement units.

METHODS: Records of 104 healthy participants (mean age = 36 years, median bmi = 23.18, median height = 172.3cm, 50% female) were obtained during various speed conditions such as low speed walking, high speed walking and running (3km/h, 4.5km/h, 6km/h and 9km/h). Spatiotemporal metrics were derived from ground reaction force recordings collected with an instrumented treadmill (M-Gait, Motek Forcelink Amsterdam) and from the WalkinSense system. The corresponding metrics were calculated as mean over the total amount of steps of the participant, respectively. Mean bias between the two systems was assessed using separate Bland-Altman analyses for each metric and condition. Mean error and limits of agreement (absolute and percentage) were calculated and the agreement was statistically quantified using a priori set thresholds (excellent <5%, good<10%, acceptable<15% and poor >15%)[1]. A two-way mixed model intraclass correlation coefficient (ICC) for consistency was also calculated. ICC was considered poor<0.5, moderate 0.5-0.75, good 0.75-0.9 and excellent >0.9.

RESULTS: Excellent agreement was achieved for stride time and cadence across all different speed conditions (<5% error). In addition, excellent agreements were found for stance time, swing time and single support time for all walking speeds (3km/h, 4.5km/h and 6km/h) and good agreement for running (9km/h). Double support time showed acceptable agreement for all walking speeds. ICC values ranged from poor (swing time at 9km/h and double support time at 6 km/h) to excellent (e.g. stance time at 3 and 4.5km/h) across all metrics and conditions. Stride time and cadence showed excellent ICC values for all speed conditions expect for 9km/h, which yielded moderate ICC values.

CONCLUSION: These findings suggest that the WalkinSense system may be useful to quantify spatiotemporal metrics with generally excellent accuracy in walking speeds, which might be the decisive gait speeds, especially in rehabilitation. Future analyses will focus on the validation of important kinematic and kinetic variables in order to be able to estimate musculoskeletal loading.

[1] Van Hooren, B., Willems, P., Plasqui, G., & Meijer, K. (2023). The accuracy of commercially available instrumented insoles (ARION) for measuring spatiotemporal running metrics. Scandinavian Journal of Medicine & Science in Sports.

EFFECT OF A SIMULTANEOUS APPLICATION OF ISCHEMIC PRECONDITIONING AND PLACEBO ON ISOMETRIC STRENGTH OF LOWER LIMBS

NASCIMENTO, B., ARAUJO, M.C.C., ROCHA, V.N., PRAZERES, E., PARISH, B., MAROCOLO, M.

FEDERAL UNIVERSITY OF JUIZ DE FORA, JUIZ DE FORA, MINAS GERAIS, BRAZIL.

INTRODUCTION: Knee injuries in physically active people are quite common, mainly those on ligamentous and meniscus, usually requiring arthroscopy surgery. For this surgery method, the tourniquet is used for blood flow occlusion but may cause muscle damage due to occlusion time and high pressure. Ischemic Preconditioning (IPC), consisting of brief periods of occlusion-reperfusion of blood flow can be a factor in tissue preservation. In this context, muscle biopsy becomes an excellent method for evaluating muscle injuries, assessing defense cell proliferation, and intracellular structure.

Thus, we have evaluated the benefits of 3-day IPC prior arthroscopy knee surgery on acute functional recovery and muscle damage.

METHODS: Nineteen volunteers (29.1 ± 9.4 yrs) were divided into 2 groups: Control, underwent knee surgery without prior intervention and IPC, submitted to 3-days IPC prior arthroscopy surgery. IPC intervention consisted of 4 cycles of 5-min occlusion (cuff pressure of 10 mmHg above occlusion pressure) while Control remained in rest for the same time. An assessment was conducted 24 hours after the surgical procedure to evaluate pain, edema, and range of motion. Muscle biopsy was collected at two different time points: at minute zero - after inflating the tourniquet - and at minute 75 after tourniquet inflation, in the vastus medialis obliquus muscle. A mixed model ANOVA, Student t-test and Effect size (ES) were carried out for moments and groups' comparisons

RESULTS: A higher thigh swallow ($p<0.01$) and higher knee extension ($p<0.051$) after surgery were found in IPC group. An observational muscle biopsy revealed lower edema and myofibrils degeneration and higher sarcomere organization in the IPC group.

CONCLUSION: A repeated IPC intervention may improve acute recovery of range of motion and reduce skeletal muscle damage after an elective arthroscopy knee surgery.

ESTIMATING THE OXYGEN COSTS OF THE INCREMENTAL SHUTTLE WALK TEST FROM A FOOT-POD POWER METER; CONCEPT EVALUATION TOWARDS CLINICAL APPLICATIONS

JONES, S., BURT, D., PHEASEY, C., BUCKLEY, J.

KEELE UNIVERSITY

INTRODUCTION: The Incremental Shuttle Walk Test (ISWT) is a recommended test of cardiorespiratory fitness for cardiopulmonary populations [1]. The accuracy of estimating oxygen uptake (VO2) during the ISWT is affected by the participants ability to match set paces. Wearable foot-pod power monitors may provide a more accurate means to derive estimates of VO2 . Benefits of more reliable and valid VO2. estimates could eliminate time needed for the requisite practice test of the ISWT. This study aimed to develop an equation to estimate VO2 from walking power measured by the Stryd-Power foot-pod (Boulder, Colorado).

METHODS: Fourteen healthy participants (31.6 +/-9.7 years) completed nine stages of the ISWT, in a counterbalanced order, over-ground (around cones) and continuously on a treadmill (Tmill). Data was collected up to the 9th stage of the ISWT, as stage 10 is the threshold for running. VO2 was measured continuously in both tests via a portable/wearable cardiopulmonary gas exchange monitor (Meta-Max 3B, Leipzig). Similarly walking power in was measured continuously via the Stryd-Power foot-pod.

RESULTS: Group mean Incremental Area Under the Curve (iAUC) for integrated VO2 x time was greater for the ISWT vs Tmill (167.4 +/-14.8 vs 153.2 +/-19.7 ml/kg; p = .003). There was no difference in iAUC walking power in ISWT vs Tmill (11.9 +/- 2.5 vs 11.6 +/- 2.0 Watts·mins; p = .267). ISWT and Tmill both demonstrated curvilinear VO2 (y) responses as a function of test stage/time (x), with these resulting equations: ISWT VO2 = 0.2069x2 - 0.1759x + 8.5048; Tmill VO2 = 0.1632x2 - 0.1887x + 8.631. Walking power displayed linear responses to incremental stages for both ISWT and Tmill test: ISWT Watts = 0.1775x + 0.1214; Tmill Watts = 0.1775x + 0.1214. The respective mean curvilinear regression equations to estimate VO2 from the Stryd-power monitor for ISWT and Tmill were: ISWT VO2 = 6.8439x2 – 3.0899x + 8.8856; TMill VO2 = 4.1162x2 – 0.6498x + 8.4621.

CONCLUSION: This study confirms it is possible to use a wearable foot-pod to assess changes in walking power during the ISWT. Corresponding measured VO2 during the ISWT over-ground around cones and on a Tmill provides a mathematical model to estimate VO2 from a foot-pod monitor that is now ready to be tested in cardio-pulmonary populations. The study also concurs with previous studies [2, 3] on the need for separate shuttle walking and Tmill regression equations to estimate VO2.

1. Buckley, JP. et al. Field-based assessments for clinical populations, British Association of Sport & Exercise Sciences Vol. II, Routledge, Taylor & Francis, London, 2022 ISBN 9780367492397

2. Oliveira, C.S. et al. Incremental shuttle walk test performed in a hallway and on a treadmill: are they interchangeable? Respiratory Care, 2018, 63 (3) 311-318

ASSOCIATION BETWEEN INTER-LIMB ASYMMETRY AND ENDURANCE RUNNING PERFORMANCE IN HEALTHY POPULATIONS: A SYSTEMATIC REVIEW

DHONDT, J., CHAPELLE, L., BISHOP, C., AERENHOUTS, D., DE PAUW, K., CLARYS, P., DHONDT, E.

VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: The presence of inter-limb asymmetry in the human body has traditionally been perceived to be detrimental for athletic performance. However, a systematic review addressing and comprehensively assessing the association of asymmetry between the lower limbs and endurance running performance is currently lacking. Therefore, the main purpose of this systematic review was to examine the relationship between lower inter-limb asymmetry and running performance in healthy endurance runners. The secondary objective was to identify possible avenues for further research in this area.

METHODS: Pubmed, Web of Science and SPORTDiscus were systematically searched by two independent researchers for studies investigating the relationship between lower inter-limb asymmetry and (determinants of) running performance in healthy and injury-free endurance runners of any level. The quality of studies eligible for inclusion was assessed using the Downs and Black Quality Index Tool (Downs & Black, 1998).

RESULTS: Out of 4817 articles screened, 8 studies were included in this review. The quality score of the included research varied between 5/10 and 9/10. Except from one finding demonstrating a positive association between peak ankle dorsiflexion asymmetry and running performance, all other lower inter-limb asymmetry outcome measures were either negatively (N = 16) or not significantly (N = 30) associated with running performance.

CONCLUSION: A high heterogeneity across study methods and outcomes was apparent, making it difficult to draw a straightforward conclusion. Despite one study showing a positive relationship, the results demonstrate that some, but not all, metrics of functional, morphological, kinematic and kinetic inter-limb asymmetry are negatively or not associated with running performance. Thus, a more extensive high-quality body of research is essential to determine whether and to what extent asymmetry between the lower limbs could affect endurance running performance as well as to establish potential trade-off values for practitioners in developing training programs.

Oral Presentations

OP-SH20 Physical activity promotion and children

PHYSICAL LITERACY AND PHYSICAL ACTIVITY

KNISEL, E., BREMER, M., NALECZ, H., LAUDANSKA-KRZEMINSKA, I.

OTTO-VON-GUERICKE UNIVERSITY OF MAGDEBURG

Introduction

Physical literacy is important to understanding and promoting childrens participation in physical activity. Based on the concept of physical literacy by Whitehead (2019) the Canadian Assessment of Physical Literacy, second edition (CAPL-2;

Longmuir et al., 2018) for children 8-12 years old consists of two questionnaires to assess Knowledge and Understanding and Motivation and Confidence domains. The Daily Behaviour domain is assessed from one item of self-reported moderate-to-vigorous physical activity (MVPA) and step counts for one week. To measure the Physical Competence domain three physical tests are applied. An aim of our validation studies of the questionnaires of CAPL-2 in Poland and Germany was to analyse the relationship of self-reported MVPA and Motivation and Confidence and Knowledge and Understanding, respectively, and the total score.

Method

The total sample size of our validation studies was N=802 with n=470 Polish students (216 boys, 254 girls; mean age=11.10) and n=332 German students (160 boys, 172 girls; mean age=11.05). Correlation analysis of Pearsons r (Polish sample) and Spearmans rho (German sample) were performed. The correlation coefficients results were interpreted as less than 0.1 – negligible; 0,1 to 0.39 – weak, 0,4 to 0,69 – moderate, 0.7 to 0.89 – strong, 0.9 to 1 – very strong (Schober et al., 2018).

Results

Motivation and Confidence domain is weakly to moderately correlated with the subjective measured MVPA among German (r=0.31; p<0.01) and Polish (r=0.44; p<0.01) sample, respectively. In Poland the correlation of Knowledge and Understanding domain and MVPA is weak (r=0.16; p<0.01), in Germany no significant correlation (r=0.07) was found. In both countries the correlation of the total score and the MVPA is significant and weak in Germany (r=0.30) and moderate in Poland (r=0.43).

Discussion

Our results demonstrate that students with higher level of Motivation and Confidence reported to be more physically active. However, no such relationships were found with Knowledge and Understanding domain. Furthermore, we observed a relationship between physical literacy and physical activity. Future research in the area of physical literacy should examine to what extent the relationship of better knowledge of physical activity and higher level of motivation influence daily physical activity in the long run.

References

Longmuir, P.E., Gunnel, K.E., Barnes, J.D., Belanger, K., Leduc, G., Woodruff, S.I. et al. (2018). Canadian Assessment of Physical Literacy second edition: a streamlined assessment of the capacity for physical activity among children 8 to 12 years of age. BMC Public Health, 18, 1-12. doi: 10.1186/s12889-018-5902-y

Schober P., Boer C., Schwarte, LA. (2018). Correlation coefficients: appropriate use and interpretation. Anesth Analg, 126(5), 1763-1768. doi: 10.1213/ANE.0000000000002864.

Whitehead, M. (2019). Physical literacy across the world. London: Routledge.

BASIC PATTERNS OF PHYSICAL DEVELOPMENT OF PRESCHOOL CHILDREN IN ECONOMICALLY DEVELOPED PROVINCES OF CHINA

HU, X., REN, X.

COLLEGE OF PHYSICAL EDUCATION AND HEALTH SCIENCE, ZHEJIANG NORMAL UNIVERSITY

Introduction

As a major component of physical health, physical fitness is considered an important indicator of child growth and development. Pre-school is the period of particularly rapid growth and physical development of children, which is characterized by intensive development the child's organism and dramatic changes in the functional system of activity, thereby promoting their motor ability. The objective of the present study was to investigate the status of physical fitness in children aged 3-6 years in economically developed provinces of China, in an attempt to explore the basic patterns.

Methods

A total of 800 preschoolers in four age groups of 3-6 years were recruited with 200 in each group. The inclusion of each physical fitness indicator was based on the Chinese Handbook of National Physical Fitness Measurement Standards (children's section). The outcomes of sit and reach, standing long jump, tennis ball throw, 10 m out-and-backs, beam walking, and two-foot hop were computed and statistically analyzed by a one-way analysis of variance (ANOVA).

Results

No significant differences were observed for sit and reach between the three age groups of 3, 4 and 5 years, but they were significantly different from the 6-year-old group ($p < 0.0001$), with the outcomes improved by approximately 3 cm. There were significant differences ($p < 0.0001$) between the groups for standing long jump, tennis ball throw, 10 m out-and-backs, beam walking, and two-foot hop. Improvement in the standing long jump decreased, with the mean values of 19 cm, 18 cm, 13 cm from ages 4 to 6. Improvement in the tennis ball throw was the greatest in age 5, with the mean values of 1.6 m compared to age 4. The greatest gains were made in the 10 m out-and-backs and two-foot hop in age 4, with the mean reduction of 2 s compared to age 3. The improvement in beam walking was essentially the same for each age group, with a mean reduction of 2.5 s.

Discussion

The findings revealed that the overall level of physical fitness of preschool children continues to gradually improve with age. The development of flexibility is significantly lower than that of other physical fitness indicators, while the develop-

ment of balance and strength is relatively faster. The motor cognition of preschoolers aged 3-6 years is in the state of enlightenment, and the motor cognition of different age groups determines the level of physical fitness development. Physical activity performed in the preschool years might be directly related to the development of physical fitness. Flexibility is a key area of concern for school-age children and requires targeted practice. Therefore, the guiding role of preschool education should be fully utilized to set up an appropriate amount of intriguing physical activity to stimulate their interest in exercise according to the pattern of physical development at different ages.

THE LACK OF SPORTS EXPERIENCES COULD BE A BARRIER TO ACHIEVING HIGH LEVELS OF MOTOR COMPETENCE AND FUNDAMENTAL MOTOR SKILLS IN SEVEN YEARS-OLD CHILDREN?

FONT-LLADÓ, R., LÓPEZ-ROS, V.1, JÓDAR-PORTAS, A.2, VASILEVA, F.2, HOMS, J.2,3, PRATS-PUIG, A.2,3

UNIVERSITAT DE GIRONA

INTRODUCTION. Motor development is described as a progressive process that occurs when an individual participates in a rich context with a variety of motor opportunities. Motor competence (MC) defines an individuals degree of proficient performance in a large range of motor skills. Proficiency barriers propose an "adequate" level of Fundamental Motor Skills (FMS) as a prerequisite for participation in sport-specific activities (1), to influence health (2). However, considering sport as a specific context with a broad range of motor opportunities, another hypothesis is possible. This study aimed at a) exploring the influence of sports experiences in MC and FMS levels in 7 years-old children, and b) assessing the impact of an Integrated Neuromuscular Training program (INT) in MC and FMS considering the baseline level of MC and FMS, and sport experiences in 7 years-old children.

METHODS. This randomized control trial recruited 228 children (y=7.45 ± 0.34). Group-based INT program in the warm-up (INT group, n=116) was compared with the group-based conventional warm-up (CON group, n=92) both over 24 PE lessons. Data were collected in 2 sessions (pre-post): Physical Activity (MVPA) with Actigrah 3GTX, IMC, sport experiences, MC, and FMS level using the CAMSA test (8). A multiple linear regression analysis was performed to identify predictor variables to MC and FMS, furthermore to MC and FMS improvements. Differences across groups (sex, IMC, and Sports experiences) were analyzed by independent T-test and ANOVA.

RESULTS. Adjusted by MVPA and sport modality, the amount of sports practice (ASP) is an independent predictor of 2-foot jumping and skipping, explaining 23,6%, and 5,7%, of its variability respectively. Also, ASP and IMC are associated with MC (28,7%), Sliding (11,2%) and 1-foot hopping (16%) explaining its variability. Finally, ASP and sex are associated with catching (11,5%), throwing (26,3%), and kicking (28,6%) explaining its variability. Interestingly, only ASP is associated positively. According to sport modality, sport-based-locomotive-skills practitioners showed faster than sport-based-manipulative-skills practitioners ($p<0.000$) and non-sport practitioners ($p=0.002$). In linear regressions analyses after adjusting for sex, IMC, and sport modality, ASP, INT interventions, and initial level of MC and FMS are associated with improvements of MC, sliding, catching, and throwing explaining 30,9%, 28,4%, 48,1% and 31% of its variability respectively, not in the other skills.

CONCLUSIONS. The amount of practice sport in 7-year-old children influenced mastery in MC and FMS patterns. MVPA and sport modality are not significant in this model. However, sports-based-locomotive-skills seem better to be faster, but not to master MC. The amount of practice sport, initial MC and FMS level, and INT intervention are good predictors of mastery MC and improved FMS levels in 7-year-old children.

(1) Seefeldt et al. (1982)

(2) Stodden et al. (2013)

AN EXAMINATION OF FACTORS RELATED TO STUDENTS' LEARNING STRATEGIES AND ATTITUDE OF PHYSICAL EDUCATION CLASS IN JUNIOR HIGH SCHOOL

YU, A.

HOKKAIDO UNIVERSITY

Introduction

In Japan, most activities in elementary and junior high schools are conducted in classrooms, students spend much of their time with teachers and classmates. Because they often take classes together, students' learning strategies and attitudes may change depending on how they perceive their teachers and classmates in their group. However, most of the studies on students' learning strategies and attitudes in physical education classes have focused on students' own consciousness, and there were few studies on how they perceive their group members. The purpose of this study was to clarify the effects of students' consciousness of norms and their perception of other students' norm consciousness and their perception of teachers' norm consciousness on their learning strategies and attitudes in physical education classes.

Methods

The subjects of the study were 548 students (254 boys and 294 girls), enrolled in two schools in Japan. The questionnaire survey was used to measure learning strategies, attitudes toward physical education classes, students' consciousness of norms, their perception of other students' norm consciousness and their perception of teachers' norm consciousness. Multiple regression analysis was conducted using students' consciousness of norms, their perception of other students' norm consciousness and their perception of teachers' norm consciousness as independent variables, and their learning

strategies and attitudes in physical education classes as dependent variables. Based on previous studies, have reported gender differences in how students perceive others, analyses were conducted separately for boys and girls.

Results & Discussion

Gender differences were found in the factors influencing learning strategies and attitudes toward physical education classes. First, in terms of learning strategies, boys showed the significant positive effect of only their consciousness of norms, while girls showed the significant positive effect of their consciousness of norms and their perception of other students' norm consciousness. Second, for the attitudes toward physical education classes, boys showed significant positive effects for their consciousness of norms and their perception of other students' norm consciousness, whereas girls showed no significant effects for any of the factors. Previous studies have reported that how perceive their teachers and classmates in their group influences own thinking and behavior, but based on the results of this study, it is possible that what is influenced by the perceptions of classmates, teachers, differs between boys and girls. Based on these findings, it can be inferred that different approaches are needed for genders if we are to consider changing learning strategies and attitudes in a positive direction.

DYSFUNCTIONAL EDUCATION AND MALTREATMENT OF YOUNG PEOPLE: A STUDY OF "BLACK PEDAGOGY"

SOOS, I., WHYTE, I., SZEKERES, D., NEMETH, ZS., BOROSAN, L., CSEPELA, Y., CSERNY, A., HAMAR, P.

HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

Introduction

"Black pedagogy" is a term that encompasses practices or behaviours identified in the pedagogical process that negatively affects the physical and mental health of young people (Hunyadine et al., 2006). This maltreatment can include physical, sexual, and mental abuse, or neglect. Any educational institution or sports club could, directly or indirectly, knowingly or unknowingly, promote black pedagogy, resulting in lasting negative consequences or feelings of grievance among young people. The aim of this study was to examine retrospectively cases of incidents and maltreatment recalled by university students from their time in primary or secondary schools.

Methods

A questionnaire was developed using data from a previous black pedagogy study (Hunyadine & Nadasi, 2014). Questions were included to identify the cause and categorisation of perceived black pedagogy incidents, the sexes and ages of perpetrators, the outcomes, and resolutions. Following ethical approval by the lead university's Sports Science Ethics Committee, university students studying sport (n=149, aged 21.6 years, s=5.0, 72.5% male, 24.8% female, 2.7% not identified) voluntarily responded to the questionnaire. Data was descriptively analysed by IBM SPSS v. 29 software package.

Results

The most often mentioned incidents were forceful behaviour or aggression by a sports coach or physical education teacher in order to enhance performance (21.5%), punishment for perceived disrespectful behaviour (11.1%), favouritism or discrimination (7.4%), lack of empathy (4%), and punishment for perceived laziness (3.4%). Issues of sexual abuse were reported by 2 respondents (1.3%).

The sex of perpetrators was identified as being predominantly male (67.1% male, 16.8% female, and 8.1% both male and female). Perpetrators were mostly classified as being middle aged with 34.9% being between 41-50 years of age (30.2% aged 51 years or over, 18.2% aged 40 years or younger, 16.8% of perpetrators ages were unspecified).

Victims informed their friends, classmates, or teammates (36.3%) or parents (32.2%), who provided them with support. Nevertheless, 20.1% never mentioned it to anybody. The incidents were resolved in one of three ways: nothing changed, nothing happened (46.3%), young people changed teacher or coach, or moved school/ sports club (23.5%), the issue was resolved in favour of the victims, e.g. apologies (16.1%). No information regarding resolutions were provided by 8.7% of respondents.

Conclusion

With 69.8% having either no resolution or the victims being forced to move, the findings call for a number of interventions. Guidelines identifying appropriate and inappropriate behaviour, policies and procedures must be developed for schools/organisations and those who work with young people, alongside reporting strategies and possible sanctions. Secondly, they must be disseminated through formal education and training, including to the pupils.

14:45 - 16:00

Invited Symposium

IS-MH12 Eccentric Exercise: Debunking Myths, Enhancing Rehabilitation, and Tailoring for Excellence

RE-EVALUATING CLASSIC BELIEFS ABOUT ECCENTRIC EXERCISE

LEPLEY, L.
UNIVERSITY OF MICHIGAN

The complexity of muscle atrophy following traumatic joint injury necessitates a therapeutic approach that targets the factors involved in muscle health and growth. Joint injuries, like anterior cruciate ligament (ACL) rupture, lead to an immediate disruption in neural signaling required for muscle activation. This disruption negatively affects muscle volume and quality, primarily due to the reduced ability to generate necessary action potentials to maintain muscle health. Exercise modalities that therefore rely on the patients neural drive to control contractions have proven ineffective after joint injury because achieving full and sustained muscle contractions is challenging. Lengthening contractions, also known as eccentric muscle actions, present an appealing alternative to shortening contractions as they have the capability to uniquely trigger the nervous system and signaling pathways that support tissue health and growth. Promising results have emerged from the use of eccentrically biased exercise prescriptions to enhance muscle recovery after injuries like ACL rupture. Various techniques, such as electromyography, neuroimaging, immunoblotting, and immunostaining, have shed light on the beneficial adaptations associated with eccentric exercise. Despite its growing acceptance as an exercise prescription, there is still reluctance within the clinical community due to longstanding associations of eccentric muscle actions with muscle injury. This dogma is due, in large part, to misinterpreted benchtop models that often involve extreme conditions that do not accurately represent the clinical scenario (i.e., the removal of the distal point of long-tendon from the bone for experimental purposes or animals that are exercised with the intent to cause injury). Through this lecture, Dr. Lepley aims to provide basic supporting evidence from the single fiber to the whole tissue level supporting the hypothesis that the inclusion of lengthening exercises in musculoskeletal rehabilitation can be a safe and effective exercise prescription for promoting muscle recovery. She will discuss how these adaptations are primarily driven by improvements in neural drive and responsive cellular signaling resulting from stretching and repetitive lengthening of activated muscles. ACL injury will be used as a model, and attendees will be encouraged to consider the responsible use of isolated lengthening exercises to address the various factors after joint injuries that contribute to the degradation of muscle tissue health and volume. Dr. Lepley will also direct therapists to a series of original clinical articles that provide protocols that can serve as guidelines for development.

ACCELERATING RECOVERY POST-ACLR WITH EARLY-STAGE ECCENTRIC CROSS-EDUCATION

ANDRUSHKO, J.
NORTHUMBRIA UNIVERSITY

Present anterior cruciate ligament reconstruction (ACLR) rehabilitation protocols typically postpone dynamic open-chain strength training exercises until 3 to 4 weeks post-surgery. Although this delay minimizes post-operative complications by allowing the graft to heal, it also dampens the recovery rate, leading to decreased quadriceps muscle strength, size, and altered neuromuscular function in both limbs. These changes, when left unaddressed, enhance the risk of developing osteoarthritis. Since quadriceps strength is protective against the development of osteoarthritis, strength training to enhance knee extensors muscle strength is a critical aspect of the rehabilitation process. In this context, the first 3 to 4 weeks post-ACLR, with current standard rehabilitation protocols, represent a pivotal yet underutilized period. This window of missed opportunity offers room for enhanced recovery strategies. Cross-education is a concept where training one side of the body benefits the opposite, untrained side. These protocols can potentially counterbalance the muscle size and strength declines stemming from disuse during this period of recovery. However, the mode of exercise matters, as work has consistently shown that eccentric cross-education promotes nearly 2 times greater strength gains and more robust neural recovery than concentric or isometric cross-education protocols. Despite its potential, eccentric cross-education hasnt been widely adopted in clinical settings due to an incomplete understanding of the mechanisms behind it. Some clinicians also fear it may exaggerate limb strength and size asymmetries; measures often monitored during ACLR rehabilitation. Despite these reservations, neglecting strength preservation in the early post-surgery phase may be shortsighted given the risks associated with weak knee extensors. This lecture emphasizes the critical role of muscular strength for preventing future knee injuries and the development of osteoarthritis. We will review the literature investigating the use of cross-education to offset disuse related declines in muscular strength and size, and introduce the potential mechanisms of cross-education in the context of developing an optimized adjunct eccentric cross-education protocol. This approach is designed to enhance and complement standard rehabilitation practices to preserve muscle strength, and accelerate recovery of the reconstructed limb during the early-stages post-ACLR.

PRACTICAL INTERVENTIONS UTILIZING ECCENTRIC EXERCISE FOR ELITE ATHLETES: MID TO LATE STAGE REHABILITATION AFTER ACL RECONSTRUCTION

LORENZ, D.
LAWRENCE MEMORIAL HOSPITAL / ORTHOKANSAS

Successful athletic performance in field and court sport athletes is largely predicated on the ability to decelerate and accelerate at high rates of speed. Thus, appropriate training in both rehabilitation and strength and conditioning settings maximizes an athlete's ability to put maximal force into the ground while also minimizing ground contact time. Since a substantial number of field and court sport athletes regularly involve themselves in high-velocity acceleration and deceleration, their aptitude for slowing down and altering their direction is intricately tied to their proficiency in managing eccentric movements before transitioning into concentric acceleration. In instances where individuals exhibit inadequate knee shock absorption and an elevated level of knee stiffness upon landing, particularly as seen in those with compromised quadriceps function, such as in the case of anterior cruciate ligament reconstruction (ACLR), it becomes imperative for clinicians to prioritize the inclusion of eccentric exercises as a pivotal component of the rehabilitation plan. The force-velocity curve illustrates the dynamic relationship between muscle force and contraction velocity. On the concentric side of this curve, we observe that the highest forces are generated when the velocity is zero, and as velocity increases, force diminishes. In contrast, when we shift our focus to the eccentric side of the force-velocity curve, where the muscle lengthens while still producing force, a remarkable characteristic emerges: the muscle can maintain relatively high-tension levels even at higher velocities. This unique attribute means that with eccentric muscle actions, the muscle exhibits the ability to generate both high force and high velocity actions. Consequently, through appropriate training strategies, athletes can aim to achieve this dual objective. The focus of this lecture is to provide attendees with practical interventions clinically throughout the rehabilitation timeline that focus on the physical qualities of athletic performance. Interventions will focus on using eccentric exercise to produce maximum force and gradually progress to high force, high velocity decelerations to match the demands for returning to sport. A secondary objective is to provide specific program design recommendations in regard to loading parameters as well as sets and repetitions performed to achieve the training objectives.

Invited Symposium

IS-AP04 Science of Feet and Footwear

MUSCULOSKELETAL DEVELOPMENT AND MOTOR SKILLS OF CHILDREN AND ADOLESCENTS ARE INFLUENCED BY GROWING UP BAREFOOT OR SHOD

ZECH, A.
UNIVERSITY OF JENA

Improvements of motor skills are basic processes of growth, maturation and development during childhood and adolescence. They are not only a direct consequence of learning processes but are also influenced by interactions between regular external (environmental) and internal (e.g. neuromuscular) factors. These include anthropometrical and muscular characteristics of the foot. It has been shown that different structural foot types such as high and low arches are associated with the performance of basic motor skills such as balancing, jumping or sprinting. Since the foot morphology differs between barefoot and shod populations, footwear habits have long been discussed to play an important role for motor learning and motor control. Evidence exists that compared to shod conditions, barefoot situations directly change gait biomechanics, postural control and jumping movements in children and adults. Individuals growing up barefoot also tend to have wider feet with a higher arch and smaller hallux angles. This emphasizes the hypothesis that the development of basic motor skills during childhood and adolescence partly depends on the amount of physical activity under barefoot conditions. A comparison of motor skills between habitually barefoot and shod individuals in the same setting is difficult, since barefoot habits seem to be influenced by sociocultural and regional factors. Individuals in western countries are used to wear shoes during almost all outdoor activities whereas especially children in some countries in the southern continents are often seen barefoot. The potential interaction between growing up barefoot or shod and performance in basic motor competencies during the different stages of childhood, adolescence and into adulthood will be discussed.

HOW THE FOOTWEAR-SURFACE ENVIRONMENT ALTERS MOVEMENT STRATEGIES AND MUSCLE RECRUITMENT IN RUNNERS

ODDY, C.
LEEDS BECKETT UNIVERSITY

Unlike other primates, the human foot has an arch capable of both stiffness and deformation to varying degrees dependent on the terrain. It can store and release energy via springs (ligaments, aponeurosis, tendons) in order to make efficient use of muscle work during running. During running, muscles are continuously operating via both feedforward (in anticipation via vision) and feedback (in response via sensory physiology) mechanisms. Muscle responses will perhaps be most evident via kinematic changes at the major joints and the extent of muscle pre-activation in anticipation of the expected ground contact. In many runners, acutely and at submaximal speeds, barefoot running results in a reduction in stride

length and increased plantar and knee flexion. Runners who are habitually barefoot demonstrate lower loading rates (force) compared with their shod counterparts. This is thought to be due to the optimisation of the limb position for ground contact and the pre-activation of muscles in anticipation. Previously shod runners who respond to a barefoot running intervention demonstrate increased biceps femoris and gluteus medius pre-activation, and decreased rectus femoris muscle activity between testing periods. The kinematic changes evident in some runners who transition to barefoot running seem to be similar to that experienced when running on an irregular surface. On an irregular surface, the knee and ankle appear to move in synchrony whereby the ankle stiffens and has a reduced rearfoot action. A spring-like ankle combined with an increase in knee flexion may increase impact attenuation. The task (barefoot running) and environmental (irregular surface) constraints may enhance the coordinated action of the spring-like function of the foot and the energy absorbing capacity of more proximal muscles. Subtle differences in ground deformation and subsequent foot placement will challenge the biotensegrity of foot structures and the plantar cutaneous nerve receptors to respond with variations of tensioning and stiffening. These variations facilitate a consistent outcome (running) using different patterns of joint relations, a concept known as dynamical systems. Lieberman and colleagues reported 72% of barefoot runners use a varied foot strike pattern compared with just 32% of shod runners. All runners used a more varied foot strike pattern on a softer surface. This lecture will aim to explore how the footwear we use and the surface we run on changes our biomechanics via altered muscle work.

THE ROLE OF FOOTWEAR IN ATHLETIC INJURY

FRANCIS, P.

SOUTHEAST TECHNOLOGICAL UNIVERSITY

For a relatively simple activity with numerous health benefits, the incidence of running injury is high compared to other aerobic activities. The debate amongst scientists about whether footwear plays a role in running injury and whether conventional, minimalist, or maximalist footwear is optimal toward injury prevention has moved on. Despite the high incidence of injury, there are many runners who do not get injured including those that run in conventional running shoes and with an infamous rear-foot strike. Indeed, most world championship marathon runners wear cushioned running shoes and use a rear-foot strike. However, in runners who do get injured, the top 5 injuries occur to non-contractile tissues (patellofemoral pain, shin splints, plantar fasciitis, achilles tendinopathy, iliotibial band), ill-equipped to absorb impact forces. There is a growing body of evidence which suggests the movement strategies used by these athletes are injurious in nature and are contributed to by footwear-surface interactions. As described in the introduction for this session, the human foot has undergone rapid changes in its footwear and surface environment in a very short space of time relative to human evolutionary history. Modern footwear is known to weaken the intrinsic muscles of the feet and encourage 'heavier' running mechanics (rear-foot strike) on what are now largely unyielding surfaces (roads, pavements, running tracks). Increasingly, scientists are beginning to view plantar fasciitis (chronic heel pain) as a mismatch disease, in other words a disease directly related to changes in the footwear-surface environments. This lecture will aim to provide insight into the role of footwear in running injury and make suggestions for how to run our way out of it.

Oral Presentations

OP-AP01 Machine Learning

A POPULATION-BASED STUDY EXPLORING BIOCHEMICAL PHENOTYPES AND THEIR RELATIONSHIP WITH PHYSICAL FUNCTION, HEALTH OUTCOMES AND MORTALITY IN OLDER ADULTS USING UNSUPERVISED MACHINE LEARNING APPROACH.

GONZÁLEZ MARTOS, R., RODRÍGUEZ-GÓMEZ, I., RAMÍREZ-CASTILLEJO, C., GALEANO, J., ARA, I, ALEGRE, L.M., RODRÍGUEZ-MAÑAS, L., GARCÍA-GARCÍA, F.J., GUADALUPE-GRAU, A.

UNIVERSIDAD POLITÉCNICA DE MADRID; UNIVERSITY OF CASTILLA-LA MANCHA

INTRODUCTION: Aging is associated with health issues leading to functional decline and disability. Identifying key factors (biochemical, physical, or social) for successful aging is crucial for resource efficiency [1]. Using unsupervised clustering analysis on routine laboratory test data, we aim to uncover biochemical phenotypes in the spectrum of old age. This approach may enhance understanding of mechanisms influencing healthy aging. We also intend to explore associations between these phenotypes and key health outcomes, including mortality [2].

METHODS: A final sample of n=1491 participants (65 to 99 years old, 57.7% women), from the Toledo Study for Healthy Aging (TSHA), was included. Hierarchical and k-means cluster analyses (Orange software) incorporated 39 variables related to white and red blood cells, and renal, liver lipid, and glucose metabolism. Health outcomes included body composition (DXA), physical functionality (SPPB test), physical activity (PASE questionnaire), disability (Katz questionnaire), frailty (FTS-5 test), comorbidity (medical history), and 12-year mortality (Spanish National Mortality Database). The associations between cluster membership and health outcomes and mortality hazard ratios (HR) were analyzed through general linear models (ANCOVA, SPSS software) and Cox regression (STATA software) respectively, including sex, age, and socioeconomic status as covariates.

RESULTS: Three different clusters were identified: Cluster 1 (41.8%, Healthy), all biochemical values within the normal range, taken as reference for statistical analysis; Cluster 2 (44.5%, Metabolic), characterized by high but sub-clinically relevant

levels of glucose, triglycerides, HOMA, and liver enzymes; and Cluster 3 (13.7%, Red Blood Cells), defined by lower levels of hematocrit, hemoglobin, and red blood cells. Our findings revealed that Cluster 2 (metabolic) showed a significantly higher BMI in men (28.70±0.21 vs. 27.46±0.35 Kg/m2) and women (31.01±0.35 vs. 29.61±0.26 Kg/m2), and a higher risk of death in women (HR=1.50; 95%CI= (1.08; 2.08)) respect to the healthy cluster. Cluster 3 (Red Blood Cells) participants were older (77.8±0.4 vs. 74.5±0.2 yrs.), and men were less physically active (PASE score: 57.46±6.03 vs 69.40±4.41) and showed worse physical functionality with less gait speed (0.85±0.04 vs 0.94±0.03 m/s) than healthy cluster. They were also less independent in their daily activities with a significantly lower Katz index in both sexes (men: 5.46±0.08 vs. 5.82±0.06; women: 5.56±0.07 vs. 5.77±0.04). Significant findings ($p<0.05$) were observed for all mentioned values.

CONCLUSION: Our findings suggest that a biochemical phenotype characterized by impaired red blood cell function is associated with a decreased health-related quality of life, whereas impaired glucose and lipid metabolism is associated with a higher risk of death. This information could be helpful to develop exercise-based interventions oriented to healthy aging.

1. Urtamo et al. (2019) 2. O 'Sullivan et al. (2011)

PREDICTING VERTICAL GROUND REACTION FORCE CHARACTERISTICS AND CONTACT TIME IN RUNNING WITH MACHINE LEARNING

BOGAERT, S., DAVIS, J., VANWANSEELE, B.

KU LEUVEN

INTRODUCTION: Running poses a high risk of developing running-related injuries [1]. The majority of RRIs are the result of an imbalance between the cumulative musculoskeletal load and a person's load capacity [2, 3]. Therefore, measuring and monitoring the musculoskeletal load during running is essential for the prevention of RRIs. A general estimate of whole-body biomechanical load can be inferred from ground reaction forces (GRFs). Unfortunately, GRF typically can only be measured in a controlled environment, which hinders its wider applicability. Applying machine-learning algorithms to wearables-collected data enables runners to monitor GRF characteristics in various settings [4], extending beyond the confines of the laboratory. Our study presents and evaluates a machine-learning method to predict contact time, active peak, impact peak, and impulse of the vertical GRF (vGRF) during running from 3D sacral acceleration.

METHODS: Twenty-seven subjects with varying running experience ran on an instrumented treadmill (Motek Medical BV) at various speeds for 150 seconds at each speed. The instrumented treadmill measured ground reaction forces, and a sensor (Xsens Technologies, Movella) on the lower back captured 3D acceleration. In total, we obtained 50072 steps of which 28078 steps had an impact peak. Subject characteristics, general statistical, and domain-specific features were extracted from the 3D acceleration signal for each step.

We used a Lasso (Least Absolute Shrinkage and Selection Operator) model to predict the characteristics of the vGRF. We partitioned the data into a training (23 subjects) and test (4 subjects) set. To select the hyperparameter settings, we conducted a leave-one-subject-out cross-validation on the training set. We compared the performance of our approach to the methods outlined in the work of Alcantara et al. [4] regarding active peak, contact time, and impulse; Verheul et al. [5] for the impact peak using a single-sensor setting.

RESULTS: The developed models for predicting active peak, impact peak, impulse, and contact time had a root-mean-squared error of 0.084 body weight (BW), 0.221 BW, 0.005 BW.s, and 0.008 seconds, respectively. Our models outperform the corresponding comparison method from the literature on our data sets by respectively 0.061 BW, 0.054 BW, 0.0032 BW.s, and 0.0006 seconds.

CONCLUSION: These results indicate the feasibility of our approach for monitoring selected factors associated with running-related injuries outside the laboratory with a single sensor.

REFERENCES:

[1] Videbæk, S. et al. Sport. Med. 45, 1017–1026 (2015)

[2] Hespanhol Junior, L. C. et al. Sport. Med. 47, 367–377 (2017)

[3] Bertelsen, M. L. et al. Scand. J. Med. Sci. Sport. 27, 1170–1180 (2017)

[4] Alcantara, R. S. et al. PeerJ 9, 1–18 (2021)

[5] Verheul, J. et al. J. Sci. Med. Sport 22, 716–722 (2019)

MACHINE LEARNING IN MOTION: ENHANCING MOVEMENT COMPETENCE ASSESSMENTS USING WEARABLES AND NOVEL DATA SIMULATION TECHNIQUES

SWAIN, T.1, MCNARRY, M.1, BARNES, C.1, SIMPSON, C.2, THOM, G.3, RYAN, L.1, MACKINTOSH, K.1

1. SWANSEA UNIVERSITY, 2. DUNDEE AND ANGUS COLLEGE, 3. INDEPENDENT RESEARCHER, DUNDEE, UNITED KINGDOM

INTRODUCTION: Assessing movement quality in real-world settings remains challenging. Indeed, previous research has questioned the reliability and accuracy of directly quantifying motion characteristics (e.g. range of motion) using wearables (1, 2). Whilst machine-learning classification techniques offer promising alternatives, they are often limited by a reliance on small sample sizes, thereby impacting robustness and real-world transferability. The aims of this study were therefore two-fold: i) to generate a machine-learning algorithm to classify foundational motor skill competence, using the

bodyweight squat as a representative movement; and ii) to develop a novel data simulation method to artificially boost the sample size and enhance classification accuracy.

METHODS: Twenty-three participants (28.1 ± 7.3 years; 17 males) performed three sets of 10 repetitions of squats. Data were captured using three Polar Verity Sense magnetic, angular rate, and gravity (MARG) sensors on the chest and both ankles. Three United Kingdom Strength & Conditioning Association accredited coaches classified each repetition as 'good', 'average', or 'poor', based on pre-determined movement criteria, with the modal score for each repetition used in data labelling. To expand and balance the dataset, original data were augmented with simulated data using Weibull distributions or Gaussian mixture models depending on the feature frequency distributions of the most informative features. A support vector machine (SVM) ensemble with a modal voting system was developed to classify squats with raw, then augmented raw and simulated data, for a comparative analysis.

RESULTS: Using only the original data for training, overall SVM ensemble classification accuracy using a hold-out dataset was 40%. However, the model yielded 0% accuracy for the repetitions labelled as 'good' due to dataset imbalance. Data-boosting improved sensitivity, increasing 'good' accuracy to >95%. However, overall accuracy did not improve due to large 'average' class inaccuracies (10%).

CONCLUSION: This study introduces a novel data-simulation method for improving movement classification by addressing imbalances often inherent in small datasets. Data-boosting was effective, improving sensitivity and accuracy for 'good' and 'poor' squat repetitions, even with small training datasets. However, overall accuracy did not improve due to classification issues in the 'average ' category. This underlines the challenges of using subjective scoring as the standard for algorithm training. Recognising the limitations of the current dataset, future research should refine data-labelling methods and seek larger, more balanced datasets to mitigate intermediate class ambiguity and further the pursuit of practical application.

References

1. T. A. Swain et al., Sports Medicine, 53, 2477–2504 (2023)

2. I. Poitras et al., Sensors. 19, 1555 (2019).

BEYOND PLAYING POSITIONS: A NEW APPROACH TO CATEGORIZE SOCCER PLAYERS BASED ON MACHINE LEARNING

DE HAAN, M., VAN DER ZWAARD, S., SANDERS, J., BEEK, P., JASPERS, R.

VU AMSTERDAM

INTRODUCTION: It is unknown if categorizing soccer players by playing position is useful from a physiological perspective. This study examined sprint, endurance, and match-specific running performance of players, assessed alignment of match-specific running performance with playing positions, and evaluated the potential of unsupervised machine learning for identification of players with similar match-specific running profiles.

METHODS: Forty elite male soccer players had match-specific running data collected over two seasons, with 31 undergoing exercise testing, consisting of a 20-meter sprint and a treadmill test to measure maximal oxygen uptake. k-means clustering identified subgroups based on players' match-specific running performance. Differences in sprint, endurance, and match-specific running were compared between playing positions and between clusters. Both grouping methods were tested for their ability to identify subgroups with similar total distance (TD), low (LIR), moderate (MIR), high intensity running (HIR) and sprint distance in matches.

RESULTS: Match-specific running performance differed between playing positions, although notable variation was observed per playing position. Clustering based on match-specific running performance revealed less variance within groups (TD: $P = 0.049$, LIR: $P = 0.032$, HIR: $P = 0.033$) and larger standardized differences between groups (LIR: $P = 0.037$, MIR: $P = 0.041$, HIR: $P = 0.035$, Sprint: $P = 0.018$) compared to grouping by playing position. Moreover, 20-m sprint speed differed between the sprint and high intensity endurance cluster (25.22 vs 23.75, $P = 0.012$), but not between playing positions.

CONCLUSION: Utilizing unsupervised machine learning to group soccer players based on match-specific running performance enhances the identification of player groups with distinct physical profiles. This data-driven approach supports performance evaluation and enables training optimization towards groups of players with similar match-specific running performance.

TRIPLE-E PRINCIPLE FACILITATES BUILDING THE SOTA MACHINE LEARNING MODELS FOR ASSESSING ENERGY EXPENDITURE IN DANCE

TAO, K., MENG, K., GAO, B., QIU, J.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Dance, as a widely practiced physical activity worldwide, encompasses diverse styles and tempos, making it challenging to accurately assess energy expenditure. Traditional methods rely on empirical formulas embedded in ActiGraph accelerometers, calculating vector magnitude counts per minute to gauge dance intensity. However, these formulas often lead to significant bias in estimating energy expenditure. To address this issue, multiple wearable sensors and accelerometers have been utilized to reduce prediction bias. Nevertheless, this approach increases the complexity of energy expenditure models and impacts participants flexibility during dance. This study introduces the Triple-E principle: effectiveness, efficiency, and extension. By adhering to this criterion, we developed state-of-the-art (SOTA) machine learn-

ing models to assess energy consumption during dance with the highest accuracy, minimal complexity, and optimal suitability.

METHODS: We enrolled 250 participants (mean age ±SD: 63.0 ±6.0 years) who engaged in one of three dance styles (ballroom, aerobic, square). Before the experiment, they completed a survey on anthropometric measures and exercise habits, underwent body composition exams, and wore CORTEX MetaMax 3B gas analyzers and ActiGraph wGT3X-BT accelerometers on five body sites. Ballroom dancers had two 10-minute dance sessions followed by a 10-minute rest. Aerobic dancers had one 20-minute session followed by a 10-minute rest. Square dancers had a 10-minute intense dance, a 10-minute soft dance, and a 10-minute rest. Participants rated perceived exertion using the RPE scale after 1-1.5 hours. After data cleaning, we obtained 311 physiological signal and 1555 acceleration count sequences.

RESULTS: Empirical formulas inaccurately assessed dance energy expenditure, with MAPE exceeding 50% and RMSE surpassing 3.23. We developed a bidirectional stepwise regression model, achieving a 0.73 average goodness-of-fit, exploring optimal accelerometer sites for Effectiveness and Efficiency. Features extracted from raw data showed varying CCC: 0.37 (waist), 0.89 (left ankle), 0.94 (right ankle), 0.78 (left wrist), and 0.80 (right wrist). A random forest regression model minimized errors to 5% (MAPE) and 0.33 (RMSE) when incorporating all site data. Wrist accelerometers and heart rate sufficed for energy expenditure estimation, with RMSE values of 0.35 and 0.36, respectively, indicating a trade-off between effectiveness and efficiency. A neural network pipeline, based on extension, automatically assessed energy expenditure, yielding R-squared values of 0.842, F1-score of 0.709, and recall of 0.774.

CONCLUSION: This study, to our knowledge, is the first to systematically assess energy expenditure in dance. Our contributions are twofold: introducing the Triple-E principle to regulate model aspects, and developing SOTA machine learning models for optimal sensor selection and accurate energy expenditure estimation.

Oral Presentations

OP-BM02 Motor Learning and Motor Control

FACILITATION OF CORTICOSPINAL EXCITABILITY DURING RECALLING AUTOBIOGRAPHICAL FEAR MEMORIES

MASHIKI, Y., KANEKO, N., KATO, T., YAMASAKI, D., TAKAHASHI, R., NAKAZAWA, K.
THE UNIVERSITY OF TOKYO

INTRODUCTION: Emotions significantly influence sports performance via modulation of motor control. A previous study indicated that negative autobiographical memories increase corticospinal excitability (CSE), which plays a crucial role in motor control [1]. However, we need to deal with various emotions, such as happiness, sadness, fear, and anger. Therefore, it is essential to explore the effect of discrete emotions for a better understanding of the relationship between emotions and motor control. Furthermore, it may provide valuable insight into improving responsiveness to various situations during sports performance by identifying the muscles in which CSE is likely to be modulated by emotions. Thus, this study aimed to investigate: (1) the modulation of CSE by discrete autobiographical emotional memories and (2) the muscle-specificity of CSE modulation in response to emotions.

METHODS: Sixteen healthy individuals (22–30 years old) participated in this study. Participants were seated on a chair. Electromyographic activity was recorded from the flexor carpi radialis (FCR), extensor carpi radialis (ECR), first dorsal interosseous (FDI), and abductor pollicis brevis (APB) muscles. CSE was evaluated by motor-evoked potential (MEP) amplitudes which were elicited by transcranial magnetic stimulation (TMS) to the primary motor cortex. Initially, participants were asked to write down situations in which they had experienced happiness, sadness, fear, and anger. For the neutral condition, participants were asked to describe their typical morning routine. We recorded 12 MEPs as they recalled the written situations for each emotion. MEP amplitudes during the recall of happiness, sadness, fear, and anger were normalized to the MEP amplitudes in the neutral condition. A statistical analysis was conducted using a two-way analysis of variance (ANOVA) with aligned rank transform. The ANOVA included two factors: 4 muscles and 5 emotions. Contrast tests were used as subsequent post-hoc tests. The level of significance was set to $p < 0.05$.

RESULTS: The two-way ANOVA showed a significant main effect for emotions ($p = 0.004$), but not for muscles ($p = 0.183$) and the interaction between muscles and emotions ($p = 0.502$). Subsequent post-hoc tests on emotions showed that the fear emotion significantly increased MEP amplitudes more than the neutral condition ($p = 0.001$, + 39.3%). On the other hand, there were no significant differences between any of the other emotions ($p > 0.05$).

CONCLUSION: Our results indicated that although no significant difference in MEP amplitudes was found between upper-limb muscles, the recall of autobiographical fear memories significantly increased MEP amplitudes. These suggest that the fear memories facilitate CSE and that this facilitation is non-specific to upper-limb muscles. Our finding enhances our comprehension of the interplay between emotions and motor control.

REFERENCE:

1. Mineo et al., Neuropsychologia, 2018.

DECODING CORTICAL BIOMARKERS IN PARKINSONS DISEASE DURING OVERGROUND WALKING

PESKAR, M., GRAMANN, K., KALC, M., MILADINOVIC, A., MANGANOTTI, P., MARUŠIC, U.
SCIENCE AND RESEARCH CENTRE KOPER

Although highly automated, human gait is dependent on cortical resources and can be observed in spectral features such as sustained beta band (18-30Hz) desynchronization and gait-phase dependent modulation in the low gamma-band (24–40 Hz) recorded over central sensorimotor cortices. Contrary, Parkinson's disease (PD) is characterized by beta-band hypersynchrony which is positively associated with the symptoms of bradykinesia. However, this cortical phenomenon has never been noninvasively investigated in ecologically valid conditions during unrestricted overground walking and concurrent performance of a cognitive task. This study aimed to elucidate the mechanisms subserving full-body movement execution in conditions where attentional resources are simultaneously allocated to both cognitive and motor tasks mimicking real-life scenarios in PD patients. Sixteen early on-medication PD patients (aged M = 62.75 ± 5.9 years; 8 women) and 16 healthy controls (HC; aged M = 64.1 ± 6.5 years; 8 women) performed a self-paced overground walking task in a wide (80 cm) and narrow (40 cm) lanes both as single-task conditions (STwide, STnarrow) and with a secondary visual discrimination task as dual-task conditions (DTwide, DTnarrow). A mobile 128-channel EEG and full-body kinematics were recorded to compute gait-phase-dependent spectral modulation at the Cz electrode. Nonparametric cluster-based permutation testing correcting for multiple comparisons across all time-frequency space was used (1000 iteration, $\alpha \leq .05$). We observed faster walking speed for HC versus PD patients ($F(1, 30)=8.10$, $p=.008$) and for ST as opposed to DT conditions ($F(1, 30)=41.61$, $p<.001$). No significantly different clusters of cortical signatures would discriminate PD patients and HC or wide and narrow lane walking conditions. However, PD patients demonstrated greater synchronization in the beta and low gamma activity in both DT conditions compared to their respective ST variants. The differences were observed in the phase of gait following the heel strikes indicating preparation for shifting the weight to a single leg. The effect was more pronounced in the narrow walk conditions. The PD patients exhibit similar cortical signatures to HC during overground walking but seem to become prone to the cortical signature related to movement inefficiency upon performing cognitive-motor dual-tasking. In PD patients but not HC a secondary cognitive task evoked a gait-phase-locked synchronization in the high spectral frequencies, which could suggest the limited availability of cognitive resources at that particular time during the gait phase while the attention had to be continuously divided between the two tasks. These results indicate that movement execution in PD could be impeded by increasing the load on the cognitive systems. These outcomes provide valuable insights into mechanisms of simple real-life cognitive-motor dual-tasking in PD and can inform intervention and fall prevention strategies.

FATIGUE-RELATED INCREASES IN ALPHA BAND COMMON SYNAPTIC INPUT IS EXPLANATORY OF ALTERATIONS IN THE STRUCTURE OF LOWER-FREQUENCY OSCILLATIONS IN KNEE EXTENSOR TORQUE.

FENNELL, C., MAUGER, A., HOPKER, J.
UNIVERSITY OF KENT

INTRODUCTION: Torque complexity (the torque signal's nonlinear temporal and spatial structure) is indicative of the neuromuscular system's ability to meet the imposed motor task, and knee extensor (KE) torque complexity has been shown to decline with fatigue (1). However, the mechanisms underlying the fatigue-induced changes in complexity are yet to be fully elucidated. It has previously been demonstrated that common synaptic inputs to the motoneuron pool, estimated by intramuscle coherence, largely determine the structure of oscillations in the torque signal (2). This study investigated whether the proportion of common synaptic input to the vastus lateralis muscle (VL) could explain the effect of fatigue on KE torque complexity.

METHODS: Fifty-seven participants completed three fresh 20 s isometric KE contractions at 20% MVC, followed by a series of repeated 3 s isometric KE contractions at 60% MVC to task failure. Immediately after failure a 20 s isometric KE contraction at 20% MVC was performed. High-density surface EMG signals were recorded from the VL during all 20% MVCs and decomposed into individual motor unit (MU) spike trains. Thirty-seven participants provided enough MUs (>6) during all 20% MVCs for coherence analysis, as such only these participants data were analysed. Intra-muscle coherence was estimated from the MU data. KE torque variability and complexity was assessed using the coefficient of variation of torque (CVT) and multiscale sample entropy (MSE; across 28 coarse-grained scales) respectively.

RESULTS: The MSE analysis revealed a condition (fresh vs. fatigue) by coarse-grained scale interaction (i.e., a MSE curve cross-over; $P<0.001$); the fatigued 20% MVCs presented with a significantly lower sample entropy (SampEn; $P<0.05$) at shorter scales (<7 scales) but a significantly higher SampEn ($P<0.05$) at longer scales (>13 scales) when compared to the fresh 20% MVCs. Alpha coherence (5-15Hz) was significantly higher after task failure ($P=0.001$; fresh=1.30±0.09 vs. fatigued=1.43±0.22). The difference in Alpha coherence from fresh to fatigue was predictive of the difference in SampEn at scales 10 to 28 (all $P<0.05$; $R2=0.11$-0.19). Alpha coherence was also predictive of SampEn calculated at coarse-grained scales 7 to 28 during fresh (all $P<0.05$; $r=0.34$-0.60; $R2=0.12$-0.36) and fatigued (all $P<0.05$; $r=0.34$-0.52; $R2=0.11$-0.27) 20% MVCs. Fatigue resulted in a significantly higher CVT ($P<0.001$). The increase in alpha coherence with fatigue was predictive of the decline in the CVT ($P<0.001$; $r=0.56$; $R2=0.31$).

CONCLUSION: The MSE curve cross-over captures a fatigue-related change in torque regularity at the different scales, suggestive of an alteration in structure across the oscillatory frequencies present within the torque signal. Common synaptic input in the alpha band may be able to explain some of the fatigue-related alterations in the structure of lower-frequency oscillations of the KE torque signals.

1)Pethick et al. J Physiol 2015

2)Farina & Negro. Exerc Sport Sci Rev 2015

LONG-TERM DEVELOPMENT OF A MOTOR MEMORY

NIETSCHMANN, P., FRANKLIN, S., PAPADOPOULOU, T., FRANKLIN, D.W.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Humans exhibit remarkable abilities in learning motor skills. While motor performance continues to improve with practice, even after years of learning[1], most studies only examine the learning of novel dynamics over several hundred trials[2 3]. That is, most of our understanding of the parameters and characteristics of motor learning rely on studies that examine only the early adaptation processes. While some studies of complex task adaptation have examined thousands of trials, the adaptation to a single velocity-dependent force field is usually considered to be complete within a few hundred movements[2 3]. Here we investigate motor adaptation to a single novel force field with over seven thousand trials and multiple weeks of training, to uncover the process of human motor learning.

METHODS: Ten right-handed participants performed training sessions once every week for eight consecutive weeks, with a follow-up session 15 weeks later to assess retention. Participants performed forward reaching movements with their right hand using a robotic manipulandum in a velocity dependent curl force field. Throughout the sessions we probed the adaptation process by measuring the decay, spontaneous recovery, retention, angular generalization, and transfer of the motor memory to the opposite limb.

RESULTS: Participants adapted quickly to the dynamics, showing a fast reduction in kinematic error and a rapid increase in predictive force compensation within the first session. Interestingly, we find continuous adaptation over the subsequent sessions. Moreover, there is strong retention of the predictive forces between sessions, increasing gradually until the fifth session. We observe a strong increase in spontaneous recovery between the first and seventh session, indicating a stronger motor memory, but little change in the decay rates over the training weeks. Despite extensive training, we found no evidence of transfer to the left hand. However, while generalization to adjacent reaching directions was stable across training weeks, we did find a slight narrowing of the Gaussian-like angular generalization with practice, suggesting a slight fine tuning of the spatial properties of the motor memory. Finally, even after 15 weeks without practice, participants immediately exhibited similar levels of predictive adaptation to the dynamics.

CONCLUSION: Our results show that learning continuously progressed over time, creating a stable motor memory that is retained for prolonged periods without task exposure. Notably, while predictive adaptation developed over time, other aspects, such as the decay rate, remained relatively unaffected during our training period. Our research highlights motor memory formation and durability and could inform training strategies aimed at developing motor skills or advancing rehabilitation.

[1]Crossman, Ergonomics. 1959, 2:153-166.

[2]Franklin et al., J Neurophysiol. 2012, 108:467-478.

[3]Shadmehr and Mussa-Ivaldi, J Neurosci. 1994 14:3208-3224.

EFFECT OF A FOUR-WEEK TRAINING WITH UNSTABLE BOARDS ON POSTURAL CONTROL MECHANISMS

RIZZATO, A., FAGGIAN, S., PAOLI, A., BOZZATO, M., MARCOLIN, G.

UNIVERSITÀ OF PADOVA

INTRODUCTION: Understanding the postural control mechanisms in dynamic balance training is warranted. We primarily aimed to study whether a four-week training with unstable boards could influence a transfer of balance ability to (i) a more challenging task and (ii) an untrained balance task (i.e., unexpected perturbation of the base of support). Moreover, we aimed to understand, through a non-linear center of pressure (CoP) analysis (i.e., Sample Entropy), whether a shift from voluntary to automatic postural mechanisms could occur in trained and untrained balance tasks.

METHODS: Thirty-four young adults participated in the study and were randomly divided into a training (TR; N=17; 27.45±3.41yrs; 1.74±0.08m; 69.35±10.8kg) and a control (CTRL; N=17; 28±4.37yrs; 1.73±0.07m; 68.3±10.79kg) group. TR and CTRL were assessed for postural balance at the beginning of the study (T0) and after one month (T1) consisting of: static balance (SB); dynamic balance on unstable boards of easy (DBE) and hard (DBH) level; balance under unexpected perturbation of the base of support (PER). For each condition, subjects performed five trials over a force plate (AMTI BP400600, US) to measure the CoP trajectory. During SB, the subjects quietly stood in an upright posture. During DBE and DBH, subjects stood on the unstable board, aiming to maintain it parallel to the ground. During PER, subjects received an unexpected perturbation of the base of support (direction: forward; displacement: 50mm; ramp rate: 200mm/s). During DBE and DBH, an inertial measurement unit recorded the angular displacement of the board to calculate three parameters of balance performance: full (FB), fine (FiB), and gross (GB) balance. During PER, the mean velocity, the first peak, and the maximal oscillations (□CoPMax) of the CoP trajectory were calculated in the 2.5s window after the perturbation. Moreover, the CoP trajectory was quantified in terms of regularity (Sample Entropy) in SB, UBE, and UBH conditions. The TR group underwent a month (T0-T1) of training (3 days/week) with increasing difficulty only using the easy-level unstable board.

RESULTS: Two-way ANOVA showed improvements in balance performance (T0 vs. T1) in the TR group for FB ($p<0.001$), FiB ($p<0.05$), and GB ($p<0.01$) both in DBE and DBH. Similarly, the PER task had significant increases (T0 vs. T1) in the first peak

(p<0.01) and□□CopMax (p<0.05). Sample Entropy parameters were significantly higher (p<0.001) after the training (T1) in DBE and DBH conditions.

CONCLUSION: The one-month training successfully improved dynamic balance performance. A transfer of the balance ability was observed towards a more difficult (i.e., easy to hard) and to an untrained (i.e., unexpected perturbation) balance task. The non-linear CoP measure showed a shift from voluntary to automatic postural control mechanisms also in the task where no training occurred.

REFERENCES:

1. Rizzato et al., Hum Mov Sci., 2023.

2. Paillard et al., Biomed Res Int., 2015.

Invited Symposium

IS-SH03 Unmasking Educator Struggles

PHYSICAL EDUCATION TEACHERS AS STREET-LEVEL BUREAUCRATS: A WAY OF UNDERSTANDING THE PROFESSION.

SEBELIUS, S.
MALMÖ UNIVERSITY

The physical education (PE) teacher profession is a profession with a long tradition, in Sweden it has existed since 1813. During large parts of the professions history in Sweden, it has struggled to increase its status, the subject and the profession have been marginalized compared to other school subjects and other teachers (Sebelius, forthcoming). Internationally, it is seen that the profession and the subject is marginalized. PE teachers are seen as less important than core subject teachers by colleagues and school management (Richards et at, 2018). In the last 15 years, research on learning and teaching in PE has been done in Scandinavia and Europe. However, this has primarily focused on students health. What has not been investigated to the same extent is the health and work situation of PE teachers. However, Swedish research (Sebelius, 2018) has shown that by understanding PE teachers as street-level bureaucrats (SLBs), a wider knowledge about their work situation can be created. The work of a SLB is characterized by the fact that they work with people (clients), have a great deal of discretion, have too few resources and work towards unclear goals. SLBs often experience states of stress stemming from having to navigate extensive workloads and conflicting demands from the policies they implement, their bosses, themselves, and their clients (Lipsky, 2010). The SLBs can deal with stress in different ways, for example by being more empathetic towards their clients and giving more of their personal time, which further increases their stress (Ropes & de Boer, 2022). Looking at the profession, there are certain risks associated with the stress of being a SLB. A Swedish study (Sebelius, forthcoming) shows that physical education teachers use different strategies to deal with the conditions that characterize their work as SLBs. They feel compelled to organize teaching which to some extent hinders their opportunity for both relevant subject teaching and competence development. This might be a problem both for the PE teachers working situation, but also for the development of the PE subject and the PE teaching profession, as well as for the status of the profession. Relevance Increased knowledge of the work situation of the PE teaching profession. Target audience PETE-researchers, PETE-teachers

NAVIGATING THE TRANSFORMATIVE LANDSCAPE OF PHYSICAL EDUCATION: INTEGRATING TECHNOLOGY WHILE PRESERVING PROFESSIONAL IDENTITY

CHOW, G.
THE EDUCATION UNIVERSITY OF HONG KONG

Physical Education (PE) is undergoing a transformative phase, driven by the outbreak of Coronavirus Disease 2019 and the subsequent need for virtual learning. Traditionally, PE has been conducted face-to-face and played a crucial role in childrens daily physical activity. However, the pandemic has necessitated disease prevention measures, including the suspension of in-person classes in Hong Kong. As a result, there is now a growing demand for virtual PE, leading to a shift from low-tech to high-tech integration in the learning environment. To meet the needs of 21st-century learners and integrate information technology (IT) and STEAM education, schools in Hong Kong have swiftly incorporated these elements into all subjects, including PE. The expectation is for PE to combine face-to-face teaching with technology, supplementing students learning through tools like self-administered fitness tests using motion tracking technology or wearable devices. The Education Bureau in Hong Kong actively collaborates with universities to equip PE teachers with the necessary technological and technological-pedagogical knowledge. While some progress has been made through professional development programs like the STEAM in PE initiative provided by the Education University of Hong Kong, there is still a need to ensure that all front-line practitioners have the required skills and knowledge. However, this shift towards technology integration in the PE curriculum may challenge a PE teachers sense of professional identity, as their training has traditionally emphasized subject- and pedagogical-related knowledge and skills. This can result in demotivation and a loss of autonomy in how they teach PE. Therefore, the objectives of this lecture are twofold: firstly, to explore the changes in the learning environment in the 21st century, encompassing worldwide health guidelines and emerging trends in technology education that PE teachers need to address; and secondly, to discuss whether PE teachers are capable of adapting to

these changes while maintaining their sense of autonomy, competence in teaching PE, and job satisfaction. By addressing these objectives, we aim to provide PE teachers with insights, strategies, and support in navigating the evolving landscape of PE education, ensuring they can effectively integrate technology while preserving their professional identity and job satisfaction.

DOES WORKING WITH CHILDREN AND ADOLESCENTS REALLY MAKE YOU HAPPY? – THE PHENOMENON OF PROFESSIONAL BURNOUT AMONG PHYSICAL EDUCATION TEACHERS

WILCZYNSKA, D.

UNIVERSITY OF PHYSICAL EDUCATION AND SPORT

Introduction: Research highlights that physical education teachers, as human service professionals, face a heightened susceptibility to occupational burnout. Delving into the burnout tendencies within this group is imperative for the holistic well-being of both educators and students. While these teachers play a pivotal role in instilling a healthy and active lifestyle among students, the inherent demands of their profession—juggling diverse classes, sustaining high energy levels, and navigating potential administrative pressures—can significantly contribute to burnout. Thus, this study intricately explores the impact of protective factors, such as personality traits and leisure-time activities, in alleviating the challenges of teacher burnout. Material and Methods: The group of participants consisted of 73 individuals. The age of the participants ranged from 18 to 63 years old. However, the study will continue as long as it is part of the developing project. The study employs a range of research methods, including the NEO-FFI Personality Inventory, the Maslach Burnout Inventory, and the Inventory of Physical Activity Objectives. Results: Initial findings indicate that personality traits such as neuroticism, extraversion, and conscientiousness were significantly correlated with professional burnout. It has also been observed that physical activity levels do not protect against burnout. Moreover, age and internship were not related to occupational burnout. Conclusions: Understanding the factors leading to burnout allows for targeted interventions and support systems to be implemented, ensuring that these educators can continue to inspire and guide students effectively. By addressing burnout in physical education teachers, we not only safeguard the mental and emotional health of the educators themselves but also enhance the quality of the educational experience for students, fostering a positive and sustainable learning environment. Relevance Increased knowledge of the work situation of the PE teaching profession. Target audience PETE-researchers, PETE-teachers

Oral Presentations

OP-PN05 Physiology

AEROBIC PRECONDITIONING DOES NOT FURTHER AUGMENT MUSCLE HYPERTROPHY DURING SUBSEQUENT RESISTANCE EXERCISE TRAINING IN HEALTHY OLDER ADULTS

BETZ, M., MONSEGUE, A.P., AUSSIEKER, T., HOUBEN, A.J.H.M., VERDIJK, L.B., VAN LOON, L.J.C., SNIJDERS, T.

MAASTRICHT UNIVERSITY

INTRODUCTION: Resistance exercise training is an effective treatment strategy to counteract the age-related loss of muscle mass and strength in older adults. However, there is a large inter-individual variation in muscle fiber hypertrophy following resistance exercise training in older adults. It has been hypothesized that an increase in muscle fiber capillarization and perfusion capacity are prerequisite to maximize muscle hypertrophy during resistance exercise training in older adults. We assessed whether 8 weeks of aerobic exercise preconditioning, to improve muscle fiber capillarization and perfusion capacity, augments the gains in muscle mass and strength during subsequent resistance exercise training in older adults.

METHODS: In a randomized parallel design, thirty-four healthy older adults (71±5 y) participated in 12 weeks of progressive resistance exercise training, preceded by either 8 weeks of aerobic preconditioning (AER) or no exercise control (CON). Muscle strength (1RM), aerobic capacity (VO2peak test), and muscle fiber characteristics (immunohistochemistry) were assessed at baseline, following 8 weeks of AER or CON, and after subsequent 12 weeks of resistance exercise training. Femoral artery blood flow and vastus lateralis muscle microvascular perfusion kinetics were assessed at baseline and following 8 weeks of AER or CON intervention. Thigh muscle volume (MRI-scan) was assessed before and after 12 weeks of resistance exercise training. Data were analyzed by two-way repeated-measures ANOVA. A statistical level of $P<0.05$ was accepted. All data are expressed as mean±SD.

RESULTS: Aerobic exercise preconditioning increased type I (C/Fi :+19±19%, $P<0.05$) and type II (C/Fi: +35±37%, $P<0.05$) muscle fiber capillarization, with no changes in the CON group (C/Fi Type I: +0±17% Type II: -3±26%). Whereas femoral artery blood flow remained unchanged, the vastus lateralis muscle microvascular perfusion capacity tended (interaction effect, $P=0.051$) to be lower during post-exercise recovery following aerobic exercise preconditioning, with no changes in the CON group. Subsequent resistance exercise training increased 1RM leg press (+16±10% vs +12±8%, respectively, $P<0.001$) and thigh muscle volume (+0.42±0.69 vs +0.31±0.62 L, respectively, $P<0.001$), with no differences between AER and CON group (interaction effects, $P>0.4$). No differences were observed in type I and type II muscle fiber hypertrophy in response to the entire intervention program between groups (interaction effect, $P>0.5$).

CONCLUSION: Aerobic exercise preconditioning increases in type I and type II muscle fiber capillarization in healthy older adults. Aerobic exercise preconditioning does not further increase muscle hypertrophy during subsequent resistance exercise training in healthy older adults. Both structural and functional microvascular characteristics do not seem to restrict the skeletal muscle adaptive response to resistance type exercise training in healthy older adults.

ECCENTRIC TRAINING INDUCES DIFFERENT MUSCLE MITOCHONDRIAL ADAPTATIONS IN OLD VERSUS YOUNG MEN

ANSALDO, M., SAZZI, C., BROCCA, L., PORCELLI, S., QUINLAN, J.I., PHLLIPS, B.E., SMITH, K., ATHERTON, P.J., NARICI, M., BOTTINELLI, R., PELLEGRINO, M.A., FRANCHI, M.V.

UNIVERSITY OF PAVIA

INTRODUCTION: Skeletal muscle aging is not only characterized by loss of muscle mass and power but also by mitochondrial impairments and reduced oxidative function (1). Resistance training (RT) is considered among the most effective strategies to counteract muscle atrophy and preserve muscle function (2). Moderate-intensity exercise based on eccentric (ECC) contractions has been proposed as an alternative to the classic conventional RT due to its potential efficacy in increasing muscle mass and function without requiring excessive effort for the elderly population (3,4). Notably, recent evidence showed significant improvement in mitochondrial function following chronic RT (5). However, the impact of eccentric-resistance training (ECC-RT) on mitochondrial adaptations is still not known. Thus, we investigated mitochondrial adaptations in response to 8 weeks of moderate ECC-RT in old (O) vs young (Y) individuals.

METHODS: Eight O (67±1.3 y.o.) and eight Y (25±6 y.o.) subjects underwent 8 weeks of moderate-load ECC-RT consisting of 4 sets of 15 repetitions performed at 60% of ECC 1RM, 3 times/week. Before the first (PRE) and after the last (POST) training session, knee-extensors maximal voluntary isometric contraction (MVIC) torque was assessed at 3 different joint angles 60°, 70°, 80° and maximum isometric torque value obtained over the three joint angles was chosen as MVIC peak value. Muscle volume (QV) was measured by MRI. Muscle biopsies were also collected from the Vastus Lateralis and markers of mitochondrial biogenesis, content, and dynamics were analyzed by western blot. Data were analyzed by two-way ANOVA.

RESULTS: After 8 weeks of eccentric resistance training, MVIC force increased in both O and Y (17 vs. 13%, respectively $p<0.05$ for both groups). QV increased in both O and Y (4% vs. 5%) ($p<0.001$) ($p<0.01$). After training, PGC-1α decreased in O (-44%, $p<0.05$) while no changes were observed in Y ($p>0.05$). TOM20 and CS decreased in O (-29% and -31% respectively, $p<0.01$) but they remained unaffected in Y ($p>0.05$). MNF1 increased in Y (+65%, $p<0.05$), while did not change in O ($p>0.05$). Regarding mitochondrial fission, levels p637DRP1 decreased in O (-41%, $p<0.05$) and not in Y ($P>0.05$); p616DRP1 increased in Y (+300%, $p<0.05$) and not in O ($P>0.05$).

CONCLUSION: Despite the positive effect on muscle mass and strength in both O and Y, ECC-RT dampened mitochondrial biogenesis, reduced mitochondrial content, and promoted fission in O while both fission and fusion increased in Y. We can hypothesize an age-dependent response to moderate ECC-RT, with a negative effect on mitochondrial adaptations in O compared to Y. This is of particular interest, as such exercise modality, which could be tailored for elderly populations for its positive neuromuscular adaptations could not be entirely suitable for counteracting reductions in oxidative function.

(1) Tieland & Trouwborst & Clark 2017

(2) Hoppeler, 2016

(3) Quinlan et al, 2021

(4) Franchi & Reeves & Narici, 2017

(5) Mesquita et al, 2020

EFFECT OF PULMONARY MECHANORECEPTORS ON SYMPATHETIC OUTFLOW DURING MILD INTENSITY EXERCISE IN HEALTHY HUMANS

EWALTS, M., GRIFFITHS, T.D., DOUGLAS, A., JENKINS, E., OLIVER, S., STEMBRIDGE, M., MOORE, J.

BANGOR UNIVERSITY, UK

INTRODUCTION: During exercise, increased sympathetic vasomotor outflow optimizes blood flow to exercising muscles and maintains blood pressure. Several mechanisms activate vasomotor outflow during exercise, including central command, muscle afferent feedback, and the arterial baroreceptor reflex. We have shown that a sustained increase in pulmonary arterial pressure, like that displayed during exercise, elicits sympathetic activation in experimental animals and humans exposed to high altitude hypoxia. The aim of this study was to investigate an additional mechanism of exercise induced sympathetic activation, which potentially arises from mechanoreceptors located in the pulmonary arterial system.

METHODS: To address our aim, 12 healthy individuals (F=2; 28±7 years old) were studied under hypoxic conditions, a setting designed to elevate pulmonary arterial systolic pressure (PASP) above normal. The experiment comprised of three conditions: i) rest in acute hypoxia (FiO_2=12.5%; baseline); ii) mild intensity exercise (RPE 11-12) in acute hypoxia (EX) and iii) mild intensity exercise in acute hypoxia combined with inhalation of vasodilator nitric oxide (iNO, 40 ppm) to selectively reduce PASP (EX reduced PASP). Muscle sympathetic nerve activity (MSNA; microneurography), ventilation (VE; breath-by-breath online gas collection system), blood pressure (BP; photoplethysmography) and heart rate (HR) were measured continuously, and ratings of perceived exertion was assessed in the final minute of exercise. PASP was measured using Doppler echocardiography. Vascular-sympathetic baroreflex gain was determined using spontaneous baroreflex sensi-

tivity. To detect differences between conditions, a one-way repeated measures ANOVA was performed, followed by Bonferroni corrected T-tests. A statistical level of p<0.05 was accepted. All data are expressed as mean±SD.

RESULTS: PASP increased during exercise (baseline 28±7 vs. EX 42±9 mmHg; P<0.001) and was lower in EX reduced PASP vs EX (42±9 vs. 36±8 mmHg; P=0.018). MSNA burst frequency increased by 61% during exercise (baseline 21±7 vs. EX 34±9 burst/min; P=0.001), which was partially reversed (12%) by reducing PASP with iNO during exercise (EX 34±9 vs. EX reduced PASP 30±9 burst/min; P=0.027). Reducing PASP during exercise also reduced MSNA operating point (burst incidence; 28±9 vs. 25±8 bursts/100Hb; P=0.030), without changing diastolic operating pressure (79±16 vs. 78±12 mmHg; P=0.307), or spontaneous vascular-sympathetic baroreflex gain (P=0.726). Reducing PASP during exercise had no effect on HR (P=0.999), VE (p=0.159), workload (P=0.701) or RPE (P=0.667).

CONCLUSION: Lowering PASP reduced sympathetic outflow and reset vascular sympathetic baroreflex control of MSNA downward during hypoxic exercise. Our findings indicate that, in addition to established neural mechanisms, an input from pulmonary arterial mechanoreceptors contributes to sympathetic activation and arterial baroreceptor reflex resetting during exercise.

SEX DIFFERENCES IN CARDIAC AND RESPIRATORY RESPONSES DURING EXERCISE AT SEA LEVEL AND HIGH ALTITUDE.

CALLOVINI, A., FORNASIERO, A., SAVOLDELLI, A., BORTOLAN, L., PELLEGRINI, B., CAPELLI, C., SCHENA, F.

CERISM - UNIVERSITY OF VERONA

INTRODUCTION: Sex differences in exercise physiology are underrepresented in the literature, particularly in specific contexts such as High Altitude (HA)1. The aim of this study was to investigate the influence of sex on the cardiac and respiratory responses to exercise at sea level (SL) and HA.

METHODS: Eight women (F; VO2max:49±3 mL/kg/min) and eight height-matched men (M; VO2max:59±5 mL/kg/min) underwent a VO2max test, at SL (20.9 FiO2) and at a simulated altitude of 4500m (11.8 FiO2). These were followed by two pulmonary function (PF) evaluation sessions, one at SL and one at HA, where cardio-respiratory responses, Inspiratory Capacity (IC), and Diffusion Capacity (DLCO) were assessed during moderate (mod), heavy (heav) and severe (sev) exercise.

RESULTS: VO2max (F:-32%, M:-31%), VEmax (F:-8%, M:-7%) and HRmax (F:-6%, M:-6%) were significantly reduced at HA (all p<0.001). During PF, submaximal VO2 was lower at HA (p<0.001) in both sexes, with a sex*intensity interaction effect (p<0.001) indicating progressively higher sex differences with increasing exercise intensity regardless of condition. SpO2 was significantly reduced at HA (≈ -29%), with no general effect of 'sex' or 'intensity'. Submaximal ventilation (VE) was similar between sexes at SL, whereas it was significantly lower during heav and sev at HA in women if compared to men (condition*intensity*sex interaction, p=0.021). Cardiac responses (i.e., Q, SV, and HR) showed a 'FiO2*intensity' interaction (p=0.028, 0.004, and 0.001, respectively), displaying a trend toward a decrease at HA as exercise intensity increased (Q: ≈+6, -6, -10%; SV: ≈+4, -5, -6%; HR:≈+2, -0.4, -4% for mod, heav and sev, respectively). No sex differences were detected in these variables. Breathing responses derived from IC were reduced in females, with no additional effect of HA. DLCO values, even when corrected for Alveolar volume (Va), were lower in females at both SL and HA (p=0.023) for all the intensity domains. Finally, a reduction in DLCO (mod:-11 and -1%; heav:-12 and -6%; sev:-7 and -12% for M and F, respectively) and DLCO/Q ratio (mod:-16 and -8%; heav: -8 and -3 %, sev: -4 and -3% for M and F, respectively) was noted in both sexes at HA (p<0.001).

CONCLUSION: Similar maximal and submaximal oxygen consumption differences between F and M have been found at SL and HA. SpO2 was reduced by hypoxia, but similar between sexes in the two conditions. Cardiac responses (e.g, HR, SV and CO) were unaffected by sex at both maximal and submaximal levels, while respiratory responses (IC and DLCO outcomes) have been confirmed to be impaired in women2, with no additional effect of HA on the sex gap already present at SL in these variables. VE differences between sexes found at HA but not SL underline the central role of ventilatory responses in determining sex differences to exercise at HA.

1. Sims ST, et al. Exp Physiol. 2018; doi:10.1113/EP086797

2. Raberin A, et al., Sport Med. 2023. doi:10.1007/s40279-023-01954-6

Oral Presentations

OP-BM03 Biomechanics II

LOWER-LIMB FORCE-PRODUCTION CAPACITIES IN ALPINE SKIING DISCIPLINES: CRITICAL FORCE MATTERS?

CHOLLET, M., HINTZY, F., BOWEN, M., MOREL, B., SAMOZINO, P.

UNIVERSITÉ SAVOIE MONT BLANC

INTRODUCTION: In competition, there are four main alpine skiing events: slalom (SL), giant slalom (GS), super giant slalom (SG), and downhill (DH). Each event differs in race duration, turn number, turn radii and speed reached (1). Therefore, the average turn-by-turn forces and impulses the skier applies vary across events (2). The off-snow lower-limb isometric force has been previously shown to be related to skiing event-specific performance (3). Nevertheless, despite evidence demonstrating the appearance of fatigue after repeated turns (4), this study only focused on free-fatigue maximal force capaci-

ties without considering strength endurance capacities The latter can be characterized by the critical force, i.e. the maximal force which can be sustained without inducing acute fatigability. Therefore, the present study aimed to test the relationship between skiing event-specific performance and maximal isometric force, rate of force development and critical force.

METHODS: Nineteen skiers (27 to 100 FIS points) participated in this study. Maximal isometric force (Fmax), maximal rate of force development (RFDmax), and critical force (CF) were assessed using an isometric leg press ergometer within the same session. CF was determined using a Ramp Above Critical Level Endurance Test (5). Briefly, this test consisted of repeated submaximal isometric 2s contractions spaced by 2s of rest during a 300s-decreasing ramp test from 80% to 0% of Fmax. Every 28s, maximal isometric force was assessed. Based on the model of Bowen et al. (6), CF was computed as the targeted force at the instant when the maximal isometric force stopped to decrease and started to recover. Performance indexes in each skiing event (SL, GS, SG, and DH) were defined as the FIS points for the 2022/2023 season. Multiple linear regressions were used to understand whether interindividual variability in each physical capacity (Fmax, RFDmax, and CF) explains variability in event-specific performance.

RESULTS: SL performance was only and positively associated with RFDmax (model R2 = 0.41, p = 0.004). GS performance was only and positively associated with CF (model R2 = 0.36, p = 0.008). SG performance was only and positively associated with CF (model R2 = 0.37, p = 0.008). DH performance was positively associated with CF and Fmax (model R2 = 0.89, p < 0.001).

CONCLUSION: This study demonstrates specific associations between skiing performance and off-snow physical capacities. Performance is mainly explained by RFDmax in SL, CF in GS, CF in SG and both CF, and Fmax in DH. Physical capacities explained a higher part of skiing performance in DH compared to the other events. These results evidence the importance of strength endurance capacities in skiing performance and can help trainers and skiers in event-specific physical preparation.

EFFECT OF VELOCITY ON CRITICAL TORQUE, CRITICAL POWER AND WORK ABOVE CRITICAL INTENSITY: EXPERIMENTAL EVIDENCE IN PEDALING

BOWEN, M., SAMOZINO, P., MOREL, B.
SAVOIE MONT BLANC UNIVERSITY

INTRODUCTION: The Critical Power is the severe intensity domain boundary above which fatigue develops drastically and non-steady-state physiological responses occur (1). However, a given power can be developed using different combinations of torque and velocity. During maximal effort, velocity is known to influence the maximal torque or power, which is well described by linear force-velocity or polynomial power-velocity relationships. Although a vast literature has studied critical power, relatively few studies have focused on the effect of the velocity condition. In addition, only 2 velocity conditions were usually tested given the physical hardship and/or time-consuming aspects of assessing critical power using time to exhaustion or 3-min all-out methods (2). Thanks to the development of a new method for assessing critical power during a single 5-min submaximal exercise: the Ramp Above Critical Level Endurance Test (RACLET) (3), the study's aim was to test the effect of the velocity condition on critical power (Pc) and torque (Tc) over a large spectrum in pedaling.

METHODS: Based on Bowen model (4), which establishes the proportionality between work accumulation above the critical intensity (Wac) and fatigability during exercise in the severe domain, RACLET was used to determine Tc and Pc under different velocity conditions. Briefly, this test consisted of a 5-min isokinetic pedaling decreasing power ramp, where maximal power was assessed every 30 s from a 6-pedal-strokes sprints. The ramp is designed such that the target power starts above and decreases below Pc without leading to exhaustion. Thus, Pc was determined to be the power target when the maximal capacities stopped decreasing and began to recover. Twenty participants realized five RACLET under different pedaling rate conditions: from 40 to 120, every 20 RPM. From each RACLET, the model was fitted to the maximum power data to obtain the initial power (Pi) & Pc parameters for each cadence. The cadence effect on Tc, Pc, and Wac was modeled and tested using ANOV

RESULTS: The model's goodness of fit on the RACLET experimental data (changes in the maximal power over time) was excellent (mean adjusted R^2=0.89, RMSE=5%Pi). Tc decreased significantly with the increase in cadence (p<0.001; from 37.3±4.5 to 18.0±4.2 %Ti for 40 to 120 rpm). Furthermore, the Tc as a function of velocity was well described by curved function (median R^2 = 0.92). The optimal velocity that allows to maximize the Pc was 67.2 ± 19.3 RPM

CONCLUSION: The results show that it is possible to determine the individual model parameters Tc & Pc, at several velocities using a newly validated submaximal not-to-exhaustion test (RACLET). This allowed us to demonstrate that the critical power was affected by the velocity conditions. The maximum critical power was produced under individual optimum cadence conditions. The velocity condition is crucial when considering and testing the critical power.

1)Burnley. EJAP, 2022

2)Dekerle, JSMS, 2014

3)Bowen, ECSS, 2023

4)Bowen, JTB, 2024

AN INNOVATIVE METHOD FOR ASSESSING ISOMETRIC CRITICAL FORCE WITHOUT EXHAUSTION IN CLINICAL CONTEXT: THE RAMP ABOVE CRITICAL LEVEL ENDURANCE TEST.

DI DOMENICO, H., BLERVAQUE, L., BOWEN, M., PERNOT, J., SAMOZINO, P., MOREL, B.
SAVOIE MONT-BLANC UNIVERSITY

INTRODUCTION: Critical power is an important fatigue threshold in exercise physiology, separating moderate to severe intensity domains. When muscle effort is performed above the critical force (Fc), acute muscle fatigue drastically occurs. This critical threshold has great potential application in optimizing athletic training programs and performance as well as improving the life quality for chronic disease (e.g. chronic obstructive pulmonary disease (COPD)) patients (1). Historically, Fc has been provided by the asymptotic force-time relationship, obtained during multiple time-to-exhaustion or all-out test. The difficulty of these tests prevents them from being used routinely in clinical context. Based on Bowen et al. (2) model, we proposed an innovative non-exhaustive test to determine the Fc: the Ramp Above Critical Level Endurance Test (RACLET). The aims of this study were to i) test the validity of the RACLET and ii) its feasibility with COPD patients.

METHODS: Sixteen healthy participants and ten COPD patients completed a RACLET on an isometric knee extension ergometer. The test consists in a 5-min decreasing ramp, from severe to moderate intensity domains, composed of intermittent contraction (3s on, 2s off) and brief maximal voluntary contraction (MVC) every 30s. RACLET started at 60% of the initial maximal force (Fi) and gradually decreased to reach 0 N after 5 min. Visual feedback enabled the participant to follow the target force. Healthy participants also performed, on a separated day, a 5-min all-out isometric test. Forces reached during all-out or MVCs performed during RACLET were modelled using derived equations based on: $Fmax(t) = -(1/Tau)*int(F(t)-Fc)dt+Fi$, where F is the target force and Tau is a time constant (2). The validity of the RACLET was assessed by examining the correlation and the root-mean-square error (RMSE) compared to the gold standard method being the 5-min all-out.

RESULTS: The model's goodness of the fit on RACLET and all-out test experimental data was excellent (median $r2 = 0.96$ and 0.97, respectively). Fi, Fc and Tau obtained from RACLET (656 ± 152 N, 283 ± 80 N and 64 ± 33 s, respectively) and from all-out test were highly correlated ($r2 = 0.94$, 0.92, 0.83, respectively, all $p<0.001$, RMSE = 6.4, 5.9, 20.8%). All COPD patients were able to complete the RACLET, the goodness of fit being excellent (median $r2 = 0.95$). The Fc expressed relatively to initial capacity was significantly lower than healthy participants (33 ± 11 vs 41 ± 7 %Fi respectively, $p<0.05$).

CONCLUSION: Compared to the gold standard all-out method, the RACLET is valid to assess Fc in isometric knee extension. This innovative test does not lead to exhaustion. Thus, it has demonstrated to be feasible to determine Fc in COPD patients (stage 1 to 3). The RACLET could thus be a useful tool for determining a muscle intensity threshold (i.e. Fc) to tailor intervention or evaluate the effect of patient rehabilitation.

REFERENCES:

1. Poole et al., MMSE, 2016

2. Bowen et al., JTB, 2023

EXPLORING ANTICIPATION EFFECTS ON KINEMATIC PATTERNS DURING THE INITIAL CONTACT PHASE OF CHANGE OF DIRECTION MOVEMENTS

KUEHNE, M., SANIN, C., MOHR, M.
UNIVERSITY OF INNSBRUCK

INTRODUCTION: In evasion sports, ruptures of the Anterior Cruciate Ligament (ACL) frequently occur with minimal opponent contact within the first 50 ms after the initial contact (IC) of change of direction (COD) movements [1]. One influencing factor for the observed movement pattern is whether or not the athlete was planning the sidestep in advance. Although previous research has suggested more injury-prone movements in unplanned CODs, conflicting results and interpretations exist, e.g. regarding knee flexion [2]. The disagreement may stem from little information available in the COD kinematics of a single point in time (such as IC). We aimed to provide further insight into the anticipation effect on CODs regarding ACL injury risk by investigating the joint angle progression after IC during multiple CODs in an on-field setting mimicking real game scenarios.

METHODS: Twenty male soccer players performed 12 maximum-speed COD sequences in a setup of 6 COD options (45°, 90°, 135°; L, R) on artificial turf. For half of the trials, participants knew the running direction in advance (planned). The other half were unplanned trials, in which participants received their direction cue during the run-up. IMU sensors (Noraxon Ultium Motion) were placed on 8 body parts and joint angles were estimated by the corresponding software (Noraxon myoMotion). Using linear mixed effect models (factors anticipation and COD angle), the change in angle from IC to IC+50 ms was examined for knee flexion and abduction, ankle flexion, hip abduction and flexion, trunk flexion, lateral lean and rotation and as pelvis orientation ($alpha = 0.05$).

RESULTS: A significant main effect of anticipation was found for knee flexion, revealing a larger flexion movement in the planned ($M = 13.3$) compared to the unplanned condition ($M = 10.7$, $p = 0.002$). Significant interaction effects (COD angle x anticipation) highlighted angle-dependent differences of planned vs. unplanned CODs for trunk rotation ($p = 0.004$) and hip flexion ($p = 0.001$). Main effects of COD angle were found for all joint angles except knee abduction.

CONCLUSION: In planned CODs, a larger knee flexion movement in the initial contact phase may enable a safer absorption of initial momentum compared to unplanned CODs, possibly reducing ACL injury risk [1]. Sagittal plane ankle and hip movements were comparatively small for both conditions, especially at sharper COD angles. This suggests a low contribution of hip and ankle and a high contribution of the knee to energy absorption during CODs. While for some variables

the observation of a single posture (e.g. at IC) might be sufficient for risk assessment, analyzing the change in joint angles in the critical first 50 ms of contact can help to gain more insight into the movement strategies that may prevent or provoke ACL injuries.

[1] Boden & Sheehan, J Orthopaed Res, 2022

[2] Brown & Hume, Sports Med, 2014

ACUTE EFFECTS OF UNPLANNED AND PLANNED HOP-LANDING TRAINING ON DECISION-MAKING AND SIDE-STEP CUTTING KNEE BIOMECHANICS

KONISHI, M., NICHOLAS, C.C.2, TAKEMURA, M.1, CORTES, N.2,3

1 UNIVERSITY OF TSUKUBA, TSUKUBA, JAPAN; 2 UNIVERSITY OF ESSEX, COLCHESTER, UNITED KINGDOM; 3 GEORGE MASON UNIVERSITY, FAIRFAX VA, USA

INTRODUCTION: Anterior cruciate ligament (ACL) injuries occur frequently in open-skill (unanticipated/unplanned) sports, and poor decision-making may be a risk for noncontact ACL injury (1). While athletes experience high-level neurocognitive demands within unanticipated athletic situations, contemporary ACL injury prevention programs (IPPs) focus typically on improving closed-skill (anticipated/planned) tasks/exercises alone (e.g., planned jump landing (2)). Contrastingly, ACL IPPs that contain more unplanned tasks/exercises more characteristic of open-skill athletic situations are uncommon. Therefore, this study aimed to investigate the acute effect of unplanned versus planned hop-landing training on decision-making and knee biomechanics during unanticipated side-step cutting motions.

METHODS: Thirty-two recreational athletes (16 female, 16 male) were assigned randomly to the unplanned training group (UT-G) or the control group (CON-G). Both groups completed dominant-leg training involving three multi-stage athletic tasks: hop-landing from a 30cm high box (HL30) + 45° side-step cutting; HL30 + sticking the landing; HL30 + forward linear running. For each task, 2 blocks × 10 trials were completed (total = 60 trials). The UT-G performed unplanned training using three randomly ordered light stimuli triggered by a wireless sensor (Swift Neo, Swift Performance, Australia): each stimulus cued specifically one of the three athletic tasks during the HL30. The CON-G performed planned training: each stimulus was presented before the HL30. During training, errors were counted for each task and designated as deviations from instructions that defined a successful trial. Error rate was calculated: number of error trials ÷ 60 total trials. Three-dimensional biomechanical data were collected from the dominant limb for all athletic tasks before and after training. Knee peak kinematic/kinetic values within 0-50% of stance phase during the unanticipated 45° side-step cutting tasks were extracted from the data. Task error rate and knee biomechanical values were analysed using a two-way repeated-measures ANOVA to determine the effects of group, training, and any interactions.

RESULTS: There were significant interactions for group and training for task error rate ($F(1.32) = 8.55$, $P = 0.01$) and peak knee abduction angle during unanticipated side-step cutting ($F(1.32) = 6.56$, $P = 0.02$). Specifically, for the UT-G only, these variables changed beneficially after training.

CONCLUSION: Only the UT-G improved the task error rate and knee biomechanics linked to noncontact ACL injury during unanticipated side-step cutting. Incorporating athletic tasks under neurocognitive demands into ACL IPPs may contribute to more optimal preparations for open-skill sporting environments. Future research should explore the mechanisms underlying the observed biomechanical improvements.

REFERENCES:

1) Swanik et al., Am J Sports Med, 2007

2) Huang et al., Am J Sports Med, 2020

Oral Presentations

OP-PN20 Energy Metabolism

ANAEROBIC SPEED RESERVE OF ELITE 400-M SPRINTERS

RIESTENPATT, S., RAPPELT, L., DONATH, L.

GERMAN SPORTS UNIVERSITY COLOGNE

INTRODUCTION: 400-m sprinting relies on predominantly anaerobic metabolism. The aerobic contribution is estimated to 40% of the total energy contribution [1]. The concept of the anaerobic speed reserve (ASR) integratively considers aerobic and anaerobic properties, defined as the velocity difference between maximal sprinting speed (MSS) and maximal aerobic speed (MAS). The corresponding Speed Reserve Ratio (SRR) was initially introduced to determine 800-m elite athletes' performance profiles and types [2]. In this regard, profiling of 400-m athletes considering their relationship to personal best (PB) are missing. We aimed at investigating the contribution of endurance and speed capabilities of 400-m elite sprinters to their PB in order to improve sprint diagnostics and training programming.

METHODS: The ASR of 18 sprinters (elite female, n=7, 23±2 years, 400-m-PB: 53.0±1.3s; elite male, n=5, 23±3 years, 400-m PB: 46.7±1.0s; highly-trained female, n=6, 20±3 years, 400-m-PB: 57.6±2.5s) was assessed. Using a laser velocity guard (LAVEG), MSS was determined as instantaneous velocity during a 60-m all-out sprint. Maximal oxygen uptake

(VO2max) and velocity at VO2max (MAS) was determined through ramp test on a treadmill. Additionally, fixed lactate threshold at 4-mmol/L blood lactate (vL4) was determined in the laboratory using an incremental step test. Profiles of three athlete subgroups were created. The SRR (MSS/MAS) was calculated according to Sandford and colleagues [1].

RESULTS: Strong statistically significant negative correlations with PB were found for maximal sprinting speed ($r = -0.96$, $p < 0.001$) and maximal aerobic speed ($r = -0.74$, $p < 0.001$). Moderate statistically significant negative correlation with PB was found for vL4 ($r = -0.60$, $p = 0.008$) but not for VO2max ($r = -0.46$, $p = 0.053$). Using a multiple linear regression, a model was created to generate the following prediction ($R2 = 0.96$, Residual standard error = 0.97):

PB [s] = 113.6815 -5.1122MSS [m/s] - 2.6023MAS [m/s] + ε

A very low variance inflation factor of 1.61 indicates a low risk of multicollinearity. The standardized beta weights for MSS and MAS are -0.80 and -0.27, respectively. Adding vL4 and/or VO2max to this initial model did not increase model fit (Likelikood ratio test: $p \geq 0.412$). Subgroups of 400-m sprinter types were defined by SRR: 200-400 m ≥ 1.75, 400 m ≤ 1.74 to ≥ 1.66, 400-800 m ≤ 1.65.

CONCLUSION: Sprinting Speed is the best predictor of 400-m performance. MAS should be used rather than VO2max alone as MAS has a better negative relationship to 400-m PBs. Calculating SRR can be useful for identifying an athlete's 400-m profile, potentially facilitating individualized training prescriptions. Future research is needed to test individualized training prescriptions based on ASR diagnostics. Training programs for aerobic speed improvements that do not impair sprinting speed are crucial.

[1] Spencer & Gastin (2001) Med Sci Sports Exerc

[2] Sandford et al. (2019) Int J Sports Physiol Perform

MANIPULATION OF RESTING LACTATE LEVELS AND NUTRITIONAL STATUS UNDERESTIMATES VLA.MAX BY REDUCING NET LACTATE ACCUMULATION

SCHÜNEMANN, F., POHL, A., GEHLERT, S.

UNIVERSITY OF HILDESHEIM

INTRODUCTION: In elite sports, the determination of anaerobic glycolytic performance (vLa.max) is becoming increasingly popular. vLa.max is determined e.g. in sprint tests, where firstly glycolysis is maximally activated, followed by the calculation of the quotient between the difference of peak blood lactate (Lapeak) and resting lactate (Larest), and the difference between exercise time and alactic time is calculated. Unintentional variations in lactate levels, such as elevated Larest levels, may affect vLa.max results because of their high impact on the numerator in this calculation.

Aim: To evaluate the effects of variations in carbohydrate availability and Larest on VLamax.

METHODS: Twenty-one subjects (13 male, 8 female; age: 23.1 ± 2.0 years, height: 177.1 ± 8.4 cm, weight: 74.2 ± 11.9 kg) completed five 15-second running sprint tests on five separate testing days under five different conditions: baseline: Larest ≤1.5 mmol·L-1; lactate+: Larest ≥2.5 mmol·L-1; CHO-: carbohydrate intake: ≤1g·kg-1 BW · d-1 for three days; CHO+: carbohydrate intake: ≥9g·kg-1 BW · d-1 for one day; and acuteCHO: 500ml juice sparkling water beverage.

Specifically, after a 10-min warm-up, subjects rested until reaching specified Larest. Subjects then carried out a 15s maximal sprint on a running track. Blood lactate was determined every minute until minute 10' after the sprint.

A Friedman ANOVA with Dunn's post hoc test was used to assess differences between conditions and time points. Statistical significance was accepted at $p<0.05$. Data are presented as mean ± standard deviation.

RESULTS: vLa.max (mmol · L-1 · s-1) was 0.59 ± 0.09 in baseline, 0.51 ± 0.01 in lactate+, 0.53 ± 0.1 in CHO-, 0.54 ± 0.1 in CHO+ and 0.57 ± 0.1 in acuteCHO. Significant differences were observed between vLa.max values from baseline and lactate+ ($p<0.001$) and baseline and CHO- ($p<0.05$). The mean delta (Δ) value, consisting of the difference between Larest and Lapeak (mmol · L-1), was 6.91 ± 1.0 in baseline, 5.99 ± 1.26 in lactate+, 6.15 ± 1.19 in CHO-, 6.32 ± 1.23 in CHO+ and 6.67 ± 1.25 in acuteCHO. Significant differences were identified between Δbaseline and Δlactate+ ($p<0.01$), Δbaseline and ΔCHO- ($p<0.05$), as well as Δbaseline and ΔCHO+ ($p<0.05$).

CONCLUSION: Variations in carbohydrate intake and Larest levels may lead to a reduction in net accumulated lactate levels in a vLa.max test. Therefore, careful consideration and adjustment of test methodology are necessary to avoid underestimating vLa.max in athletes.

EFFECT OF HYPOXIA ON MAXIMAL FAT OXIDATION RATE DURING INCREMENTAL CYCLING

HASSANEIN, Y., IBRAHIM, D., MURIAS, J., TOWNSEND, N.

HAMAD BIN KHALIFA UNIVERSITY

INTRODUCTION: The maximum fat oxidation rate (MFO) has been suggested to provide useful information regarding endurance training status in athletes, but also as an index of metabolic health in untrained populations. Training in hypoxia is a popular method used by athletes for the purpose of performance enhancement and is emerging as a therapeutic intervention to improve cardiometabolic health. It is known that the addition of hypoxia induces a shift towards carbohydrate utilization, however the few studies that examined fat oxidation in hypoxia reported equivocal results. This may be due to differences in the methods used to normalize relative intensity. The aim of this study was to evaluate MFO matched intensity relative to the respiratory compensation point (RCP) in both normoxia (NORM) and hypoxia (HYPO).

METHODS: Seventeen recreationally active adults (5F/12M; age: 36.2±7.4 yr; weight: 76.6±13.1 kg) performed a ramp and a step test, in NORM (FiO2≈21%) and HYPO (FiO2≈13.5%), on separate days. The gas exchange threshold (GET), RCP and VO2peak were determined from the ramp tests. The step test involved 6 constant load stages (4-8 min) matched for intensity relative to the RCP in each condition. Indirect calorimetry was used to estimate MFO rate during the step test. Each participant's diet, fasting hours, and testing time were consistent between conditions. Paired t-tests and a 2-way ANOVA were used to examine differences between NORM and HYPO. Pearson correlation was used to assess the relationship between MFO and GET.

RESULTS: Fat oxidation rate was decreased in HYPO across all stages (main effect of condition: P<0.001; η_p^2=0.64). Subsequently a 25% decrease in MFO in HYPO (0.26 ±0.08g.min-1) compared to NORM (0.35±0.08g.min-1; P<0.001; d=1.24) was observed. %VO2peak where MFO occurred was similar in HYPO (39±21%) and NORM (39±21%; p=0.97), however the correlation between MFO and GET (as %VO2peak) was not significant in either NORM (r = 0.3; P>0.05) or HYPO (r = 0.07; P>0.05).

CONCLUSION: MFO was markedly decreased in hypoxia during step incremental cycling where each workload was normalized to RCP. Furthermore, the decrease in fat oxidation was apparent at all workloads and was greater than expected from the lower absolute exercise intensity. This suggests the reduced fat oxidation was not fully accounted for by a decrease in absolute workrate alone, but there was an independent effect of reduced oxygen availability. Hypoxia did not alter the relative intensity, as a percentage of VO2peak where the MFO occurred.

IL-15 IS ASSOCIATED WITH FAT OXIDATION DURING CARDIOPULMONARY EXERCISE TEST IN ENDURANCE ATHLETES

ALVES DE FONTES-JÚNIOR, A., SIERRA, A.1, DE OLIVEIRA, L.1, DE SOUSA, C.1, CURY-BOAVENTURA, M.

1 UNIVERSIDADE CRUZEIRO DO SUL, 2 UNIVERSIDADE DE SÃO PAULO

INTRODUCTION: The magnitude of physical exertion possibly represents a significant regulator of the secretion of several myokines. It has been reported that acute exercise increases the activity of PPARδ and PGC-1α through the release of myokines, as IL-15, stimulating mitochondrial biogenesis, lipid oxidation and browning of white adipose tissue (WAT) and benefiting the cardiometabolic system. However, few studies have evaluated the role of IL-15 in cardiometabolic function in different exercise loads. The present study investigated the correlation between IL-15 plasma concentration and cardiometabolic parameters at the three thresholds of a cardiopulmonary exercise test (CPET) in endurance runners.

METHODS: Seventy-two endurance athletes, between 30 and 55 years old (mean ± 41.4), healthy and with no history of cardiovascular diseases, participated in this study. Blood samples were collected at rest to determine the plasma levels of interleukin (IL)-15 by enzyme immunosorbent assay. The CPET test was performed using a treadmill protocol (TEB Apex 200, TEB, São Paulo, Brazil), with a fixed inclination of 1% and the speed starting at 8km/h increasing 1km/h per minute until the runners maximum exhaustion. The analysis of expired gases was performed in a breath-by-breath system (CPET Quark, Cosmed, Rome, Italy) at the first, second and third thresholds (anaerobic threshold, AT, respiratory compensation, RC, and Peak, respectively). Correlations between the parameters IL-15 and CPET were performed using Spearmans test. Statistical significance was accepted at $p < 0.05$ in all analyses.

RESULTS: The data showed that IL-15 levels were positively correlated with speed (km/h) in AT, RC and Peak (r= 0.3595, p= 0.0019, r= 0.2814, p= 0.0166, r= 0.2749, p= 0.0194, respectively) and with fat oxidation (%) in AT and RC (r= 0.4618 p= <0.0001, r= 0.3007 p=0.0103,respectively). Moreover, IL-15 levels also had inverse correlation with relative quotient (RQ) in AT, RC and Peak (r= -0, 469 p= <0.0001, r= -0.4129 p= 0.0003, r= -0.2587 p= 0.0282, respectively), with VE/VO2 in AT, CR and Peak (r= -0.3993 p= 0.0005; r= -0.3661 p= 0.0016; r= -0.3669 p= 0.0015, respectively) and with CHO (%) in AT and RC (r= -0.4879 p= <0.0001; r=-0.3007 p= 0.0103).

CONCLUSION: IL-15 is associated with greater lipid oxidation in all thresholds of a cardiopulmonary exercise test demonstrated by higher % of fat oxidation and RQ which may can sustain the exercise longer in each threshold. Our findings suggest that IL-15 is crucial to improve lipid metabolism and promote resistance in endurance runners.

ACUTE EFFECTS OF PHOSPHODIESTERASE-5 INHIBITION ON EXERCISE TOLERANCE AND THE PHYSIOLOGICAL RESPONSES TO MODERATE- AND SEVERE-INTENSITY EXERCISE IN HUMANS

GOMES BERNARDES, A., GABARDO, J.M.2, OLIVEIRA, L.S.3, MITAMURA, F.M.3, AGUIAR, A.F.3, ALTIMARI, L.R.2, DELL'ANNA, S.1, DE GIORGIO, A.1, BALDARI, C.1, BUZZACHERA, C.F.4

1 ECAMPUS UNIVERSITY, ITALY; 2 STATE UNIVERSITY OF LONDRINA, BRAZIL, 3NORTH UNIVERSITY OF PARANÁ, BRAZIL, 4UNIVERSITY OF PAVIA, ITALY.

INTRODUCTION: The nitric oxide (NO)-3'5'cyclic guanosine monophosphate (cGMP) signaling pathway plays a plethora of important roles in the human body. Recent studies suggest that increased NO production can enhance skeletal muscle function and improve exercise performance in some circumstances. The effects of elevated cGMP production on exercise performance, however, are less clear. While some authors have demonstrated improvements, others have shown no effect on exercise tolerance following the inhibition of phosphodiesterase-5, a member of a larger group of phosphodiesterase enzymes that deactivate cGMP. The inconsistencies found in previous studies are not well understood and warrant further research. We, therefore, investigated the effects of phosphodiesterase-5 on exercise tolerance and the physiological responses to moderate- and severe-intensity exercise.

METHODS: Twelve recreationally active men (mean age 23 ± 4 years) volunteered for this study. Each participant visited the laboratory on five separate occasions. On Day 1, they underwent a ramp incremental exercise test on an electronically

braked cycle ergometer to establish gas exchange threshold (GET) and peak oxygen uptake (VO2peak). Subsequently, on Days 2-5, participants were administered, in a randomized, double-blind, crossover manner, a single tablet containing either placebo or tadalafil citrate (20 mg) 80 minutes prior to completing three "step" exercise bouts: two at moderate intensity followed by one at severe intensity. Following a 7-d washout period, participants repeated the tests to complete a total of four moderate-intensity exercise bouts and two severe-intensity exercise bouts for each experimental condition. Pulmonary gas exchange and ventilation and NIRS-derived muscle oxygenation were continuously monitored throughout the tests. Blood samples were collected to determine blood lactate concentration 20 seconds before the onset of the first step exercise bout and 20 seconds following exhaustion during the severe-intensity exercise bout.

RESULTS: Pulmonary gas exchange and ventilation and NIRS-derived muscle oxygenation responses to either moderate- or severe-intensity exercise did not show significant differences between the two experimental conditions. However, the phosphodiesterase-5 inhibition improved tolerance to severe-intensity exercise (399 ± 81 vs. 438 ± 110 sec; $p < 0.05$). Similarly, changes in blood lactate concentration differed between the two experimental conditions (7.0 ± 2.0 vs. 8.3 ± 2.4 mmol/L for placebo and phosphodiesterase-5 inhibition, respectively; $p < 0.05$).

CONCLUSION: Our findings indicate that acute administration of a phosphodiesterase-5 inhibitor, tadalafil, improved exercise tolerance without affecting the physiological responses to submaximal exercise in humans. This ergogenicity is possibly associated with the augmented activation of anaerobic sources of energy by the skeletal muscles mediated through the NO/CGMP signaling pathway.

Oral Presentations

OP-PN21 Endurance Physiology I

MARKED PLASMA VOLUME EXPANSION WITHOUT TOTAL HEMOGLOBIN MASS CHANGES FOLLOWING A 330-KM EXTREME MOUNTAIN ULTRAMARATHON

KRUMM, B., RABERIN, A., CITHERLET, T., TAGLIAPIETRA, G., FAISS, R., DEBEVEC, T., GIARDINI, G., MILLET, G.P.
UNIVERSITY OF LAUSANNE

INTRODUCTION: Mountain ultramarathon (MUM) represents extreme physiological and environmental stress for the human body. In this context, blood volume changes might play a pivotal role in overall homeostasis. In contrast to shorter distances (e.g., marathons), a plasma volume (PV) expansion has previously been reported following ultramarathon distances. Nevertheless, reduced neuromuscular fatigue or muscle inflammation was interestingly observed after 330 km compared to a 177-km MUM, suggesting distance-specific effects. To test the hypothesis of a substantial rise in both hemolysis and PV following MUM, this study investigated select hematological changes following a 330-km MUM.

METHODS: Thirteen healthy participants (42 ± 7 years; 175 ± 8 cm; 68 ± 10 kg) completed a 330-km MUM (Tor des Géants). Total hemoglobin mass (Hbmass), total blood volume (BV), red blood cell volume (RBCV), and PV were determined before and immediately after the race by an optimized carbon monoxide (CO)-rebreathing method using a fully automated instrument (OpCo, Detalo Instruments). Blood viscosity was measured at different speeds (11.25, 22.5, 45, 90, and 225 s-1) at native and corrected (40%) Hematocrit (Hct) using a cone/plate viscometer (Brookfield DVII, Brookfield Engineering Labs).

RESULTS: The participants' average finishing time was 118 ± 19 h. A significant change in PV (+590 ± 0.38 mL [+17.7%]; $p < 0.001$), BV (+0.55 ± 0.42 L [+9.5%]; $p < 0.001$), and Hct (-4.1 ± 4.2%; $p = 0.004$) was noted after the race. A decrease in native viscosity was observed at all speeds ($p < 0.001$), although only the 45 s-1 speed was affected by the corrected viscosity (-1.08 ± 1.78 cP; $p = 0.002$). No significant differences were observed for absolute Hbmass (802 ± 102 vs. 833 ± 111 g; $p = 0.09$), relative Hbmass (11.8 ± 1.1 vs. 12.2 ± 1.0 g·kg-1; $p = 0.14$), nor RBCV (2.5 ± 0.3 vs. 2.4 ± 0.3 L; $p = 0.5$).

CONCLUSION: In the present study, a comparable increase in PV (+17.7%) and related BV (+9.5%) was noted to what had been observed previously on a 171-km MUM. Generally explained by sodium retention coupled with the exercise-induced inflammatory response, this transient hypervolemia does therefore not seem to be more severe with increasing distance. In addition, although the drop in Hct largely explains the decreased blood viscosity, the reduction in the corrected viscosity at intermediate speeds suggests slight changes in RBC behavior. However, in contrast to expectations suggesting a decreased Hbmass due to hemolytic effects, a trend towards increased Hbmass (+31 g) was observed. While probably explained by splenic contractions or enhanced CO diffusion to intramuscular myoglobin, an actual stimulation of erythropoiesis during the race cannot be completely excluded. This study provides further insights into the physiological mechanisms that occur during one of the world's most challenging MUM.

RUNNING FOR YOUR LIFE: METABOLIC EFFECTS OF A 160.9/230 KM NON-STOP ULTRAMARATHON RACE ON BODY COMPOSITION, INFLAMMATION, HEMORHEOLOGY, HEART FUNCTION, AND NUTRITIONAL PARAMETERS

BIZJAK, D.A., SCHULZ, S., JOHN, L., SCHELLENBERG, J., BIZJAK, R., WITZEL, J., VELDER, S., KOSTOV, T., DIEL, P., GRAU, M.
UNIVERSITY HOSPITAL ULM

INTRODUCTION: Moderate endurance exercise leads to an improvement in cardiovascular performance, stress resilience, and blood function. However, the influence of chronic endurance exercise over several hours or days is still largely un-

clear. We examined the influence of a non-stop 160.9/230 km ultramarathon on body composition, hemorheology, stress response, cardiac adaptations and nutrition parameters.

METHODS: Blood samples were drawn before (pre) and after the race (post) and analyzed for hematological and hemorheological variables as well as ghrelin, insulin, irisin, glucagon, cortisol, kynurenine, neopterin, and total antioxidant capacity. Additional measurements included heart function by echocardiography, nutrition questionnaires, continuous glucose measurements and body impedance analyses. A possible influence of different beverages on the release of bacterial endotoxin as possible monitoring tool for regeneration was also assessed.

RESULTS: Of the 28 included ultra-runners (7f/21m), 16 participants dropped out during the race. The remaining 12 finishers (2f/10m) showed depletion of antioxidative capacities and increased inflammation/stress (white blood cells/neopterin/cortisol), while energy metabolism (insulin/glucagon/ghrelin) remained unchanged despite a high negative energy balance (6000-9000 kcal). Free fat mass, protein, and mineral content decreased. Red blood cell (RBC) deformability increased while osmolality in both the hypotonic and hypertonic region and viscosity declined post-race. RBC nitrite metabolism showed different responses and adaptations depending on race distance. Echocardiography revealed a lower stroke volume, left end diastolic volume, and ejection fraction post-race. Endotoxic values were lower 3 hours post-race if beverages without sugar or together with polyphenols were ingested.

CONCLUSION: Optimizing nutrition (high-density protein-rich diet) during the race may attenuate the observed catabolic and inflammatory effects induced by ultramarathon running. Monitoring of hematological and hemorheological changes may reveal RBC mechanistic adaptions for counteracting molecular stress during this orthopedic and cardiovascular demanding long-term endurance competition. As a rapidly growing discipline, new strategies for health prevention and extensive monitoring are needed to optimize the athletes' performance.

COMPARATIVE ANALYSIS OF MATCH DURATION AND FOOTBALLERS RUNNING PERFORMANCE: 2022 FIFA WORLD CUP VS. 2018 FIFA WORLD CUP

ZHAI, Y., WANG, J.
TONGJI UNIVERSITY

INTRODUCTION: This study aims to explore differences in match duration and player running between the 2022 FIFA World Cup and the 2018 FIFA World Cup , investigate the relationship between match duration and running distance, and discuss the implications of the 2022 extra time reform on future football-specific fitness training.

METHODS: Video replays of 64 matches from the 2018 and 2022 FIFA World Cups were meticulously analyzed. Match time data for the first and second halves, as well as extra time, were recorded based on referees whistle signals. Running data for each team in both tournaments were obtained from FIFAs official website and categorized into walking (0-7km/h), low-speed running (7-15km/h), medium-speed running (15-20km/h), high-speed running (20-25km/h), and sprint running (25km/h+). Differential comparisons of time and running data were conducted using IBM SPSS Statistics 19, and Pearson correlation analyses were performed between time and running data.

RESULTS: Match Duration: The average match duration per match was significantly higher in the 2022 FIFA World Cup compared to the 2018 FIFA World Cup (103.90±9.219 vs. 99.45±8.702 minutes, $p<0.05$, Cohens d=0.50). The average effective playing time per match in 2022 was 58 minutes 04 seconds, higher than 55 minutes 09 seconds in 2018. Statistically significant differences were observed in match durations for the first and second halves, while overtime duration showed no statistical significance. Differences in match durations were significant in the group stage matches but not in the knockout stage.

Footballers Running Performance: In terms of team average total distance run per match, 2022 was significantly higher than 2018 (114603±433.16 vs 104662±376.17 meters, $p<0.05$, Cohens d=24.51). Similarly, team average per-match high-intensity running distance (speed ≥20km/h)(9170.87±821.38 vs 7554.37±574.35 m , $p<0.05$,Cohens d=2.28)and distance per sprint (speed ≥25km/h)(2389.94±302.61 vs 2026.03±230.99 m , $p<0.05$,Cohens d=1.35) were significantly higher in 2022 compared to 2018. The team average number of sprints per match in 2022 was also significantly higher than in 2018(528±40 vs 330±24 , $p<0.05$,Cohens d=6.00).

Correlation Analysis: In 2022, there was a very large positive correlation between match duration and total team distance run per match ($r=0.834$, $p<0.05$), a moderate positive correlation for both high-intensity running ($r=0.477$, $p<0.05$) and sprinting distance run ($r=0.403$, $p<0.01$), and a large positive correlation for the number of sprints ($r=0.570$, $p<0.05$), all statistically significant.

CONCLUSION: The reform of extra time regulations in football matches significantly increased match duration in the 2022 FIFA World Cup compared to the 2018 FIFA World Cup. Players were required to cover longer distances with higher intensity and engage in more sprints during matches, highlighting increased demands on players physical fitness, especially anaerobic endurance.

MODELLING OF THE VO2/PO RELATIONSHIP DURING RAMP VS. CONSTANT WORK RATE EXERCISE IN HEALTHY ACTIVE INDIVIDUALS

STUER, L., MUCCI, P., BOONE, J., CAEN, K.
GHENT UNIVERSITY

INTRODUCTION: Introduction: Ramp incremental (RI) tests are frequently used to prescribe exercise intensities. However, the dissociation that exists between the RI versus constant work rate (CWR) VO2/power output (PO) relationship complicates the translation from RI PO to CWR PO [1]. The current translation strategies assume a linear development of the CWR VO2/PO relationship in the heavy domain [2, 3]. Hence, the main purpose of this study was to mathematically model this relationship within the heavy and severe intensity domains to analyse whether the loss of mechanical efficiency truly develops linearly. A second aim was to assess the reliability of parameters used in the existing translation strategies (i.e., baseline VO2, mean response time (MRT), and slopes of the RI VO2/PO relationship).

METHODS: Methods: 14 healthy young participants (7 men and 7 women; 22 ± 2 yr; 44.4 ± 7.4 mL • min-1 • kg-1) performed a maximal RI test and a series of CWR tests with intervals of 10 W (starting from GET up to VO2peak) on separate days. All tests were conducted on a cycle ergometer. For reliability purposes, every CWR test was preceded by a linear increase in PO (similar to the RI test) from baseline cycling until target PO was reached. The individual RI VO2/PO relationship was modeled using two linear regression lines (i.e., one portion below and one portion above GET). The individual CWR VO2/PO relationship was modeled linearly and the slope was calculated both for the heavy domain only and for the heavy and severe domain. To assess test-retest reliability, coefficients of variance (CV) were calculated.

RESULTS: Results: The CWR VO2/PO relationship in the heavy and severe domains was strongly linear (R^2: 0.92 ± 0.04 – 0.94 ± 0.03). The slopes above GET from the CWR VO2/PO relationship (11.1 ± 1.1 – 11.6 ± 1.0 0 mL • min-1 • W-1) were significantly higher compared to the slope above GET from the RI VO2/PO relationship (8.7 ± 0.9 mL • min-1 • W-1) ($p < 0.001$). CV for baseline VO2 was 4.3 ± 0.8%. CV for the slopes, below and above GET, from the RI VO2/PO relationship were respectively 8.9 ± 6% and 19.1 ± 10.5% . CV for MRT was 28.6 ± 9.8%.

CONCLUSION: Conclusions: This study confirmed that the loss of mechanical efficiency develops linearly in the heavy and severe intensity domains. The reliability of the parameters used in the current correction strategies ranged from acceptable to very good. For both reasons, applying such translation strategies is justified.

1. Keir, D.A., et al., Using ramp-incremental VO(2) responses for constant-intensity exercise selection. Appl Physiol Nutr Metab, 2018. 43(9): p. 882-892.

2. Caen, K., et al., Translating Ramp V O2 into Constant Power Output: A Novel Strategy that Minds the Gap. Med Sci Sports Exerc, 2020. 52(9): p. 2020-2028.

3. Iannetta, D., et al., A "Step-Ramp-Step" Protocol to Identify the Maximal Metabolic Steady State. Med Sci Sports Exerc, 2020. 52(9): p. 2011-2019.

RELIABILITY OF CRITICAL VELOCITY DURING STANDARDIZED TREADMILL ENDURANCE RUNNING

ISAIAH, R., PASTELLIDOU, E., JOHNSTON, L., WILSON, J., PRICE, K., PENPRAZE, V., KEMI, O.
UNIVERSITY OF GLASGOW

INTRODUCTION: Performance during continuous high-intensity exercise is determined by the hyperbolic speed-tolerable duration (S-tLIM) relationship, defined as the limit of tolerance by the asymptote for critical velocity (CV), the metabolic equivalent oxygen uptake (VO2) and the curvature constant D' that indicates the amount of work (duration) that can be achieved above CV. The lower boundary of CV thereby demarcates between heavy and severe exercise intensities, and the relationship is therefore useful for monitoring exercise capacity, for pacing, and for accurate intensity setting in the severe exercise domain. However, a series of constant load time to exhaustion (TTE) performance tests are required to establish S-tLIM in individuals, which introduces a source of variability, but reproducibility of S-tLIM remains unknown.

AIM:

This study therefore investigated the test-retest reproducibility of CV in healthy controls (non-runners) and club-level runners.

METHODS: Healthy male participants volunteered; 11 non-runners and 10 active runners (running training >5/week). They performed incremental exercise tests (IET) to determine VO2max and Vmax (maximal aerobic speed). Then, at least 4 individualised constant load TTE tests (range 3-15 mins), each separated by at least 48 hours, were performed to establish S-tLIM within acceptable modelling limits. These were then retested to establish test-retest reproducibility.

RESULTS: Runners presented with 15-20% increased VO2max and Vmax and 25% increased CV vs controls. On completion of the constant load TTE tests and after confirming tests were performed to true exhaustion by comparing VO2max obtained during IET to VO2 obtained during TTE tests (all P>0.05), the V-t and V-1/t relationships were plotted. From test and retests, runners presented with CV 14.4±0.4 km/h and 14.6±0.4 km/h (P=0.267, not different) and D' 903.3±112.1 m and 1010.5±95.3 m (P=0.116, not different), while controls presented with CV 11.2±0.6 km/h and 11.8± 0.6 km/h (P=0.003, different) and D' 1269.0±117.6 m and 963.8±103.8 m (P=0.002, different). The magnitude of test-retest difference is smaller in runners vs controls, and in runners, 8/10 achieve test-retest agreement within 5%, whereas only 5/11 achieve this in controls, whereas Bland-Altman analysis also indicated greater test-retest bias in controls vs runners.

CONCLUSION: Protocols for determining CV and D' were more reproducible for runners but not controls, in which significant . Therefore, the S-tLIM relationship obtained during treadmill exercise should be used with consideration in non-

running cohorts, whereas in athletes accustomed to the exercise mode, the S-tLIM presents an accurate performance-based indicator of functional exercise capacity in the severe intensity domain that may be applied for pacing and intensity control.

Oral Presentations

OP-AP21 Sports Technology/Equipment

EFFECTS OF SPIKE MIDSOLE FOAM AND BENDING STIFFNESS ON RUNNING ECONOMY AND MIDDLE-DISTANCE PERFORMANCE

RODRIGO CARRANZA, V., MUÑOZ DE LA CRUZ, V., GONZÁLEZ-MOHÍNO, F., RODRÍGUEZ-BARBERO, S., GONZÁLEZ-RAVÉ, J.M., HOOGKAMER, W.

1 SPORTS PERFORMANCE RESEARCH GROUP , UNIVERSITY OF CASTILLA-LA MANCHA, TOLEDO, SPAIN. 2 INTEGRATIVE LOCOMOTION LABORATORY, DEPARTMENT OF KINESIOLOGY, UNIVERSITY OF MASSACHUSETTS, AMHERST, USA

INTRODUCTION: Research into the benefits of different advance footwear technologies (AFT) spikes on middle/long distance track performance is lacking. This study aimed to examine the influence of different spikes technologies on running economy (RE) and middle-distance performance measures in trained runners.

METHODS: Sixteen male trained runners completed four different visits on a 400 m outdoor track, running in three different spikes conditions. We compared a traditional EVA midsole spike (Control) with a modern midsole foam (PEBA) spike and a spike with a PEBA midsole and a carbon-fiber plate (PEBA+Plate). During the first three visits, participants performed 6x200 m at self-perceived 800 m race pace wearing each condition twice in a mirrored order (a-b-c-c-b-a) separated by 8 min rest between trials. Subsequently, they performed a 3,000 m time trial using one of the three shoe condition, in each visit. During visit 4, participants completed 6x4 min efforts at 18 km/h in each condition to assess RE (W/kg).

RESULTS: The main effect for spike condition was significant for the runs at self-perceived 800 m pace ($p<0.001$; $\eta 2 =0.438$), the 3,000 m time trial ($p=0.013$; $\eta 2 =0.342$) and RE ($p<0.001$; $\eta 2 =0.694$). At 800 m race pace, PEBA+Plate (6.63±0.36 m/s; $p<0.001$) resulted in 2.8% faster 200 m runs compared to Control (6.45±0.36 m/s), while PEBA (6.53±0.45 m/s) and Control were similar. The 3,000 m speed improved in the PEBA (5.79±0.23 m/s; $p=0.034$; 1.0%) and PEBA+Plate conditions (5.87±0.37 m/s; $p=0.032$; 2.4%) compared to Control (5.73±0.29 m/s). RE improved significantly in the PEBA (20.25±1.79 W/kg; $p<0.001$; 5.1%) and PEBA+Plate conditions (20.47±1.43 W/kg; $p<0.001$; 4.0%) compared to Control (21.30±1.59 W/kg), without significant differences between the PEBA and PEBA+Plate conditions.

CONCLUSION: Our results suggest that AFT spikes with modern foams enhance running performance across middle- and long-distance events. However, at mid-distance speeds the PEBA+Plate technology performed better than Control, while modern foam alone (PEBA) did not significantly improve performance. This may be because when running at higher speeds, the optimal longitudinal bending stiffness of the shoe might be higher (1). However, for running at 18 km/h, RE improved similarly in both AFT spikes (PEBA and PEBA+Plate) compared to traditional EVA spikes. At sub-maximal speeds, differences may be mainly due to differences in midsole foam rather than in longitudinal bending stiffness (2).

References

1. Rodrigo-Carranza, V., et al., (2022). European Journal of Sport Science, 22(10), 1508-1521. https://doi.org/10.1080/17461391.2021.1955014

2. Rodrigo-Carranza, V., et al., (2023). Scandinavian Journal of Medicine & Science in Sports. https://doi.org/10.1111/sms.14526

INVESTIGATING THE APPLICATION OF SKATE-SECURED 3-D ACCELEROMETERS TO ASSESS ON-ICE PERFORMANCE AND THE ASSOCIATED RELATIONSHIPS WITH OFF-ICE PERFORMANCE METRICS IN COMPETITIVE YOUTH HOCKEY ATHLETES

TWIBLE, B., DALTON, B., MCNEIL, C.

UNIVERSITY OF BRITISH COLUMBIA - OKANAGAN

INTRODUCTION: The ability to rapidly generate muscle force (produce power) is a critical determinant of athletic performance. Recent technological progress provides opportunities for limb-specific assessment of neuromuscular parameters during training or competition, which can reveal inter-limb asymmetries (ILAs) that may limit functional capacity. Yet, due to difficulties with on-ice data collection, hockey athletes are an understudied population compared to other sporting groups. The purpose of this study was to explore the implementation of skate-secured 3-D accelerometers to assess on-ice performance, and to investigate the relationship between on- and off-ice performance metrics. We hypothesized that relationships would exist between on- and off-ice metrics, including ILAs, and that lower-limb ILA would be inversely related to skating performance.

METHODS: Seventeen participants (15.0 ± 1.2 years; seven females) completed two performance-based tasks to assess lower-limb function: a 30-m forward sprint (on-ice), and a vertical countermovement jump (CMJ) (off-ice). On-ice metrics of interest included mean stride power and total sprint time. The vertical CMJ was performed on a dual force plate system, and metrics of interest included peak jump height, relative peak force and power, relative braking rate of force develop-

ment, and impulse (braking and propulsive). Mean stride power, as well as CMJ impulse (braking and propulsive), force, and rate of force development were used to assess ILA. Linear regressions were performed to determine relationships between on- and off-ice variables.

RESULTS: An inverse relationship was found for mean stride power and skating sprint time ($R2 = 0.30$; $p = 0.02$). Positive relationships were detected between peak CMJ height and both mean stride power ($R2 = 0.37$; $p = 0.01$) and skating sprint time ($R2 = 0.75$; $p < 0.01$), as well as between peak CMJ relative power and both mean stride power ($R2 = 0.30$; $p = 0.02$) and skating sprint time ($R2 = 0.71$; $p < 0.01$). Regarding asymmetries, there was a positive relationship between ILAs for CMJ rate of force development and mean stride power ($R2 = 0.31$; $p = 0.02$); however, no other relationships between off-ice and on-ice ILA measures were significant ($p \geq 0.32$). Additionally, no on- or off-ice measure of ILA related to skating sprint time ($p \geq 0.09$).

CONCLUSION: In summary, skate-secured 3-D accelerometers allow assessment of limb-specific on-ice parameters that are important for skating performance. Although a relationship between on- and off-ice performance was identified, the presence of on- or off-ice ILAs may not be important for short-term power production.

EXPLORING BREATH-VOLATILE ORGANIC COMPOUNDS AS NON-INVASIVE BIOMARKERS TO PREDICT CARDIORESPIRATORY FITNESS – PRELIMINARY DATA FROM THE PREDICT-FIT PROJECT

TEIXEIRA, E., SILVA, G., RUFO, J.

RESEARCH CENTER IN PHYSICAL ACTIVITY, HEALTH AND LEISURE, FACULTY OF SPORTS, UNIVERSITY OF PORTO, PORTUGAL

INTRODUCTION: Cardiorespiratory fitness (CRF) is a fundamental exercise-related factor and a well-established vital sign (1). Maximal oxygen consumption (VO2max), the CRF gold-standard assessment, is cumbersome and imposes significant participant stress, limiting testing frequency. Expedient and safer CRF assessment methods are imperative to exercise and health professionals. Recent studies analysing the exhaled breath (breathomics) volatile organic compounds (VOCs), which differ depending on health status (2), may pose such an alternative. Breathomics is conducted through the analysis of exhaled VOCs with electronic nose systems (eNose), which are capable of discerning distinct compound profiles, holding predictive value for CRF assessment. This study investigated the use of breathomics to identify individuals with directly measured peak VO2max (VO2) above or below the age- and gender-specific estimated oxygen consumption (eVO2) (3).

METHODS: Breathomics of sixty-five participants (age: 34.8±11.5 years, 86% males) were performed by collecting the individuals' VOCs while fasting for at least 3 hours, following a 2-minute preliminary breathing procedure through an A2 filter. VOCs were collected in Tedlar bags and analyzed by Cyranose 320 eNose. Then, participants performed a VO2max test (Quark, COSMED), cycling nearly 15 minutes during progressive intensity levels until exhaustion, to determine VO2. Participants were dichotomized based on their eVO2 for analytical purposes.

RESULTS: Recursive partitioning regression identified twenty participants with a distinct breathomics profile (DBP) defined by eNose sensors S4 and S26. Post-hoc analysis showed a significantly higher proportion of individuals who did not meet eVO2 criteria when having the DBP (66.6%, $p<0.001$). In addition, a t-student test revealed significant differences in mean VO2 values between groups, being lower in individuals with the DBP (40.8±6.0 vs 46.8±11.1, $p=0.027$). Logistic regression showed a significant association between having the DBP and failing the eVO2 criteria, even when adjusted for exercise volume and the number of fasting hours (OR 95%, CI = 17.5 [4.2, 97.3], $p<0.001$). This model identified individuals who failed to meet the eVO2 criteria with a sensitivity of 75% and a specificity of 95% (AUC = 0.87).

CONCLUSION: Individuals with DBP were, on average, 17.5 times more likely to have VO2 values lower than eVO2. Further analysis of the breathomics profile using mass spectrometry methods is needed to identify the specific discriminant VOCs. While further research is warranted, breathomics holds promise for predicting VO2 outcomes, potentially fostering continuous CRF monitoring both in exercise and health-related scenarios.

References:

1-Circulation, 2016, 134(24), e653–e699. https://doi.org/10.1161/CIR.0000000000000461

2-Allergy, 2015, 71(2), 175–188. https://doi.org/10.1111/all.12793

3-European journal of preventive cardiology, 2020, 25(7), 742–750. https://doi.org/10.1177/2047487318763958

MECHANICAL PROPERTIES OF DIFFERENT TYPES OF TENNIS COURT SURFACES

COLINO, E., GARCÍA-UNANUE, J., FELIPE, J.L., QUINTANA-GARCÍA-MILLA, I.

UNIVERSIDAD FRANCISCO DE VITORIA

INTRODUCTION: Tennis is one of the sports in which the surface plays an important role in performance and injury risk. Professional players face an extensive competition calendar in which they must adapt to different types of surfaces. However, unlike other sports, tennis lacks standards that regulate surface properties affecting athlete-surface interaction on each type of surface. The objective of this study was to evaluate shock absorption (SA), vertical deformation (VD), energy restitution (ER) and slip resistance (SR) in different types of tennis surfaces, compare them with each other and look for correlations between variables.

METHODS: Thirty-six tennis courts (12 hard court, 16 clay, 8 artificial grass) were evaluated. SA, VD and ER were assessed using the apparatus (advanced artificial athlete) and test method described in the FIFA Handbook of Test Methods, and SR was measured using a pendulum device and conducted according to EN 16165:2021.

RESULTS: All variables differ significantly between surfaces (p<.001). SA (1.1±0.5% to 13.9±3.4%) and VD (0.02±0.04mm to 1.07±0.19mm) were lower on hard court compared to clay and artificial grass; ER (72.5±4.7% to 89.9±1.5%) evolved in the opposite way; and SR (in PTV) was lower on clay (53.6±2.5) compared to grass (61.4±1.3) and hard court (66.6±1.1). No significant correlations between variables were identified in hard court. However, both clay and artificial grass showed a significant positive correlation (p<.001) between SA and VD (0.872 and 0.947, respectively), and a significant negative correlation (p<.001) between SA and ER (-0.807 and -0.981, respectively). Also, significant negative correlations were found between VD and ER both in clay (-0.802; p<.001) and artificial grass surfaces (-0.890; p<0.01). As for the SR, only a significant negative correlation with VD in artificial grass (-0.715; p<0.05) was identified.

CONCLUSION: These results suggest that more compliant artificial grass surfaces may provide reduced friction in the shoe-surface interface, and that the frictional properties of clay and hard courts may be related to other variables other than SA, VD or ER of the surface (e.g., humidity or particle size of the clay). This study is the first one to describe the mechanical properties of tennis courts as is usually done in other sport surfaces when the athlete-surface interaction is assessed. These data reveal the disparities among surfaces and may contribute to laying out the foundations of future regulations aimed to assess and control the mechanical properties of tennis surfaces. These regulations would allow facility managers and competition organisers to carry out a more systematic and exhaustive control of the surfaces functionality; would give court constructors, suppliers, and end-users a common language to describe different products; and, most importantly, would contribute to reducing the risk of injury due to the state of the surface and to preserve safety and performance of tennis players.

DETAILED ANALYSIS OF MOVEMENTS DURING WHEELCHAIR TENNIS MATCHES

DEVES, M., SAURET, C.2, HAYS, A.3, FAUPIN, A.1

JAP2S <1>, CERAH <2>, HIPE <3>, FFT <4>

INTRODUCTION: Wheelchair tennis (WT) involves intermittent aerobic activity with multidirectional movements, including high-speed linear and rotational actions, and rapid accelerations [1]. Quantifying physical loading during matches is crucial for trainers to develop effective training programs. The use of onboard sensors, particularly inertial sensors, has become common for studying wheelchair movements, enabling detailed descriptions of specific movements in WT [2]. However, theres a lack of studies focusing on precise quantification of physical load during WT matches. Generic training programs may lead to poor performance and injuries due to interindividual variability within the wheelchair sports population [3]. Our study aims to propose a method for characterizing and describing locomotor activities during WT matches.

METHODS: Nine French WT international players, comprising six men and three women, participated in our study. We recorded thirteen matches, totaling 26 sets and 213 games. Athletes utilized their own wheelchairs equipped with Xsens Inertial Measurement Units (IMUs) on the wheels and frame, enabling kinematic data collection during all games. Time series data of linear velocity, rotation velocity and radius of curvature were processed using a PAA-SAX method for data reduction and symbolic representation. A final logical pattern search on these signals identified different locomotion tasks.

RESULTS: Across all recorded matches, players spend an average of 25 ± 14% of the time in a static state, 41 ± 10% of the time moving in a straight line, and 24 ± 9% of the time executing wide curves. Movement characteristics and intensity are measured through segmentation. During games, players engage in various types of straight lines: 433 ± 152 within 0 to 3 meters, 154 ± 54 within 3 to 8 meters, and 55 ± 22 longer than 8 meters, with respective intensities of 4 ± 3%, 7 ± 4%, and 3 ± 4% at very high intensity (> 75% of maximal acceleration). They also execute wide turns (715 ± 222) and tight turns (363 ± 82) during the match. Among wide turns, 41 ± 5% are at high rotational velocity (>= 120°/s), with an average rotation of 84.47 ± 67.65°, covering 2.14 ± 2.02 meters. Among tight turns, 66 ± 5% are executed at high rotational velocity (>= 120°/s), with an average rotation of 78.93 ± 48.38°, covering 0.55 ± 0.36 meters.

CONCLUSION: The employed method confirms our initial hypothesis by enabling quick and simplified visualization of entire games, sets, or matches. Subsequently, this method allows us to characterize different types of activities to describe the intensity of play. Physical trainers can use this processing method to determine the external load of the activity and adapt their training accordingly. Future studies could be designed to compare the intensity of matches at different level.

Oral Presentations

OP-PN32 Hormonal Biology II

BRAIN-DERIVED NEUROTROPIC FACTOR RESPONSES DURING MULTI-STRESS MILITARY TRAINING

NYKANEN, T., OJANEN, T., KYRÖLÄINEN, H.

FINNISH DEFENCE FORCES

INTRODUCTION: In addition to a well-documented role in neurodegenerative diseases, brain-derived neurotropic factor (BDNF) has also been studied in military environments, where mental stress, energy and sleep deficit, and prolonged physical activity are continuous and fluctuating stress factors (Beckner et al. 2022). Reduction in body mass and remarkable hormonal responses are often observed simultaneously in this type of trainings (Ojanen et al. 2023). BDNF concentration typically decreases in strenuous environments, but the function of this neurotrophin is not clearly understood. Thus,

the purpose of this study was to a) describe BDNF responses in multi-stress military training, b) examine associations between BDNF, body composition and biomarkers, and c) study the effect of 36 hours' recovery on these outcomes during training.

METHODS: Two groups of male soldiers were studied: FEX (n=42, 19.5 ± 0.8 years, 179 ± 6 cm, 74.4 ± 10.8 kg) had continuous winter field training with energy and sleep deficit, while REC (n=26, 19.7 ± 1.2, 181 ± 6 cm, 78,2 ± 9.6 kg) had 36-hours active recovery phase in the middle of training (days 6 to 8). Body composition was measured via bioimpedance, and blood samples for BDNF and biomarkers (testosterone, cortisol, IGF-1, leptin, ghrelin, adrenalin, noradrenalin, prolactin, sex hormone binding protein) were collected at days 1, 6, 8, 10 during training. Linear mixed model was used for evaluating main effects and interactions between time and group, and Spearman correlations with FDR adjustments for associations between BDNF, body composition and biomarkers. Statistical significance was set as $p<0.05$.

RESULTS: BDNF decreased in both groups during training and systematically lower BDNF values were found in the REC group compared to the FEX group (main effects with time $p<0.001$ and group $p=0.011$). No associations were found between BDNF, body composition or metabolic biomarkers at any time points, and further, changes in BDNF concentration did not associate with changes in body composition or biomarkers.

CONCLUSION: A decrease in BDNF levels was found during multi-stress military training in both groups, regardless of the active recovery period of the REC group. Higher initial body mass was observed in the REC group, but none of the body composition variables, or biomarkers, explained the systematic difference in BDNF levels observed in this data. Further research is needed to elucidate the role of BDNF in anabolic and catabolic processes in multi-stress military environments.

Beckner ME, Main L, Tait JL, Martin BJ, Conkright WR, Nindl BC. 2022. Circulating biomarkers associated with performance and resilience during military operational stress. Eur J Sport Sci. 22(1):72-86.

Ojanen, T., Pihlainen, K., Yli-Renko, J., Vaara, J., Nykänen, T., Heikkinen, R. & Kyröläinen, H. (2023). Effects of 36-hour recovery on marksmanship and hormone concentrations during strenuous winter military survival training. BMC Sports Science, Medicine and Rehabilitation, 15(1).

THE IMPACT OF TWO MODES OF EXERCISE OF THE SAME INTENSITY (ENDURANCE VS. COORDINATIVE) ON CORTISOL LEVELS

BUDDE, H.

MEDICAL SCHOOL HAMBURG

INTRODUCTION: Physical exercise interventions can cause neuroendocrine activation, which in turn increases salivary cortisol concentrations (Budde et al., 2015). We aimed to investigate the influence of different acute exercise interventions on cortisol levels. Here, we distinguished between a coordinative exercise and an endurance exercise. To our knowledge, there have been no studies to date on whether the hypothalamic-pituitary-adrenal (HPA) axis differ between an acute coordinative exercise and an acute endurance exercise of the same intensity and duration. The purpose of this study was to examine the effects of these two different acute physical stressors on cortisol levels, specifically focusing on an intraindividual comparison between an acute coordinative and acute endurance exercise.

METHODS: Sixty-one students between eighteen and thirty years of age were included in the study and completed first a coordinative exercise and seven days later an endurance exercise of the same intensity and length which was self set on the first day, with a mean heart rate of 75-80% max over a period of 15 min. To measure changes in HPA axis activity, saliva samples were collected before and 5 and 30 minutes after exercise. The exercise intensity was controlled individually on a heart rate (HR) monitor as was the Rate of Perceived Exertion (RPE) using the Borg Scale (Borg and Loellgen, 2001). The saliva was stored at -20C° and analyzed within the next month for cortisol.

RESULTS: The results showed that the coordination exercise (co) produced a higher cortisol release than the endurance exercise (en). While the mean intensity was: HR 143 and the RPE was 13.9 co vs. 13.8 en.

CONCLUSION: We argue that interventions such as a coordinative exercise require a higher cognitive component, which results in stronger cortisol release than an endurance exercise of the same intensity and length and RPE level. Neither the motor fitness level nor the physical activity level hat an impact on the cortisol secretion. Thus, the type of acute physical exercise would be a psychophysiological factor in determining the neuroendocrine stress response and may be of interest in further research to sufficiently elucidate the proximate mechanisms of the stress reactions from acute physical exercise. Until now these results could only be obtained when we observed a blunted cortisol awakening response (CAR) due to coordinative vs endurance training (Wegner et al., 2019).

References

Borg and Loellgen (2001), "Borg's Perceived Exertion and Pain Scales," vol. 52.

Budde et al., (2015) The cortisol response to exercise in young adults. Frontiers in Behavioral Neuroscience. 3;9:13 doi: 0.3389/fnbeh.2015.00013

Wegner et al., (2019) Effects of different types of exercise training on the cortisol awakening response in children: A Randomized Controlled Trial. Frontiers in Endocrinology. doi: 10.3389/fendo.2019.00463

PLASMA LEVELS OF ANABOLIC STEROID HORMONES FROM CAPILLARY BLOOD SAMPLING DURING THE MENSTRUAL CYCLE IN TRACK AND FIELD ATHLETES

SIPPL, J.1, KEILER, A.M.2,3, KRUMBHOLZ, A.2, BÜTHE, E.1, PILZ, M.1, PLATEN, P.1

1 SPORTS MEDICINE AND SPORTS NUTRITION, RUHR UNIVERSITY BOCHUM, 2 INSTITUTE OF DOPING ANALYSIS AND SPORTS BIOCHEMISTRY DRESDEN , KREISCHA, 3 ENVIRONMENTAL MONITORING & ENDOCRINOLOGY, TU DRESDEN

INTRODUCTION: The menstrual cycle (MC) is characterized by fluctuations of the sex steroids estrogen and progesterone. However, the cyclic fluctuations of anabolic steroid hormones such as testosterone and androstenedione, which are secreted from both ovaries and the adrenal cortex, and the influence of hormonal oral contraception (OC) are largely unknown in elite female athletes. As the phases of MC might influence athletic performance and strength training adaptations1, a deeper understanding of the secretion and metabolism of anabolic sex steroid hormones through the MC is needed. The present study aimed to investigate the plasma levels of these hormones using capillary blood sampling as a new sampling method during MC in elite athletes with and without OC (wOC/noOC).

METHODS: 22 elite track and field athletes participated in a longitudinal study of MC monitoring in sports. 12 athletes with normal MC (n=19 cycles) and 5 athletes with OC (n=10 cycles) (26±6 y, 172±5 cm, 68±7 kg) were included in the analysis. In addition to the progesterone measurement, the intravaginal body temperature was measured daily for 24 hours to determine ovulation. Further, athletes collected capillary EDTA blood before training each Monday, Wednesday, and Friday. Plasma steroid hormones were analyzed by LC-MS/MS. Linear mixed models were used to compare testosterone (T) and androstenedione (A) during different phases of MC/noOC (7-phases: menstruation, mid and late follicular phase (FP), ovulation, and early, mid and late luteal phase (LP) and wOC (7-"phases": 28 days/ 7). The average of T and A was used for statistical comparison between noOC and wOC using the Mann-Whitney-U test.

RESULTS: In noOC plasma levels of T and A were significantly higher during ovulation compared to menstruation (T: ovulation: 0,44±0.23 ng/ml; menstruation: 0.30±0.12 ng/ml; 95% CI [0.03 0.18], p=0.032; A: ovulation: 1.45±0.65 ng/ml; menstruation: 0.88±0.38 ng/ml; 95% CI [0.22 0.68], p<0.001). In addition, A differed between ovulation and mid FP, late FP, mid LP, and late LP (ANOVA summary, p=0.012). Further, steroid hormone concentrations in wOC did not differ between the respective "phases". Median A concentration was higher in noOC compared wOC (noOC: 0.84 (0.6, 1.06) ng/ml; wOC: 0.97 (0.79, 1.29) ng/ml; 95% CI [-0.27 -0.10], p<0.001), while median T did not differ between groups.

CONCLUSION: In regular menstruating athletes plasma T concentrations were about 45% and A concentrations about 60 % higher around ovulation compared to menstruation. These findings of higher anabolic steroid hormone concentrations around ovulation support the rationale for periodizing training to MC. Results between athletes without and with OC are contradictory concerning T and A. Hormonal changes in the MC were highly variable and require individual analysis and interpretation. This project was funded with research funds from the Federal Institute for Sports Science based on a decision by the German Bundestag.

1. Alexander et al., 2022

CHANGES IN ENDOGENOUS ANDROGEN HORMONE PROFILE AFTER ~8-WEEKS OF MODERATE INTENSITY ENDURANCE TRAINING IN NATURALLY MENSTRUATING AND MONOPHASIC ORAL CONTRACEPTIVE USING FEMALES

SALMI, V., LEHTI, M.1, HACKNEY, A.C.2, IHALAINEN, J.K.1,3, MIKKONEN, R.1

1 UNIVERSITY OF JYVÄSKYLÄ, JYVÄSKYLÄ, FINLAND; 2 UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL, NORTH CAROLINA, USA; 3 FINNISH INSTITUTE OF HIGH PERFORMANCE SPORT KIHU, JYVÄSKYLÄ, FINLAND

INTRODUCTION: Concentrations of sex steroid hormones, including androgens, fluctuate during the menstrual cycle (MC) and with hormonal contraceptive (HC) use [1]. However, research regarding the effects of chronic endurance training on basal androgen concentrations in females is limited. Therefore, we examined changes in androgen concentrations after ~8-week of a moderate intensity endurance training program (MIET).

METHODS: Forty-four (tier 1) [2], naturally menstruating females (NM) [3] (length of MC 28 ± 4 d, age 30 ± 4 y, height 1.66 ± 0.05 m, weight 68.1 ± 10.8 kg, fat percentage 33.7 ± 8.3 %, and VO2max 38.4 ± 5.3 ml·kg-1·min-1) and 14 (tier 1) monophasic combined ethinyl estradiol-progestin containing oral contraceptive using females (OC) (age 27 ± 4 y, height 1.69 ± 0.06 m, weight 69.2 ± 5.9 kg, fat percentage 35.3 ± 5.1 %, and VO2max 39.0 ± 3.4 ml·kg-1·min-1) performed ~8-week MIET consisting of two MCs in NM and two 28-day HC "cycles" in OC. Prescribed training volume and intensity were the same in both groups and followed global exercise recommendations. Exercise included walking/running at 60–75 % of maximum heart rate. Fasting blood samples were collected before (PRE) and after (POST) MIET. In NM, samples were collected after the onset of bleeding between days 1–5 of the MC in the early follicular phase (FP) and 4–8 days after a positive ovulation test in the mid-luteal phase (LP). In OC, samples were collected between days 2–9 in the beginning of the active phase (i.e. pill taking days) and between days 2–6 of the inactive phase (i.e. pill free days). Estradiol (E2), progesterone (P4), total testosterone (tT), free testosterone (fT), dihydrotestosterone (DHT), androstenedione (A4), sex hormone-binding globulin (SHBG), dehydroepiandrosterone (DHEA) and its sulphate (DHEA-S) were analyzed from serum. Statistical analyses were conducted using generalized estimating equations.

RESULTS: Ovulation was detected in 89 % of participants during the first MC and in 82 % of participants during the second MC of the ~8-week MIET. In NM, serum concentrations of fT were significantly lower at POST compared to PRE at FP (B = -0.37, p = 0.043). Concentrations of DHEA-S were significantly lower at POST compared to PRE at LP (B = -0.35, p = 0.029). In OC, concentrations of DHT were significantly lower at POST compared to PRE at the inactive phase (B = -89.25, p =

0.045). Concentrations of other androgens, as well as concentrations of E2, P4 and SHBG remained unchanged in both groups.

CONCLUSION: Our findings suggest that chronic endurance training decreases androgen concentrations without concurrent changes in E2 and P4 both in naturally menstruating and monophasic combined oral contraceptive using females. However, the training induced reductions in specific androgenic hormones varied between NM and OC females.

References:

1. Salmi VM et al. (2024) in review.

2. McKay AKA et al. (2022) Int J Sports Physiol Perform. 17(2): 317–331.

3. Elliott-Sale KJ et al. (2021) Sports Med. 51(5): 843–861.

ANGIOGENIC T-CELL NUMBER AND TRANSCRIPTOMIC CHANGES WITH ACUTE EXERCISE

ROSS, M., NIEMIRO, G., SMITH, K., BAKER, F., ZUNIGA, T., DIAK, D., SECKELER, M., KATSANIS, E., SIMPSON, R.

HERIOT-WATT UNIVERSITY

INTRODUCTION: CD31+ T-cells are a highly vasculogenic T-cell phenotype and have demonstrated potent angiogenic capabilities, such as containing elevated VEGF-A content, promoting blood flow recovery in a hindlimb ischaemia mouse model and being essential for optimal endothelial progenitor cell growth. One mechanism by which exercise may promote tissue angiogenesis and vascular repair may be through promoting angiogenic T-cell (TANG) mobilisation, resulting in exposure of these TANG cells to the endothelium. These cells are known to ingress into the circulation in response to exercise, but new technologies, such as single cell sequencing, can provide some insight into transcriptomic changes, which may underpin any upregulation of angiogenic functions.

METHODS: Ten healthy, non-smoking, physically active participants (26 ± 5 years, 171.2 ± 12.3cm, 66.9 ± 11.9kg) underwent a 30-minute cycling exercise bout at an intensity 15% above the pre-determined lactate threshold. Peripheral blood samples were taken by cannulation before exercise (PRE) and in the final minute prior to the completion of the exercise bout (POST). Peripheral blood mononuclear cells (PBMC) were isolated from whole blood using density gradient centrifugation and T-cells quantified using flow cytometry.

CD31+ T-cells underwent single cell sequencing using 10X Genomics platform. 5' RNA whole transcriptome libraries were generated using the 10xGenomics Chromium Next GEM Single Cell 5' reagents kit, following recommended guidelines. The gene expression libraries were quantified, normalized, pooled, and sequenced on an Illumina NextSeq500 sequencer. Differentially expressed genes were detected, with a log2 fold cutoff of 0. Gene set enrichment analysis was performed and annotated to both KEGG and GO terms.

T-cell number changes with exercise were analysed using paired T-tests. A p-value of <0.05 was deemed statistically significant.

RESULTS: Exercise resulted in a significant ingress of CD3+CD31+ (PRE: 268±176 cells·μL-1; POST: 437±345 cells·μL-1, p=0.027, t=2.631), driven by the changes in CD3+CD8+CD31+ (PRE: 130±73 cells·μL-1; POST: 221±165 cells·μL-1, p=0.024, t=2.708) subset, with no changes evident in the CD3+CD4+CD31+ (PRE: 123±115 cells·μL-1; POST: 186±197 cells·μL-1, p=0.091, t=1.896) T-cells. Whilst CD31+ T-cells demonstrate significantly greater expression of angiogenic genes (VEGFA, PIK3CB, MMP-9, THBS1) the acute bout did not stimulate changes in these pathways but did result in several transcriptomic changes in these CD31+ T-cells, with ribosomal biogenesis genes and pathways largely downregulated, and lymphocyte-mediated immune functional pathways upregulated.

CONCLUSION: CD31+ T-cells exhibit an angiogenic profile, and acute exercise non-preferentially mobilises CD31+ T-cells, which may expose the vasculature to their angiogenic supporting processes, but transcriptomic changes are largely immune-, rather than angiogenesis-related.

Oral Presentations

OP-MH28 Exercise Snacks

STAIR-CLIMBING "EXERCISE SNACKS" INTEGRATED INTO DAILY LIFE: A PROOF-OF-CONCEPT STUDY

RITTER, Y., SUN, X., SPINDLER, L., PFISTER, D., GRUBER, M., SCHWENK, M.

UNIVERSITY OF KONSTANZ

INTRODUCTION: Traditional exercise programs are rarely taken up due to insufficient time or motivation. The innovative approach Exercise snacking is a time-saving training method integrating short high-intensity training bouts (≤ 1 minute) (Francois et al., 2014). Previous studies used resource-intensive procedures with each exercise snack administered by a personal trainer (Jenkins et al., 2019) which may not be transferable into practical applications. This study aimed to test the proof-of-concept of a self-administered stair-climbing exercise snacking training program into daily routines.

METHODS: Eight physically inactive participants (6 females), aged 23–59 years took part in a 6-week pre-post intervention study. The participants were instructed to conduct 3 exercise snacks/day during 3 days of the week (9 snacks/week in total), monitored by a sports watch. After the intervention, the feasibility was tested with a Likert-scaled questionnaire

including acceptability, frequency of practice, adverse events, and safety, reported as median and interquartile range (IQR). For pre-post changes in anaerobic performance (countermovement jump test, stair climbing test) and aerobic performance (spiroergometry, maximal oxygen uptake VO2max, max load Wmax), descriptive statistics (mean and standard deviation) are given.

RESULTS: Participants rated the exercise snacking training "good" to "very good" (IQR: 1.25), indicating high acceptability. For frequency of practice, 9-16 exercise snacks/week were integrated into daily life with up to 120 stairs per exercise snack. No adverse events were reported. Participants perceived the exercise snacking program "safe" (IQR: 1). Pre-post changes for the countermovement jump test showed increased maximum height (Pre: 34.8±8.6cm, Post: 35.5±8.2cm), and maximum power (Pre: 2.5±1.0W, Post 2.7±2.5W), but reduced results for maximum force (Pre: 1.4±0.6kN, Post 1.3±0.4kN). The stair climbing test showed reduced time (Pre: 5.9±1.0sec, Post: 5.2±0.7sec). Pre-post changes for aerobic performance showed increased VO2max (Pre: 26.2±4.4ml/min/kg, Post: 26.8±5.2ml/min/kg) and for Wmax (Pre: 157.6±42.3W, Post: 171.1±47.4W).

CONCLUSION: Our results suggest that self-administered stair climbing exercise snacks are well accepted and feasible for integrating into daily life. Pre-post increases may indicate specific effects on anaerobic and aerobic performances but need to be verified in a randomized controlled trial.

RESISTANCE EXERCISE SNACKS: AN EFFECTIVE AND TIME-EFFICIENT METHOD TO IMPROVE MUSCLE MASS IN FEMALE UNIVERSITY EMPLOYEES

BRANDT, T., SCHWANDNER, C.T.L., SCHMIDT, A.

INSTITUTE OF SPORT SCIENCE, UNIVERSITY OF THE BUNDESWEHR MUNICH

INTRODUCTION: Although resistance training (RT) is essential to preserve musculoskeletal fitness and maintain a healthy, independent life into old age, few women perform RT. We investigated whether resistance exercise snacking (RES) could be an efficient training approach for the workplace health promotion (WHP) to minimize barriers for participation and facilitate RT in women in order to improve musculoskeletal fitness.

METHODS: This pilot-study followed a prospective, controlled intervention design. Female employees with sedentary occupations doing RT on less than 2 days/week before study participation were included. Participants self-selected for either intervention (IG) or control group (CG). While the IG [N = 15, mean age 42.1 (SD = 11.1) years] did 10 min of RES on working days for 12 weeks, the CG [N = 15, mean age 49.9 (SD = 9.7) years] was instructed to maintain their habitual physical activity. Primary endpoint was change in muscle mass. Secondary endpoint was change in maximum isometric strength. Balance, cardiovascular fitness, perceived health, and general life satisfaction was assessed for exploratory purpose. Measurements were taken before and after the intervention.

RESULTS: 12 participants of IG and 14 of CG completed the study. Muscle mass improved significantly more in the IG [+0.42 (SD = 0.54) kg] compared to the CG [−0.16 (SD = 0.51) kg] ($p = 0.01$, $\eta 2p = 0.24$). Strength did not change significantly between groups. Nevertheless, there was a trend for greater improvements in the IG compared to the CG for trunk extension, trunk flexion, and upper body push but not upper body pull. Regarding exploratory endpoints, no significant between-group changes were found. Despite their poor fitness, both groups perceived their health as good and had high life satisfaction before and after the intervention.

CONCLUSION: RES could be an effective approach for the WHP to promote RT in inactive women with sedentary occupations and improve their muscle mass.

FEASIBILITY OF TECHNOLOGY-ENABLED EXERCISE SNACKS IN A REAL-WORLD SETTING: A PROOF-OF-CONCEPT RANDOMIZED CLINICAL TRIAL.

BABIR, F., ISLAM, H.2, MCCREARY, S.2, VAZ, E.2, JUNG, M.2, SINGER, J.3, RICHARDS, D.1, GIBALA, M.1, LITTLE, J.2

1 MCMASTER UNIVERSITY, HAMILTON, ON, CANADA; 2 THE UNIVERSITY OF BRITISH COLUMBIA - OKANAGAN, KELOWNA, BC, CANADA; 3 THE UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, BC, CANADA

INTRODUCTION: Physical inactivity increases the risk of mortality and many chronic diseases. Regular physical activity confers health benefits that can include increased cardiorespiratory fitness (CRF), but many people are insufficiently active. Common cited barriers include a perceived lack of time and limited access to appropriate facilities and equipment. Exercise snacks (ES) are isolated bouts of vigorous effort lasting ≤1-min performed sporadically throughout the day. Small laboratory-based studies have shown that short-term ES interventions can increase CRF, but the intervention remains to be tested in real-world settings. This two-site pilot randomized controlled trial investigated the feasibility and preliminary efficacy of a 12-wk technology-enabled, remotely delivered ES intervention (ClinicalTrials.gov NCT05574426).

METHODS: Seventy-seven inactive adults aged 40-64 y (56 females/21 males; 54±6 y, body mass: 77±12 kg, body mass index: 27±3 kg/m2) were recruited and randomized to an ES group (n=38) or a placebo control (CON) group (n=39). The ES intervention involved bodyweight exercises whereas CON involved stretching activities performed at lower intensity. Both interventions were conducted at home or work and required minimal space and no specialized equipment. Participants were encouraged to complete a minimum of 9 bouts/wk with a recommended frequency of 3 bouts/d on 3 d/wk. Participants received text and/or email prompts that directed them to a web platform with instructional videos of ES and CON activities that was custom-built by an industry partner. The primary outcome was CRF measured as peak oxygen uptake before and after training. Secondary outcomes included feasibility measured as adherence. This was determined

as the number of bouts recorded as complete in real-time on the web platform and the number of bouts subsequently reported through weekly adherence surveys.

RESULTS: Seventy participants completed the intervention (ES: n=33, placebo: n=37). There was no difference in the change in absolute [0.03 (-0.05 to 0.12) L/min] or relative [0.4 (-0.6 to 1.4) ml/kg/min] CRF after training between ES and CON (constrained baseline linear mixed model, mean difference with 95% confidence interval, both P = 0.43). Total bouts recorded as complete on the web platform over the 12-wk intervention were 171±70 for ES and 152±84 for CON. The number of weekly bouts reported on the adherence surveys were 15±5 for ES and 15±7 for CON. Both reported measures of adherence exceeded the minimum recommendation, which was 9 weekly bouts or 108 total bouts for the entire intervention.

CONCLUSION: A 12-wk technology-enabled, remotely delivered ES intervention was feasible for inactive adults to complete in a real-world setting. The lack of change in CRF may be owing to an insufficient bout intensity under free-living conditions and/or total volume of activity.

Supported by a Canadian Cancer Society/CIHR Action Grant.

EXPLORATION OF ACTIVITIES PEOPLE PARTICIPATE IN TO MEET THE MUSCLE STRENGTHENING PHYSICAL ACTIVITY GUIDELINES

ROSAINI, N.D., GRAY, S., RYDE, G.

UNIVERSITY OF GLASGOW

Introduction

Muscle strengthening activities confer broad health benefits, yet participation remains low. The UK 2019 Physical Activity Guidelines state that people should perform muscle strengthening activities, such as carrying heavy bags, gardening, stair climbing, yoga and going to the gym, at least 2 days per week. It is currently unclear what activities different people do to meet these guidelines. The aim of the current study, therefore, is to identify the activities that people engaged in to meet the guidelines.

Methods

Adults aged 18 to 64 years old living in the United Kingdom were invited to this cross-sectional study through online advertising and asked to complete a survey covering adherence to the guidelines and participation in nine different types of muscle strengthening activities based on a validated questionnaire. Crosstabulation and Pearson Chi-Square test were used to examine the distribution of the types of muscle strengthening activities, separately in males and females.

Results

Of the 620 adults who completed the survey, 77% self-reported that they meet the muscle strengthening guidelines, with higher participation in males (81%) than females (75%). On further analysis, 96% of adults who self-reported not meeting the guidelines did meet the guidelines primarily based on participation in activities such as carrying heavy bags (89% males; 80% females) and stair climbing (93% males; 89% females). In adults who self-reported meeting the guidelines, stair climbing (92% males; 95% females) and carrying heavy bags (89% males; 90% females) were the most frequently reported activities. There were some notable sex differences with males participating more in weight machines (57% males, 40% females, p=0.002) and resistance exercises (80% males, 70% females, p=0.033), but females participating in more holistic exercise (33% males, 55% females, p<.001), such as Pilates and yoga.

Discussion

The data demonstrates that many people who reported not meeting the current muscle strengthening physical activity recommendations do meet it when activities such as stair climbing, carrying heavy bags, and other daily living activities are included. This suggests that these activities need to be specified when ascertaining whether people meet the guidelines. However, whether these activities are sufficient to increase muscle strength and confer the associated health benefits remains to be established. The data also revealed clear differences between men and women in the kinds of activities they perform to meet the guidelines. This information may be important in directing the development of interventions to increase participation in muscle strengthening activities.

DEVELOPMENT AND RELIABILITY TESTING OF THE PERCEIVED ENVIRONMENT AND MUSCLE STRENGTHENING EXERCISE QUESTIONNAIRE

BROWN, E., ZEIGLER-HILL, V., RAJAEE, M., DRIGNEI, D., REZNAR, M., REGENSTEINER, J., DESANDRE, M., GADA, S., BISTAYI, A., SELOU, A., BARKHO, H., PALMER, T.

OAKLAND UNIVERSITY

INTRODUCTION

There are many health benefits to muscle-strengthening exercise (MSE), yet only 23.5% of U.S. adults meet the national MSE guidelines [1]. While barriers to MSE exist, there is a lack of understanding of these barriers [2]. Increasing knowledge in this area may help to encourage its use. Thus, the aim of this study was to develop and test the reliability of a questionnaire that measures how the perceived environment may influence MSE behaviors.

METHODS

The Perceived Environment and Muscle Strengthening Exercise Questionnaire (PEMSE-Q) was developed to understand how MSE may be affected by the environment. Key domains were identified through a literature search, and question-

naire items were developed. Expert review and cognitive interviews were employed to ensure the PEMSE-Q had good content validity and was understood by the target population, respectively. The PEMSE-Q included 77 items measuring the following domains: physical environment, home MSE equipment accessibility, and MSE social support. Test-retest reliability measurements were conducted in a U.S. national sample of two combined independent groups (group 1: healthy adults, n=237 [female(f), n=125; male(m), n=111; intersex, n=1], mean age [±standard deviation, SD]=36.1±10.7 years; group 2: type 2 diabetes [T2D], n=221 [f, n=122; m, n=99], mean age=46.5±10.9 years). Prolific.co is an online research participant recruitment tool, and was used for this study. The factor structure, internal consistency, and test-retest reliability of the PEMSE-Q were calculated using exploratory factor analyses, Cronbach's alpha, and intraclass correlation coefficients (ICCs), respectively.

RESULTS

Exploratory factor analyses revealed the following scales for the PEMSE-Q: physical environment (19 items; e.g., "Muscle-strengthening exercise machine [examples: Bowflex Home Gym®, Total Gym®, or other type of home gym] in your home, yard, or apartment complex." [α=0.77]), accessibility (14 items; e.g., "Muscle-strengthening exercise machine [examples: Bowflex Home Gym®, Total Gym®, or other type of home gym] accessibility." [α=0.79]), and social support (22 items; e.g., "I have someone who can provide support or encouragement in muscle-strengthening exercise." [α=0.90]). For test-retest reliability, the ICCs calculated were 0.94 for the physical environment, 0.83 for accessibility, and 0.88 for social support.

DISCUSSION

The results of the factor analyses showed that physical environment, accessibility, and social support were all separate constructs. Additionally, all of the ICCs suggested that the PEMSE-Q had very good test-retest reliability. The PEMSE-Q is a reliable tool for assessing MSE home equipment and accessibility, convenient MSE facilities, and social support. This tool can be used by researchers, public health professionals, and clinicians to better understand MSE barriers and facilitators in their target population.

REFERENCES

1. Bennie et al., 2019 2. Rhodes et al., 2017

Oral Presentations

OP-MH27 Technology supported interventions

VALIDATION OF AN IN SITU ACCELEROMETRY-BASED METHOD TO EVALUATE THE ANAEROBIC THRESHOLD VELOCITY.

ROZIER, P., MOREL, B.

UNIVERSITÉ SAVOIE MONT BLANC

INTRODUCTION: Critical power is an important fatigue threshold in exercise physiology [1]. It delimits efforts in the severe domain, where acute fatigue quickly and drastically appears, from efforts where disturbances remain moderate and can be maintained over long periods. It has great potential applications like evaluating and proposing training programs to improve quality of life of individuals with chronic diseases. However, gold-standard methods that evaluate critical intensity require maximal intensity and/or exhaustion tests, which are extremely difficult to use in a clinical context. In situ methods have been proposed to determine the critical intensity in cycling and running [2]. Training and racing data are compiled over months so the speed-duration relationship can be modelled. Dynamic Body Acceleration (DBA) is an indicator derived from ecological sciences that uses body acceleration as a proxy for locomotion speed [3]. Therefore, this study aimed to assess the validity of critical DBA (DBAc) derived from field data as a reliable proxy for anaerobic threshold velocity.

METHODS: Twelve participants with various physical training and disease conditions wore a 3D accelerometer (GT3X-BT, ActiGraph) for one month. The only instruction was to "continue living as usual". They then performed a submaximal incremental walk test on a 15% inclined treadmill. Blood lactate concentration [La-] was measured at the end of each 3-min stage. The stage speed increment was 0.5 km.h-1 when [La-] < 2 mmol.L-1, and 0.2 km.h-1 when [La-] > 2 mmol.L-1. Exercise was stopped as soon as [La-] > 4 mmol.L-1. An exponential model was fitted to the lactate concentrations as a function of speed to estimate the speed at 4 mmol.L-1 (S4mmol). The mean DBA records for each day were computed for durations ranging from 1 to 30 min. These records were fitted with a 2-parameter critical intensity model using quantile regression ($\tau = 0.9$) to obtain DBAc. The relationship between DBAc and S4mmol was calculated by linear regression analysis (least squares method).

RESULTS: The median values of DBAc and S4mmol were respectively 1.14 m.s-2 (range = [0.43 ; 1.40]) and 5.7 km.h-1 (range = [3.3 ; 6.6]). A very strong correlation was found between DBAc and S4mmol ($r2 = 0.91$, RMSE = 7%, $p < 0.001$).

CONCLUSION: The DBAc obtained from the accelerometry data is a valid proxy for S4mmol. It is therefore possible to characterise the anaerobic threshold of individuals solely on the basis of accelerometry data obtained without any particular instructions during real life. This opens up interesting perspectives for evaluating patients without the need for time-consuming and physically demanding tests. Clinical studies including patient follow-up via actimetry are common and can use the proposed methodology to evaluate patients without additional constraints.

[1] Poole et al. (2016). Med Sci Sports Ex.

[2] Smyth et al. (2020). MSSE.

[3] Wilson et al. (2006). Journal of Animal Ecology.

EFFECTIVENESS OF 'BRAIN-IT' - AN EXERGAME-BASED TRAINING CONCEPT FOR SECONDARY PREVENTION OF MILD NEUROCOGNITIVE DISORDER - RESULTS OF A RANDOMIZED CONTROLLED TRIAL

MANSER, P., DE BRUIN, E.D.

ETH ZURICH

INTRODUCTION: The combination of exergame-based motor-cognitive training with resonance breathing guided by heart rate variability biofeedback (HRV-BF) targets various relevant mechanisms of action to alleviate the pathological state in individuals with mild neurocognitive disorder (mNCD).

METHODS: This randomized controlled trial (RCT) investigated the effectiveness of adding a novel intervention approach that combines exergame-based motor-cognitive training with HRV-BF to usual care, compared to usual care alone, in individuals with mNCD. The individualized intervention was delivered via the 'Brain-IT' training concept that was iteratively co-designed, tested, and refined with patient and public involvement [1]. We assessed global (primary outcome) and domain-specific cognitive performance, spatiotemporal parameters of gait, instrumental activities of daily living, psychosocial factors, and resting cardiac vagal modulation. In addition, we evaluated brain structure and function with (functional) magnetic resonance imaging to explore possible underlying neural changes of the training in relation to adaptations in cognitive performance. Analyses of covariance were computed and partial eta-squared (η2p) effect sizes with 90% confidence intervals (CI90%) were calculated.

RESULTS: We observed a significant (p = 0.007) effect with a large effect size (η2p [CI90%] = 0.197 [0.034, 0.371]) for global cognitive performance in favor of the intervention group. A post-hoc power analysis revealed a statistical power of 0.832 for this analysis. 55% of participants in the intervention group and 23% of participants in the control group were responders, showing a clinically relevant improvement in global cognitive performance. For our secondary outcomes, we observed significant effects with large effect sizes in favor of the intervention group for immediate (p = 0.022, η2p [CI90%] = 0.154 [0.013, 0.332]) and delayed (p = 0.007, η2p [CI90%] = 0.204 [0.034, 0.382]) verbal recall, and a borderline significant effect with a moderate effects size for an improvement of quality of life (p = 0.065, η2p [CI90%] = 0.097 [0, 0.263]). The remaining (underpowered) statistical analyses revealed no consistent effects on behavioral outcomes.

CONCLUSION: 'Brain-IT' training is effective for improving global cognitive performance as well as immediate and delayed verbal recall. Confirmatory RCTs are warranted to (i) be able to conclude about potential near- and far-transfer effects of the training, (ii) investigate whether the observed improvements in cognitive performance translate to influencing the progression rates to dementia, and (iii) elucidate the underlying biological mechanisms of action of this novel type of intervention.

References:

1. Manser P, de Bruin ED. Making the Best Out of IT: Design and Development of Exergames for Older Adults With Mild Neurocognitive Disorder - A Methodological Paper. Front Aging Neurosci. 2021;13:734012. doi: https://doi.org/10.3389/fnagi.2021.734012.

VALIDATION OF A NEW DIGITAL HEALTH SOLUTION FOR REMOTE MONITORING OF DAILY LIFE PHYSICAL ACTIVITIES

SCHURMANS, G., BACKES, A., FAYAD, J., MEYER, T., ECKELT, M., GRIMM, B., MOUTON, C., SEIL, R., MALISOUX, L.

LUXEMBOURG INSTITUTE OF HEALTH

INTRODUCTION: A new digital health solution consisting of pressure-sensitive insoles combined with inertial measurement units has been developed to provide clinicians with relevant information on the progress of their patients in their natural environment by detailing aspects of movement quality and quantity, and to monitor their patient's everyday activities. This study aims to test the system's ability to properly identify and quantify different types of daily life activities.

METHODS: Healthy volunteers were invited to complete a series of 12 different usual daily life activities (i.e., sitting straight and relaxed, standing, shuffling, walking straight and non-straight, walking with crutches, hill climbing and descending, stairs climbing and descending, and indoor cycling). Participants were instructed to perform each of the activities twice, in the order and duration of their choice. Data from the system was compared with direct observation of video recording using software for behavioural research. Two observers analysed independently each video recording. Outcomes include both the total duration of each activity and the total counts of events, when appropriate (e.g., steps). The interrater reliability was assessed using Cohen's Kappa statistic (K). The system's accuracy to properly identify and quantify activities was examined by calculating the mean absolute percentage error (MAPE scores) and Bland Altman plots.

RESULTS: A total of 100 participants were included (50 females (50%); median age = 29 years [IQR: 26; 43.3]; median body mass index = 24.7 kg.m^-2 [21.3; 25.9]). The total measurement time was approximately 10 min per participant (activities lasted from 5 to 60 seconds). The interrater reliability was excellent (K=0.85). Overall, MAPE scores between video analysis and the device ranged from 10.4% (total duration of level walking) to 381.1% (total standing count). The system seems to have a general good estimation for some walking duration variables (walking straight, level and non-level walking; MAPE score between 10-20%) and reasonable estimation for the total sitting duration and certain counts (total steps and stairs; MAPE score 20-50%). The performance to identify and quantify the other activities was lower (MAPE score > 50%), and it

seems that the algorithm was particularly ineffective in identifying and quantifying standing count and duration (MAPE score > 100%).

CONCLUSION: In a controlled laboratory environment, the system's performance in classifying and quantifying accurately daily life activities was heterogeneous as some activities were estimated with good accuracy (e.g., walking straight duration) while other activities were erroneous (e.g., standing duration). Further development is needed to improve classification algorithms. Future studies will evaluate the acceptance and ease of use of the system in orthopaedic patients.

Oral Presentations

OP-MH18 Physiotherapy I

THE EFFECT OF SCAPULAR STABILIZATION EXERCISES ON SHOULDER SYMPTOMS AND SCAPULAR POSITION IN PATIENTS WITH SUBACROMIAL IMPINGEMENT SYNDROME

XI, R.1, ZHOU, J.B.2, LI, G.P.2

1 CHINA INSTITUTE OF SPORT SCIENCE; 2 CHINA NATIONAL INSTITUTE OF SPORTS MEDICINE.

INTRODUCTION: Scapular focused exercise interventions are frequently used to treat individuals with shoulder pain. However, evidence for changes in scapular position after intervention is limited. The purpose of this study is to explore the effect of 8-week scapular stabilization exercises on shoulder joint function and scapular position in patients with subacromial impingement syndrome.

METHODS: Methods : 45 patients with subacromial impingement syndrome were randomly divided into intervention group (n = 22) and control group (n = 23). The intervention group received scapular stabilization exercises and two health education courses for 8 weeks (three times a week), while the control group received two health education courses. All outcomes were measured preintervention and postintervention at 8 weeks. Outcome measures were Visual Analogue Score(VAS),Shoulder Pain and Disability Index(SPADI), Coracoid upward shift distance (CUSD), length of the scapular spine line (LSS), and scapular upward rotation angle (SURA) which were measured on the radiographs.

RESULTS: The intervention group showed significant improvement ($p< 0.05$) in VAS and SPADI compared to the control group. Significant changes were found in SURA and CUSD in the intervention group after 8weeks($p< 0.05$).

CONCLUSION: This study indicated that scapular stabilization exercise can improve symptoms and alter the position of the scapula in subacromial impingement syndrome patients.The results provide biomechanical support for the clinical rationale for indicating therapeutic exercises focused on the scapular muscles to improve scapular dynamics and shoulder function.

EFFECTS OF VIDEOCONFERENCE-SUPERVISED GROUP EXERCISE ON LOW BACK PAIN: SHORT AND LONG-TERM RESULTS FROM THE REVIEEW RANDOMISED CONTROLLED TRIAL

ESPIN, A., IRAZUSTA, J.1, RUIZ-FERNÁNDEZ, A.1, MARTÍN-PÉREZ, A.1, ACEDO, K.2, RODRIGUEZ-LARRAD, A.1

1. UNIVERSITY OF THE BASQUE COUNTRY , 2. HOME CARE LAB, S. COOP.

INTRODUCTION: Although benefits of exercise on low back pain (LBP) have been demonstrated, most evidence is limited to short-term effects, and videoconference-supervised interventions are lacking. Therefore, our primary aim was to assess the effects of videoconference-supervised exercise on the LBP of eldercare workers, a population with high prevalence of this disorder. We also included additional pain sites, psycho-affective parameters, muscle performance and sick leave as secondary outcomes.

METHODS: 130 eldercare workers were randomised to a control (CG, n=65) or experimental (EG, n=65) group. Both groups participated in workplace prevention programs, and the EG received an additional 12-week exercise intervention, consisting of progressive moderate-intensity resistance exercises. The intervention was followed by advice to continue exercising until a 48-week follow-up. Assessments were done at baseline, 12 and 48 weeks. Primary outcome was LBP, measured by a 0-10 scale. Secondary outcomes included: neck, shoulder and hand/wrist pain (0-10 scale), pain medication (days), happiness (Lyubomirsky's scale), anxiety and depression (Goldberg's scale), quality of life (EuroQol-5D), sleep quality (single-item scale), hypnotic/anxiolytic medication (days), lower-limb (5-repetition sit-to-stand), upper-limb (kneeling push-up) and trunk (Shirado-Ito flexor) muscle performance, and sick leave (days). Group-by-time ANCOVA was used to assess intervention effects, and both intention-to-treat (ITT) and per-protocol (PP, adherence ≥50%) analyses were done. Significance was set at $p<0.05$.

RESULTS: At 12 weeks, ITT showed a beneficial effect on LBP ($p=0.034$), as well as on hand/wrist pain ($p=0.023$) and upper-limb muscle performance ($p=0.040$). PP demonstrated additional benefits in depression ($p=0.021$), quality of life ($p=0.002$), hypnotic/anxiolytic medication ($p=0.011$) and lower-limb ($p=0.026$) and trunk ($p=0.030$) muscle performance. At 48 weeks, ITT showed a loss of the beneficial effect on LBP, as well as on hand/wrist pain and upper-limb muscle performance. However, a reduction in hypnotic/anxiolytic medication was observed ($p=0.006$). Moreover, PP demonstrated additional benefits on depression ($p=0.033$), trunk muscle performance ($p=0.049$) and sick leave ($p=0.013$).

CONCLUSION: The intervention reduced the LBP of eldercare workers at short-term. However, despite the advice to continue exercising, this improvement was not maintained at long-term. Additional benefits were observed in hand/wrist pain and upper limb muscle performance at short-term, as well as in hypnotic/anxiolytic medication use at long-term. Moreover, workers with higher adherence to the intervention had additional benefits in psycho-affective parameters and sick leave. This study provides new evidence on an alternative, feasible and effective exercise modality to reduce LBP in eldercare workers. However, advice to continue exercising was not able to maintain most of the benefits obtained.

EFFECTS OF ACTIVE-MOTOR-CONTROL MYOFASCIAL RELEASE ON CHRONIC SHOULDER PAIN IN OVERHEAD ATHLETES

HUANG, T., ZOU, H.L., ZHANG, W., LIU, H.Y., YAN, B.
BEIJING SPORT UNIVERSITY

INTRODUCTION: Chronic shoulder pain (CSP) affects 50%–91% of overhead athletes, severely impacting their training and competition [1]. Although scapular stabilization exercise (SSE) is a first-line treatment, it has a limited and slow effect on pain relief [2]. This study introduces an integrated approach combining active motor control with myofascial release (AMC-MR), aiming to enhance pain relief and functional recovery in overhead athletes with CSP [3].

METHODS: Twenty-four overhead athletes with CSP were randomized into AMC-MR and SSE groups for a 6-week intervention. The AMC-MR group received treatment weekly, while the SSE group had sessions three times weekly. Primary outcomes were pain intensity assessed by the Numeric Rating Scale (NRS, 0-10 scale), including present, average, and most severe pain intensity. Secondary outcomes included Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow Score (KJOC) for patient-reported outcomes, active range of motion (AROM), and maximum isometric muscle strength (MIMS). Average and most severe pain intensity and KJOC were assessed at baseline and 6 weeks. Present pain intensity, AROM, and MIMS were assessed at baseline, after the first session, and at 6 weeks.

RESULTS: All participants completed the study without dropouts. For primary outcomes, present pain intensity was 4.00±1.21 in the AMC-MR group and 4.16±1.53 in the SSE group at baseline. The AMC-MR group showed a significant reduction in present pain intensity after the first session (1.08±1.38) and at 6 weeks (0.75±0.97), surpassing the SSE group significantly after the first session (P=0.02), with the SSE group also noting significant present pain relief at 6 weeks (1.83±1.89). Both groups showed considerable improvements in average and most severe pain intensity at 6 weeks. Secondary outcomes revealed significant improvements in both groups for KJOC, and shoulder abduction and flexion at 6 weeks, with the AMC-MR group showing superior improvement in KJOC (P=0.02). The AMC-MR group also notably enhanced AROM including external rotation, internal rotation, abduction, and flexion after the first session, with external rotation improvements outperforming the SSE group (P=0.01). No significant changes were observed in MIMS for the serratus anterior and trapezius in either group.

CONCLUSION: AMC-MR has shown clear advantages in both rapid pain relief and improved function, as well as duration of efficacy.

References:

1. Kibler WB, Sciascia AD, Hrsg. Disorders of the Scapula and Their Role in Shoulder Injury: A Clinical Guide to Evaluation and Management. Cham: Springer International Publishing; 2017.

2. Nodehi Moghadam A, Rahnama L, Noorizadeh Dehkordi S, et al. Exercise therapy may affect scapular position and motion in individuals with scapular dyskinesis: a systematic review of clinical trials. J Shoulder Elbow Surg 2020; 29: e29–e36.

3. Schleip R. FASCIA AS A SENSORY ORGAN: Clinical Applications. Terra Rosa E-Mag 2017; 20: 2–7.

EVALUATING PHYSICAL THERAPIES FOR DELAYED ONSET MUSCLE SORENESS: AN EVIDENCE MAPPING

WIECHA, S., POSADZKI, P., ZAJAC, J., WISNIOWSKI, P., PAWLICZEK, P., CIESLINSKI, M., PRILL, R., CIESLINSKI, I., PLASZEWSKI, M.
JOZEF PILSUDSKI UNIVERSITY OF PHYSICAL EDUCATION, WARSAW, POLAND.

INTRODUCTION: Delayed onset muscle soreness (DOMS) commonly arises from intense and unfamiliar physical exertion, leading to diminished muscular strength, heightened soreness, and inflammation. Various systematic reviews (SRs) evaluate diverse physical therapy (PT) approaches aimed at reducing DOMS. Nevertheless, these SRs frequently yield conflicting findings, hindering the formulation of therapeutic strategies by clinicians.

METHODS: An umbrella review method with meta-meta-analysis has been utilized to evaluate the efficacy and safety of PTs in reducing DOMS. Medline, Embase, Cochrane Database of Systematic Reviews, PEDro, and Epistemonikos were searched from 1998 until May 2023. SRs of RCTs of any treatment used by physical therapists or physiotherapists to reduce DOMS in healthy adults have been eligible. AMSTAR-2 has been used to evaluate the risk of bias of the included SRs. An evidence map categorized interventions based on the effect size and strength of evidence (Class I-V based on the number of cases, p-value, heterogeneity, Egger's test, and excess of significance bias).

RESULTS: Twenty-nine SRs (24 with meta-analysis) meet inclusion criteria, including 863 unique RCTs. Interventions were diverse, including 24 different PTs. The quality of SRs was generally low, with only 7% rated as high quality.

With the highest strength of evidence, significant effects in pain reduction were observed immediately after post-exercise intervention in contrast therapy (Class II), massage therapy at 24 hours (Class II), compression, contrast therapy, Kinesio taping, and cryotherapy at 48 hours (Class III), Kinesio taping at 72 hours (Class III), while compression, phototherapy, and

contrast therapy showed effectiveness at 96 hours (Class IV). The effect size (Hedges' g) varied widely for individual therapies from 0.36 [95%CI 0.46, 3.18] for cold therapy to 1.82 [95%CI 0.46, 3.18] for heat therapy, with a prominent increase in the 95%CI as the effect size increased.

CONCLUSION: This is the first umbrella review to analyze the effects of different therapeutic interventions on pain reduction in DOMS. In the analyzed SRs, therapies were not directly compared with each other or ranked by the strength of scientific evidence. The overlap between SRs varied, indicating differences in search strategies. The analyses reveal a wide disparity in the effectiveness of PTs and an overall low strength of scientific evidence for most therapies. This may be attributed to the high methodological heterogeneity of first-line studies and the significant internal variation in the therapies applied.

EFFECTS OF MICROCURRENT THERAPY ADDED TO PHYSICAL EXERCISE ON BODY COMPOSITION, PERFORMANCE, AND MUSCLE SORENESS: A META-ANALYSIS OF RANDOMISED CONTROLLED TRIALS

KOLIMECHKOV, S., SEIJO, M., COLADO, J.C., NACLERIO, F.

UNIVERSITY OF GREENWICH

INTRODUCTION: Microcurrent therapy (MCT) uses sub-sensory electric current across the skin to enhance healing after injury, improve post-exercise recovery or optimise training outcomes in athletes. This meta-analysis aimed to assess the effectiveness MCT combined with physical exercise for attenuating symptoms of delayed onset muscle soreness and enhancing body composition, muscle strength, and endurance compared to exercise alone (sham MCT with exercise) in physically active individuals.

METHODS: A meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The search of the literature was conducted using Cochrane Library, EBSCOhost, Google Scholar, MEDLINE PubMed, and Web of Science, considering publications until the 1st of February 2024. The inclusion criteria were randomised controlled trials (RCTs), including adult participants (≥18 years old) undergoing any exercise intervention combined with MCT or a sham (control condition). Continuous data on fat mass percentage, maximum load moved in resistance exercises (1RM) as a marker of strength, VO2peak as a marker of endurance, and delayed onset muscle soreness (DOMS) were pooled using a random-effects model. The Comprehensive Meta-Analysis Software, v. 4.0.000 (Biostat Inc., Englewood, New York, USA) was used for the analysis.

RESULTS: Data from eleven RCTs were included in the qualitative summary and six in the quantitative analyses (n=364 participants). The overall quality of the included studies was high, demonstrating a low risk of bias. Compared to sham, MCT added to exercise significantly reduced the symptoms of DOMS (g = -0.487, 95 % CI -0.75 to -0.23). No further significant benefits of MCT were identified for fat mass percentage (g = -0.144, 95 % CI -0.48 to 0.19) or strength (g = 0.116, 95 % CI -0.45 to 0.69).

CONCLUSION: MCT added post-workout is an effective, safe modality for reducing the symptoms of delayed onset muscle soreness in healthy physically active humans.

Oral Presentations

OP-SH12 Psychology/Cognition II

EFFORT MANAGEMENT IN SHORT TRAIL RUNNING: QUALITATIVE ANALYSIS BY SELF-CONFRONTATION

DE COCK, F., FOSSION, G., ECCLI, C., PAQUOT, Q., JIDOVSTEFF, B.

UNIVERSITY OF LIÈGE

INTRODUCTION: According to Glazier's model (2017), self-organization plays a key role in short trail running performance. As a consequence, understanding how trail runners' particular possibilities for acting, feeling and thinking which are embedded in the race topography, environment and circumstances would be helpful to understand effort management and performance. A qualitative approach using the self-confrontation method would appear to be the most appropriate way to investigate the main effort management processes used by runners during a trail running.

METHODS: Subjects participating in a short trail race (10 to 30km) were equipped with a GoPro and a Garmin watch in order to record their activity throw GPS data and video recording. In the 5 days following the race, each subject participated in a self-confrontation interview following a thematic analysis. They were asked to describe for each relevant event what they feel, think and the decisions they make according to race chronology. Via a triangulation of researchers, the interviews were transcribed and coded to immerse main management processes.

RESULTS: The qualitative approach used in this study gave rise to a plurality of experiences and was successful to identify and characterize particular ways of acting in a running situation. Based on Glaziers model (2017), effort management and trail running performance depend on the task, the environment and the organism. We found that runners organize themselves according to the constraints that influence their perceptions, feelings, cognitive processing and decision-making which are particularly influenced by the chronology of the race. We identify strategies influencing the management of effort such as trail recognition, position on the start line, goal setting, management of vitality, nutrition and hydration, motivation and pleasure.

CONCLUSION: The results of this qualitative research was successful to identify main effort management strategies during short trail running. The data from this study provide a better understanding of how runners coordinate their control throughout the race, especially in delicate moments, and could be used to optimize performance.

References:

Glazier, P. S. (2017). Towards a grand unified theory of sports performance. Human movement science, 56, 139-156.

COMPARATIVE ANALYSIS OF EVENT-RELATED POTENTIAL AND VISUAL WORKING MEMORY IN ELITE GYMNASTICS, FOOTBALL, AND ESPORTS ATHLETES

RAMYARANGSI, P., SIRIPORNPANICH, V.1, NANBANCHA, A.1, POKAISASAWAN, A.2, AJJIMAPORN, A.1
MAHIDOL UNIVERSITY NAKHON PATHOM, THAILAND; 2 RANGSIT UNIVERSITY, BANGKOK, THAILAND

Introduction

The significance of the visual system and the specific acquisition of visual skills for enhancing athletic performance is paramount in elite sport (Erickson, 2020). Sports, such as gymnastics, football, and eSports, may necessitate equally unique visual abilities. As such, research has placed an increasing emphasis on better understanding the nuances of visual cognition in athletes across different sports. The purpose of this investigation was to examine and contrast the characteristics of the P300 evoked potential elicited by a visual oddball paradigm (visual P300 ERP) and visual working memory among elite athletes from three distinct sports.

Methods

A total of 42 athletes across three sports participated in the study. Of these, fourteen were gymnasts (age: 20±1 yrs, BMI: 22.0±1.5 kg/m2), fourteen were footballers (age: 21±1 yrs, BMI: 20.8±2.5 kg/m2), and fourteen were eSports athletes (age: 21±2 yrs, BMI: 21.5±3.3 kg/m2). Participants had normal or corrected-to-normal vision and right-hand dominance and undertook the visual P300 ERP using electroencephalography and used the Gorilla.sc experiment builder program to evaluate visual working memory (n1-back and n2-back). Data analysis among the three athlete groups was performed using a one-way ANOVA. The Bonferroni post hoc test was used for pairwise comparisons.

Results

Results revealed notable differences among the athlete types in visual P300 ERP. The eSports group demonstrated a significantly longer P300 latency than the gymnastic group ($p=0.01$) at the midline Frontopolar site of electrodes, but there were no differences in amplitude. In addition, both the eSports ($p=0.03$) and gymnastic ($p=0.04$) groups exhibited a superior percentage of correct responses in visual ERP compared to the football group. Regarding mean visual ERP reaction time, the eSports group exhibited significantly longer durations than both the soccer ($p<0.01$) and gymnastic ($p<0.01$) groups. Moreover, the mean reaction time of the soccer group was significantly longer than the gymnastic group ($p<0.01$). There were no differences among the groups for the visual working memory task.

Discussion and Conclusion

These findings demonstrate that the visual P300 ERP observations in athletes are different contingent on the type of sport. In doing so, it adds further credence to the notion of sport-specific characteristics in visual attention. Future research that takes into consideration how the specific training regimens and cognitive demands of different sports influence visual processing might yield further valuable insights that would add to the knowledge base.

Acknowledgements

This research is supported by the NRCT: NRCT5-RGJ63012-129

References

1) Erickson GB. Sports vision: vision care for the enhancement of sports performance. Elsevier Health Sciences; 2020 Nov 24.

EXPERT PERFORMANCE IN ACTION ANTICIPATION: VISUAL SEARCH BEHAVIOR IN VOLLEYBALL SPIKING DEFENSE FROM DIFFERENT VIEWING PERSPECTIVES

ZHU, R., ZOU, D., WANG, K., CAO, C.
TSINGHUA UNIVERSITY

Introduction

Volleyball spiking requires defenders to possess exceptional anticipatory skills. Athletes' visual search skills, enable them to execute appropriate responses, thereby facilitating effective anticipation. Behavioral studies have consistently demonstrated that athletes tend to exhibit superior perceptual-cognitive abilities, particularly in sports-specific contexts. In addition to subjective methods such as verbal reports, eye-tracking devices can be used as scientifically objective instruments to measure expert athletes' visual search skills. However, Previous volleyball defense video eye-tracking studies used fixed or off-court perspectives, failing to replicate real-world environments. The present study investigated visual search behaviors in spike defense anticipation from different back-row viewing perspectives, including one baseline off-court perspective and three on-court perspectives.

Methods

We examined the spiking anticipation ability and visual search behavior of 14 competitive elite, 13 semi-elite, and 11 novice players using the Tobii Pro eye-tracking device. We let them see the spiking video and instructed them to press a key to anticipate the landing location of the ball. For video production, We captured spiking videos from three on-court perspectives using GoPro cameras mounted on the back-row defenders heads, closely replicating real game scenarios. For comparison, we recorded baseline videos using a fixed camera. For Areas of interest, we divided videos into 2 phases: pre-spike and spiking phase. We used repeated ANOVA and subsequent Bonferroni post hoc analyses in SPSS to explore the differential effects between groups and perspectives.

Results

The repeated measures ANOVA with factors 3 (group) × 4 (perspective) demonstrated a notable interaction effect on RA ($F(6,68) = 2.204$, $p = 0.050$, $\eta 2 = 0.163$). The CE (58.5% ± 3.3%) and SE (56.3% ± 5.0%) groups were significantly superior to the novice group (49.9% ± 4.8%). Competitive elite players used fewer fixations($t=6.241$, $p<0.001$). Regardless of skill level, all participant groups showed similar visual allocation among areas of interest. However, notable differences in visual search patterns and AOI allocation were observed between baseline and on-court perspective videos ($F(3, 35) = 123.108$, $p < 0.001$, $\eta 2 = 0.918$).

Discussion

Elites are more skilled than novices in utilizing early visual cues to anticipate opponents' actions. Elites superior performance was related to stable visual search patterns (fewer fixations and longer duration). CEs are likely more adept than SEs and novices at utilizing their peripheral vision for global perception. From the baseline perspective, the participants primarily utilized global perception and peripheral vision, focusing more on the setter zone or the spiker's trunk. Conversely, from the on-court perspective, they employed more fixations, focusing more intensely on the spiker's detailed movements.

THE COMPLEX RELATIONSHIPS BETWEEN VO2MAX METRICS, COGNITIVE AND BRAIN OUTCOMES IN OLDER ADULTS

BHERER, L., MAGNAN, P.O., VINCENT, T., BESNIER, B., DUPUY, E., GAGNON, G., MOHAMMADI, H., NIGAM, A., GAYDA, M.
UNIVERSITY OF MONTREAL

Background: Exercise-related physiological adaptations by which it improves brain function are still poorly known. Some studies, including ours, have shown that change in VO2max is a strong predictor of cognitive benefits, but the underpinning physiological mechanisms are not well documented. This study investigated which VO2max metrics better predict various cognitive functions and brain imaging structural markers known to be altered in aging.

Methods: Ninety adults aged 60 and older performed a maximal cardiopulmonary exercise Test (CPET) using an individualized incremental bike protocol according to the most recent recommendations. CPET key parameters were measured with gas exchange analyze (Quark, Cosmed, Italy) during exercise test. They also participated in an MRI session to acquire T1 brain images (1x1x1 mm, Siemens Skyra 3T). CPET key parameters were VO2max normalized with body mass, lean body mass and in % of predicted value (VO2max/kg, VO2max/LBM, VO2max % pred. Brain imaging involved hippocampal volume (average of left and right sides), total grey matter and T1 Hypointensities volumes normalized by intracranial volume as obtained by the Freesurfer segmentation pipeline (version 7.4).

Results: All VO2max metrics were associated to some extent with global cognition, executive function, verbal and working memory, and processing speed. However, when considering composite scores of cognitive performances, and after controlling for age, sex and education, VO2max/kg ($p.<.05$) and VO2max/LBM ($p.<.01$) predicted executive functions, while VO2max % pred was the only significant predictor of verbal memory ($p.<.001$), and none of the VO2max metrics predicted processing speed. All brain imaging measures predicted executive functions ($p.<.05$), while only total grey matter ($p.<.001$) and hippocampal volumes ($p.<.05$) predicted verbal memory. VO2max/LBM and VO2max % pred predicted all brain imaging measures ($p.<.05$), while VO2max/kg only predicted T1 Hypointensities ($p.<.001$). Significant partial mediation effects were independently found for total grey matter ($p.<.05$) and hippocampal volumes ($p.<.05$) explaining the association between VO2max/LBM and executive functions.

Conclusion: Results support the notion that VO2max metrics are not equivalent predictors of cognitive functions and brain imaging outcomes, highlighting the importance of consistency in reporting results on the relationship between cardiorespiratory fitness and cognition. These results could also inform on more targeted and personalized exercise intervention to maintain and improve cognition and brain health in seniors.

16:30 - 17:30

Conventional Print Poster Presentations

CP-AP01 Training and Testing in Sports I

THE INTERUNIT RELIABILITY OF STATSPORTS APEX GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) AND ACCELEROMETER METRICS DURING REPEATED SPRINTS OF VARIED DISTANCES AND CHANGE OF DIRECTION FREQUENCY.

DAWSON, L., MCERLAIN-NAYLOR, S., DEVEREUX, G., BEATO, M.
ST MARYS UNIVERSITY TWICKENHAM

INTRODUCTION: The importance of athlete monitoring in team sports is now widely recognised and commonly achieved using GNSS trunk-mounted player tracking systems. Systems allow for the output and interpretation of multiple external load metrics which practitioners use to inform the prescription and adaptation of training load. However, interunit reliability is important to allow comparisons to be made within and between athletes and teams. The aim of this study was to assess the interunit reliability of STATSports Apex units during repeated sprints of varied distances and changes of direction, to assess how reliability and metrics may change with the demands of repeated sprints.

METHODS: Thirty-three female football players performed 5 sets of 2 x 20 m, 4 x 10m and 8 x 5 m repeated sprint protocols (200m total), while wearing two harnesses and STATSports Apex GNSS units, placed alongside each other, between the scapulae. The interunit reliability was assessed using intraclass correlation coefficient (ICC), for each protocol and all combined, for a selection of GNSS and accelerometer-based (ACC) metrics. One-way ANOVAs were used to compare the metrics reported for each sprint protocol.

RESULTS: Across all protocols GNSS metrics demonstrated good to excellent interunit reliability (ICC: 0.845 - 0.999), while ACC metrics fatigue index (ICC: 0.495) and dynamic stress load (ICC: 0.484) were poor. Variation in reliability across individual sprint protocols was found for accelerations (2 x 20m ICC: 0.692, moderate; 4 x 10m ICC: 0.865, good; 8 x 5m ICC: 0.789, good), metabolic distance (2 x 20m ICC: 0.871, good; 4 x 10m ICC: 0.928, excellent; 8 x 5m ICC: 0.974, excellent), fatigue index (2 x 20m ICC: 0.393, poor; 4 x 10m ICC: 0.438, poor; 8 x 5m ICC: 0.544, moderate), and dynamic stress load (2 x 20m ICC: 0.445, poor; 4 x 10m ICC: 0.455, poor; 8 x 5m ICC: 0.539, moderate). Notably, despite increased acceleration and deceleration demands with more changes of direction, ACC metrics were not significantly different between any sprint protocols ($p = 0.064 - 1.000$).

CONCLUSION: GNSS metrics show good to excellent interunit reliability, except for accelerations (moderate to good), therefore it is recommended that practitioners can confidently use APEX GNSS units for load monitoring of GNSS metrics. However, ACC metrics have demonstrated largely poor to moderate interunit reliability and highlighted difficulty distinguishing between the demands of varied sprint distances. It has been recognised that the ICC increases from 2 x 20m to 8 x 5m, suggesting that reliability may improve by increasing the amount of activity monitored. Therefore, short protocol duration may also explain the lack of significant differences identified between sprint protocols. It is recommended to avoid the interchanging of units between athletes and sessions, and interpret ACC metrics cautiously, with regard to the type and duration of activity being monitored.

IMPACT OF TENNIS SPECIFIC HITTING AND RUNNING LOADS ON RESPIRATORY PATTERNS COMPARED TO TREADMILL RUNNING WITH SIMILAR OXYGEN UPTAKE

RAASCH, K., EDEL, A., FERRAUTI, A.
FACULTY OF SPORTS SCIENCE, RUHR UNIVERSITY BOCHUM

INTRODUCTION: Studies on respiratory patterns in tennis are rare and there is no evidence regarding the relation between stroke production, breathing patterns and oxygen uptake. Therefore, the aim of this study was to compare respiratory patterns and gas exchange during a standardized tennis protocol with corresponding measures during continuous treadmill running at a similar oxygen uptake.

METHODS: 15 female and male competitive tennis players (women n= 7: age: 22.6 ± 2.4 years, weight: 69.7 ± 11.9 kg, height: 172.6 ± 8.0 cm; men n= 8: age: 25.5 ± 3.1 years, weight: 83.4 ± 8.2 kg, height: 187.4 ± 6.8 cm) completed three experimental parts on separate occasions. A standardized tennis protocol (TP, Day 1), a treadmill-based incremental running test (RT, Day 2) and a standardized running protocol metabolically matched to TP (RP, Day 3). TP (Day 1) included low or high running loads (RL, RH) and low or high stroke velocities (SL, SH) which were combined in four stages (TP1: RL+SL; TP2: RL+SH; TP3: RH+SL; TP4: RH+SH). RT (Day 2) was used to determine the running velocity matching the oxygen consumption during each stage of TP (TP1-TP4). RP (Day 3) included four stages with identical length and oxygen consumption as during TP. Oxygen uptake (VO2), energy expenditure (EE), tidal volume (VT), breathing frequency (bf), minute ventilation (V'E), inspiration (tI) and expiration time (tE) as well as stroke velocity (SV) were compared between TP and RP. Number (NP) and duration of breathing Plateaus (DP) were calculated from VT. A plateau was defined as a minimum of 0.2 s with no air exchange and constant VT. TP was recorded by video and synchronized to respiratory data. Repeated measures ANOVA was used to compare TP and RP on each stage.

RESULTS: Mean VO2 (p<.001), EE (p<.001), and RER (p<.001) increased significantly between stage 1 to 4 but did not differ between TP and RP. TP corresponded to mean running velocities of 3.2±0.2 m/s (RP1), 3.5±0.4 m/s (RP2), 3.8±0.5 m/s (RP3) and 4.2±0.5 m/s (RP4). Regarding respiration parameters, NP was significantly higher in TP compared to RP on stages TP2 (5.9±3.8vs.0.4±0.5,p<.001), TP3 (2.6±2.7vs.0.3±0.6,p=0.04) and TP4 (4.6±4.1vs.0.3±0.6,p<.001). No significant differences were observed for VT, bf, V'E, tI and tE between TP and RP. Specifically in tennis, VT (1.8±0.4 vs. 2.9±0.7 L/s,p<.001), bf (36.2±7.7vs.44.3±6.6 b.min-1,p<.001) and V'E (52.9±11.3vs.85.0±18.4L/min,p<.001) increased from TP1 to TP4, whereas tI (0.9±0.2vs.0.8±0.1s,p<.001) and tE (0.9±0.2vs.0.7±0.1s,p<.001) decreased. NP was higher in TP2 (p<.001) compared to TP1, whereas no differences were found between TP3 and TP4 and DP.

CONCLUSION: Respiration patterns differ significantly between tennis and running. Breathing plateaus occur exclusively in tennis during a time window around the hitting point and can be attributed to a higher hitting power. These specific demands might come along with challenges for coaches since powerful strokes can be accompanied with individual respiratory disturbances.

DIFFERENCES IN PRE- AND POSTSEASON PERFORMANCE INDICES OF SWEDISH ADOLESCENT FLOORBALL PLAYERS.

UHRAS, B., TERVO, T., THEOS, A.

SECTION OF SPORTS MEDICINE

INTRODUCTION: Previous research conducted in floorball has focused on sports related injuries and on its health benefits for older adults [1, 2]. Monitoring players' performance capabilities throughout the season has been previously examined in football players [3, 4], but no previous study has examined how competition season affects floorball players' physical performance.

The purpose of the present study was to examine differences in pre- and postseason performance indices of Swedish adolescent floorball players.

METHODS: A total of 420 adolescent floorball players, 232 boys (age:18.9 ± 0.8 years) and 188 girls (age:18.9 ± 0.8 years) participated in the study. Performance testing included pushups (upper body strength), one-leg sit to stand test (lower limb unilateral strength), broad jump (lower body power and explosiveness), 20m shuttle run test (aerobic endurance) and hexagonal obstacle (agility and coordination). The tests were conducted before (PRE) and directly after (POST) the 2022-23 floorball season. Differences in performance indices were analyzed with the use of paired t-test. The level of significance was set to α=0.05. Data are presented as mean ± standard deviation.

RESULTS: Performance in pushups (PRE: 20.0 ± 12.8 vs. POST: 20.9 ± 13.2 reps, p=0.03), one-leg sit to stand test left leg (PRE: 5.0 ± 1.4 sec vs. POST: 4.7 ± 1.1 sec, p<0.001) and right leg (PRE: 5.0 ± 1,3 sec vs. POST: 4.6 ± 1.1 sec, p<0.001) and hexagonal obstacle clockwise (PRE: 10.9 ± 1,6 sec vs. POST: 10.5 ± 1.3 sec, p<0.001) and anti-clockwise (PRE: 11.0 ± 1.5 sec vs. POST: 10.6 ± 1.4 sec, p<0.001) differed significantly between pre- and post-season. No statistically significant differences were observed in standing broad jump (PRE: 215 ± 27.3 cm vs. POST: 216 ± 30.2 cm, p=0.104) and 20m shuttle run test (PRE: 53.2 ± 7.13 ml/kg/min vs. POST: 52.8 ± 7.23 ml/kg/min, p=0.150).

CONCLUSION: The findings suggest that in-season floorball training has positive effects in strength and agility performance indices but no significant effects in explosive strength and aerobic fitness, despite floorball's high-intensity intermittent work character.

References:

1. Pasanen et al. (2008). Injury risk in female floorball: a prospective one-season follow-up. Scandinavian journal of medicine & science in sports, 18(1), 49–54.

2. Wikman et al. (2017). The Effect of Floorball Training on Health Status, Psychological Health and Social Capital in Older Men. AIMS public health, 4(4), 364–382.

3. Emmonds et al. (2020). Seasonal Changes in the Physical Performance of Elite Youth Female Soccer Players. Journal of strength and conditioning research, 34(9), 2636–2643.

4. Meckel et al. (2018). Seasonal Variations in Physical Fitness and Performance Indices of Elite Soccer Players Sports, 6, 14.

RELATIONSHIP BETWEEN CURVE SPRINT, LINEAR SPRINT, VERTICAL JUMP, AND CHANGE OF DIRECTION ACROSS DIFFERENT AGE CATEGORIES IN SOCCER PLAYERS.

BARROS, T., NAKAMURA, F.Y., FILHO, R.S.L., SILVA, N.M.G., LIMA, V.F., BIBROWICZ, B., HENRIQUE, R.S.

UNIVERSIDADE FEDERAL DE PERNAMBUCO

INTRODUCTION: Sprinting in soccer has received considerable attention due to its occurrence at decisive moments of the match (1). However, most sprint actions occur in a curvilinear trajectory (2). Few studies have investigated which field-based physical abilities correlate with curved sprinting (CS) performance, and how these relationships evolve across age categories. Thus, the the study aimed to investigate the differences of CS from the U-13 to Senior category and the relationship between CS and different physical abilities (linear sprint, change of direction, and vertical jump) in highly trained soccer players across different age categories.

METHODS: 121 male soccer players from the U13 (n=25; 11.0-12.9 years old), U15 (n=35; 13.0-14.9 years old), U17 (n=31; 15.0–16.9 years old) and Senior (n=30; aged 25.59 ± 3.83) categories of a Brazilian soccer club performed: (1) maximal 20-m linear sprint (LS) test (2) maximal 17-m CS test on arc of the area of an official soccer field with dominant and non-

dominant legs; (3) Zigzag 20 m change-of-direction (COD) test; and (4) a countermovement jump (CMJ) test on a contact platform. The CS test was then classified as a good side (fastest side) and a weak side (slowest side). Pearson's correlation test and One-way ANOVA were used to verify the relationship between physical tests and to compare performance tests according to the maturity groups, respectively. Cohen's d effect size was used to the magnitude of differences between groups in the CS performance.

RESULTS: CS performance for the good and weak sides increased as age categories increased, Differences between all pairs of age categories were moderate to very large, with Cohen's d varying from 0.90 to 5.72 for both legs. Correlations were found for CS good and weak side, and LS-20m in all groups, with r-values varying from 0.38 to 0.77. Only the U-15 and U-17 groups exhibited statistically significant correlations between CS and COD, for both age categories the r-values were lower in the CSGS (r = 0.46 and 0.48) than CSWS (r = 0.59 and 0.64). Excepting for the U-17 group, correlations between CS and CMJ were statistically significant in all age categories for both the good and weak sides (U-13: r = 0.61 and 0.67; U-15: r = 0.46 and r = 0.66; Senior: r = 0.57 and r = 0.58).

CONCLUSION: CS performance evolved across age categories. In addition, moderate to moderately high relationships were observed between CS, both on the good and weak sides, and LS, 20-m COD, and CMJ performance, although the pattern did not always increase or decrease as a function of advancing age. Given that the most strongly correlated tests only shared a maximum of 46% of the shared variance, it is plausible to assume that in soccer players under the age of 17, maximum sprint speed in curved and linear trajectories, COD, and CMJ are abilities that can be considered and trained independent of each other.

1. Gualtieri et al., 2023 2. Caldbeck & Dos'Santos, 2022

BOTH VERTICAL AND HORIZONTAL PLYOMETRIC TRAINING INFLUENCE SPRINT FORCE-VELOCITY PROFILE IN YOUNG ELITE SOCCER PLAYERS.

FOURÉ, A., NORGEOT, F.
UNIVERSITÉ CLAUDE BERNARD LYON 1

INTRODUCTION: During a soccer match, sprint horizontal acceleration ability is determinant for performance. Development of sprint force and velocity qualities has been reported after plyometric training (1). However, the orientation of plyometric training exercises can influence functional performance (2). The purpose of this study was to compare horizontal and vertical orientation plyometric training on explosiveness performance and sprint force-velocity profile in young soccer players.

METHODS: Twenty-eight soccer players were recruited and divided in two groups: vertical group (VG, n = 14) and horizontal group (HG, n = 14). Tests including vertical and horizontal jumps (i.e., squat jump [SJ], countermovement jump and 30-cm drop jump [DJ]) and a 30-m sprint were conducted before and after the 8-wk training period. Sprint force-velocity profile (FVP) was evaluated during a 30-m sprint test.

RESULTS: The results demonstrated significant improvements in both VG and HG for vertical jump performances (from +5.0% to +11.5%), horizontal jump performances (from +5.6% to +9.8%), sprint times (from -4.7% to -12.2%) and FVP parameters. Higher decrease in sprint performance for HG were found in 5-m (VG: -6.4% vs. HG: -12.2%) and 15-m (VG: -4.7% vs. HG: -8.6%) sprint times, horizontal DJ (VG: +5.8% vs. HG: +9.8%), but also in FVP parameters, especially the maximal power (VG: +16.4% vs. HG: +28.1%) and the horizontal orientation of force (VG: no significant difference vs. HG: +22.9%) during the 30-m sprint ($P < 0.05$).

CONCLUSION: Both horizontal and vertical plyometric training can be either used in young soccer players to improve vertical and horizontal performances in jump and sprint as previously reported (3). However, horizontal plyometric training may give a larger gain in horizontal ballistic actions while developing vertical jump qualities in young soccer players. Further studies are necessary to more deeply compare motor coordination and muscular synergies involved in vertical and horizontal actions and potential specific effects on musculoskeletal structural adaptations.

REFERENCES:

1) Barrera-Dominguez FJ et al., Eur J Sport Sci, 2023.

2) Dello Iacono A et al., J Strength Cond Res, 2017.

3) Ramirez-Campillo R et al., J Strength Cond Res, 2015.

WELL-BEING AND EXERTION INDICATORS OF AN ELITE GERMAN FIELD HOCKEY TEAM: A COMPARISON OF A COVID IMPACTED SEASON AND REGULAR SEASON

RAHLF, L., KHER, S.1, MÖLLER, L.2, FÖRSTER, M.1, MASON, J.3, ZECH, A.3
1 EUROPA-UNIVERSITÄT FLENSBURG, 2 UNIVERSITÄT HAMBURG, 3 FRIEDRICH-SCHILLER UNIVERSITY JENA

INTRODUCTION: The German domestic hockey league was interrupted by the COVID pandemic just like all sports leagues around the world, which resulted in a higher density of match play upon return. Evidence indicates that a higher density of match play in hockey increases the risk of injury (Mason et al., 2021), but little is known about internal and external load (and their interactions) during the period of restricted public life compared to a regular season.

METHODS: During the second half of the outdoor seasons 2021 and 2022, 33 players of a national division one field hockey team were asked daily about their internal load via well-being surveys on sleep quality, fatigue, soreness, stress, mood, and post-session perceived exertion (RPE). The well-being items were summed to create an averaged readiness

score. Additionally, the training and match load (carried over exposure; CoE) were tracked to assess external load. The individual values of the players were aggregated for each day of the season. A linear regression analysis was performed and the variables of well-being and RPE were controlled for season, day of the season and exposure.

RESULTS: Overall, the analysed data included n= 66 seasonal days (32 and 34 days in season 2021 and 2022 respectively). None of the well-being indicators, including overall readiness score, differed significantly between seasons. However, all indicators of well-being showed lesser values on later days in both seasons as well as the greater the exposure the stronger the state of fatigue and soreness. Considering the power and the beta error, tendencies towards higher RPE values over the season were observed as well as tendencies towards lower sleep quality and stress with increasing exposure.

CONCLUSION: The results show that the season progress and exposure is affecting well-being and exertion. The athletes showed lesser well-being on later days in the season and higher tendencies of exertion. In terms of exposure, the athletes showed higher soreness, fatigue and a trend to reduced quality of sleep and stress levels. Although no specific seasonal effect was found, the results show that higher exposure leads to reduced well-being and greater exertion, which may indicate inadequate management of higher exposure and may lead to further consequences such as injury or symptoms of overtraining.

References

Mason, J., Rahlf, A. L., Groll, A., Wellmann, K., Junge, A., & Zech, A. (2022). The Interval Between Matches Significantly Influences Injury Risk in Field Hockey. International journal of sports medicine, 43(3), 262–268. https://doi.org/10.1055/a-1577-3451

ANALYSIS OF EYE GAZE DURING OFFENSE SITUATION WITHOUT BALL HOLDING IN BASKETBALL : COMPARISON OF SKILLED AND UNSKILLED PLAYERS

SAITO, T., NAKAJIMA, T.

北海道教育大学大学院

INTRODUCTION: Vickers (1996) found that players with a free throw success rate of 75% or more are characterized by a long gaze on one point in the ring just before the start of the ball down, while players with a free throw success rate of 60% or less have an unstable gaze in the ring or backboard. Kato (2002) reported that skilled people are relatively looking at the center of the field of view, but unskilled people tend to vary greatly from enforcement to enforcement. In addition, the gaze behavior of skilled people when jump shot and rebounding is revealed. However, there are few previous studies focusing on the gaze behavior during ball non-possession.

The purpose of this study is to clarify the gaze behavior of skilled basketball players when they do not have a ball in offense comparing unskilled players.

METHODS: The subjects were six male students who belonged to the Hokkaido University mens basketball first division league as skilled players and six general male students who did not specialize in basketball as unskilled players. The subject players played half-court 3vs3 games wearing the eye tracker (Tobii Glasses 3). We analyzed the number of gazing targets, number of gazes, and gazing time regarding players gazing behavior when they were not in possession of the ball. Data were statistically compared between skilled and unskilled players.

Results and discussion:

Skilled players tend to look at the empty space, teammates, and defense more often than unskilled players. In addition, skilled players shifted their gaze fast, and obtained a lot of visual information by looking at more objects even in the same time. On the other hand, unskilled players tended to look at the ball holder. In a study by Ishibashi et al. (2010), it is reported that unskilled players tend to place their gaze on the ball, and the rate of skilled players placing their gaze on the ball is low. As a result, unskilled players received fewer passes and took fewer shots at the goal than skilled players. From this, it is consider that the ball holder does not contain important clues to run into the space and get a pass.

References:

1)Vickers, J.N, Visual control when aiming at a far target, 1996

2)Takaaki Kato et al, Visual search activities of the defensive player of a basketball, 2002

3) Yukimasa Ishibashi et al, Visual Search Behavior of Experienced Players while Anticipating the Success of Basketball Free Throws, 2010

ACUTE EFFECT OF DYNAMIC BALANCE SHOOTING TRAINING ON DYNAMIC BALANCE IN MALE BASKETBALL PLAYERS

BOONSOM, N., BUNGMARK, W.

SILPAKORN UNIVERSITY

INTRODUCTION: In a dynamic game of basketball that changes by the instant, athletes need to be conditioned to sustain the highly stressful workloads experienced during practice or a game. Shooting goals is the most important skill to indicate the ability of the athletes and team. Because a team who can shooting more goals would be more likely to win. Especially jumping shot is the most common goal scored during a game of basketball. While the jumping shot athletes who can maintaining balance will lead to power and timing control in basketball shooting. From these reasons we are

interested to study acute effect of dynamic balance shooting training on dynamic balance in male basketball players. This study aims to study acute effect of dynamic balance shooting training on dynamic balance in male basketball players.

METHODS: Volunteers were 10 university students who learn basketball for general education at Silpakorn University (mean age 19±1.3 years). Training 8 exercises of dynamic balance, 5 repetitions per set, 3 sets. First set at an angle of 15 degree with the hoop, second set at an angle of 45 degree with the hoop and third set at an angle of 90 degree with the hoop. Before and after participating in the training program, the volunteers must evaluate the dynamic balance by Y-balance test.

RESULTS: Y-balance test before and after dynamic balance shooting training with 8 exercises (One foot touch (right), One foot touch (left), Front lunge, Jump front, Lunge lateral, Jump right, Jump left and 180 degree jump turn), 5 repetitions per set, 3 set. We found that after dynamic balance shooting training can increases anterior reach of right leg from 74.1±8.7 to 78.8±10.3 cm. and posterior reach of left leg from 87.6±17.1 to 97.8±12.66 cm. When analyzed statistically with pair t-test were significant at level .05.

CONCLUSION: Balance is important for basketball shooting skills. Dynamic balance shooting training can increased anterior reach and posterior reach in dynamic balance by a short time. Further study should study for long-term effect of dynamic balance shooting training on dynamic balance and jumping shot performance in basketball players.

CHANGES IN POST-SEASON BODY COMPOSITION AND ATHLETIC PERFORMANCE IN ELITE LEVEL MALE MOGULS ATHLETES FOLLOWING A CYCLE-INTEGRATED NEUROMUSCULAR TRAINING INTERVENTION

LIU, Y., YUAN, X.

BEIJING SPORT UNIVERSITY

INTRODUCTION: The aims of this study were to analyze overall and local body composition changes throughout the competition season using dual X-ray absorptiometry (DXA), to assess improvements in post-season athletic performance indices, and to examine the relationship between changes in body composition and changes in athletic performance, following the implementation of a cyclical integrated neuromuscular training programme for elite male moguls athletes of the Chinese national training team.

METHODS: Preseason and postseason DXA scans and performance data from the 2022–2023 season were retrospectively collected for 10 athletes.Body composition parameters included total and regional fat mass, lean mass, and body fat percentage, while athletic performance measures encompassed the standing triple jump on one leg, 30m dash, and 3000m run. The sport-specific test involved timing an athletes skate across 10 moguls, recorded in the field with a high-speed camera. All variables were quantitative and analyzed using paired t-tests or their nonparametric equivalents, with an alpha level of $p<0.05$ determining significance.

RESULTS: After a cycle of integrative neuromuscular training intervention, athletes exhibited significant decreases in fat mass($F=3.863$;$P=0.012$;effect size=0.584)and increases in lean mass in various body regions($P<0.05$), and total body measurements ($F=4.735$,$P<0.01$;effect size=0.784), While athletes demonstrated a significant decrease in the time required to skate across 10 moguls at the seasons end($F=6.757$, $P<0.01$;effect size=0.584), no significant differences were observed in other performance metrics($P>0.05$). Moderate correlations were noted between changes in body composition (total fat mass（$r=-0.684$, $P<0.01$）and total lean mass（$r=-0.574$, $P<0.01$）) and changes in athletic performance.

CONCLUSION: Cycle-integrated neuromuscular training can effectively shorten the skating time, increase lean body mass and reduce body fat content of moguls athletes, and there is a moderate correlation between body composition and athletic performance.This study offers a novel longitudinal assessment of body composition and athletic performance for elite male moguls athletes, aiding trainers and coaches in understanding seasonal variations in these variables and better preparing athletes for competitive success.

VALIDATION PROCESS OF GPS AND IMU TO DESCRIBE HIGH INTENSITY ACCELERATION AND DECELERATION IN FOOTBALL: A METHODOLOGICAL SYSTEMATIC REVIEW

DI CLAUDIO, C., CONTE, D., FANCHINI, M., SHARP, C., CAPRANICA, L.

UNIVERSITY FORO ITALICO OF ROME, AS ROMA FOOTBALL CLUB, UNIVERSITY OF VERONA, UNIVERSITY OF DENVER U.S.A.

INTRODUCTION: Football players are required to perform intermittent and multi-directional high-intensity accelerations and decelerations (HIAD), which impacts the players performance (1). Among various technologies to assess HIAD in football (2-3), Global Positioning System (GPS) devices and Inertial Measurements Units (IMU) embedded into GPS are often used to monitor the football players' activities. The present systematic literature review aims to investigate the validity, reliability and responsiveness of HIAD metrics commonly used in football.

METHODS: A systematic search of scientific articles published from January 1990 to March 2023 was conducted in three databases (PubMed, Web of Science and SPORTDiscus). Inclusion criteria were: full text in English; inclusion of information regarding the validity, reliability, and responsiveness of GPS and IMU of HIAD metrics. The study selection was performed by two independent authors assessing titles, abstracts and full text. The methodological quality of eligible studies was performed using the COSMIN checklist, therefore each study was rated on a 4-point scale: "very good", "adequate", "doubtful", "inadequate", and the lowest rating per measurement property was consider as quality outcome (4).

RESULTS: Out of a preliminary list of 152 studies, 15 papers met the inclusion criteria and an additional 7 studies were identified through a snowballing technique, resulting in a total of 22 studies. Findings revealed 8 studies examining validi-

ty (construct validity: n=2; criterion validity: n=6). The construct validity studies focused on IMU metrics (i.e. player load) and showed a lack of gold standards, despite their "very good" methodological quality. Radar guns, timing gates and portable gas analyzer were used to validate peak acceleration/deceleration and metabolic power metrics in the criterion validity studies, with five showing "very good" methodological quality and one "doubtful". Reliability was investigated in 17 studies with 2 rated as "adequate", 13 as "doubtful", and 2 as "inadequate" in methodological quality. The unclear stability of the participants, the time interval, and the conditions during the test and re-test procedures, negatively affected the methodological quality of the "inadequate" studies. Finally, no studies investigated the metrics' responsiveness.

CONCLUSION: The present systematic review generally highlights inconsistent methodological quality for both validity and reliability studies, which should caution sport scientists and football coaches in interpreting the collected HIAD metrics when monitoring daily practice. Therefore, further investigations are warranted to provide thorough validity, reliability and responsiveness of HIAD metrics in football.

REFERENCES:

1) Bangsbo J. Acta Physiol Scand Suppl 1994

2) Delaney JA, J Strength Cond Res. 2018

3) Harper DJ, Sports Med, 2019

4) Mokkink LB, Qual Life Res. 2018

Conventional Print Poster Presentations

CP-PN07 Thermoregulation and heat stress

THE EFFECTS OF REPEATED COLD- AND HOT WATER IMMERSION AFTER MUSCLE DAMAGE IN WOMEN: A RANDOMISED CONTROLLED TRIAL

WELLAUER, V., CLIJSEN, R., BIANCHI, G., HOHENAUER, E.

UNIVERSITY OF APPLIED SCIENCES AND ARTS OF SOUTHERN SWITZERLAND

INTRODUCTION: Exercise-induced muscle damage (EIMD) can result from unaccustomed or high-intensity eccentric exercise and is typically evaluated using objective and subjective markers of recovery. Cold- and hot water immersion (CWI and HWI, respectively) have emerged as potential post-exercise recovery interventions to accelerate recovery between training sessions or competitive events, but there is still a lack of evidence, especially in the female population. Therefore, this study aimed to evaluate the acute physiological changes and assess the effectiveness of repeated CWI and HWI in enhancing recovery in women compared to a passive control group (CON).

METHODS: 30 healthy women (23.4 ±2.9 years), randomly assigned to CWI, HWI or CON groups, completed a standardised EIMD protocol. Immediately and 120min after the EIMD, participants underwent a 10min recovery intervention (CWI, HWI, or CON). To assess acute physiological responses, muscle oxygen saturation (SmO2), core and skin temperature were recorded at baseline, after muscle damage, directly after the recovery intervention (postInt) and during a 30min follow-up period. Recovery was evaluated by assessing maximal voluntary isometric contraction of the knee extensors, muscle swelling, delayed onset of muscle soreness, and creatine kinase at baseline, 24, 48 and 72h following EIMD.

RESULTS: SmO2 was significantly lower in CWI than HWI (20min: 67.8 ± 2.7% vs. 74.7 ± 3.2%, $p = .006$; 30min: 64.4 ± 6.4% vs. 74.4 ± 3.9%, $p = .001$) and CWI compared to CON (20min: 73.5 ± 6.6%, $p = .026$; 30min: 73.0 ± 6.1%, $p = .006$). Core temperature was significantly higher in HWI compared to CWI at postInt and 30min (both $p < .01$) and compared to CON at postInt and throughout 30min follow-up (all $p < .05$), while there was no difference ($p > .05$) between CWI and CON. Skin temperature was significantly reduced in CWI compared to HWI (all $p < .001$) and compared to CON (all $p < .05$) between postInt and 30min follow-up. No significant differences were observed between CWI and HWI in objective and subjective markers of recovery throughout 72h follow-up.

CONCLUSION: Despite acute physiological changes, neither CWI nor HWI improved subjective and objective recovery characteristics during a 72h follow-up period compared to the CON group.

EFFECTS OF HIGH-CONCENTRATION CO2-WATER IMMERSION ON CORE BODY TEMPERATURE AND SLEEP CONDITION.

IWATA, R., NAKAMURA, M., TAKAHASHI, S., TAMAI, S., SASADAI, J., SHIMIZU, R., FUKAMI, K., SHOJI, R., NAKAJIMA, K.

JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Compared to tap water immersion, CO2-water immersion is expected to increase oxygen supply through vasodilation, decrease pain, enhance immunity, and increase parasympathetic nerve activity (1,2). Therefore, CO2-water immersion has been used in our support centers to promote recovery in athletes. However, the effects of CO2-water immersion on recovery after training or consecutive games have not been reported. The purpose of the present study was to clarify the effects of CO2-water immersion on core body temperature, sleep condition, and fatigue in college athletes after training.

METHODS: In a crossover design, ten male college baseball players completed three trials: CO2-water immersion (CO2), tap water immersion at 40 °C (HOT), and seated at room temperature (25 °C) (CON) for 15 min after regular training. Partic-

ipants wore Actiwatch sleep monitors on their wrists on the night of the experiment to evaluate their sleep state. Core temperature (Tcore) was measured throughout the night until the morning of the next day.

RESULTS: The maximum Tcore showed moderately higher values (d = 0.534, p = 0.541) in the CO2 trail (38.12 ± 0.50 °C) than in the HOT trail (37.86 ± 0.48 °C). The CO2 and HOT trials exhibited mostly higher values (d = 1.852, p = 0.004 and 1.238, p = 0.032, respectively) than the CON trail (37.38 ± 0.27 °C). Minimal variations were observed in sleep duration (CO2, 5.76 ± 1.1 h; HOT, 5.42 ± 1.1 h; and CON, 5.93 ± 1.0 h), and the effect size was small (d < 0.5). Sleep efficiency and quality of sleep were moderately higher in the CO2 trail than in the HOT trail (d = 0.577, p = 0.574 and 0.512, p = 0.669, respectively). The difference between the Tcore at sleep onset and the maximal Tcore was slightly greater (d = 0.364, p = 0.497) in the CO2 trail (-0.94 ± 0.54 °C) than in the HOT trail (-0.78 ± 0.32 °C).

CONCLUSION: CO2-water immersion increased core body temperatures more significantly than hot tap water immersion at 40 °C. These increased temperatures resulted in positive effects on sleep efficiency and sleep quality, which may be due in part to the significant decrease in core body temperature at the time of sleep onset.

References

(1) Ihsan M, Watson G, Abbiss CR. What are the physiological mechanisms for post-exercise cold water immersion in the recovery from prolonged endurance and intermittent exercise?. Sports Med,46(8):1095–109,2016.

(2) Versey NG, Halson SL, Dawson BT. Water immersion recovery for athletes: effect on exercise performance and practical recommendations. Sports Med,43(11):1101–30,2013.

ECCENTRIC MUSCLE-DAMAGING EXERCISE IN THE HEAT LOWERS CELLULAR STRESS PRIOR TO AND IMMEDIATELY FOLLOWING FUTURE EXERTIONAL-HEAT EXPOSURE

DUNN, R., LUK, H., APPELL, C.R., JIWAN, N.C., KEEFE, M.S., SEKIGUCHI, Y.

TEXAS TECH UNIVERSITY

INTRODUCTION: Bouts of eccentric muscle-damaging exercise or heat exposure have the potential to reduce physiological and cellular stress during future exertional-heat exposure. Given potential cross adaptations, this study investigated the effect of muscle-damaging exercise in the heat on reducing physiological and cellular stress during future exertional-heat exposure.

METHODS: Ten healthy, physically active males (mean ± SD; age, 23 ± 3 years; body mass, 78.7 ± 11.5 kg; height, 176.9 ± 4.7 cm) completed this study. In a randomised, counterbalanced order, participants were assigned into two groups; a) downhill running (DHR) in the heat (ambient temperature [Tamb], 35°C; relative humidity [RH], 40%), and b) DHR in thermoneutral (Tamb, 20°C; RH, 20%) to evoke muscle damage. Seven days following DHR, participants performed a 45-minute flat run in the heat (FlatHEAT [Tamb, 35°C; RH, 40%]). During exercise trials, heart rate (HR) and rectal temperature (Trec) were recorded at baseline and every 5-minutes. Peripheral blood mononuclear cells were isolated and homogenised to assess heat shock protein 72 (Hsp72) concentration between conditions at baseline, immediately post-DHR, and immediately pre- and post-FlatHEAT.

RESULTS: Mean Trec during FlatHEAT between hot (38.23 ± 0.38 oC) and thermoneutral (38.26 ± 0.38 oC) were not significantly different (p = 0.68), with no mean HR differences during FlatHEAT between hot (172 ± 15 beats.min-1) and thermoneutral (174 ± 8 beats.min-1; p = 0.58). Hsp72 concentration change from baseline to immediately pre-FlatHEAT was significantly lower in hot (-51.4%) compared to thermoneutral (+24.2%; p = 0.025), with Hsp72 change from baseline to immediately post-FlatHEAT also lower in hot (-52.6%) compared to thermoneutral (+26.3%; p = 0.047).

CONCLUSION: A singular bout of muscle-damaging exercise in the heat reduces cellular stress levels prior to and immediately following future exertional-heat exposure. Individuals regularly exposed to exertional-heat stress (e.g., athletes, military personnel, and firefighters) would likely benefit from implementing this preconditioning modality during heat preparation, particularly when the window to perform more robust heat adaptation methods is insufficient (e.g., heat acclimation/acclimatisation).

EFFECT OF HEAT ACCLIMATION ON PERFORMANCE IMPROVEMENTS IN COOL TEMPERATURE CONDITIONS: A PILOT STUDY

KEEFE, M., DUNN, R., SEKIGUCHI, Y.

TEXAS TECH UNIVERSITY

INTRODUCTION: Training and competing in the heat negatively impact athlete performance and health. Heat acclimation (HA) involves repeated heat exposures that many endurance athletes use to optimize performance and safety when competing in the heat. Although HA has been shown to improve endurance performance in the heat, contention remains whether it may confer these adaptations to a cool environment. Thus, the purpose of this study was to investigate physiological and performance adaptations in a cool environment following HA in endurance athletes.

METHODS: Seven high-level endurance runners (6 females [age: 20±2 years; body mass: 62.05±5.81 kg; maximal oxygen uptake [VO2max], 61.52±7.21 mL·kg-1·min-1], 1 male [age, 19 years; body mass, 66.80 kg; VO2max, 79.60 mL·kg-1·min-1]) participated in this pilot study. As a baseline assessment, participants completed a VO2max test, followed by an 8-kilometer time-trial (TT) in cool conditions (ambient temperate [Tamb], 11°C; relative humidity [RH], 40%). Following this, participants completed a 7-day training protocol consisting of 60-minutes running at 50% velocity at VO2max in either a thermoneutral (n = 3; Tamb, 22°C; RH, 40%) or hot condition (n = 4; Tamb, 40°C; RH, 35%). Physiological variables (i.e.,

core temperature [Tc], sweat rate [SR], plasma volume [PV]) were assessed on days 1 and 7 to determine HA adaptations. A post-testing visit was conducted to determine performance (VO2max, lactate threshold [LT], TT) changes. A two-way repeated measures ANOVA was conducted to assess physiological and performance changes from pre- to post-testing for performance variables, and from days 1 to 7 for physiological variables, between conditions. Cohen's d classification of effect sizes was calculated to determine small (0.20-0.50), medium (0.50-0.80), and large (>0.80) effects.

RESULTS: No significant differences were identified for physiological variables (i.e., Tc, SR, and PV) between days 1 and 7 in both conditions (ps > 0.05), however, large effects for SR (d = 0.95), and small effect sizes for Tc (d = 0.20) and PV (d = 0.18) were observed in the heat condition. The thermoneutral condition experienced small effect sizes for Tc and SR (d = 0.06-0.37), and a medium effect size for PV (d = 0.51). Similarly, there were no significant improvements in performance metrics (i.e., VO2max, LT, and TT) from pre- to post-training between conditions (ps > 0.05). In the heat condition, LT and VO2max demonstrated medium effect sizes (d = 0.51-0.63), but TT (d = 0.08) resulted in a small effect size. For the thermoneutral condition, LT, VO2max, and TT demonstrated small effect sizes (d = 0.00-0.19).

CONCLUSION: The present findings indicate that heat acclimation may procure the necessary adaptations to improve endurance performance in cool temperatures. Caution should be taken when interpreting these findings due to the nature of pilot data analyzed. This research was supported by a World Athletics Research Grant from the American College of Sports Medicine.

INVESTIGATING THE MECHANISMS OF A NAP AND THE EFFECTS ON SUBMAXIMAL PERFORMANCE, FOLLOWING TWO NIGHTS OF PARTIAL SLEEP RESTRICTION

GALLAGHER, C., GAINTATZIS, A., LAMB, E., MCDONALD, M., PULLINGER, S.A., EDWARDS, B.J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: We investigated the effects of partial sleep deprivation (3 h for two consecutive nights, retiring at 03:30 and waking at 06:30h) on the thermoregulatory responses during a nap at 13:00h and the effect on submaximal weight-lifting at 17:00.

METHODS: Eight resistance trained males (22.8±2.1 years; 177.8±5.9 cm; 82.8±12.2 kg) participated in this study. Prior to the experimental protocol, one repetition max (1RM) for bench press and back squat, normative habitual sleep and food intake were recorded. Three familiarisation sessions were completed by all participants prior to testing. All conditions were separated by 7 days with trial order counterbalanced. Participants completed three experimental conditions which all required the participant to follow two consecutive nights of partial sleep deprivation prior to the testing day. Actimetry was used to monitor sleep and protocol compliance over these two nights. On the third day at 13:00h participants either reclined: 1) at 45 degrees in a hospital bed for 60-min remaining awake and able to read in ambient lighting of 250 Lux (PSR0), 2) in a supine position for 30min in complete darkness and attempt to sleep (PSR30), 3) in a supine position for 60 min in complete darkness and attempt to sleep (PSR60). During the testing session at 13:00h, rectal and skin temperature variables (7-sites) were monitored. At 17:00h participants completed three repetitions of left-and right-hand grip strength, followed by an active warm up and dynamic stretching. Three repetitions at 40, 60 and 80% of the individuals 1RM value, for bench press and back squat were then undertaken. MuscleLab linear encoders were attached perpendicular to the Olympic bar to record performance variables (average power, average velocity, peak velocity, and displacement).

RESULTS: Data were analysed using a general linear model with repeated measures. No significant main effect was reported for conditions for all MuscleLab variables, for both bench press and back squat. There was a significant main effect for RPE breathing values for bench press (P=0.046), with greater mean values in the PSR0 condition compared to both PSR30 and PSR60. A significant main effect for load was identified across all Musclelab variables and RPE, whereby perceived exertion increased with greater load on the bar. We report a significant effect for retiring time (Fell asleep) for actimetry variables, with an earlier retiring time on the second night of partial sleep deprivation (P=0.041). No significant effect was reported for absolute and relative Trec, however there was a significant main effect of condition (P<0.001; ES=0.952; Power=1.00) for time point of temperature gradient (Trec–Tskin).

CONCLUSION: In summary, heat-loss mechanisms during a nap are greater at 30 than 60 min, although this did not translate to an improvement in submaximal performance.

GIG WORKERS' WORKLOAD AND PHYSIOLOGICAL STRAIN: A CASE OF THE PARCEL DELIVERY WORKERS IN SOUTH KOREA

LIM, G., TAN, P., KWEK, J.H., TRAN, T., LEOW, C.H.W., LEE, J.K.W., LEE, J.Y.

HEAT RESILIENCE AND PERFORMANCE CENTRE, NATIONAL UNIVERSITY OF SINGAPORE

INTRODUCTION: Despite the increasing number of parcel delivery workers' fatalities and injuries, there have been few comprehensive investigations into the workers' occupational health risks. This study aimed to quantify delivery workers' workload, assess their physiological strain, and investigate the impact of workload on their physiological strain.

METHODS: A total of forty male delivery workers from two logistics work sites in South Korea (site A and site B) participated in this study. Wet Bulb Globe Temperatures (WBGT) at each site were measured throughout the work shifts. Workload, work environment, and workers' dietary behaviors were investigated through in-depth interviews and wearable devices. Workload was quantified using working hours per day, workdays per week, the number of parcels, and total step count on the measurement day. Workers' body core temperature (Tc), heart rate (HR) and step count were continuously recorded throughout their shifts, while body mass was measured at four timepoints: pre-shift, mid-shift, post-shift, and the next morning. Urine specific gravity (USG) was measured pre-shift and the next morning.

RESULTS: Mean WBGT was below 20°C throughout the work shifts. The workers worked 11.7 hours per day on average and 5–7 days per week. The number of parcels they delivered on the measurement day ranged from 150 to 571 and step counts ranged from 14,400 to 38,068. Regarding nutrition, 45% of the workers skip both breakfast and lunch on busy days, with 25% skipping both meals every working day. 32.5% of the workers' maximum Tc exceeded 38°C, which is the upper limit of the Threshold Limit Values® for heat stress from the American Conference of Governmental Industrial Hygienists guidelines. 47.5% of the workers exceeded 80% of their age predicted maximum HR during their shift. 87.5% of the workers showed a decrease in their body mass after their shifts and 25% lost more than 2 kg. Categorizing dehydrated workers as those with 1.025 or greater values of USG, 15% and 17.5% were dehydrated in the pre-shift and next morning timepoints, respectively. The number of parcels delivered by the workers showed significant correlations with both peak HR (Pearson's R = 0.499, p = 0.035) and their body mass loss (Pearson's R = 0.665, p = 0.001) for site A. Total step count also displayed a significant correlation with the maximum value of workers' Tc for site A (Pearson's R = 0.484, p = 0.036). No significant correlation between workload and physiological responses was found for site B in this study.

CONCLUSION: The results of this study demonstrated that workers' workload may be related to their physiological strain. This study suggests that heat-preventive measures, such as appropriate work-rest cycles, may be beneficial to the physical health of parcel delivery workers. Future research might further investigate workers' nutrition and hydration, the effect of extreme temperature conditions on physiological strain, as well as the impact of workload on workers' performance.

EFFECTS OF PRE-COOLING ON PHYSICAL PERFORMANCE, VO2PEAK, %VO2PEAK UTILIZATION, AND THE VO2 KINETICS DURING CYCLING EXERCISE PERFORMED IN A HOT ENVIRONMENT

PRADO, L., MAIA-LIMA, A., GORDON, D., MERZBACH, V.
FEDERAL UNIVERSITY OF MINAS GERAIS

INTRODUCTION: Physical performance during prolonged exercise performed in hot environments tends to be reduced when compared to those carried out in temperate environments. Several strategies have been proposed in an attempt to mitigate the harmful effects of hot environmental conditions on physical performance, and one of the most popular among them is pre-exercise body cooling. However, there is no consensus on which are the main mechanisms involved in its already well-established ergogenic effect.

METHODS: This study examined the effects of pre-cooling on physical performance, VO2PEAK, %VO2PEAK utilization, and the VO2 kinetics during a cycling exercise performed in a hot environment. Four men and four women cycling athletes (age 39.75 ± 10.25 years, VO2MAX 52.39 ± 8.74 ml.km-1 .min-1, body mass 65.66 ± 6.37 kg, 16.77 ± 6.86% body fat) volunteered for this study. The participants performed 03 exercise trials – an exercise bout in a temperate environment (20° C, 41% RH; TEMP), an exercise bout in a hot environment (34° C, 60% RH; HOT), and an exercise bout in a hot environment preceded by a precooling intervention through full-body water immersion (PREC). Each exercise trial was composed of 04 sets of cycling separated by a 05-minute rest interval. Each set consisted of 06 minutes of fixed-intensity exercise in a moderate domain, 09 min of self-paced exercise, and 1.5 minutes of performing in the same peak power output that was recorded in the previous VO2max testing.

RESULTS: Precooling attenuated the decrease in distance covered observed in the HOT condition when compared to TEMP. This physical performance improvement in the PREC condition was associated with prevention in the VO2PEAK reduction seen in the HOT condition, the lower heart rate values observed during the moderate intensity phase, and lower core temperature when compared to the HOT condition. The %VO2PEAK utilized during the self-paced phase did not differ between HOT and PREC conditions but was lower in these situations when compared to TEMP. VO2 kinetics was enhanced during the first set in the hot environment, and precooling prevented this effect. Precooling did not affect skin temperature, thermal comfort, reported perceived exertion, water intake, or sweat rate during the exercise.

CONCLUSION: In conclusion, precooling attenuated the distance covered reduction observed in the hot environment when compared to the exercise performed in a temperate environment. Physical performance enhancement was associated with a reduction in cardiovascular strain but not with an alteration in %VO2PEAK utilized. Precooling prevented the VO2 kinetics acceleration seen at the first set in the hot environment.

Conventional Print Poster Presentations

CP-AP13 Statistics and Analyses

CRACKING THE CODE: PREDICTING PLAYER POSITIONS IN HANDBALL WITH MACHINE LEARNING

VENZKE, J., SCHÄFER, R., MANCHADO, C., PLATEN, P.
RUHR-UNIVERSITY BOCHUM

INTRODUCTION: In team sports, an increasing amount of data is being collected to assess tactical behavior and monitor physical performance. Strong physical performance is a cornerstone of success in professional team sports. An individual or position-specific performance profile is highly desired by coaches for player monitoring. However, many analyses focus on selected parameters to describe position specific exercise load. A comprehensive understanding of player performance requires the consideration of multiple parameters. However, coaches are faced with an overwhelming number of parameters and require a more detailed view of the most meaningful parameters.

Our aim is to identify the most influential predictor of locomotion data across different positions in handball.

METHODS: A supervised machine learning model was used to classify positions with 10-fold cross validation. Our analysis included several conventional parameters (distance, mean velocity, speed/acceleration zones) and parameters derived from the metabolic power approach (energy cost, metabolic power). Local positioning system data (Kinexon Precision Technologies) from all 65 EHF EURO 2020 matches were used. 414 elite male handball players were included, resulting in 1596 datasets. We analyzed net playing time with durations longer than 1 min. Goalkeepers were excluded.

RESULTS: 1437 datasets were used for training and validation and 159 for testing. The test accuracy of our model was determined to be 78.6%. Wings were the most accurate position to predict, with 80 out of 81 players correctly predicted. Center backs were often confused with outer backs. Pivots were also often predicted as outer backs. Average speed had the greatest relative influence on predicting position (47.4%) and weight the second greatest (31.2%), followed by average metabolic power (5.2%) and height (4.9%).

CONCLUSION: Our study highlights the importance of using multiple parameters to accurately classify player positions in elite handball. Our model demonstrated robust performance, as evidenced by high accuracy on the test dataset. Wings consistently stood out as the most accurately predicted positions, reflecting their typically lower body weight. Average speed being the best predictor is consistent with recent research showing positional differences in average speed (Manchado et al., 2022). For example, wing players cover the most distance and spend the most time in the high-speed categories. These findings highlight the potential of machine learning techniques to improve our understanding of player performance dynamics in team sports such as handball.

EMERGING TRENDS AND KNOWLEDGE STRUCTURES ON SOCCER RESEARCH: A SCIENTOMETRIC ANALYSIS

LUO, H., NASHARUDDIN, N.A., TENGKU KAMALDEN, T.F., ZHU, X.L., XIANG, C.Q.

UNIVERSITI PUTRA MALAYSIA, NATIONAL SPORTS INSTITUTE , SHENZHEN TECHNOLOGY UNIVERSITY

INTRODUCTION: The sport of soccer has received increasing attention and sparked multidisciplinary exploration. There is a lack of comprehensive scientometric analyses of this change over time. Our objective is to understand emerging trends and knowledge structures in the field of study through scientometric analyses.

METHODS: The scientometric scrutiny conducted in this investigation was underpinned by the Web of Science Core Collection as the designated database. The search strategy encompassed the employment of the following query: TS= ("football" OR "soccer"). The ambit of citation indexing was confined to SCI-E, SSCI, and A&HCI indices. Within the spectrum of document classifications, exclusivity was accorded to entries categorized as Article or Review Article. The temporal scope spanned from December 1, 2003, to December 1, 2023, with an absence of linguistic constraints. Redundancies were expunged utilizing the CiteSpace tool, culminating in a corpus of 9069 unique documents, subsequently imported into CiteSpace version 5.7.R5 for ensuing analysis.

RESULTS: The five most cited references within this dataset were as follows: Gabbett TJ, 2016, titled "The training—injury prevention paradox: should athletes be training smarter and harder?". Ekstrand J, et al., 2011, titled "Injury incidence and injury patterns in professional football: the UEFA injury study". Ekstrand J, et al., 2016, titled "Hamstring injuries have increased by 4% annually in mens professional football, since 2001: a 13-year longitudinal analysis of the UEFA Elite Club injury study". Rampinini E, et al., 2009, titled "Technical performance during soccer matches of the Italian Serie A league: Effect of fatigue and competitive level". Hopkins W, et al., 2009, titled "Progressive statistics for studies in sports medicine and exercise science". The five most cited journals were the Journal of Sports Sciences, Sports Medicine, Medicine & Science in Sports & Exercise, Journal of Strength and Conditioning Research, and British Journal of Sports Medicine. The United States was the country with the highest number of publications and citations, followed by the United Kingdom, Australia, Spain, and Brazil. The top five most cited institutions were Liverpool John Moores University, Victoria University, Australian Catholic University, Edith Cowan University, and University Technology Sydney. The top 5 authors with the highest number of total citations in our dataset were Hopkins WG, Bangsbo J, Reilly T, Rampinini E, and Gabbett TJ.

CONCLUSION: This study reveals three prominent and discrete general research trends that have occurred over the last five years. These trends were denoted as "training load and athlete monitoring," "sports injury risk and prevention," and "sports performance and analysis". This study identified emerging trends and knowledge structures in the field of soccer research. These findings can inform the future direction of funding agencies and research groups.

QUANTIFYING MATCH TIME REQUIRED FOR RELIABLE IN-SITU PROFILING IN RUGBY UNION PLAYERS.

MAVIEL, C., COUDERC, A., DUCHÉ, P., MORIN, J.B., VERCRUYSSEN, F.

UNIVERSITÉ DE TOULON

INTRODUCTION: The force-velocity profile (P-FV) is commonly used to assess sprint-related physical qualities in sports, to orient training based on athletes performance. However, this method has limitations, particularly the inability to gather physical engagement's information under actual match conditions in rugby. In this context, the use of Global Position System (GPS) technology has paved the way for collecting in-situ acceleration and speed data during rugby matches. Morin et al.[1] have introduced an in-situ method using GPS to generate an Acceleration-Speed (AS) profile conceptually close to the P-FV [2]. It is therefore crucial to understand players profiles in a match within a minimal time frame to avoid the confounding measures relative to the effects of training. This study aims to determine the saturation point of the AS profile in-match for rugby players, to provide a precise minimal time window for obtaining a meaningful AS profile in a match situation.

METHODS: The playing time of 25 professional rugby players was recorded using GPS technology and segmented into four groups from 40 to 160 minutes of play. The analysis was conducted over 8 official matches during a period of 49 days. This segmentation enabled the gradual incorporation of data into the AS profile analysis. For each interval, the impact of integrating new match data on the AS profile outputs was assessed, aiming to identify the saturation point where additional data did not induce significant changes and thus, altered the profile. A repeated measures ANOVA was applied, and the significant differences were then explored using Bonferroni post-hoc tests, allowing for detailed comparisons between time windows.

This methodology led to identifying the saturation point for theoretical maximum acceleration (A0) and maximum acceleration (S0), namely the threshold beyond which adding new gameplay data in the analysis does not result in statistically significant changes in these parameters.

RESULTS: The ANOVA revealed a significant effect under all tested conditions with a loss of statistical significance from 120 minutes of play for acceleration ($p = 0.12$) and speed ($p = 0.15$), with an intra-subject variability of 3.29% for A0 and 1.99% for S0. Beyond 160 minutes, a lack of significant effect was observed for A0 ($p = 1.00$) and S0 ($p = 0.99$), with an intra-subject variability of 1.51% for A0 and 1.20% for S0.

CONCLUSION: These findings indicate that the significant effect is not observed after 120 minutes of play, despite an important intra-subject variability. However, beyond 160 minutes, this variability is reduced, suggesting a clear saturation point. Therefore, it is recommended for practitioners to use 160 minutes of actual match play (equivalent to about 2 complete games), to derive a reliable AS profile.

REFERENCES:

1 J.-B. Morin et al., (2021)

2 P. Clavel et al., (2022)

EFFECT OF THE AWAY GOAL RULE ON THE TECHNICAL PERFORMANCE OF FOOTBALL TEAMS IN THE UEFA CHAMPIONS LEAGUE

KUBAYI, A., STONE, J.

TSHWANE UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Despite significant debate surrounding UEFA's removal of the away goal rule in 2021, its impact on technical performance has not been studied. Therefore, this study aimed to investigate how selected technical performance indicators were impacted by the change in the away goal rule during the UEFA Champions League.

METHODS: Data were sourced via the Wyscout platform. The sample consisted of 112 UEFA Champions League games played during the knock-out stages of the competition, in which 56 games were played during seasons with an away goal rule (2017–2018 and 2018–2019) and 56 were played in seasons without an away goal rule (2021–2022 and 2022–2023).

RESULTS: The findings showed that the removal of the away goal rule was accompanied by significant ($p < 0.05$) decreases in average pass length, long passes, progressive passes, passes to the final third, offsides, duels, duels won, and counterattacks. Furthermore, a significant ($p < 0.05$) interaction was found between the away goal rule and the leg of competition, affecting the number of counterattacks with shots.

CONCLUSION: Therefore, UEFA should take cognisant of the present findings when considering the use of the away goal rule in future competitions.

EFFECTS OF CHANGES IN DEFENSE STRATEGY ON OPPONENTS OFFENSIVE PERFORMANCE IN BASKETBALL

OGISO, G., KITAMURA, M., KAMIBAYASHI, K.

DOSHISHA UNIVERSITY

INTRODUCTION: In basketball, there has been extensive discussion about the effectiveness of changing defense systems mid-game. Such "changing defense" employs various defensive tactics during a game, such as man-to-man defense and zone defense, with the aim of catching their attacking opponent by surprise.

In fact, this strategy is commonly utilized not only at world tournaments such as the Olympics and the World Cup but also at the university level in Japan. However, the decision to implement changes in defense during a game often relies on subjective judgments of coaches and managers. Although there are numerous references to the changing defense in instructional books, including Smiths book [1], its effectiveness remains unclear without rigorous game analytics.

Therefore, this study aimed to quantitatively evaluate the effectiveness of changing defense on the opponents offensive performance in university mens basketball games held within the Kansai region (south-central part) of Japan.

METHODS: The analysis focused on closely contested games (defined as games with difference up to 8 points at the end of the third quarter and 12 points at the end of the game) in the first division of the 2021/22 Kansai region (south-central part of Japan) Student Basketball League. A total of 35 games met the analysis criteria. From the game video, we identified which of the four main defensive systems was employed for each ball possession: man-to-man defense, zone defense, press defense, or mixed defense. In addition, the number of passes and elapsed time to a shot were examined for each possession. Turnover percentage, free throw rate, and points per possession extracted from the four factors [2], as well as shot clock duration (evaluated as time taken to shoot) and the number of passes were averaged for the opponents

offenses against man-to-man defense, the opponents first offense after a change from man-to-man defense to a different defensive system, and the opponents second and third offenses after changing the defense.

RESULTS: The results revealed a statistical advantage associated with the changing defense: immediately after the changing defense, the opponents offense had more time to shoot, and the free throw rate dropped. In addition, it was numerically evident to induce opponents turnovers and reduce the expectation of scoring immediately after the changing defense.

CONCLUSION: The findings of the present study indicated the effectiveness of changing defense in limiting the opponents offensive performance, especially immediately after the change.

REFERENSES

1. Smith, Dean, and Bob Spear. Basketball, multiple offense and defense. (1982).

2. Oliver, Dean. Basketball on paper: rules and tools for performance analysis. U of Nebraska Press, (2011).

DATA VARIABLES RELATED TO WINS AND LOSSES OF GAME IN DIFFERENT SCENARIOS IN THE WNBA 2023 SEASON

DENG, Y., XU, X., LUO, B., LIN, F.
BEIJING SPORT UNIVERSITY

INTRODUCTION: The research subarea of sports performance analysis is in constant evolution, with a growing emphasis on the game data analysis. However, available research on womens basketball games is relatively scarce. Therefore, in this paper the author aims to explore the key variables that influence the game outcomes in the Women's National Basketball Association (WNBA) during the 2023 season.

METHODS: Firstly, chi-square tests and k-means clustering to control variables was applied to categorize games into four groups (home balanced, home unbalanced, away balanced, and away unbalanced). Secondly, stepwise regression and logistic regression were employed to identify key variables influencing game outcomes in each group.

RESULTS: In the home balanced group 8 variables including field goals made (FG) (+), field goal attempts (FGA) (-), 3-Point field goals made (3P) (+), free throw shooting made (FT) (+), total rebounds (TRB) (+), steals (STL) (+), turnovers (TOV) (-), and personal foul (PF) (-) were identified as key variables. Meanwhile, in the home unbalanced group 6 variables including FG (+), FGA (-), offensive rebounds (ORB) (+), STL (+), blocks (BLK) (+), and TOV (-), similarly away balanced group 8 variables including FG (+), FGA (-), FT (+), TRB (+), assists (AST) (+), STL (+), TOV (-), and PF (-), and in the away unbalanced group 4 variables including 3P (+), offensive rebound percentage (+), defensive rebound percentage (+), and total rebound percentage (+) were identified as key variables.

CONCLUSION: The most significant divergence observed occur in the away unbalanced group, while similarities are prominent between home and away balanced groups. Furthermore, these variables encompass both offensive and defensive aspects, contributing to a relatively balanced situation. This research enriches the understanding of the characteristics of key game variables in high-level womens basketball games.

THE INFLUENCE OF SERVE SPEED ON ITS EFFICIENCY IN THE EXAMPLE OF THE ESTONIAN HIGHEST LEAGUE VOLLEYBALL TEAM.

STAMM, R., STAMM, M., ESNA, A.
SCHOOL OF NATURAL SCIENCES AND HEALTH

INTRODUCTION: This work aimed to find out which serve speeds have the greatest influence on ball reception. Do the balls hit the fastest are more difficult for the receivers of the ball to receive?

METHODS: The research was carried out with the Selver/TalTech men's volleyball team who is playing in the highest league in Estonia. There were 15 players (3 middle blockers, 6 outside hitters, 3 setters, 1 opposite hitter, 2 liberos) aged 17 to 30 years and their mean height was 191 cm and mean weight was 80,26 kg. Altogether 818 serve speeds were measured together with the reception quality of the opponents during 10 matches in the Baltic League in 2022. Serve speed was measured by Pocket Radar SD2000 and the reception efficiency using the 5 balls scale according to the Data Volley program.

RESULTS: From the 818 served serves 61 went to the direct points (aces) and with the mistake ended 109 serves. The maximum speed of the serves was 109 km/h and the minimum speed was 42 km/h. Maximum speed was reached twice-once by the middle blocker and once by an outside hitter. The best ball reception scores were achieved by receiving the slowest serves.

CONCLUSION: The following conclusions can be drawn from the analyzed RESULTS: The success rate of inaccurate reception of the ball is increasing compared to the increase in the speed of the serve. We divided the serve speeds by standard deviation into three different classes (fast serves, medium serves, and slow serves) and compared slow serve receptions with fast serve receptions efficiency by mean values. And can conclude after the students' t-test that the efficiency for the receptions that followed the fast serves was statistically significantly lower than the receptions efficiency that followed slow serves ($p<0,01$).

The highest number of direct serve errors were made at the fastest serve speed, so the faster the serve, the higher the probability of a direct serve error. This agrees with Mercelino's work (Mercelino et al., 2008) which concluded that better teams are gathering the mistakes during the serves more, but they succeeded in earning direct points also more often.

The authors think that we still must take risks with high-speed serving because as Paulo's research concluded the direct points earned by the serves are correlated with winning the matches. (Paulo et al., 2017)

REFERENCES:

Mercelino, R., Mesquita, I., & Alfonso, J. (2008). The weight of terminal actions in Volleyball. Contributions of the spike, serve and block for the teams rankings in the World League 2005. International Journal of Performance Analysis in Sport.

Paulo, A., Davids, K., & Araujo, D. (2017). Co-adaptation of ball reception to the serve constrains outcomes in elite competitive volleyball. International Journal of Sports Science and Coaching.

ASSESSING WHEELCHAIR TABLE TENNIS CLASSIFICATIONS: PERFORMANCE ANALYSIS AND CLASS CONSOLIDATION PROPOSAL

WU, S.K., SHEU, Y.H.

NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: In the Paralympic Games, classification plays an important role in ensuring the fairness and credibility of competition. To provide an evidence-based classification in wheelchair table tennis, the objective measurement of wheelchair players with physical impairments is essential. The purpose of this study was to evaluate the current issues related to the classification of wheelchair classes in para table tennis through performance analysis. In theory, higher wheelchair classes should correlate with superior abilities and performance.

METHODS: We conducted an analysis of the world rankings of the top 50 wheelchair players, comparing them with the total number of world rankings for male players (N=310) and female players (N=115). Additionally, we used an intelligent racket to measure swing speed and efficiency in the maximal forehand swing stroke of 10 male players in the top 20 rankings (5 players in class 4 and 5 players in class 5), following the testing method outlined in the study by Sheu and Wu (2023).

RESULTS: The world top 50 ranking in wheelchair male players from classes 1 to 5 was 0 (0%), 2 (4%), 13 (26%), 23 (46%), and 11 (22%), respectively. For wheelchair female players, the rankings were 1 (2%), 6 (12%), 17 (34%), 15 (30%), and 11 (22%). Notably, players in classes 1 to 3 performed much weaker than classes 4 and 5. Using the intelligent racket to conduct 27 maximal strokes and maximal topspin swings, no significant differences in swing speed and efficiency were found between classes 4 and 5.

CONCLUSION: Contrary to the anticipated advantage of better trunk functions in class 5 players, our analysis of performance rankings and intelligent racket tests in wheelchair classes 4 and 5 did not reveal a significant performance difference. We propose the consolidation of classes 4 and 5 into a new category, thereby reducing the current five classes in wheelchair table tennis to four. Ensuring fairness in competition for wheelchair table tennis players requires careful consideration of new minimal impairment criteria for this proposed combined class.

TACTICAL AND TECHNICAL ANALYSIS OF MEN'S 800M RACES IN WORLD ATHLETICS CHAMPIONSHIPS

KADONO, H.

SENDAI UNIVERSITY

INTRODUCTION: In 800m running event, it is reported that the pacing strategy of world record was positive pacing [1], on the other hand there were various pacing strategies in Olympic games [2] and World Championships [3]. Tactical preparations that improve ability to change running speed and respond dynamically changes in speed are required for runners and coaches when they prepare for championship races. In running biomechanics, running speed, step frequency and step length are basic parameters which represent running technique. Previous studies focused on only paces (time or speed), but in this study focused on not only speed but also step frequency and time and aimed to investigate technical characteristics during men's 800m races in World Athletics Championships.

METHODS: This study used a digital video camera (Panasonic, HC-VX992, 60Hz) to videotape all heats of men's 800m (6 heats for 1st round, 3 heats for semi-final and a final) in the World Athletics Championships, Oregon 2022 (WC22). This study used official race analysis on the WC22 web site to classify all heats into positive pacing races (POS) and negative pacing races (NEG). POS was the heat that faster 1st lap, NEG was the heat that faster 2nd lap. First 2 finishers of each heat were picked out and they were classified into POS and NEG. Every 100m split times on the WC22 website were used to calculate average running speed of each 100m for 8 all sections. The video camera movies were used to measure the time which runner took 10 steps with their natural running form in each 100m section, followed by calculating average time which runner take a step. Step frequency (SL) in each 100m section was calculated by inverse step time, and step length (SL) was calculated by running speed divided by SF.

RESULTS: 6 of 10 heats were POS (n=12) and 4 of 10 heats were NEG (n=8). There was no significant difference in goal time between POS (1:45.32±00.56) and NEG (1:46.25±02.05). POS was significantly faster in 1st lap time than NEG ($p<0.05$, $d=1.248$), especially running speed was significantly faster (200-300m: $p<0.001$, $d=0.214$; 300-400m: $p<0.01$, $d=0.286$) and SF was higher (n.s.) in 200-400m. And SL was larger in 100-400m (n.s.). On the other hand, NEG was significantly faster in 2nd lap time than POS ($p<0.001$, $d=0.433$), especially running speed was faster (500-600m: $p<0.01$, $d=0.171$; 600-700m: $p<0.01$, $d=0.137$) and SF was higher (n.s.) in 500-700m. And SL was almost the same as POS in 400-800m.

CONCLUSION: There were both POS and NEG in WC22, and running speed, SF and SL were different between 2 types of pacing. In POS, it was faster in 200-400m with high SF and large SL. In NEG, it was faster in 500-700m with not large SL but

high SF. This study suggests that when runners and coaches do tactical preparation for championship races, they should take into account not only pace or speed but also techniques (changing SF and SL).

REFERENCES

1. Tucker et al., IJSPP, 2006 2. Thiel et al., JSS, 2012 3. Sandford et al., IJSPP, 2018

CURRENT STATUS OF ENDURANCE DIAGNOSTICS IN GERMANY: A QUESTIONNAIRE SURVEY

BÜTHE, E., VENZKE, J., SCHÄFER, R., PLATEN, P.
RUHR-UNIVERSITÄT-BOCHUM

INTRODUCTION: Performance diagnostics in endurance sports are indispensable tools in sports and medical research, providing precise insights into the physical capabilities, strengths, and weaknesses of athletes. A wide variety of methods are used worldwide to assess performance, including diverse threshold concepts, protocols, and standardisations. In order to assess the current state of performance diagnostics and to identify significant similarities and differences in methods within Germany, an online questionnaire survey was designed and distributed to various performance diagnostics institutions.

METHODS: The online questionnaire included the following categories: test procedures, protocols and load schemes, threshold concepts, standardisation, individualisation and training planning. The survey was completed by 40 sports diagnostic facility managers over a two-week period. Estimates and confidence intervals were derived using binomial distribution and Clopper-Pearson adjustment.

RESULTS: Regarding threshold concepts, 45% CI95% [29.3; 61.5] (18/40) of the respondents chose the individual anaerobic threshold according to Stegmann & Kindermann et al. (1981) or the aerobic-anaerobic threshold according to Mader et al. (1976). In 82.5% CI95% [67.2; 92.7] (33/40) of the cases, training recommendations were based on heart rate, whereas in 80% CI95% [64.3; 90.9] (32/40) they were based on speed/power. Regarding standardisation, in 72.5% CI95% [56.1; 85.4] (29/40) of the centres, changes in test conditions were not documented, when testing the same person twice. In 77.5% CI95% [61.6; 89.2] (31/40), no medical history was taken before the start of the test. Dietary considerations before testing, such as drinking, carbohydrate intake, or caffeine, were also not specified in 35% CI95% [20.6; 51.7].

CONCLUSION: These results indicate considerable variation between institutions in the choice of threshold concepts and the regulation of intensity and speed. The lack of documentation of changes in test conditions and the absence of discussion about personal clarification raise questions about standardisation and quality assurance. It is clear that strict clear guidelines and protocols are needed to ensure the validity and reliability of performance testing across the country. Quality assurance has many advantages, including the exchange of data between different diagnostic centres. These findings provide suggestions for critical review and improvement of testing practices.

Conventional Print Poster Presentations

CP-BM01 Motor Learning and Motor Control

DISTINCT HYPERTROPHY OF THE ELBOW FLEXORS AFTER INCLINE VERSUS PREACHER DUMBBELL CURL TRAINING

KOBAYASHI, Y., MAEO, S.1, EIHARA, Y.1, ONO, M.1, SATO, M.1, SUGIYAMA, T.1, KANEHISA, H.2, ISAKA, T.1
1. RITSUMEIKAN UNIVERSITY 2. NATIONAL INSTITUTE OF FITNESS & SPORTS IN KANOYA, JAPAN

INTRODUCTION: The elbow flexors consist of the biceps brachii (BB), brachialis (BRC), and brachioradialis (BRR). Among them, BB is a biarticular muscle crossing not only the elbow but also the shoulder joint, and lengthened more in a shoulder-extended than shoulder-flexed position. Previous studies have found greater muscle hypertrophy after training at long than short muscle lengths (e.g. seated > prone leg curl for the hamstrings [Maeo et al., 2021] and standing > seated calf raise for the triceps surae [Kinoshita et al., 2023]). Based on these findings, this study examined the effects of incline (shoulder-extended, BB lengthened) versus preacher (shoulder-flexed, BB shortened) arm curl training on elbow flexor hypertrophy.

METHODS: Twenty-one untrained healthy young adults participated in this study. Using a dumbbell, they performed incline arm curls with one arm and preacher arm curls with the other arm (shoulder 50-deg extended and flexed, respectively) at 70% of one repetition maximum of the corresponding task. Each arm performed 5 sets of 10 repetitions per session (2 s for each of the concentric/eccentric phases), 2 sessions per week for 12 weeks. Before and after the intervention, T1-weighted axial 3-T MR images (field of view: 200 × 200 mm, slice thickness & gap: 2.5 mm) were obtained to assess muscle volume of BB, BRC, BRR, and the whole elbow flexors. In addition to muscle volume, anatomical cross-sectional area (ACSA) was calculated/interpolated at 10% intervals of muscle length (i.e. 10–90%, proximal–distal) for each muscle to examine whether regional hypertrophy occurred after each training.

RESULTS: Muscle volume significantly increased in all three muscles and the whole elbow flexors for both arms. The changes in whole elbow flexor volume did not significantly differ between the incline and preacher conditions (+16.5% vs +17.6%, P = 0.167, Cohen's d = 0.18). However, the changes in BB muscle volume were significantly greater for the incline than preacher condition (+18.0% vs +14.9%, P = 0.026, Cohen's d = 0.41), with significant between-condition differences in ACSA changes found in proximal muscle regions (at 20–40%, P = 0.015–0.045, d = 0.48–0.80). On the other hand, BRC

(+17.0% vs +21.0% P = 0.022, d = 0.52) and BRR (+10.0% vs +13.0%, P = 0.018, d = 0.49) had significantly greater muscle volume changes after the preacher condition. Significant between-condition differences in ACSA changes were found in distal muscle regions (at 70–80%, P = 0.005–0.014, d = 0.76–0.81) for BRC and in a middle muscle region (at 60% P = 0.001, d = 0.72) for BRR.

CONCLUSION: While incline and preacher arm curls resulted in similar whole elbow flexor hypertrophy, the former appears more effective for BB and the latter for BRC/BRR hypertrophy, especially their proximal and distal/middle regions, respectively.

REFERENCES:

Maeo et al. (2021) Med Sci Sports Exerc, 53(4), 825-37.

Kinoshita et al. (2023) Front Physiol, 14, 1272106.

THE ROLE OF INTRACORTICAL INHIBITION FOR MOTOR MEMORY CONSOLIDATION

EGGER, S., WÄLCHLI, M., MEYER, S., TAUBE, W.

UNIVERSITY OF FRIBOURG

INTRODUCTION: Recent findings have demonstrated that low-frequency repetitive magnetic stimulations (rTMS) over the primary motor cortex (M1) impaired short-term consolidation of a balance task, underscoring the causal connection between M1 and the consolidation of balancing skills (Egger et al., 2023). However, the underlying neural mechanisms induced by rTMS and whether these adaptations endure over an extended period, encompassing multiple acquisition sessions, remain insufficiently elucidated. So far, its is widely acknowledged that GABAergic processes play an important role for consolidation (Sanes & Donoghue, 2000), at the same time, balance learning can enhance GABA-mediated inhibition (Taube et al., 2020). Therefore, the present study aimed to investigate the impact of rTMS on GABA-mediated short-interval intracortical inhibition (SICI) and to explore the role of M1 in the long-term consolidation of a balance task (i.e., across multiple acquisition sessions).

METHODS: Thirty-one volunteers underwent six balance acquisition sessions on a rocker-board, each followed by either rTMS or sham rTMS based on group affiliation. During the first and last training session, SICI was measured twice; before the balance acquisition and after the application of rTMS or sham-rTMS to investigate potential short- and long-term adaptations in intracortical inhibition. Adaptations were assessed during the execution of the learned balance task and in a non-learning postural control task (i.e., stable upright stance).

RESULTS: Regardless of group affiliation, all participants achieved comparable improvements within the balance acquisition sessions. However, consolidation varied between groups. In particular, between the third and the fourth acquisition session, as Tukey corrected post-hoc tests showed a significant decline in performance for the rTMS group (p = 0.006). Both short- (p = 0.014) and long-term (p = 0.038) adaptations in SICI were affected by rTMS: while the sham rTMS group upregulated SICI, rTMS led to reduced levels of inhibition. No neurophysiological effects were observed in the non-learning control task (upright stance).

CONCLUSION: The task-specific interference effect of rTMS on balance consolidation and on upregulation of SICI indicates that increased intracortical inhibition is an important mechanism to protect and consolidate newly acquired motor memories.

REFERENCES:

Egger, S., Wälchli, M., Rüeger, E., & Taube, W. (2023). Short-term balance consolidation relies on the primary motor cortex: a rTMS study. Scientific reports, 13(1), 5169. https://doi.org/10.1038/s41598-023-32065-x

Sanes, J. N., & Donoghue, J. P. (2000). Plasticity and primary motor cortex. Annual review of neuroscience, 23, 393-415. https://doi.org/10.1146/annurev.neuro.23.1.393

Taube, W., Gollhofer, A., & Lauber, B. (2020). Training-, muscle- and task-specific up- and downregulation of cortical inhibitory processes. The European journal of neuroscience, 51(6), 1428-1440. https://doi.org/10.1111/ejn.14538

THE NEUROPHYSIOLOGICAL MECHANISMS BEHIND THE RELATIONSHIP BETWEEN TORQUE COMPLEXITY AND CONTRACTION INTENSITY: THE ROLE OF MOTOR UNIT BEHAVIOUR

OLIVEIRA, J., GOMES, J.S., BAUER, P., PEZARAT-CORREIA, P., VAZ, J.R.

FACULLTY OF HUMAN KINETICS

INTRODUCTION: Torque complexity has been proposed as a key marker of the ability of the neuromuscular system to adapt to external changes and, therefore, is considered as an important measure of motor control. Interestingly, the literature demonstrates an inverted U-shape relationship between the torque complexity and contraction intensity, suggesting that motor control is influenced by the intensity of contraction. Furthermore, it has been suggested that changes in torque complexity are only observed above the critical torque (CT)/end-test torque (ETT) intensity. However, the physiological mechanisms behind this well documented relationship are yet to be determined. This study aimed to investigate whether changes in motor unit behaviour (motor unit recruitment and firing rate) with contraction intensity would accompany and potentially explain the inverted U-shape relationship between force complexity and contraction intensity.

METHODS: 25 participants were asked to perform a knee extensors' sustained submaximal hold isometric task at the intensities corresponding to their ETT, 50%ETT, 75%ETT, 150%ETT and 175%ETT. Measurements involved recordings of sub-

maximal isometric torque while recording high-density surface EMG signals from the vastus lateralis (VL) and vastus medialis (VM) muscles. Sample Entropy (SampEn) and Coefficient of Variation (CV) were extracted from torque signals as measures of temporal structure (i.e. complexity) and magnitude of torque variability. EMG signals were decomposed into individual Motor Unit Action Potentials (MUAP) and Firing Rate (FR). A one-way ANOVA for repeated measures was performed on SampEn, CV, MUAP and FR to test the effect of contraction intensity on the temporal structure and magnitude of torque variability as well as on motor unit related measures. In addition, a stepwise multiple linear regression analysis was conducted to predict changes in torque SampEn based on changes in motor unit related variables.

RESULTS: The results showed an effect of contraction intensity on SampEn ($p<0.001$), with ETT and 150%ETT presenting higher SampEn's values when compared with 50%ETT ($p<0.001$) and 75%ETT ($p<0.001$ and $p=0.019$, respectively). For motor unit behaviour, we observed a significant effect of contraction intensity in MUAP and FR for both VL and VM (all $p<0.001$). The results demonstrated that MUAP and FR increased with contraction intensity until 175%ETT. Additionally, the multiple linear regression was statistically significant ($R2=0.18$, $p<0.001$), indicating that SampEn is lower when MUAP and FR of VL present higher and lower values, respectively.

CONCLUSION: The study demonstrated that torque complexity is contraction intensity dependent in an inverted U-shape relationship that could be, potentially, explained by changes in motor unit behaviour with contraction intensity, particularly above the CT/ETT, which could influence the capacity of the neuromuscular system to be flexible and to adapt the motor output to the changes in task demands.

ACUTE EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON MAXIMUM STRENGTH PERFORMANCE AND ENDURANCE STRENGTH TASK IN HEALTHY YOUNG INDIVIDUALS.

GONZÁLEZ, I.M., COLOMER-POVEDA, D., SÁNCHEZ-MOLINA, J.A., MARCOS-FRUTOS, D., BOTANA-LÓPEZ, L., MORENILLA-BURLÓ, L., BOUZA-MÉNDEZ, K., MÁRQUEZ, G., LÓPEZ-ALONSO, V.

UNIVERSITY OF A CORUÑA

INTRODUCTION: Transcranial direct current stimulation (tDCS) is a safe, non-invasive, pain-less type of stimulation that has been used with the aim to influence different aspects of gross motor performance. The main objective of this study was to verify the acute effect of a single session of tDCS applied to the primary motor cortex (M1) or the dorsolateral prefrontal cortex (DLPFC), on maximum strength, endurance, neurophysiological and perceptual parameters, in a manual hand-grip task in healthy young adults.

METHODS: The study follows a randomized, controlled, triple-blind, crossover design with a placebo condition. The sample comprised 42 healthy university students (21.52±1.40 years; 19 women). Maximal strength, corticospinal excitability and intracortical inhibition and facilitation were assessed before and after the application of 20 minutes of 2mA tDCS (M1, DLPFC or Sham). After tDCS, the number of maximum contractions performed until a 30% loss of hand-grip maximum strength was recorded.

RESULTS: No effect was detected on maximal strength, corticospinal excitability, intracortical inhibition and facilitation, the number of repetitions done until a 30% of maximum strength loss and perception of effort following the administration of tDCS over M1 and DLPFC.

CONCLUSION: The results of the present study suggest that tDCS over M1 or DLPFC does not influence corticospinal and intracortical structures and has no effect over maximum strength nor the ability to repeat maximum contractions. The absence of corticospinal and intracortical changes precludes to link the response pattern between functional and neurophysiological variables. Further research is needed to determine under what conditions or tasks tDCS could potentially benefit gross motor performance before its recommendation as a tool aimed at optimizing performance during motor tasks.

DOES THE INITIATION OF A COGNITIVE TASK CAUSE A TEMPORARY DOWNREGULATION OF VESTIBULAR CONTROL OF BALANCE?

MALONE, Q., TUTT, H., REEKIE, P.K., DAKIN, C.J., MCNEIL, C.J., DALTON, B.H.

UNIVERSITY OF BRITISH COLUMBIA: OKANAGAN

INTRODUCTION: Vestibular control of balance is temporarily downregulated upon initiation of a goal-directed movement (e.g., reaching, gait, and posture transition), which fits with the optimal feedback control theory. This theory states that a sensation that does not contribute to, or causes interference with, a planned movement is downregulated (i.e., not used to plan the movement). With the previously examined tasks, it was not possible to isolate the effects of cognitive planning and transitions from the motor response with the previously examined tasks. As such, this experiment was designed to determine if a predominantly cognitive task also causes this vestibular downregulation. We hypothesised that initiation of a cognitive task response would cause a downregulation of vestibular control of balance.

METHODS: While standing on a force plate measuring ground reaction forces (GRFs), participants (N=18) received binaural, bipolar stochastic (0-25Hz, root mean squared≈1mA) electrical vestibular stimulation (EVS). Meanwhile, participants performed two tasks: 1) a simple reaction time (SRT) task requiring a button-press in response to a visual cue, and 2) a Stroop task requiring a verbal response to the textual colour of a presented word. These tasks were chosen because both involve a minimal motor response, yet require varying levels of cognitive complexity; a factor which influences many motor outcomes. Mean coherence between the EVS signal and the mediolateral GRF signal from 0-10Hz was calculated in 5ms

steps over 5000ms centered around the time of movement onset. Two-tailed, paired-sample t-tests were used to compare mean coherence 1000-600ms before movement onset and from 200ms before to 200ms after movement onset.

RESULTS: Contrary to our hypothesis, there was a significant increase in coherence upon initiation of the SRT task response ($t17=2.95$, $p=0.01$) and no differences for the Stroop task ($t17 = 1.92$, $p=0.07$).

CONCLUSION: These results imply that previously reported drops in vestibular control of balance are likely due to the transition to a gross movement, rather than a result of cognitive processes occurring during a transition. Potential explanations for the vestibular downregulation during a transition to a gross movement include: 1) a technical artifact arising from the data analysis technique used, or 2) a result of changes in head movement variability (which is positively associated with EVS-GRF coherence). That is, initiation of a gross movement causes anticipatory postural adjustments that stabilize the body and reduce head movement variability, which could downregulate the vestibular control of balance (lower EVS-GRF coherence). In contrast, during the transition to fine movements, there is no voluntary command to drive the head in a particular direction, so the balance controller remains reliant on vestibular cues to maintain posture.

CORTICOSPINAL EXCITABILITY IS NOT FACILITATED BY OBSERVATION OF ASYMMETRIC WALKING ON A SPLIT-BELT TREADMILL IN HUMANS

KITAMURA, M., ISHIKURA, T., OGISO, G., KAMIBAYASHI, K.

DOSHISHA UNIVERSITY

INTRODUCTION: Observing others actions facilitates the corticospinal excitability (CSE) of the muscles associated with the observed actions [1]. A previous study [2] indicated that motor-related brain areas are strongly activated when observers observe movements that they have repeatedly practiced and are already skilled in, compared to when they observe movements they have not experienced. The previous study only investigated voluntary movements with complex actions (e.g., dancing) and did not analyze semi-automatic rhythmic movements (e.g., walking). Thus, it is unclear how the observers motor system is activated by observing unusual walking patterns that they have not experienced before. Therefore, we aimed to investigate changes in CSE by observing walking in a split-belt condition with different left and right treadmill belt speeds, which the observers had not experienced before. When humans are exposed to the split-belt condition, their gait becomes asymmetric at the initial period of the split-belt condition but approaches symmetry after several minutes [3]. Thus, we examined CSE during the observation of the asymmetric and symmetric walking at the initial and late periods of the split-belt condition, respectively.

METHODS: Fifteen healthy adults participated in the study. From the video of lower limb movements during walking captured from the actors left side, three different video clips were created: 10 seconds during walking in the tied condition (belt speeds: 1.25 m/s), as well as the initial 10 seconds (initial period) and last 10 seconds (late period) during a 10-minute walking in the split-belt condition (left and right belt speeds: 1.0 and 1.5 m/s, respectively). The video clips showed that the actors step lengths were almost symmetric in the tied condition and late period of the split-belt condition, but largely asymmetric in the initial period of the split-belt condition. The participants observed a fixation cross (control condition) and three different video clips that were presented randomly on a monitor. The motor-evoked potential (MEP) of the left tibialis anterior muscle was recorded by delivering transcranial magnetic stimulation to the right primary motor cortex during the observation.

RESULTS: The MEP amplitude during the observation of walking in the tied condition and the late period of the split-belt condition was significantly larger than that in the control condition. However, no significant difference in the MEP amplitude was observed between the control condition and the initial period of the split-belt condition.

CONCLUSION: These results suggest that when observing semi-automatic movements like walking, observation of symmetric walking, similar to observers walking, facilitates CSE. However, observation of asymmetric walking, which observers have not experienced, does not appear to facilitate CSE.

[1] Fadiga et al. 1995., J. Neurophysiol.

[2] Calvo-Merino et al. 2005., Cereb. Cortex

[3] Reisman et al. 2005., J. Neurophysiol.

EXAMINING VISUOMOTOR INTEGRATION BEHAVIOURS USING A SPORT-SPECIFIC TASK: DOES MOVEMENT SPEED (WALKING VS. RUNNING) AFFECT HOW ATHLETES AVOID COLLISIONS?

WALTERS, M., CINELLI, M.

WILFRID LAURIER UNIVERSITY

INTRODUCTION: In dynamic sports environments, athletes navigate complex scenarios, requiring split attention toward demanding tasks and interactions with opponents. Sport-specific training can improve one's ability to integrate visual information, potentially improving collision avoidance behaviour (1). However, athletes collision avoidance behaviours are task-specific, emphasizing the importance of challenging athletes in sport-like environments to elicit visuomotor integration enhancements (2). While previous research found no difference in collision avoidance behaviours between athletes and a general population when walking (3), the current study introduces running to evoke a sport-specific context. The aim of the study is to identify differences in collision avoidance behaviours of athletes between walking and running scenarios, with the hypothesis that athletes will exhibit superior performance in a sport-specific setting (i.e., when running).

METHODS: Sixteen field-sport athletes were immersed in a virtual environment using a Vive Pro 2 head-mounted display (HMD), while performing a collision avoidance task in a virtual soccer stadium. Participants were required to approach a goal, while avoiding a collision with a virtual player (VP) approaching at three different speeds. Athletes performed two blocks of trials (walking and running) in a counterbalanced order. Within each block, a secondary attention task was included in half of the trials to ensure sport-specificity; athletes reported a changing shape while simultaneously attending to the collision course. The HMD was used to record positional data to calculate each athlete's minimum clearance distance (m).

RESULTS: Although there were no differences in secondary task performance during running and walking conditions, results indicate a significant effect of movement speed on minimum clearance distance, $F(1, 15) = 10.19$, $p < .05$. As such, athletes maintained a small and constant minimum clearance distance between themselves and the VP when running, regardless of the VP's approach speed. Alternatively, when walking, the minimum clearance distance matched the speed at which the VP approached (i.e., greater distance when VP moving slower).

CONCLUSION: A consistently smaller minimum clearance distance in a sport-specific context suggests athletes are attuned to the limits of their action capabilities when challenged in a sport-like environment. Similar to research findings with aperture crossing (2), athletes can efficiently regulate their minimum spatial requirement while running. These insights are crucial for sports training and injury prevention, offering valuable knowledge on how athletes adapt to dynamic scenarios. Understanding these behaviours can inform training interventions aimed at enhancing athletes collision avoidance skills, ultimately fostering safer and more effective athletic performance.

1. Pfaff & Cinelli, Hum Mov Sci. 2018

2. Higuchi et al., Hum Mov Sci. 2011

3. Thompson & Cinelli, [Unpublished Manuscript]. 2023

DO ATHLETES HAVE BETTER DECISION-MAKING CAPABILITIES IN SPORT-SPECIFIC SITUATIONS

MYSKO, P., CINELLI, M.

WILFRID LAURIER UNIVERSITY

INTRODUCTION: Assessing the passability of a closing gap requires correct perception of affordances and the utilization of tau-coupling. Affordances are influenced by embodiment, which suggests that through experiences in different situations, a person will have a sense of self and can make accurate decisions based on their perceived abilities. Athletes who are presented with a task that matches their sports requirements show an increase in the accuracy of their behaviours, suggesting embodiment can be influenced by specific situations [1]. However, does embodiment impact the decision-making capabilities of athletes? Therefore, the studys purpose was to determine if athletes have better decision-making capabilities in dynamic sport-specific situations. We expected that athletes' actions would be better tuned when performing a task at a faster rate (i.e., closer to training situations).

METHODS: 6 field varsity athletes (4 male; 20.8±1.2yrs) were immersed in a virtual environment using a VR head-mounted display (HTC Vive Pro2). Individuals walked towards sliding doors situated 6.5 meters from start, at 3 meters from the aperture the doors began to close at a rate of 0.6-1.2m/s* each participant's baseline walking or running (approach) speed. Participants completed a total of 42 trials (i.e., 3 trials x 7 closing speeds x 2 approach speeds). Participants were instructed to approach the doors at a consistent speed only passing through the closing gap if they could safely cross without manipulating their body. Data analysis included distance from the aperture in which each participant slowed down for each closing rate and approach speed.

RESULTS: A significant interaction was observed between door closing rate and approach speed concerning slow down distance ($p = .002$). Post-hoc pairwise t-test between the door closing rate and approach speed showed a significant difference between walking and running at a closing rate of 1.0 ($p= .011$, $g= 0.49$). The switch point in behaviours (i.e, crossing doors vs. stopping prior to the doors) occurred at similar relative door closing rates for both approach speeds.

CONCLUSION: Findings suggest that athletes' actions are equally tuned when approaching closing doors while walking or running. Athletes' decisions (slow down distance) was similar during both approach speeds for each door closing rate. However, when the door closing rate was the most difficult (i.e., 1.0x), slow down distance was closer to the doors when running than when walking. The most probable explanation is that when the closing rate matched the athletes' boundary of success, they take more time for successful visuomotor processing to occur, leading to athletes getting closer to the doors when running.

References

[1] Higuchi, T., Murai, G., Kijima, A., Seya, Y., Wagman, J. B., & Imanaka, K. (2011). Athletic experience influences shoulder rotations when running through apertures. Human Movement Science, 30(3), 534–549. https://doi.org/10.1016/j.humov.2010.08.003

PREDICTIVE VISUAL STRATEGIES IN HIGH-SKILLED TABLE TENNIS PLAYERS DURING FOREHAND RALLIES

SHINKAI, R., ANDO, S., NONAKA, Y., KIZUKA, T., ONO, S.

UNIVERSITY OF TSUKUBA

INTRODUCTION: Eye movements are crucial for acquiring visual information during interceptive performances such as table tennis. Previous studies have indicated that table tennis players spend less time looking at the ball as it approaches

them (Ripoll and Flurence, 1988; Rodrigues et al., 2002; Shinkai et al., 2022). However, it is still uncertain where table tennis players direct their gaze after tracking the ball. We hypothesized high skill players in table tennis would direct their gaze toward opposite side of the court because aiming the landing position of the ball they hit back is important based on kinematic information of the opposite player. In addition to gaze direction, attentional direction could enhance our understandings about visual strategies during rallies. Saccade eye movements reflect our attentions relative to visual targets (Hoffman and 77 Subramaniam, 1995). Therefore, we raised an additional hypothesis that the directions of saccades are also the opposite side of the court. Thus, the purpose of this study was to clarify the predictive visual strategies in skilled table tennis players during forehand rallies.

METHODS: Collegiate male table tennis players (n = 7) wearing an eye-tracking device (Pupil Invisible glasses, Pupil Labs, Berlin) conducted forehand rallies at a constant tempo (100, 120 and 150 bpm) using a metronome. In each tempo condition, participants performed a total of 30 strokes (three conditions). Gaze fixation time, areas of interest where gaze could be directed (Gaze target) and saccade eye movements were detected by video footage of an eye tracking device.

RESULTS: The mean relative fixation time on the ball approaching participants in each tempo condition was 19.6 ± 2.4 % in the 100 bpm, 19.5 ± 1.5 % in the 120 bpm and 19.4 ± 1.1 % in the 150 bpm. These data indicate that participants gazed at the ball approaching them only 20 % of the time during the rallies. After fixation on the ball approaching participants, most of gaze targets stayed on the opposite court in each tempo condition (100 bpm; 99 % of the total trials, 120 bpm; 100 % of total trials, 150 bpm; 97.7 % of total trials). Furthermore, gaze targets immediately after saccade eye movements tended to be other areas of interest away from the ball location. Thus, not only gaze targets but also the attentional directions were opposite side of the court.

CONCLUSION: We found that participants gazed at a ball approaching them only 20 % of the time during the rally. Participants tended to gaze at the ball when the opponent hit the ball and move their gaze away from the ball after that. Furthermore, saccades were directed toward the opposite side of the court including the opponent after tracking the ball. These findings suggest that focusing on the opponent's motion is important for successful forehand table tennis rallies. Taken together, skilled table tennis players are likely to use unique visual strategies for interceptive sports players to estimate spatiotemporal information about the ball.

THE EFFECT OF A SHORT TERM DYNAVISION-D2 TRAINING PROGRAM ON IMPROVING THE ACCURACY OF THE DYNAMIC THREE-POINT SHOOT

ABU ALIM, M., HATAMLEH, M.

YARMOUK UNIVERSITY

INTRODUCTION: Modern training seeks quick, effective training strategies to improve players skills. Sports vision training proved to enhance the efficiency and reaction time of the players performance by mainly enhancing the eye-brain coordination, perception, and visual processing of an athletes vision. The current study investigated the impact of a suggested training program using the Dynavision-D2 in improving the three-point shooting accuracy of the Yarmouk University basketball team.

METHODS: Eight players the coach recommended were selected out of 15 team members, who took part in two weeks (3 sessions (30 minutes each)/week) Dynavision-D2 suggested a training program alongside their regular team practice schedule, but on different weekdays. The Dynavision-D2 suggested intervention took place during the general conditioning training session of the university basketball training and had no focus on game skills training. The Dynavision-D2 training program was developed using pre-programmed training and assessment of the Dynavision-D2 software and a specific developed by researchers tests that included the T-scope, reaction time, Endurance, Proactive mode A, and the Reactive mode B, with a total training time of 30 minutes for each session. The accuracy of the dynamic three-point shoot was assessed using the widely used "60s dynamic three-point shooting" assessment (test protocol (Pojskić et al.,2014)). Statistical analysis included comparing the average scored points, percentages, and a paired T-test evaluation.

RESULTS: However, the suggested training programs effect was relatively small and non-statistically significant ($p>0.05$). The trained participants showed an improvement in their total scored points of the "60s dynamic three-point shooting" test; the average scored points on the pre-training were (6 points) and on the post-training were (8.6 points) as the average percentage accuracies improved from (15%) to (21.56%).

CONCLUSION: In practice, the results of including short-term Dynavision-D2 intervention could be helpful in detecting talented basketball shooters in early team preparation. In addition, it can assess coaches advance their efficient training program focusing on overall development. Furthermore, it could help players handle fatigue and stay accurate during the games. Further research studies are advised for further evaluation of implementing Dynavision-D2 interventions in early sports training stages.

Conventional Print Poster Presentations

CP-MH01 Health and Fitness I

PROTECTIVE EFFECT OF PHYSICAL ACTIVITY ON MORTALITY WITH EMOTIONAL DISTRESS IN KOREAN ADULTS

KIM, S.Y., CHOI, Y., KIM, Y.
SEOUL NATIONAL UNIVERSITY

INTRODUCTION: Emotional distress (ED) is known as a critical risk factor for mortality. The suicide rate in South Korea has been the highest among OECD nations, emphasizing the need for effective interventions to mitigate this risk associated with ED. Current physical activity (PA) guidelines recommend adults to engage in at least 150 min/wk of moderate to vigorous PA (MVPA) to prevent and manage health problems. However, the protective effect of PA against mortality in individuals with ED remains unclear. This study aims to investigate the impact of PA on mortality in individuals with ED.

METHODS: This study included 35,059 Korean adults from the 2007-2013 Korea National Health and Nutrition Examination Survey, with their all-cause and cardiovascular disease (CVD) mortality data linked up to 2019. ED was assessed using a self-reported questionnaire that evaluated the presence of stress, depressive symptoms (DS), and suicidal thoughts (ST). MVPA levels were also determined by questionnaires and classified as inactive (0 min/week), insufficiently active (<150 min/wk), and active (>=150 min/wk). Cox proportional hazards model was applied to estimate the risks of mortality associated with ED and MVPA levels. The study also assessed the combined effect of emotional status and MVPA on the risk of mortality. In a combined analysis investigating the association between ED and mortality risk across different levels of MVPA, six groups were categorized based on the presence of ED and MVPA levels (inactive, insufficiently active, active).

RESULTS: Over a mean follow-up of 9.2 years, 2,033 deaths occurred, including 439 from CVD. The hazard ratios (HR) for all-cause mortality due to stress, DS, and ST were 1.13 (95% CI: 1.02-1.26), 1.13 (1.00-1.27), and 1.34 (1.21-1.49), when compared to non-affected individuals. For those with all three ED categories, the HRs for all-cause and CVD mortality were 1.31 (1.10-1.55), and 1.72 (1.24-2.39). Adhering to PA guidelines was significantly associated with lower risk of mortality: 0.76 (0.62-0.94) for stress, 0.71 (0.55-0.92) for DS, and 0.76 (0.62-0.95) for ST. Similarly, CVD mortality risks were reduced to 0.47 (0.29-0.77), 0.43 (0.23-0.79), and 0.65 (0.41-1.02) for stress, DS, and ST, respectively. In the combined analysis, individuals with ED who engage in PA (either insufficiently active (HR =0.75 (0.57-0.98) or active (HR=0.79 (0.67-0.93)) were associated with a lower risk of all-cause mortality compared to those without ED but who were inactive (HR=0.83 (0.74-0.93)). Similar patterns of associations were observed for CVD mortality.

CONCLUSION: ED and MVPA were both independent predictors for risk of mortality. The higher risk of mortality associated with ED was significantly reduced by adherence to PA guidelines. Combined analysis also indicated that PA is associated with a lower mortality risk in individuals with ED, emphasizing the importance of promoting PA as a key strategy for reducing mortality risk in public health.

LOAD-VELOCITY PROFILING TO ESTIMATE ONE-REPETITION MAXIMUM IN OLDER MEN

DEBOUTTE, J., ALCAZAR, J., WALKER, S., DELECLUSE, C., VAN ROIE, E.
KU LEUVEN

INTRODUCTION: Resistance exercise is the primary therapeutic strategy to counteract age-related declines in muscle function. To individualize exercise intensity, training loads are often prescribed based on an individual's one-repetition maximum (1-RM) [1]. Despite the excellent reliability of 1-RM measurements [2], the protocol is time-consuming and may enhance the risk of injuries, especially in older adults [3]. Consequently, various approaches for estimating 1-RM, and thus accurate training intensity, have been introduced. The load-velocity (L-v) profile has emerged as one potential method, considering that movement velocity can accurately predict relative load [4]. Therefore, the aim of this analysis was to determine how accurately the 1-RM of older men can be estimated from their individual L-v profile.

METHODS: Sixty-four men (66.9 ± 5.4 years old) completed the L-v profiling protocol on a pneumatic leg press device [5]. The protocol started with a maximal isometric test, followed by explosive concentric leg extensions at five pre-fixed increasing loads. Each load was a set percentage of the maximal isometric force, and participants performed 2 to 3 attempts per load. For each of the five loads, the attempt with the highest mean velocity was selected, and the load and velocity values of that attempt were used to create each participant's individualized linear regression equation. Following the five sub-maximal contractions, all participants performed additional single repetitions until reaching 1-RM. Each individual's velocity at 1-RM was recorded and used to calculate the group's mean velocity at 1-RM. This value (0.10 ± 0.07 m/s) was used as an input in the individualized L-v equations to finally obtain each individual's estimated 1-RM.

RESULTS: Estimated 1-RM was slightly higher than measured 1-RM, but the difference was not significant (-0.5 ± 6.4 kg, p=0.525). In addition, the methods showed excellent absolute agreement (ICC=0.92, p<0.001). Despite the strong relationship at a group level, there was substantial inter-individual variability in the agreement between the two methods. The large difference between the estimated and measured 1-RM in some individuals was reflected in the Bland-Altman plot, as well as in the linear regression analysis that yielded a standard error of estimate of 6.3 kg.

CONCLUSION: Estimating 1-RM from L-v profiling provides a low risk, time-efficient alternative for prescribing resistance training load. The results are promising at a group level but may not be generalizable to all individuals and should therefore be interpreted with caution.

REFERENCES:

1. Thompson, S.W., et al. Sports Med, 2020. 50(5): p. 919-938.

2. McMaster, D.T., et al. Sports Med, 2014. 44(5): p. 603-23.

3. Niewiadomski, W., et al. J Hum Kinet, 2008. 19(1): p. 109-120.

4. González-Badillo, J.J. and L. Sánchez-Medina. Int J Sports Med, 2010. 31(5): p. 347-52.

5. Poffé, C., et al. J Sports Sci Med, 2023. 22(2): p. 345-357.

A DELPHI SURVEY OF THE KNOWLEDGE AND SKILLS OF A CLINICAL EXERCISE PHYSIOLOGIST IN THE UNITED KINGDOM.

OSIN, C., SADLER, I., CROZIER, C., GRAVES, L., DAWSON, E., MILLER, G., NAYLOR, L., GREEN, D., ASKEW, C., JONES, H.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Registered Clinical Exercise Physiologists (CEPs) are recognised healthcare professionals in the United Kingdom (UK) and are registered through the Academy of Healthcare Science (AHCS). Their practice is guided by the Clinical Exercise Physiology UK (CEP-UK) standards outlined in the scope of practice [1] and the accompanying curriculum framework [2]. This study aimed to identify and reach consensus on the key knowledge and skills of a UK CEP.

METHODS: Two phases, (i) a scoping review, (ii) a modified, 1-round Delphi survey were utilised. Key requirements were identified from analysis of 24 studies in the scoping review, and the current UK CEP standards and training documents. The survey contained CEP knowledge and skills (n=58), health conditions that a CEP should be able to work with (n=15), and healthcare professions that a CEP should understand the roles and expertise of (n=9). Academics (n=26), healthcare professionals (n=25), CEPs (n=10), service managers (n=6), and researchers (n=4) were identified through purposive sampling (university websites, and databases of exercise rehabilitation services), public advertisement through social media, and snowball sampling. A 1-to-5 rating Likert scale was completed by participants based on the importance of each component for a CEP to practice effectively in the UK.

RESULTS: n=58 of the 71 participants identified (82%) completed the survey. All knowledge and skills identified from the scoping review and the CEP-UK and AHCS standards and training documents (n=58) were accepted, with those in clinical practice (99.7%) deemed the most important and those in behaviour change and communication (82.7%) the least important. n=12 of the 15 health conditions identified (80%) were accepted, with cardiovascular and respiratory diseases (100%) being the most important and eating disorders (54%) the least important. All healthcare professions (n=9) were accepted, with specialist exercise instructors (100%) being the most important and podiatrists (73%) the least important.

CONCLUSION: The final consensus list contains 58 key knowledge and skills, 12 health conditions and 9 healthcare professions that are important for CEPs to work effectively in UK healthcare. This list shows that the current CEP-UK curriculum framework is fit for purpose. Further, this could contribute to future iterations of the framework, and form the bedrock of a growing workforce in the UK.

1. Clinical Exercise Physiology UK (2022a) The Scope of Practice for a UK Clinical Exercise Physiologist [online]

Available at: https://www.clinicalexercisephysiology.org.uk/application-resources

[Accessed: 22nd January 2024]

2. Clinical Exercise Physiology UK (2022b) Clinical Exercise Physiology Curriculum Framework Statement [online]

Available at: https://www.clinicalexercisephysiology.org.uk/msc-degree-accreditation

[Accessed: 22nd January 2024]

JOINT ASSOCIATIONS OF HYPERTENSION AND MEETING BOTH AEROBIC AND MUSCLE STRENGTHENING RECOMMENDATIONS WITH MORTALITY

HWAN, C.Y., YUNMIN, H., HOYONG, S., JIYEON, Y., DUCK-CHUL, L., YEON SOO, K.

SEOUL NATIONAL UNIVERSITY

INTRODUCTION: Hypertension is a well-known risk factor for various cardiovascular diseases (CVD), leading to premature deaths globally. Lifestyle interventions, such as physical activity (PA), can effectively mitigate the risk. While current PA guidelines recommend both aerobic PA and muscle-strengthening activities (MSA), most studies have focused mainly on aerobic PA, leading to uncertainty about the additional health benefits of MSA recommendations for individuals with hypertension. Therefore, this study aims to investigate the mortality risk associated with hypertension and adherence to both PA guidelines.

METHODS: This study included 34,990 participants from the 2007-2013 Korea National Health and Nutrition Examination Surveys (KNHANES), linked to Cause of Death Statistics through 2019. Participants were categorized into four groups based on current PA guidelines: Neither (aerobic PA < 500 METs-min/wk and MSA < 2 days/wk), Only MSA (aerobic PA < 500 METs-min/wk and MSA >= 2 days/wk), Only aerobic PA (aerobic PA >= 500 METs-min/wk and MSA < 2 days/wk), and Both (aerobic PA >= 500 METs-min/wk and MSA >= 2 days/wk). Cox regression, adjusting for potential confounders, estimated hazard ratios (HR) and 95% confidence intervals (CI) for associations of hypertension and meeting PA guidelines

with all-cause and CVD mortality. Stratified analyses assessed whether the relationship between meeting PA guidelines and mortality varied based on hypertension status. Additionally, participants were cross-classified into eight groups to assess the joint association of hypertension status and meeting PA guidelines with mortality, with the reference group being hypertensive participants meeting neither of PA guidelines.

RESULTS: During 9.2 years of the mean follow-up period, 1,948 participants died from any cause, and 419 from CVD. Hypertension was associated with a higher risk of mortality (HR 1.11, 95% CI, 1.01-1.22 for all-cause; HR 1.40, 95% CI, 1.14-1.73 for CVD) compared to normotensive participants. However, adherence to both aerobic PA and MSA guidelines was associated with a lower risk of mortality (HR 0.72, 95% CI, 0.61-0.85 for all-cause; HR 0.54, 95% CI, 0.36-0.80 for CVD). This association was more pronounced in hypertensive participants, but not apparent in normotensive participants. Joint analysis showed that hypertensive participants meeting both aerobic PA and MSA guidelines consistently had lower mortality risk compared to normotensive participants meeting neither of guidelines. Overall, adherence to both PA guidelines was associated with lower risks of all-cause and CVD mortality, regardless of hypertension status.

CONCLUSION: The findings of this study indicate that meeting both aerobic PA and MSA guidelines, as recommended by current guidelines, is associated with a significant reduction in the risk of all-cause and CVD mortality, even among hypertensive individuals. These results underscore the importance of not only aerobic PA, but also MSA as public health strategies.

ASSOCIATIONS OF SEDENTARY TIME AND PHYSICAL ACTIVITY WITH MORTALITY A REPROSPECTIVE FROM THE KOREA NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (KNHANES)

YUN, S., YOUNGHWAN, C., YEON SOO, K.
SEOUNL NATIONAL UNIVERSITY

INTRODUCTION: Sedentary time (ST) has been recognized as an independent health risk factor, regardless of moderate-to-vigorous physical activity (MVPA). Although the relationship between sedentary time and a higher risk of mortality has been found in earlier research, only a few studies have examined the combined effects of ST and MVPA on mortality risk. Thus, the purpose of this study was to investigate the association of ST and MVPA with all-cause mortality.

METHODS: We analyzed data from 8,568 Korean adults who participated in the 2014-2015 Korea National Health and Nutrition Examination Survey (KNHANES). During follow-up through 2019, a total of 172 deaths were documented. Cox proportional hazard model was used to examine the associations of ST and MVPA on mortality. To determine the risk of mortality associated with ST and MVPA, ST was categorized into 6 groups (<4, 4-6, 6-8, 8-10, 10-12, >=12 hr/day) and MVPA was categorized into 3 groups (0, 1-149, >=150 min/wk of MVPA). In combined analysis, participants were categorized into 6 groups based on their level of SB (<8, 8-12, >=12 hr/day) and MVPA (<150, >=150min/wk). Reference group was defined as SB <8 hr/day and MVPA >=150min/ wk.

RESULTS: The longest ST (>=12 hr/day) was associated with a significantly increased risk of mortality (HR = 2.10, 95% CI 1.20-3.67). Conversely, increasing levels of physical activity were associated with a decreased risk of mortality (HR = 0.64, 95% CI 0.43-0.94 for insufficient activity; HR = 0.58, 95% CI 0.40-0.82 for active group). When examining the combined effects of ST and MVPA on mortality , we observed a progressive increase in mortality risk with higher sedentary group, particularly among those with insufficient activity (HR = 1.90 95% CI 1.18-3.05 for 8-12 hr/day; HR = 2.63, 95% CI 1.61-4.27 for >=12 hr/day). However, individuals who were sufficiently active (>=150 min/wk of MVPA) were not associated with a higher risk of mortality, regardless of their ST.

CONCLUSION: Our findings suggest that adhering to current physical activity guidelines (>=150min/wk of MVPA) may attenuate the higher risk of mortality associated with high sedentary time. These results highlight the importance of incorporating sufficient MVPA to counteract the detrimental effects of prolonged ST.

This study was funded by the Shenzhen Research Fund [JCYJ-20230807-14041-4029].

THE EFFECT OF EIGHT WEEKS OF VIGOROUS EXERCISE TRAINING ON IRON STATUS IN YOUNG MEN AND ITS ASSOCIATION TO PHYSICAL PERFORMANCE

ALTMAN, A., MARKUS, I., GEPNER, Y.
TEL AVIV UNIVERSITY

INTRODUCTION: Iron deficiency (ID) is prevalent among extensively trained recreational and professional athletes. Unaddressed, ID may accelerate degradation in both physical and cognitive performance. This study aimed to determine the effect of eight weeks of high-volume exercise training on hepcidin and ferritin concentration, and its association to physical performance, cognitive functions, and agility.

METHODS: Thirty healthy males (18-30y, 75.5±5.9kg) were recruited from a base training combat unit to participate in eight weeks of high-volume (30 h/week) exercise training with a monitored diet. Iron status, inflammation, and endocrine markers were measured pre- and post-intervention. In addition, anaerobic capacity (peak and mean power), muscle strength [isometric mid-thigh pull (IMTP), hand grip (HG), and vertical jump (VJ)], and reaction agility were measured. Changes between baseline and post-eight weeks were assessed by paired sample t test.

RESULTS: Significant (p<0.001) increases were found in hepcidin (51.2 ± 41.7%) and ferritin (50.8 ± 60.6%) following eight weeks of training compared to baseline. In addition, significant (P<0.001) elevation was found in cognitive function [agility tests (-14.2 ± 9%), cognitive stressor tests (-3.7 ± 5.7%)] and muscle strength [IMTP (12.1 ± 9.1%), HG (8.8±12%), and VJ

(5.6±11%)]. IL-6 increased (31±1.9%, p = 0.059) following the training and was strongly associated with hepcidin change (r=0.448, P<0.01), but not with ferritin (p=0.34). Changes in iron status were not associated with changes in exercise performance. Although no associations were found between total calories or macronutrient intake and iron status, total protein intake during the training correlated with ferritin change (r=0.376, P<0.05).

CONCLUSION: Eight weeks of high-volume exercise training among young active male increase hepcidin and ferritin. Those changes were not associated with exercise performance, but with chronic inflammation.

BELT ELECTRODE ELECTRICAL STIMULATION PREVENTS DENERVATION-INDUCED MUSCLE ATROPHY IN MULTIPLE SKELETAL MUSCLE GROUPS IN RATS.

UNO, H., KAMIYA, S., AKIMOTO, R., HOSOKI, K., TADANO, S., ISEMURA, M., KOUZAKI, K., TAMURA, Y., KOTANI, T., NAKAZATO, K.

NIPPON SPORT SCIENCE UNIVERSITY, HOMER ION LABORATORY CO., LTD.

INTRODUCTION: Electrical muscle stimulation (EMS) induces muscle hypertrophy and inhibits atrophy. EMS is thought that pad electrodes are most often used in clinical practice. However, it is difficult to activate multiple muscle groups simultaneously and efficiently as in voluntary exercise, because the electrodes are usually placed on the target muscle and current can only be applied to a single muscle, making it difficult to exercise multiple muscle groups simultaneously and obtain the effect of suppressing muscle atrophy. Recently, a method called Belt Electrode Skeletal Muscle Electrical Stimulation (B-SES) has been considered to be effective in addressing the problems of pad electrodes. This is an electrical stimulation method that can stimulate multiple muscle groups simultaneously. In addition to being able to stimulate multiple muscle groups simultaneously, the electrode area is larger than that of a pad electrode, resulting in a smaller amount of current per unit area (current density) and an increase in the maximum threshold value that can be tolerated when energized, thus enabling more intense stimulation. Although the clinical usefulness of B-SES has been demonstrated, its molecular mechanism remains unclear. In this study, we developed a novel rodent B-SES ankle stimulation system to test whether tetanus stimulation prevents muscle atrophy caused by denervation and examined the effect of B-SES on preventing muscle atrophy.

METHODS: Ten-week-old male SD rats were divided into an untreated control group (CONT), denervation group (DEN), and denervation and electrical stimulation group (DEN+ES). DEN+ES rats wore belt electrodes on both ankles and were energized between the two electrodes. Electrical stimulation was applied once two days for 7 days under isoflurane inhalation anesthesia, beginning immediately after denervation, at a frequency (60 Hz) that induces tetanus in rats for 5 minutes (5s on 2s off cycle). Twenty-four hours after the last electrical stimulation, the rats were bled to death under anesthesia, and the tibialis anterior and gastrocnemius muscles were removed bilaterally.

RESULTS: After 7 days of denervation, muscle wet weight (n=8~11) and muscle fiber cross-sectional area (CSA, n=6) of tibialis anterior and gastrocnemius muscles were lower in DEN and DEN+ES than CONT showed atrophy but were significantly higher in DEN+ES than DEN, showing atrophy prevent. In 18s and 28S ribosomal RNA, DEN+ES was significantly higher than CONT and DEN in the tibialis anterior and gastrocnemius muscles.

In addition, mRNA levels of muscle proteolytic signals, Atrogin-1 and Murf1, were greatly increased by denervation compared to CONT, while B-SES suppressed their expression (p<0.05).

CONCLUSION: Tetanus stimulation of both rat ankles with belt electrodes may effectively prevent denervation-induced atrophy in multiple muscle groups by sciatic nerve transection via enhancement of muscle protein synthesis and prevention of muscle proteolysis.

A CROSS-SECTIONAL STUDY OF SEASONAL HIKING FREQUENCY, INJURIES AND FOOTWEAR CHOICES OF HIKERS.

JOCHER, K., JACOB, I., BREEN, S., SQUIBB, M., BLACKBURN, H., ODDY, C., FRANCIS, P.

SOUTH EAST TECHNOLOGICAL UNIVERSITY

INTRODUCTION: Hiking is a form of physical activity (PA) (Caspersen et al., 1985) that typically takes place in natural environments e.g. mountains/countryside/forests. The habitual performance of this type of PA is reported to have many health benefits (Manferdelli et al., 2019). Other than this, little is known of what defines a hiker, their injuries and behaviours. The aim of this study was to determine seasonal hiking participation, injuries sustained and footwear choices among hikers.

METHODS: A cross-sectional questionnaire design was used to determine seasonal hiking participation, injuries sustained and footwear choices among hikers. Participants were recruited from Ireland (n = 62), United Kingdom (n = 37), United States of America (n = 18) and New Zealand (n = 6) through hiking/hillwalking organisations/groups on social media, emails and word of mouth. Two-hundred-and-eight individuals responded, of which eighty-five individuals were excluded (78x drop-out/incomplete, 7x Chronic Illness/Advised not to participate in PA by medical professional), One hundred and twenty-three were included in the analysis (Biological Sex: n= 58 male, n = 63 female, n= 2 prefer not say, age = 45 ±14.6). The survey was designed using Qualtrics TM software (version 2023) and statistical analysis was conducted using IBM SPSS statistical software package version 28.1.0.

RESULTS: 69% (95% CI: 0.59, 0.79) of hikers participated in hiking during all 4 seasons. Spring, Summer and Autumn demonstrated the highest participation rates (93 – 98% of participants) and winter had the lowest participation rates (72%, 95% CI: 0.65, 0.79).

Injury incidence among hikers is 37% (95% CI: 0.28, 0.46) in the previous 12-months. The foot (30%, 95% CI: 0.16, 0.44), knee (26%, 95% CI: 0.13, 0.39) and ankle (23%, 95% CI: 0.10, 0.36) were the most injured anatomical sites in injured hikers. Traditional style shoes were most prevalent among hikers (81%, 95% CI: 0.74, 0.88), followed by minimalist shoes (11%, 95% CI: 0.05 – 0.17) and barefoot hikers (2%, 95% CI: 0.0, 0.06), 3% (95% CI: 0.0, 0.05) of hikers used a combination of traditional and minimalist shoes.

CONCLUSION: This study is the first to report data on seasonal hiking participations, injuries sustained and footwear choices from a sample of hikers located in Ireland, the United Kingdom, United States of America and New Zealand. This data may act as a positive first step in profiling hikers for future research in the areas of injury prevention and footwear choices.

References:

CASPERSEN, C. J., POWELL, K. E. & CHRISTENSEN, G. M. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reports, 100, 126 - 127.

MANFERDELLI, G., LA TORRE, A. & CODELLA, R. 2019. Outdoor Physical Activity Bears Multiple Benefits to health and society. The Journal of Sports Medicine and Physical Fitness, 59, 868 - 879.

HELICOPTER LOADMASTERS´ OCCUPATIONAL LOADING

OJANEN, T., KOIVURANTA, J., KYRÖLÄINEN, H., HONKANEN, T.

FINNISH DEFENCE RESEARCH AGENCY

INTRODUCTION: The workload of helicopter loadmasters can be physically and mentally demanding. The workload has been studied mostly with questionnaires instead of objective measures. The purpose of this study was to find out the amount of physical and mental load on the loadmasters before the flight (PRE), during the immediate flight activities (WALK), during the actual flight (FLIGHT), and after (POST/POST2) the flight.

METHODS: A total of 16 (age 34±6 yrs., height 180±5 cm, and body mass 82±5 kg) male loadmasters voluntarily participated in the study. Data on the occupational load of loadmasters was collected through objective and subjective measurements. As objective measurements, heart rate and heart rate variability, saliva biomarkers, and isometric and dynamic force production tests were used. The aim of the objective measurements was to obtain information on the functioning of the cardiovascular, autonomic nervous, and excretory systems at PRE, WALK, FLIGHT, and POST/POST2 time points. A diary was used as a subjective method, with which the loadmasters evaluated the load caused by the flight and the other activities on the day of the flight.

RESULTS: The maximum heart rate of the loadmasters during the flight was significantly higher compared to other measurement periods (FLIGHT = 173±14 bpm vs. PRE = 133±21 bpm, $p<0.01$, WALK = 153±16 bpm, $p<0.05$ & POST = 145±20 bpm, $p<0.05$), but heart rate variability was significantly lower during WALK than during POST (SDNN = 47±14 ms vs. 58±15 ms, $p<0.01$; RMSSD = 39±17 ms vs. 51±17 ms, $p<0.05$). Based on the cortisol levels, the load of the loadmasters was significantly higher PRE than POST or POST2 (PRE = 8.35±3.79 nmol/l vs. POST = 5.57±3 .79 nmol/l, $p<0.05$ & POST2 = 5.12±3.03 nmol/l, $p<0.05$). The saliva alpha-amylase concentration was significantly higher after POST compared to POST2 (150.23±99.94 U/ml vs. 87.62±69.18 U/ml, $p<0.01$). No statistically significant differences were observed in the results of the physical tests. Based on the subjective assessment collected from the subjects, the load caused by helicopter flights on a scale of 1–10 was a 6.

CONCLUSION: According to the present study, the physical load on loadmasters during the flight is momentarily intense but not long-lasting. In addition, standing still during the flight seems to enable the activation and recovery of the parasympathetic nervous system of loadmasters, further reducing the overall physical load caused by the flight. In addition, good muscle endurance and maximal strength may have a more significant effect than aerobic endurance in reducing the load of the flight tasks. In the future, it will be important to study more in detail the load exerted by different load-bearing components during a flight.

FROM COURT TO WELLNESS: A SYSTEMIC REVIEW OF THE BENEFITS OF HEALTH AND WELL-BEING OF BADMINTON FOR CHILDREN AND YOUNG PEOPLE

YIN, C., XIAOJIA, C., SHUJIE, L.

UNIVERSITY OF EDINBURGH

INTRODUCTION: Acknowledging the limited appeal of the current health system for adolescents, this study advocates for badminton, a globally embraced sport with over 220 million participants (Phomsoupha & Guillaume Laffaye, 2014), to promote health and well-being in individuals under 25.

METHODS: Following PRISMA 2020 guidelines, the study meticulously searched key databases from October to November 2023, identifying 29 studies exploring badmintons impact on health and well-being in young people. Screening, using WHO age range criteria, resulted in a robust selection, and ATLAS.ti software facilitated systematic categorization and analysis.

RESULTS: Conducting a comprehensive review of 937 papers, the study included 29 studies examining the relationship between badminton engagement and health and well-being in young people. The most productive year was 2022, with China as the predominant research location. The diverse focus of studies encompassed recreational, academic, and

professional badminton types, with a collective sample of 3746 participants. Interventions targeted physiological parameters, fitness levels, mental health, and cognitive function, yielding significant positive improvements.

CONCLUSION: Badminton emerges as a multifaceted catalyst for fostering the overall well-being of young individuals. Significant contributions to physical health include impacts on bone mass, muscular strength, flexibility, and cardiovascular fitness (Gustavsson et al., 2003; Tervo et al., 2010; Naughton and Carlson, 1991; Stovba et al., 2019; Mohammed, 2020; Lee et al., 2021). The sport also showcases substantial cognitive benefits, enhancing eye–hand coordination, cognitive functions, and neural efficiency (Dube et al., 2015; Jawoeski et al., 2017; Hung et al., 2018; HÜLSDÜNKER et al., 2017; Liao et al., 2017; Dai et al., 2016; Santos et al., 2022; Chen et al., 2019; Akin et al., 2017).

Badminton positively influences mental health, promoting emotional stability and reducing psychological stress, particularly crucial during the transitional phase of youth (Li, 2004; Li et al., 2010; Yue & Xiao, 2022; Zhang et al., 2016; Wu & Li, 2022; Pan & Song, 2022; Chen et al., 2021; Cabello-Manrique et al., 2022). The discussion highlights the sports potential as a lifelong engagement tool, promoting intrinsic motivation, sports commitment, and excellence desires (Gomis-Gomis et al., 2023; Chen et al., 2021). Inclusive interventions, like "Shuttle Time Badminton Lessons," emphasize adaptability and motivational impact, making it a promising avenue for fostering sustained physical activity and sports participation among diverse young populations. In essence, badminton emerges as a holistic tool positively impacting the physical, cognitive, and mental well-being of young individuals, contributing to lifelong engagement in sports and physical activity.

Conventional Print Poster Presentations

CP-MH14 Adolescents/Children

ASSOCIATION BETWEEN PHYSICAL FITNESS AND TRAINING COMPETENCE AMONG ADOLESCENTS

GROßE SIEMER, J., THIENES, G.

UNIVERSITY OF VECHTA

INTRODUCTION: Supporting people to adopt and maintain an active lifestyle is a worthwhile goal. Across Europe, around 27% of over 15-year-olds participate in self-organized sport without supervision. In addition to promoting motor fitness, this emphasizes the need to develop a training competence, that enables people to plan, carry out and evaluate their training activities independently according to their individual requirements and without the need for supervision. Training competence encompasses knowledge on effects, exercises and methods of training and the application of that knowledge as well as perceiving exertion and pacing training accordingly. Here we investigate the relationship between physical fitness (PF) and training competence (TC). This is based on the assumption that training competence is acquired during the training process.

METHODS: A cross-sectional study was conducted with adolescents in German schools from grades 5-12 (138m / 77f; M 16.05 SD 2.56 years) and bivariate Pearson correlation and (multiple) linear regression analysis were performed to analyze the relationship between PF (independent variable) and TC (dependent variable). PF was determined with different tests for strength, coordination, flexibility and aerobic endurance and values were standardized to ensure comparability. TC (five facets with three items each) was collected using a standardized questionnaire with five-point Likert scales [1].

RESULTS: The standardized total score for PF showed a moderate positive correlation with total TC ($n = 215$; $r = .318$; $p = <.001$). Significant correlations were found for all five facets ($r = .16$ - $.35$). Differences in the correlations between girls and boys are not significant; only slight differences were found between some classes for three facets. The regression, controlled for sex and age, explained 18% of the variance in total TC ($r2 = .18$, $f (3, 209) = 15.29$, $p <.001$) and showed a significant association with total TC for PF (beta = .28, $p <.001$). Significant associations were found for four of the five facets (beta = .11 - .30). Age was negatively associated with total TC (beta = -.26, $p <.001$).

CONCLUSION: As expected, higher PF in adolescents correlates positively with TC overall and PF is a predictor of TC. Future research should include the assessment of training experience as a suspected moderator between PF and TC [2] and beyond that help clarify the unexpected negative correlation between age and TC.

References:

[1] Braksiek, M. et al. (2022). In M. Wegner & J. Juergensen (Hrsg.), Sport, Mehr & Meer: Sportwissenschaft in gesellschaftlicher Verantwortung: 25. Dvs-Hochschultag, Kiel (S. 441). Feldhaus, Edition Czwalina

[2] Thienes, G. et al. (2022). In M. Wegner & J. Juergensen (Hrsg.), Sport, Mehr & Meer: Sportwissenschaft in gesellschaftlicher Verantwortung: 25. Dvs-Hochschultag, Kiel (S. 439). Feldhaus, Edition Czwalina.

INVESTIGATION OF METHODS FOR IDENTIFYING THE OCCURRENCE OF ADOLESCENT AWKWARDNESS DURING THE GROWTH SPURT AND THE TIMING OF SUBSEQUENT RAPID DEVELOPMENT: A CASE STUDY

KOKUDO, S.

CHUKYO UNIVERSITY

INTRODUCTION: Beunen and Malina (1986) reported that 25% of boys exhibit a temporary decrease in running speed during the growth spurt period. Furthermore, Philippaerts et al. (2006) found that 30m dash speed decreased by -0.6 seconds/year 12 months before the age of peak height velocity (APHV) in junior soccer players. Kokudo (2019) indicated

that there may be a temporary stagnation in running speed development and a deterioration of running movement due to adolescent awkwardness (AK) just before or after the APHV. He also highlighted the difficulty in treating the occurrence of AK as a group phenomenon due to significant individual differences in the timing of rapid developmental stages and motor skills, underscoring the necessity of meticulously tracking individual changes.

The purpose of this study was to investigate methods for clarifying the appearance of AK and the characteristics of its subsequent development. Additionally, it aimed to elucidate the process of onset and offset of AK through a case study targeting individuals who have undergone continuous training and have long-term records of height and athletic performance.

METHODS: We hypothesized that the emergence of AK would be more likely in exercises that involve moving ones body weight, and that this feature would be more pronounced with ongoing training. The subject was a Japanese male who continuously performed the high jump from primary school until adulthood, with a final height of 180.5 cm and a best high jump record of 2.15m. Growth data were collected from school health checkup records. Due to the rarity of individuals recording all their performances, records equaling or surpassing previous personal bests and the ages at which these records were achieved were used as data. A modified BTT model, including two logistic functions with the infant growth period defined as constant, was used for growth data. For the high jump record, the BTT model, characterized by three logistic functions, was employed to analyze performance development (Bock et al., 1990).

RESULTS: The goodness of curve fitting was R^2 = 0.999 for growth and R^2 = 0.994 for high jump performance development, indicating excellent fits. The peak height velocity (PHV) was 10.66 cm/year at age 12.25 years. Performance development speed was less than 5.0 cm/year from ages 10.9 to 12.7 years. A rapid development speed was observed shortly thereafter, from 13.0 to 13.8 years of age, reaching 126.8 cm/year at 13.4 years of age, 1.15 years after APHV. At this time, the height velocity was 6.74 cm/year, which was 63.2% of the PHV. The growth rate remained above 7 cm/year until around 17 years of age.

CONCLUSION: The BTT model, with three combined logistic functions, adequately explained the growth in height and development of performance. In this sample, performance stagnation was observed during the period corresponding to the adolescent surge phase, but the end of the growth surge phase represented an explosive period of rapid developmental progression.

ADOLESCENTS WITH TYPE 1 DIABETES PERCEPTIONS OF 24-HOUR MOVEMENT BEHAVIOURS: A MIXED METHODS STUDY

PATIENCE, M., KIRK, A., JANSSEN, X., SANDERS, J., CRAWFORD, M.

UNIVERSITY OF STRATHCLYDE

INTRODUCTION: Adolescents with type 1 diabetes (T1D) are required to manage their condition throughout the entire 24-hour day. Physical activity, sedentary behaviour and sleep (24-hour movement behaviours) all play a crucial role in the management of T1D [1], yet no research has explored adolescents with T1Ds perceptions towards all three behaviours collectively. The aims of this study are to conduct a mixed method study to explore adolescents with T1D perceptions of 24-hour movement behaviours (24-h MBs) and assess the amount of time they engage in each behaviour.

METHODS: Qualitative data was gathered using semi-structured interviews. These were recorded, transcribed using intelligent verbatim and analysed using thematic analysis. Quantitative data was gathered using a wrist-worn accelerometery (GT3X-BT). The Hildebrand cut-points were used to categorise sedentary behaviour (SB), <35.6 mg/1s, light physical activity (LPA), ≥35.6 mg/1s and moderate-vigorous physical activity (MVPA), ≥201.5-706.9 mg/1s, while the Van Heest heuristic algorithm was used to estimate sleep.

RESULTS: In total 15 adolescents (6M, 9F) participated with mean age 14.6±2.0yrs, HbA1c 7.4±1.0%, diabetes duration 3.7±3.1yrs. Most used a continuous glucose monitor (80%) and delivered insulin by pump (67%). The main themes arising from the data were: 1) adolescents understanding of 24-h MBs (indicating awareness of how one behaviour impacts the other); 2) adolescents perception of 24-h MBs on mood (indicating better sleep and increased physical activity had a positive impact on mood, whereas sedentary behaviour had a negative impact) and 3) adolescents perceptions of 24-h MBs impact on blood glucose (mixed perceptions on their relation to blood glucose levels). Average sedentary time was 9.8±1.7h/d, LPA time was 5.6±1.4h/d, MVPA time was 28.5±27min/d and sleep time was 8.1± 0.7h/night. Most of the sample did not meet the MVPA recommendations (91.1%) while 58.3% met the sleep duration recommendations.

CONCLUSION: This study highlights adolescents with T1Ds understanding of the interconnectedness of each behaviour within a 24-hour day and the positive impact the correct balance of each behaviour can have on mood/emotions. Despite this, a large proportion of adolescents with T1D in this study are not meeting the 24-hour movement behaviour recommendations. The results from this study promote the use of a holistic 24-hour movement behaviour approach in the management of T1D and can inform future interventions aiming to support healthy 24-hour movement behaviours in this population.

1. Patience, M, et al., 24-hour movement behaviours (physical activity, sedentary behaviour and sleep) association with glycaemic control and psychosocial outcomes in adolescents with type 1 diabetes: a systematic review of quantitative and qualitative studies. International Journal of Environmental Research and Public Health, 2023. 20(5): p.4363.

EFFECTS OF STRENGTH TRAINING IN UPPER SECONDARY SCHOOL PHYSICAL EDUCATION CLASSES DEPENDING ON THE ENJOYMENT OF TRAINING

THIENES, G., GROßE SIEMER, J.
UNIVERSITY OF VECHTA

INTRODUCTION: The effectiveness of strength training has been proven for physical education (PE) classes. Few findings include the conditions of German schools or higher adolescence [1]. Pupils who actively participate in strength training can link it to the self-efficacy experience of being able to influence their own motor performance and change their fitness in a self-directed manner through their own effort and commitment to training. The assumption to be tested is then that the students expressed enjoyment of training opens up these positive experiences, which then indirectly contribute to the greater effects of the training. This study examines enjoyment of strength training as a possible relevant (indirect) influencing factor on the effectiveness of training.

METHODS: Of 88 adolescents (68m/20f; M 17.5 SD 1.30 years), 54 participated in the 7-week resistance training programme. Strength training took place once a week during physical education classes, and the average training compliance was 4-5 training sessions (training group). A whole-body strength circuit of 12 exercises was implemented in the 90 minute lessons in conjunction with conversations and reflective discussions in class. Lessons in the parallel classes were not related to strength training (control group). Curl-up, back test, pull-up hang and push-up [3] and sport enjoyment scales [2] were collected.

RESULTS: Mixed ANOVA shows a significant interaction effect in favour of the TG for the push-up ($F(1.0, 85.0) = 12.79$, $p < .001$, eta-sq = .13), the pull-up hang ($F(1.0, 86.0) = 8.18$, $p = .004$, eta-sq = .09), and the back test ($F(1.0, 86.0) = 13.93$, $p < .001$, eta-sq = .13). In addition, a significant interaction was found in favour of the group that enjoyed the training more for the push-up ($F(2.0, 50.0) = 4.65$, $p = .014$, eta-sq = .15) and the curl-up ($F(2.0, 51.0) = 3.67$, $p = .032$, eta-sq = .12).

CONCLUSION: Evidence is supported by three out of four tests, that under conditions of PE classes in Germany training once a week has low but relevant effectiveness [4]. The study also suggests that enjoyment of strength training leads to significantly greater training effects for two of the four test procedures, with medium to large effects. It is recommended to investigate potential age-related and methodological causes, such as the time of survey.

References:

[1] Cox, A., et al. (2020). Sports Medicine, 50, 543-560.

[2] Scanlan, T.K. et al. (1993). Journal of Sport and Exercise Psychology, 15, 16-38.

[3] Thienes, G. (2008). Leipziger Sportwissenschaftliche Beitraege, 49(2), 135-145.

[4] Thienes, G. et al. (2022). In M. Wegner & J. Juergensen (Hrsg.), Sport, Mehr & Meer: Sportwissenschaft in gesellschaftlicher Verantwortung: 25. Dvs-Hochschultag, Kiel (S. 509). Feldhaus, Edition Czwalina.

EFFECT OF A NATIONWIDE INITIATIVE (HEALTHY ACTIVE LEARNING) ON PHYSICAL ACTIVITY OF CHILDREN AGED 5-13 YEARS

ALI, A., MUGRIDGE, O., OBRIEN, W., BASU, A., MUMME, K., ADAMS, J., SNOWLING, N.
MASSEY UNIVERSITY

INTRODUCTION: The Healthy Active Learning (HAL) initiative aims to increase physical activity (PA) of students in school and community settings. This study examined the effect of HAL on PA metrics using accelerometry.

METHODS: Students (5-13 y) wore an accelerometer on the non-dominant wrist for 5-7 days. Data (hourly steps; sedentary, light, moderate and vigorous minutes/hour) were recorded at two timepoints (T1=2020/21, T2=2022/23) at 46 New Zealand schools. Schools were classified by the level of intervention at each timepoint. Phase 1 schools (P1) were baseline at T1, Phase 2 schools (P2) were baseline at T2. Logistic regression explored the effect of HAL over time for overall movement; in-school (9am-3pm); out-of-school (7-9am/3-9pm, weekdays); weekdays; and weekend movement.

RESULTS: Overall, 1972 students (~53% female, mean age 9.5y) participated from 17 Phase 1 schools (n=756 [T1], n 457 [T2]) and 19 Phase 2 schools (n=489 [T1], n=272 [T2]). Some students (n=134) took part at both timepoints. In-school steps increased over time for Phase 2 schools and decreased for Phase 1 schools (1213 [T1, P1] to 1178 [T2, P1] steps/hour, 1177 [T1, P2] to 1215 [T2, P2] steps/hour, p=0.001). Overall, in-school, and weekday light minutes/hour increased for Phase 1 and Phase 2 schools (20 [T1, P1] to 33 [T2, P1] minutes/hour, 20 [T1, P2] to 33 [T2, P2] minutes/hour, p=0.02; p<0.001, p=0.03 respectively). In-school and weekday moderate/vigorous minutes/hour decreased for Phase 1 and Phase 2 school (21 [T1, P1] to 14 [T2, P1] minutes/hour, 22 [T1, P2] to 15 [T2, P2] minutes/hour, p<0.001; p=0.02 respectively).

No effect of HAL over time was observed for overall, out-of-school, weekdays and weekend steps; any time measure of sedentary minutes/hour; out-of-school and weekend light minutes/hour; overall, out-of-school and weekend moderate/vigorous minutes/hour; nor longitudinal student data.

CONCLUSION: The increase in light intensity activity over sedentary behaviour is a positive outcome. Nevertheless, there was a significant reduction in MVPA in both Phase 1 and Phase 2 over time. This may be due to low-intensity PA during the so-called 'brain breaks' that was becoming more commonplace in schools. In-school activity was higher than out-of-school activity, and weekend hours. However, the changes to sedentary, light and MVPA were similar to overall activity.

CONTRIBUTION OF WALKING TO AND FROM SCHOOL ON OVERALL PHYSICAL ACTIVITY: A ONE-YEAR FOLLOW UP STUDY

SASAYAMA, K.

MIE UNIVERSITY

INTRODUCTION: Walking to and from school rates are low in many countries (Aubert et al., 2022). Therefore, the contribution of active transport to the overall population's MVPA is relatively low (Martin et al., 2016). In addition, Larouche's review (Larouche et al., 2014) on the relationship between active transport and physical activity highlighted a limited number of longitudinal studies. This study examines the prospectively relationship between walking to and from school and physical activity in a sample with a high rate of Japanese children who walked to and from school.

METHODS: A total of 76 participants (57.9 % girls) completed baseline and follow-up assessments. Their mean age was 9.6 ± 1.0 years at baseline and 10.6 ± 1.0 years at follow-up. The participants' mode of school commute was measured by a questionnaire. Step counts, sedentary time, light physical activity (LPA) and moderate-to-vigorous physical activity (MVPA) were assessed using an accelerometer (ActiGraph, LLC, Pensacola, FL, USA). Comparisons of physical activity variables at baseline and follow-up were analyzed using the Wilcoxon signed-rank test. The contribution of walking to and from school to the entire day was calculated. The tracking of physical activity was analyzed using Spearman's correlation coefficient.

RESULTS: Overall physical activity levels decreased at follow-up compared to baseline. However, the contribution of walking to and from school to overall physical activity significantly increased at follow-up compared to baseline, especially in step counts and MVPA. Walking to and from school contributed to the participants' overall physical activity in MVPA were 39.6 ± 15.3% and 49.1 ± 13.8% for all participants at baseline and follow-up, respectively. The tracking correlation coefficients were high for the steps counts ($r = 0.799–0.889$, $p < 0.05$) and MVPA ($r = 0.713–0.745$, $p < 0.05$) in before school and after school.

CONCLUSION: Walking to and from school significantly contributed to overall daily physical activity in primary school students. Physical activity during the school commute in short-term exhibited a low-to-strong association. In conclusions, these findings emphasize the importance of promoting physical activity interventions and implementing school policies that encourage walking to and from school.

References: 1. Aubert, S, et al., Global Matrix 4.0 physical activity report card grades for children and adolescents: results and analyses from 57 countries. Journal of physical activity and health, 2022. 19: p700-728.

2. Martin, A, et al., Contribution of walking to school to individual and population moderate-vigorous intensity physical activity: systematic review and meta-analysis. Pediatric exercise science, 2016. 28: p353-363.

CHILDREN'S PHYSICAL ACTIVITY BASED ON NUTRITIONAL STATUS

UVACSEK, M., WÁGNER, B.

HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: Inactivity is the fourth most important risk factor for early death (WHO 2010). WHO's aim for 2030 is to decrease inactivity by 15% (WHO 2018). Monitoring the different types of activities in children is the first essential step in order to achieve the global goal. The aim of the study was to collect data about primary school children's physical activity. The questionnaire was compiled using the Global Matrix 4.0 indicators. We asked parents about the children's overall physical activity, organized sport and physical activity, active transport and activity doing together, and their parental support.

METHODS: In the online data collection, 677 parents (42.85±6.49 years old) provided information about 677 children (10.98±2.53 years old). Data were collected in spring 2023 using social media platforms and internet correspondence. The nutritional status categories were determined by WHO reference. Our questionnaire was edited with the Qualtrics program, and the data were analyzed using TIBCO 14.0 Statistics.

RESULTS: Altogether, 77% of children achieved the 60-minute MVPA/day on average; the highest rate was 81% in the underweight children group, and the lowest (63%) was found in overweight children. 63% of children participated in organized sport or activity; the highest rate (67%) was found in the normal weight group and the lowest (51%) in obese children. Active transport was present at the same level in every group. Interestingly, the overweight and obese children's rates (81%) were a bit higher than the others. Doing physical activity with parents was most characteristic in normal-weight children (73%) and the least in obese children (63%). The parental support for physical activity was also high, 83% in general, with the highest rate (88% in underweight children) and the lowest in the overweight group.

CONCLUSION: The physical activity of children changed in a positive direction compared to previously published data. Active transport was chosen at a higher rate than before, and the data for family support also increased. Based on nutritional status, the data was not significantly different, which means that overweight and obese children had almost the same participation rate in sports activities as others.

WHO 2010: Global recommendations on physical activity for health. Geneva: World Health Organization ISBN 978 92 4 159 997 9

WHO 2018: Global action plan on physical activity 2018–2030: more active people for a healthier world. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO

SCHOOL NEIGHBORHOOD PHYSICAL ENVIRONMENT, SOCIOECONOMIC STATUS, AND PHYSICAL ACTIVITY OF ADOLESCENTS IN JAPAN

OISHI, K., AOKI, T., MORI, T., IKEUE, K., YAMAGUCHI, H., HANANO, H., YAMAMOTO, Y., HIROE, Y., ISHII, K.
DOSHISHA UNIVERSITY

INTRODUCTION: Abundant physical activity in adolescents is not only consistently and favorably associated with various health indicators, but also transitions to an active lifestyle in adulthood. In recent years, an increasing number of studies have focused on the neighborhood physical environment as a potential factor related to physical activity. However, previous studies have been biased in favor of a few countries. Thus, this study aimed to clarify the association of school neighborhood physical environments and socioeconomic status (SES) with adolescents' physical activity.

METHODS: A total of 21491 fifth- through twelfth-grade students from 76 schools covering all regions of Japan were included in the study. The International Physical Activity Questionnaire for Japanese Early Adolescents was used to investigate daily time of vigorous physical activity (VPA) and moderate-to-vigorous physical activity (MVPA). Using the geographic information system, three natural environment elements, seven built environment elements, and areal deprivation index (ADI) as SES variables were examined in each school neighborhood.

RESULTS: For elementary school students, the amount of green cover was significantly positively associated with VPA for the low ADI group. For junior high school students, average temperature was significantly positively associated with VPA for the overall group, average temperature and the amount of green cover for the low ADI group, and the number of parks for the high ADI group. For high school students, average temperature and the number of sports facilities were significantly positively associated with VPA for the overall and low ADI groups. For elementary school students, average temperature was significantly positively associated with MVPA for the overall and high ADI groups. For junior high school students, average temperature was significantly positively associated with MVPA for the overall group, average temperature and the number of intersections for the low ADI group, and average temperature, the number of parks, and the number of destination types for the high ADI group. For high school students, ADI and the number of public transportations were significantly negatively associated with MVPA, while average temperature was significantly positively associated with MVPA. When dichotomized by ADI, average temperature and the number of sports facilities were significantly positively associated with MVPA for the low ADI group, and the number of intersections for the high ADI group.

CONCLUSION: A number of physical environmental factors were significantly associated with physical activity among adolescents, suggesting the presence of contextual effects. In particular, higher temperatures may promote physical activity among adolescents. The built environment factors associated with physical activity in adolescents differed by school type and socioeconomic status, suggesting the need for flexible built environment development based on developmental stage and local SES.

LONGITUDINAL STUDY OF THE DEVELOPMENT OF MOTOR IMAGERY IN PRIMARY SCHOOL CHILDREN: PRELIMINARY FINDINGS FROM A ONE-YEAR FOLLOW-UP STUDY

MALI, A., ŠLOSAR, L., PUŠ, K., MARUSIC, U.
SCIENCE AND RESEARCH CENTRE KOPER

INTRODUCTION: Motor imagery (MI) involves mentally stimulating actions without physical movement and can be kinaesthetic (KI) or visual, where one can either imagine the sensation of the movement in the body or imagine the image of movement from internal (IVI) or external (EVI) perspective. Throughout various development phases, children acquire and refine a multitude of skills. However, the process by which MI develops with age and the factors that play the most significant role in its progression remain unclear. Research on the combination of MI and motor skills has predominantly targeted the adult population, and more studies need to explore the impact of regular physical activity on MI and its developmental trajectory during childhood. This study aims to compare the results of MI after one year and recognise any changes in the development of MI in primary school children.

METHODS: The Movement Imagery Questionnaire for children (MIQ-C) was used to measure the MI ability of forty-four children (twenty-one boys and twenty-three girls) between the ages of 7 and 13 years. The MIQ-C was performed twice, with assessments conducted a year apart. The results were compared between the two assessment days, and gender and athletic status differences (athletes N = 24; non-athletes N = 19) were evaluated. Correlations between MI ability and age were also determined.

RESULTS: Correlation testing between age and MI perspectives revealed significant associations with IVI and EVI at both Day 1 (IVI rs = 0.476, P = 0.001; EVI rs = 0.600, P = 0.000) and Day 365 (IVI rs = 0.453, P = 0.002; EVI rs = 0.479, P = 0.002). Notably, KI showed no correlation with age across both assessment periods (Day 1: rs = 0.271, P = 0.075; Day 365: rs = 0.253, P = 0.102). Mann – Whitney U test showed there were differences in KI between athletes and non-athletes on both Day 1 (KI p = 0.023) and Day 365 (KI p = 0.012), and no difference in IVI and EVI (p > 0.05).

CONCLUSION: The preliminary results of this longitudinal study show no difference in MI between the two assessments. It highlights that on both assessment days, there was a significant association between age and IVI and EVI, suggesting that the development of MI is related to age-related changes in internal and external perspectives. The KI is better developed in children involved in sports, indicating the potential impact of physical activity on MI development. This study provides valuable insights that influence the development of MI in primary school children and highlights the need for further research in this area.

THE FOOTWEAR HABITS AND PREFERENCES OF AUTISTIC CHILDREN AND ADOLESCENTS

KUCZYNSKA, A., JONES, A., FRANCIS, P., KINSELLA, S.
SOUTH EAST TECHNOLOGICAL UNIVERSITY

INTRODUCTION: Autistic children often receive a Sensory Processing Disorder (SPD) diagnosis, marked by atypical sensory responsiveness (Brout & Miller, 2015). This can present in clothing intolerance, yet little research explores the impact of footwear on sensory-related issues in this population (Daly et al., 2022; Kyriacou et al., 2023). This study aimed to examine the relationship between sex, autism support levels, SPD diagnosis, and footwear choices. A secondary aim of this study was to explore parental perception of changes in a childs motor skills and behaviour when wearing shoes.

METHODS: Data obtained for this study came from a more extensive mixed-methods questionnaire on the experiences of autistic children and their parents in relation to footwear. The questionnaire was administered to autism families with a version for parents of autistic children (4-18 years) and a modified version for autistic adolescents aged 13-18. Only one questionnaire could be answered within the household. Both questionnaires were created using the Qualtrics platform. Participants were sampled from the UK and Ireland between October 2022 and April 2023 and recruited through autism charities, organisations, schools, support groups, and social media. Analysis used descriptive statistics, chi-square tests, Mann-Whitney U, Kruskal-Wallis tests, and thematic analysis. Statistical Package for Social Sciences (SPSS), version 28, and Excel software were used to analyse the results.

RESULTS: A total of 314 responses were received, with 82% completed by parents and 18% by adolescents. Most children (77%) were 4-12 years old, with 69.1% males and 28.9% females. Support levels were: 52.5% Level 1, 26.4% Level 2, and 21.1% Level 3. Additionally, 50% of children received a formal SPD diagnosis. Footwear choices included lace-less trainers (31%), Velcro shoes (20%), and laced trainers (20%). No significant associations were found between footwear choices, support levels, sex, or SPD categories ($p>0.05$). However, 90.5% of children could not/would not tie shoelaces, with females displaying higher lacing proficiency ($\chi2(2, n=300) =7.95$, $p<0.05$, Cramers V = 0.16). Preferences favoured light, loose-fitting, soft, and smooth shoes for sensory comfort. Forty per cent of respondents noted changes in a childs motor skills, behaviour, and emotional status when wearing shoes, with the majority describing negative changes.

CONCLUSION: This study found no significant differences in footwear choices based on sex, support levels, or SPD diagnosis, but preferences for specific shoe types were evident. Differences in motor skills, behaviour, and emotional status, when children wore shoes, were noted, emphasising the potential shoe intolerance in autistic children. This study further highlights the importance of ongoing research into footwear for this population to optimise motor skills, behaviour, and emotional health.

Conventional Print Poster Presentations

CP-AP14 Coaching

SPRINT RUNNING DEVELOPMENT: EXAMINING 100 METERS PERFORMANCE BETWEEN SPANISH AND FRENCH ATHLETES FROM JUNIOR TO SENIOR CATEGORIES.

AGUDO-ORTEGA, A., SALINERO, J.J., RODRIGUEZ-BARBERO, S., VALERO, F., GONZALEZ-RAVE, J.M.
CASTILLA-LA MANCHA UNIVERSITY

INTRODUCTION: Human development is a messy, complex, and difficult road to predict. At an early age, growth, maturation, and development occur simultaneously and influence physical activity, fitness, and performance (1), however, in the sports domain, the development of athletes will be strongly determined by favourable environments (2). To date, no study has analysed the differences in terms of sprint performance across categories between countries. The objective of our study is to compare the progression of marks from junior (U16 and U20) to senior categories between two different European countries.

METHODS: An observational and longitudinal analysis was carried out using the Spanish Athletics and French Athletics Federations database rankings. We analysed the top 25 marks from 100 meters sprint running athletes (1523 recorded marks; 757 females and 766 males) from U16, U20 and senior categories who have been recorded between 2015 and 2019. A two-way ANOVA (country x category) was used to analyse the differences between Spanish and French sprint athletes' marks. Effect sizes (ES) were calculated by using the Cohen's d (<0.20 trivial, ≥0.20-0.59 small, ≥0.60-1.19 moderate, ≥1.20-1.99 large, and ≥2.00 very large) (8).

RESULTS: The two-way ANOVA illustrated significant interaction ($p < 0.01$) between countries and categories. There were significant differences between countries both in males and females in U16 ($p = 0.017$ in females and $p < 0.01$ in males), in U20 ($p < 0.01$ in females and males) and the senior category ($p < 0.01$ in females and males). However, this difference increased from a small effect size at U16 (0.30 females; 0.58 for males) to moderate at U18 (0.82 for females and 1.08 males), and large at the senior stage (1.55 females, 1.49 males).

CONCLUSION: Data between Spanish and French sprint running athletes show significant differences between all categories from U16 onwards. Although the results showed significant differences in all categories, the effect size increases as athletes progress through the categories widening the gap between countries. These results reinforce the idea that national sports systems might play an important role in long-term athletes' development.

References

1. Malina RM. Res Q Exerc Sport. 2014;85(2):157-73.
2. Baker J. Aberrant Press; 2022. 232 p.
3. Barth M, Guellich A, Macnamara B, Hambrick Z. Sports Medicine. 2023:1-10.
4. Barth M, Güllich A, Macnamara BN, Hambrick DZ. P. Sports Med. 2022;52(6):1399-416.
5. Güllich A, Barth M, Macnamara BN, Hambrick DZ. Sports Med. 2023;53(6):1201-17.
6. Agudo-Ortega A, Gonzalez-Rave JM, Salinero JJ. Journal of Human Kinetics. 2023.
7. Kearney PE, Hayes PR. Journal of Sports Sciences. 2018;36(21):2502-9.
8. Hopkins WG. [Internet]. 2002. Available from: http://www.sportsci.org/resource/stats/

AWARENESS SURVEY ON VIDEO ANALYSIS IN JAPANESE MENS WRESTLING

TAKATANI, S.

UNIVERSITY OF TSUKUBA

INTRODUCTION: In recent years, the filming of practices and competitions in many Olympic sports has become commonplace, being utilized for the analysis of athletes techniques and characteristics. It has also become an indispensable tool for athletes and coaches in analyzing rival players techniques, match dynamics, and constructing tactics.

While video analysis is considered a valuable factor in enhancing athletes performance, there have been no initiatives in Japanese wrestling to capitalize on these benefits, and prior research on the utilization of video analysis in competitions or related areas is not evident. The purpose of this study is to gather input from active athletes, coaches, and the wrestling association in Japan to elucidate their impressions, perceived necessity, expectations, and barriers preventing the implementation of video analysis in wrestling.

METHODS: This study conducted a single 70-minute group focus interview with a total of eight participants, including three athletes with experience in international competitions, three coaches with experience in coaching international development athletes, and two members of the associations strengthening committee. Participants were selected using the purposive sampling method, and prior to the survey, the researchs purpose, objectives, and details regarding recording were explained. Informed consent was obtained before proceeding.

The semi-structured interview consisted of three main questions:

Impression of video analysis

Barriers to video analysis

Expectations for video analysis

Analysis Method: The recorded interview data were transcribed verbatim, and qualitative analysis was conducted using the KJ method to identify and categorize key themes and insights.

RESULTS: In a survey on video analysis, various opinions were gathered from athletes, coaches, and the association. Despite the absence of prior strategies utilizing video analysis in the sport, all participants expressed the necessity of video analysis in wrestling. However, there is a concern in Japan regarding the prohibition of recording match footage, and even during practice, filming is restricted without the consent of training partners.

CONCLUSION: In the sport of wrestling, the challenge has been the lack of analysis and implementation of acquired footage, hindering its application in the field. This study aimed to elucidate the awareness, barriers, and expectations regarding video analysis from the perspectives of athletes, coaches, and the wrestling association. As a result, it is believed that the findings can contribute as a stepping stone to enhance the international competitiveness of wrestling in the future.

ADDITIVE EFFECTS OF EXPERT MODELING AND VIDEO ANALYSIS ON TECHNIQUE DEVELOPMENT IN NOVICE SPORT CLIMBERS

DEBEVEC, T., LESKOŠEK, B., OKRŠLAR, L., VRECEK, L., BLAGUS, R.

JOZEF STEFAN INSTITUTE

INTRODUCTION: Sport climbing is becoming increasingly popular around the world, and this is reflected in its inclusion in the 2020 Tokyo Olympics program and further approval for the 2024 Paris and 2028 Los Angeles Olympic games. It is a complex sport that, besides physical underpinnings, also requires appropriate techniques to master and optimise movements. However, training methodologies aimed to facilitate climbing technique acquisition are still in their infancy. Given the previously suggested potential of expert modeling and video analysis to facilitate climbing technique learning we aimed to investigate their utility for the development and acquisition of three climbing-specific techniques (drop knee, heel hook, and high step).

METHODS: Thirty novice climbers completed two testing sessions before and after a climbing intervention consisting of three supervised training sessions. During the training sessions, participants climbed symmetrical boulder problems designed to target the three techniques. Participants were randomly assigned to a control group, who received verbal feedback, or an experimental group that additionally received expert modeling and video feedback via the Dartfish tablet application. Expert video model was recorded using the same female expert climber (bouldering world cup finalist) exe-

cuting each move of the problem with 100% accuracy and fluency. Video recordings of all participants" movement executions were subsequently evaluated by two climbing experts on a 7-point scale.

RESULTS: There were no significant differences between the two groups in terms of age, gender, body mass, height, ape index, and past climbing experience. Also, the expert scores did not differ significantly between the control and experimental group during pre-testing for all techniques. The intervention increased the expert scores significantly in both groups ($p<0.001$), but more so in the experimental than in the control group for the high step ($p=0.017$). Improvements for the drop knee ($p=0.52$) and heel hook ($p=0.75$) were similar in both groups.

CONCLUSION: These data suggest that a coached climbing session(s), that is performed correctly and under the supervision of an experienced climbing coach, can quickly lead to substantial technical improvements in novice climbers. When compared to coached session solely, the use of video analysis and expert video modeling has the potential to additionally enhance the acquisition of certain climbing skills, particularly those related to movement efficiency/technique.

EFFECTS OF SHORT DURATION INTERVENTION ON SWIMMING PERFORMANCE, ON MIDDLE ADOLESCENCE SWIMMERS.

NICOLAOU, K., LOUCAIDES, G.
CYPRUS SPORTS ORGANIZATION

INTRODUCTION: In improving swimming performance, training volume (VOL) increases, or short high intensity speed efforts, or both in the right mixture apply in the regime of athletes (2,3). A previous study involving elite adult swimmers suggested that with an increase of training VOL, that had a polarized method (POL), small improvements in 100m performance was produced. Studies with elite adults show slightly improved performance that is not highly consistent to all (1). Critical velocity (CV) is the swimming speed an athlete can hold for a long time without significant exhaustion and drop in speed (5). The incremental speed intensity spectrum demonstrates that heart rate (HR) and LA show a positive linear correlation (4). The aim of this study was to observe how 6 weeks intervention (increase in training VOL with: small segment of those km in high intensity, and a big segment of km in low and middle intensity training), using individual training speeds, affected performance in adolescent swimmers.

METHODS: Middle adolescence swimmers, N=7 (5 females, and 2 males avg.16.1 y old +1.1years, avg b.w. 59.6kg +6.8kg), underwent an incremental step test, 6x100m, departing every three-min and reaching their true max effort at the 6th repetition. Warm-ups varied between 500-700m. Two evaluations occurred, T1 and T2, six weeks apart. In T1 & T2, it was recorded: body mass (kg), (heart rate (bpm), and LA m.mol during each step), LA, post max effort, to calculate removal rates. Active recovery took place post max effort. All recorded info were analyzed and presented on a graph with X and Y axis of LA m.mol & V m/sec respectively. After T1, training indices had an increased km load (compared before T1), between 11-18%. Training VOL was broken down for simplification in three intensities z1 & z2 (A1), z3 & z4 (A2), and z5 (A3). The km in the intervention phase were broken down in terms of intensities as: A1= 45%, A2=46%, and A3=+6%. .

RESULTS: After T2 these results emerge. An increase in lactate tolerance, or LAMAX in 6 out of 7 swimmers (86%), with 1.9, sd +2.7 m.mol. A smaller increase, 4 out of 7 swimmers (57%) produced faster times, with 1.2 sec, sd+ 3.6sec. In T2, 1 out of 7 swimmers (14%) was able to lower LAMAX values and remove lactic acid (LA) post max effort, 4 out of 7 (57%) maintained a similar removal rates, and 2 out of 7 (29%) revealed a lower removal ability.

CONCLUSION: The individual training zones from the LA & V curve, during T1, were used. The removal rates of LA post max effort did not reveal great results, probably due to further aerobic work that is needed for that mechanism. Obstacles can materialize during the training process, and each swimmer has different coping mechanisms brought forward for adaptation. In conclusion this intervention, showed a promising improvement for some adolescent swimmers in swim performance, and more in LA tolerance. 1. M J Costa et al 2013 2,3. A G Toubekis et al 2006, 2013 4. A Lucia et al 2002 5. K Wakayoshi et al 1992

IN IT TO WIN IT?:TRAINING HABITS OF MALE AND FEMALE ENDURANCE RUNNERS.

DEAR, S., PUMMELL, E.K.L.1, AUGUSTUS, S.1, SWANN, N.2, MOIR, H.J.1
1 KINGSTON UNIVERSITY <2 UNIVERSITY OF SURREY>

INTRODUCTION: Representation of female runners in mass participation events is growing (1) although when it comes to performance, male athletes still appear to dominate (2). Studies have highlighted certain sex differences in relation to physiological qualities such as VO2max and fat metabolism (3) yet there is limited understanding of the training habits, perspectives, and event participation of male and female runners. The aim of this study was to determine how male and female runners train, where they seek training information and their approach to race participation in terms of performance outcomes and key event attractors.

METHODS: An online survey was cascaded to experienced runners (5km, <25minutes) between January 2022 and April 2022. The survey was comprised of 39 questions, and there were 335 responses analysed (163 females, 172 males). Participants reported competing over distances from 5km to ultramarathons (>42.4km). Data were analysed through descriptive statistics; Pearson Chi-square tests were performed to identify differences between the sexes and Mann-Whitney U tests were used to examine differences in training volumes/frequency of runners following a programme and those who were not.

RESULTS: Both weekly running volume and running frequency were broadly similar for both groups ($p>0.05$) although males were more likely to complete >50km a week (56% males, 39% females) and run 5 times or more a week (55%

males, 47% females). More male runners believed they had adequate time available to exercise (66% males, 52% females), work commitments were stated as the biggest barrier to participation for both sexes. Most runners obtained their training information from online sources, with 59% following a training plan. Running frequency, volume and injury rate were similar between those following a programme and those working independently. Speed was stated as the key performance marker runners wanted to improve. It was reported that guidance was lacking in respect to the female hormonal cycle and how this affects training. In relation to race participation, 162 runners enrolled in 1-5 events a year, only 25% of females and 30% of males enrolled in more than 10 events a year. Scenery and cost proved key attractors to event selection, for female runners' enjoyment was the main performance objective, for men it was race time.

CONCLUSION: Although no significant difference was detected in the training habits adopted by male and female runners it appears men invest more time in the sport and perceive fewer participation barriers, indicating scope to further reduce the performance gap between the sexes. Those hosting running events should be aware of what runners' value and the outcomes that are important when attracting particular demographics. The study also highlights more accessible research relating to the menstrual cycle and menopause is required to support female participation.

1. Sierra et al. (2015), 2. Hallam & Amorim (2022), 3. Joyner (2017).

VARIABLES ASSOCIATED WITH MARATHON PACING OUTCOME: A SCOPING REVIEW

SLATER, M., WILLMOTT, A., GORDON, D.

ANGLIA RUSKIN UNIVERSITY

INTRODUCTION: Even pacing is integral to achieving optimal marathon performance and the fastest time, with runners who maintain close-to-even splits considered to possess superior pacing ability [1]. However, research on factors associated with marathon pacing outcome has not been consolidated. This scoping review aimed to (a) identify marathon pacing indices present in the literature, (b) succinctly summarize and disseminate research findings on variables associated with marathon pacing, (c) determine which variables may exhibit the strongest relationships with marathon pacing, and (d) identify any significant gaps in the literature to guide future research. Understanding these aspects is crucial for enhancing both theoretical knowledge and practical applications in marathon pacing.

METHODS: A systematic search of SPORTDiscus, Web of Science, SCOPUS, and PUBMED identified relevant studies. Eligibility criteria followed the Joanna Briggs Institute framework, including participants >18 years old, comparing variables with calculated marathon pacing metrics from road races.

RESULTS: Searches identified 2119 studies; 42 full-texts were analysed, with 20 studies meeting inclusion criteria. These studies unveiled five pacing metric categories: absolute average change in speed, early vs. late segment analysis, pace range, 5 km coefficient of variation, and second vs. first half slowing. Sixteen categories of variable were identified: age, sex, marathon time, gender, previous marathon races, training, marathon time prediction, psychological constructs, physiological measures, muscle breakdown biomarkers, race ranking, halfway time, shorter race personal bests, performance level, environmental conditions, anthropometrics, and carbohydrate consumption. Challenges arose in comparing results due to diverse metrics and analytical methods. Nevertheless, carbohydrate consumption, overall marathon time, performance level, and environmental temperature emerged as factors with the strongest relationships to pacing outcomes.

CONCLUSION: The literature exhibits bias toward demographic data, neglecting psychological, physiological, nutritional, and strategic factors related to the skill of marathon pacing. Moreover, minimal research focuses on practical applications to aid marathon runners in improving their pacing outcomes. This bias impedes the researchs practical relevance for runners aiming to enhance the skill of pacing. Further exploration into these underrepresented areas is warranted, and future studies should prioritize these aspects, opting for research designs beyond cross-sectional analytical studies whenever possible.

REFERENCES:

[1] Swain P, Biggins J, Gordon D. Marathon pacing ability: Training characteristics and previous experience. Eur J Sport Sci. 2020 Aug;20(7):880-886.

PHYSICAL FITNESS, PSYCHOLOGICAL CHARACTERISTICS AND GAME PERFORMANCE IN YOUTH MALE SOCCER PLAYERS

GIANNAKI, C., KOUDELLIS, M., TSOULOUPAS, C., APHAMIS, G., CHRISTOU, M., BOGDANIS, G.

UNIVERSITY OF NICOSIA

INTRODUCTION: Soccer is a sport with various demands, including good levels of physical fitness, technical and tactical qualities, while the psychological demands are also high (1,2). In recent years, the development of match analysis systems has allowed the examination of factors associated with game performance, including tactical parameters (3). The current study aimed to examine the associations between physical fitness, psychological parameters, and game performance in young soccer players.

METHODS: Two-hundred forty-three young male soccer players (aged 16-17 years) participated in this study. A number of physical fitness parameters were assessed, including cardiorespiratory fitness, countermovement jumping (CMJ) ability, sprinting, and change of direction (COD). Body fat was estimated using skinfolds measurement. Psychological characteristics were evaluated using the Profile of Mood State (POMS) questionnaire, Athletic Coping Skills Inventory (ACSI-28) and the Test of Performance Strategies (TOPS). Technical and tactical data were recorded and assessed during a competitive

soccer match using a multicamera, semiautomatic optical tracking system. The InStat index was considered an index of game performance. A multivariate linear regression model was used to evaluate the predictors of game performance.

RESULTS: Game performance was associated with coping with the adversity and coachability subscales of ACSI-28, tension-anxiety, anger-hostility and fatigue-inertia sub-scales of POMS. Of the physical fitness parameters examined, only COD and CMJ with free arms were associated with game performance, while a tendency toward significance was found regarding cardiorespiratory fitness.

CONCLUSION: Both physical and psychological parameters are essential predictors of game performance. Both specific physical fitness and psychological parameters in youth soccer players should receive special attention as this appears to affect game performance.

REFERENCES

1. Musculus L, Lobinger BH. Front Psychol, 2018, 9:41.

2. Bangsbo J, Mohr M, Krustrup P. J Sports Sci , 2006. 24 (7):665-674

3. Sarmento, H., et al. J Sports Sci, 2014. 32(20): p. 1831-1843.

ASSOCIATION BETWEEN ISOMETRIC MIDTHIGH PULL FORCE-TIME CHARACTERISTICS AND RUNNING ECONOMY AT HIGH RUNNING SPEED IN WELL-TRAINED DISTANCE RUNNERS

TANJI, F., NISHIDE, N., MOROZUMI, H., MIYAZAKI, S.

TOKAI UNIVERSITY

INTRODUCTION: Ground contact time during running is less than 250 ms and becomes shorter as speed increases. Distance runners must produce force to support body weight from their lower limb muscles in this short ground contact time. The short contraction time may not allow for maximal muscle force. However, the ability to produce faster and higher lower limb muscle force would contribute to increased running gait stability and less energy expenditure (i.e., increased running economy [RE]) at a given running speed. The use of isometric mid-thigh pull (IMTP) can be used to measure the lower limb's maximum force-generating capability (peak force), the rate at which force is developed (rate of force development [RFD]) and force produced at various time points (force epoch) (Lum et al., 2020). Therefore, we aimed to clarify the relationship between force-time characteristics obtained from IMTP and running economy (RE) at low and high running speeds.

METHODS: Twenty-five well-trained male distance runners (age, 19 ± 1 years; height: 172.6 ± 4.5 cm, body mass: 57.3 ± 3.6 kg), with a mean seasonal best time of 14:07.8 ± 0:54.7 for 5,000 m run, participated in this study. They performed a multi-intermittent incremental running test on a treadmill. RE was calculated using oxygen uptake, respiratory exchange ratio and accumulated blood lactate concentration (Tanji et al., 2017) at 250 and 330 m/min running (their blood lactate concentration was 1.8 ± 0.3 and 5.3 ± 1.3 mmol/L, respectively). In addition, they performed an IMTP test on an instrumented force platform with an IMTP testing rack. The highest absolute peak force and RFD at 0–100 (RFD0–100) and 0–200 ms (RFD0–200) from the onset of pull were used for analysis. Pearson's correlation coefficient was analyzed to determine the association between IMTP measures and RE, and the significance was set at a P value of < 0.05.

RESULTS: The absolute peak force, RFD0–100 and RFD0–200 were 1722 ± 255 N, 5405 ± 1788 N/s and 4124 ± 919 N/s, respectively. There was no significant relationship between RE at 250 m/min (0.98 ± 0.06 kcal/kg/km) and each IMTP measure ($r = -0.14$, -0.09 and -0.13, respectively; $P > 0.05$). RE at 330 m/min (1.09 ± 0.08 kcal/kg/km) had a significant relationship with the RFD0–200 ($r = -0.46$; $P < 0.05$) and no significant relationship with the absolute peak force and RFD0–100 ($r = -0.31$ and -0.28, respectively; $P > 0.05$).

CONCLUSION: These results suggest that the ability to produce high force up to 200 ms in lower limb strength contributes to superior RE at high running speed. It can be concluded that well-trained distance runners must train their lower limb muscle strength and run-based training.

REFERENCES: Lum D et al. (2020) J Trainology, 9(2): 54–59; Tanji F et al. (2017) J Phys Fitness Sports Med 6: 41–48.

CONTACT: fumiya.tanji@tsc.u-tokai.ac.jp

FACTORS THAT INFLUENCE ACTUAL PLAYING TIME: EVIDENCE ON CHINESE FOOTBALL ASSOCIATION SUPER LEAGUE

ZHANG, G., WANG, J., LI, S., CAO, J.

TONGJI UNIVERSITY

INTRODUCTION: The actual playing time of football is a crucial index for assessing the excitement and caliber of a league. With advancements in data tracking technology in football matches, the statistical analysis of net duration has progressively become more efficient and convenient. A study has conducted to explore factors influencing actual playing time of Chinese Football Association Super League (CSL).

METHODS: 40 factors were classified into quantifiable(n=9) and non-quantifiable (primary = players, team, character of a game, referee, and others, secondary =26) indicators. Entropy method was used to ascertain the weights of quantifiable indicator. The magnitude of dispersion is positively correlated with the impact of the indicator on the comprehensive evaluation. The data encompasses from 240 matches involving 16 teams in the CSL during season 2018. For non-quantifiable indicators, 40 experts specializing in football were invited to evaluate these indicators through a structured questionnaire.

Following the principal component analysis method was to derive the weights for each indicator. The weights of primary indicators are composed by aggregating the secondary indicators.

RESULTS: For quantifiable indicators, the highest weights of indicator were the opponents free kicks in their own half (0.1760), followed by the restart of play after scoring a goal (0.1738), and throw-ins (0.1302). For non-quantifiable indicators, the weight of player was 0.1920, which influenced by the top three secondary indicators being subjective procrastination intent (0.0447), aggressiveness (0.0432), and physical fitness (0.0405). The weight of team was 0.1805, which influenced by the top three secondary indicators being home and away performance (0.0409), tactical execution level (0.0367), and the degree of coordination (0.0356). The weight of character of a game was 0.0785 comprising by match attributes (0.0407) and the disparity in strength between the two sides (0.0378). The weight of referee was 0.1917, which influenced by the top three secondary indicators being officiating proficiency (0.0405), judgment scale (0.0388), and team coordination (0.0384). The weight of other factors was 0.3517, which influenced by the top three secondary indicators being on-field violent incidents (0.0442), on-field special events (0.0418), and medical support measures (0.0414).

CONCLUSION: The actual playing time in CSL games was affected by multiple factors. These results provide a reference for practitioners to design effective training and formulate game strategies for elite soccer leagues. Chinese Football Association needs to set out a series of specific measures based on the weights of different factors, and encourage all relevant organizations to take measures to enhance the continuity, quality, and watchability of a match, elevating the standard of Chinese football to align with international norms.

JUMP OFF THE BEAM: FUNCTIONAL AND ANTHROPOMETRICAL CHARACTERISTICS OF ELITE BELGIAN WOMEN'S ARTISTIC GYMNASTS

DHOE, B., BOONE, J., COLOSIO, A.L.
GHENT UNIVERSITY

INTRODUCTION: Elite Womens Artistic Gymnastics is a complex sport that requires high physiological and technical demands from childhood onwards. Knowledge of the functional and anthropometrical characteristics of high level gymnasts is paramount to guide selection, training and recovery strategies throughout the growth and development (1; 2). While some information about gymnasts physiques is available, there is limited knowledge about gymnasts' functional characteristics, and a need for country-specific databases (3). Therefore, this investigation was aimed at providing up-to-date functional and anthropometrical data of elite Belgian women's artistic gymnasts.

METHODS: Between November 2021 and January 2024, we screened 19 female artistic gymnasts belonging to the Belgian national team to assess anthropometrical characteristics (i.e., height, body weight (BW), body fat%, and bone density Z-score), maximal strength (i.e., 1 rep-max (1RM) for squat, half squat, leg press, bench press, and bench pull), cardiovascular fitness (i.e., VO2max, ventilatory thresholds 1 and 2 for running), jump height and flexibility. For analysis, the most recent and complete representative values were used. Average values and standard deviation were assessed per variable.

RESULTS: Mean age at the time of screening was 17.8 ± 2.3 years, with 2 individuals categorized as junior and 17 as senior. The mean height upon screening was 158.8±6.4cm, BW was 52.1±7,6kg, bodyfat% was 20.8±4.3% and bone density Z-score was 1.2±1.1. As for mean strength values, relative 1RM to BW for squat was 1.3±0.2kg×BW-1, 2.6±0.5kg×BW-1 for half squat, 4.9±0.9kg×BW-1 for leg press, 0.9±0.1kg×BW-1 for bench press and 1.0±0.1kg×BW-1 for bench pull. Concerning mean cardiovascular fitness, VO2max was 51.3±3.4ml/min/kg, the mean ventilatory threshold 1 and 2 occurred at 68.8±4.4% and 85.1±3.6% of VO2max respectively. Regarding jumping performance, squat jump was 26.0±3.7cm, counter movement jump was 27.6±3.2cm, counter movement jump with arms was 34.9±3.6cm, single leg jump for the right leg was 15.0±2.6 and 14.9±2.7cm for the left leg. It was found that flexibility was considerably higher compared to a non-gymnast reference population, except for wrist supination which was lower (4; 5).

CONCLUSION: Our sample of elite Belgian women's artistic gymnasts have similar height, BW, VO2max and relative 1RM to BW for squat compared to values observed in other countries (6; 7). Bodyfat% is within the range but at the higher end than earlier examined (3), while jump heights were lower (6). Bone density and flexibility were higher than the non-gymnast reference population, with the exception of wrist supination which was lower (8). Finally, there is a need to integrate upper body strength measures in elite female gymnasts to allow for quantitative comparisons.

1. Armstrong (2013), 2. Isacco et al. (2019), 3. Bacciotti et al. (2017), 4. McKay et al. (2017), 5. Kim et al. (2014), 6. Höög et al. (2021), 7. George et al. (2013), 8. Nichols et al. (1994)

Conventional Print Poster Presentations

CP-MH02 Sports Medicine I

ARRHYTHMIC BURDEN IN ASYMPTOMATIC HEALTHY ULTRARUNNERS AND THE ASSOCIATION TO CARDIAC STRUCTURE AND FUNCTION

AGGOKABO, O.P., JOHNSON, C., MORRISON, B., ASHLEY, E., FROLELICHER, V., HADDAD, F., SHAVE, R., SHANTSILA, A., SPRUNG, V., LIP, G.Y.H., GEORGE, K., OXBOROUGH, D.

1LIVERPOOL JOHN MOORES UNIVERSITY, 2LIVERPOOL CENTRE FOR CARDIOVASCULAR SCIENCE, 3TRINITY WESTERN UNIVERSITY, CANADA, 4STANFORD UNIVERSITY,CALIFORNIA,USA, 5UNIVERSITY OF BRITISH COULMBIA,CANADA

INTRODUCTION: Undertaking aerobic exercise training to meet World Health Organisation guidelines is associated with positive cardiovascular benefits. There is however, evidence suggesting that very high volumes of endurance exercise training may be associated with adverse cardiac remodelling and increased prevalence of arrhythmia (including atrial fibrillation [AF]). Quantifying the burden of arrhythmia and its association with lifetime training exposure and cardiac remodelling in highly trained ultra-endurance athletes was the focus of the present study.

METHODS: 20 male (age 48 ± 10 years) and 15 female (age 47 ± 12 years) asymptomatic, healthy ultrarunners who secured a place at the 2022 Western States endurance race or were attending the pre-race training camp (California, USA), were recruited. A continuous electrocardiogram (ECG) monitor was worn for one week prior to the race/training camp providing incidence of premature atrial contractions (PACs), premature ventricular contractions (PVCs) and number of episodes of AF. A questionnaire captured lifetime training volume (MET-hr) and lifetime running miles. A full transthoracic echocardiogram was undertaken 24-48 hours before the race/training run. LV structure was defined by LV mass (LVM), end diastolic volume (EDV) and mean wall thickness (MWT) whilst function was determined by ejection fraction (EF) and global longitudinal strain (GLS). Left atrial (LA) structured was defined by LA volume (LAV). Pearsons correlation determined the association between arrhythmia burden and (1) cardiac structure and function, and (2) training exposure.

RESULTS: There was a 0.6 ± 0.8 (0-3.4%) and 0.7 ± 0.7 (0-2.6%) PAC and PVC burden, respectively. There were no episodes of AF. A weak but significant correlation was apparent between PVC burden and LVEDV (r= 0.376; P=0.044). There were no significant associations between arrhythmia burden and indices of cardiac structure and function. There were significant correlations for PAC burden (%) with lifetime training volume (MET-hr) (r=0.506 P=0.005), and lifetime running miles (r=0.367 P=0.046). PVC burden did not significantly correlate with measures of lifetime training exposure.

CONCLUSION: In a unique cohort of asymptomatic ultra-endurance athletes with significant lifetime endurance training exposure, we observed a relatively low overall arrhythmic burden and lack of AF. We observed an association between PVC burden and LV size suggesting some level of linkage between cardiac remodelling and ventricular arrhythmia burden that requires further evaluation. The association between atrial arrhythmia burden and measures of lifetime exercise exposure maybe a pre-cursor to the development of AF that could be a focus of future clinical evaluation.

THE ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING THE SEMITENDINOSUS TENDON MAY ADVERSELY AFFECT SPRINT RUNNING KINEMATICS EVEN SEVERAL YEARS AFTER SURGERY

UMEDA, T., KAWAMA, R.2,3, TAKAHASHI, K.2, WAKAHARA, T.1, ARAI, A.2, HOJO, T.1

1,2 DOSHISHA UNIVERSITY

INTRODUCTION: The anterior cruciate ligament (ACL) reconstruction using the Semitendinosus (ST) tendon is a common surgery. This surgery is called the ST method. It has been reported that 2 to 4 years after harvesting the ST tendon for the ACL reconstruction, the length and volume of the ST in the operated leg are shorter and smaller than those in the healthy leg 1). Previous research has shown that the ST method reduces knee flexion strength 2). Another study reported that knee flexion and extension torque correlate with sprint running velocity 3). Additionally, Sprint velocity is correlated with the volume of the ST in sprinters 4). However, there are no reports on sprint running kinematics after the ST tendon harvesting. This study aimed to investigate the ST morphology, knee flexion/extension torque, and sprint running kinematics of athletes who have undergone the ACL reconstruction using the ST methods and have returned to sports.

METHODS: Nine male patients (mean age ± SD: 21.4 ± 1.4 years old, 37.3 ± 17.2 months after surgery) participated. All patients underwent isolated unilateral the ACL reconstruction, using the ST method. Length and volume of the bilateral the ST were measured using MRI. Maximal isometric knee flexion and extension torque was measured in supine positions at every 10° from 60° to 120° of knee flexion angle using a dynamometer. Step frequency, step length, and knee flexion angle were measured in the 40-50 m interval of the 50 m sprint using high-speed cameras. These variables were calculated using KINOVEA software. Paired-sample t-test was used to analyze the differences in the ST length, the ST volume, step frequency and step length between the operated and healthy leg. Two-way ANOVA was used to analyze the differences in knee flexion torque between operated and healthy legs and between every knee flexion angle.

RESULTS: Length and volume of the ST muscle belly were significantly shorter and smaller in the operated leg than in the healthy leg ($p < 0.05$). Isometric knee flexion torque was significantly lower in the operated leg than in the healthy leg in all knee flexion angles ($p < 0.05$). Isometric knee extension torque was not significantly different between the healthy and operated legs at all knee flexion angles. During sprint running step frequency and step length were not significantly different between the healthy and operated legs. During sprint running the maximum knee flexion angle in the backward

swing phase and minimum knee flexion angle in the forward swing phase were significantly smaller in the operated leg than in the healthy leg ($p < 0.05$).

CONCLUSION: Even 37.3 months after the ACL reconstruction using the ST method, there was still the ST atrophy and decreased knee flexion torque. These factors may adversely affect sprint running kinematics. The ST methods should be used with caution.

CLINICAL EXERCISE PHYSIOLOGISTS: THE PRESENT SITUATION IN AUSTRIA

BIRKLBAUER, A., BIRKLBAUER, J.1, TSCHAKERT, G.2, HOFMANN, P.2
UNIVERSITY OF SALZBURG

INTRODUCTION: Lack of physical activity is a significant risk factor for global mortality, as evidenced by Katzmarzyk et al. (2022). Studies (e.g., Heath et al. 2022) have demonstrated the effectiveness of exercise training as a preventive and treatment strategy for a wide range of at least 26 non-communicable diseases (Pedersen & Salting 2015). Consequently, an increasing number of countries are incorporating clinical exercise physiologists (CEPs), university graduates specialized in sport and exercise science, into their healthcare systems. Given the worldwide strain on healthcare systems, CEPs are seen as a cost-effective add-on therapy to hospitals, clinics and private physician practices.

METHODS: Research has shown the necessity of personalized exercise prescriptions that adhere to the so called F.I.T.T. principle (i.e., frequency, intensity, time, and type of exercise) (Garrahy et al., 2020), underpinning the inadequacy of a one-size-fits-all approach (Duong, 2022). A comparative study by Carrard et al. (2022) showed the varying roles of CEPs within the healthcare systems of Australia and Switzerland, representing two different modern approaches. Already formally recognized as a health profession in Australia, the respective graduates are not implemented as healthcare providers in Switzerland yet. Looking at other countries like the UK, New Zealand, Canada or Hong Kong, CEPs are increasingly integrated into these healthcare systems.

RESULTS: Locally, the CEP situation in Austria is comparable with some substantial differences. Austria is a country with one of the highest per capita health expenditures among the EU countries but persistently high preventable mortality rates and even more important less healthy life years (OECD, 2023). Recently, the Austrian government legalized exercise scientists as formally accredited health-professionals (referred to as Training Therapists) within the in-patient system. Since 2012, Training Therapists are recognized as an allied healthcare profession. However, they are limited to work salaried and are not allowed to offer training therapy services in a self-employed position, being a dissatisfying solution with respect to patient care in general.

CONCLUSION: Although appropriately qualified professionals providing individually adjusted and international guideline- and evidence-based exercise interventions are available, the Austrian healthcare system is still missing this opportunity to implement Training Therapists at an individual, societal, and nation-wide level.

Carrard et al. Front Sports Act Liv (2022) doi: 10.3389/fspor.2022.766641

Duong CMAJ. (2022) doi: 10.1503/cmaj.1095991

Garrahy et al. Gen Pract. (2020) doi: 10.31128/AJGP-03-20-5294

Heath et al. BMC Med (2022). https://doi.org/10.1186/s12916-022-02236-0

Katzmarzyk et al. Br J Sports Med (2022) doi: 10.1136/bjsports-2020-103640

OECD/European Observatory on Health Systems and Policies (2023) doi.org/10.1787/0f110d90-en

Pedersen & Saltin, ScandJMedSciSports (2015) doi: 10.1111/sms.12581

PREVALENCE OF URINARY INCONTINENCE IN FEMALE GYMNASTS: A SYSTEMATIC REVIEW

KNEIßLER, E., ZENTGRAF, K.
GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: According to common knowledge, it is assumed that there are mainly older people, pregnant women and those who have just given birth, who suffer from urinary incontinence. However, young and healthy women being active in sports are also affected by this phenomenon. Based on the study situation, it can be assumed that people who practice high-impact sports are more prone to incontinence than others of the same age. The objective of this review is to evaluate the occurrence of urinary incontinence in female gymnasts as high-impact athletes and identify the factors most likely to contribute to it.

METHODS: A systematic review of the literature was conducted by making use of electronic databases, including PubMed, Web of Science and Cochrane Library, for studies published in the English language up to January 2024. The search strategy included the keywords stress urinary incontinence, female urinary leakage, trampoline, artistic gymnastics, cheerleading, female athletes. The subjects were female gymnasts and the outcome formed prevalence of urinary incontinence.

RESULTS: The search identified 49 studies, 6 of which met the methodologic criteria for a complete analysis. In this review, 928 women aged 13 to 44 were included. The Risk of Bias in these studies was assessed using Risk of Bias in non-randomized Cohort Studies by Cochrane and ROBINS-I depending on the type of study.

CONCLUSION: These data suggest that exercise in gymnastics show a high prevalence of urinary incontinence, mainly due to sport-specific movements. Preventive measures are also rarely taken. The leakage of urine massively influences

the athlete's quality of life and their performance in training and competition. The findings of the present review indicate a high prevalence of urinary incontinence in gymnasts. This review aims at bringing this issue into focus as it may have a major impact on well-being and involvement of females in sports.

EFFECTS OF DIFFERENT OCCLUSION PRESSURES IN BLOOD FLOW RESTRICTION TRAINING ON EXERCISE-INDUCED SKELETAL MUSCLE DAMAGE: A RANDOMIZED CONTROLLED DOUBLE-BLIND TRIAL

HAPP, K., SCHWIETE, C., NIEDERER, D., BEHRINGER, M.
GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: The use of blood flow restriction (BFR) is a well established training method. However, it is still unknown whether increased metabolic stress, possibly caused by higher cuff occlusion pressures, has an additional effect on muscle damage [1]. Therefore we investigated the effects of mechanical and metabolic stress on the extent of BFR exercise-induced muscle damage.

METHODS: Forty participants (25.4 ± 3.5 years, 68.4 ± 13.1 kg, 173 ± 8.9 cm) were randomly divided into four parallel groups with different BFR occlusion pressures.

Groups were defined as no pressure (NP), low pressure (LP; 50%), medium pressure (MP; 75%) and high pressure (HP; 100%) based on the individually measured limb occlusion pressure (LOP)

Following baseline measurement, participants performed a maximum of four sets with 20 repetitions and 30 seconds rest at 30% of the 1-repetition maximum (1RM) or until reaching muscle failure.

During training, number of completed repetitions (n of reps) and oxygen saturation [%] via near-infrared spectroscopy were recorded.

Muscle damage markers such as isokinetic peak torque [Nm] during knee extension (PT) and subjective pain perception (visual analog scale; VAS) were measured before and 1h, 24h, 48h and 72h after intervention. Potential between-group differences were calculated using repeated measures ANOVAs and post-hoc 95%-confidence interval comparisons.

RESULTS: We found between-group differences in reps absolved ($F(3,16) = 50.38$, $p<.001$); with NP and LP completing more reps than MP and HP. Conversely, groups exhibited different oxygen saturation values during exercise ($F(3,17.3) = 3.23$, $p<.05$).

Results showed an effect for pain perception ($F(12,140) = 2.29$, $p = .011$, $n^2p = .078$), In particular between NP and MP/HP at 24h and 48h post intervention (MD = 2.05, SE = 0.78, t (35) = 2.6, $p < .025$), (MD = 2.07, SE = 0.76, t (35) = 2.74, $p <.025$), (MD = 2.05, SE = 0.71, t (35) = 2.87, $p < .025$), (MD = 1.59, SE = 0.69, t (35) = 2.52, $p <.05$).

Concentric PT also revealed an interaction effect of group x time with concentric baseline PT as a covariate ($F(6,60) = 3.56$, $p = .004$, $n^2p = .263$). Post-hoc confidence interval comparisons show a higher PT reduction for NP compared to MP and HP and for LP compared to HP at 24h post (NP, *M* = 178, 95%CI [165, 190]), (LP, *M* = 181, 95%CI [170, 193]), (MP, *M* = 191, 95%CI [180, 203]), (HP, *M* = 195, 95%CI [183, 207]).

CONCLUSION: Training with LP BFR demonstrated muscle damage comparable to non-BFR training, while MP and HP groups showed less muscle damage based on PT reduction, combined with fewer symptoms as evident by lower VAS values. Based on our findings, we assume that higher total load serves as the primary trigger for muscle damage.

[1] Loenneke JP, Thiebaud RS, Abe T. Does blood flow restriction result in skeletal muscle damage? A critical review of available evidence. Scand J Med Sci Sports. 2014 Dec;24(6):e415-422. doi: 10.1111/sms.

THE ROLE OF MUSCLE STRENGTH CAPACITIES FOR KNEE KINEMATICS DURING DOWNHILL HIKING WITH TOTAL KNEE ARTHROPLASTY AFTER A TRAINING INTERVENTION

BLEUEL, J., WILLWACHER, S., MITTENDORFER, I., DEBERTIN, D., MOHR, M., MICHEL, B.
MEDICAL CENTER GARMISCH-PARTENKIRCHEN

INTRODUCTION: During downhill hiking, people with unilateral knee arthroplasty (uKA) show muscular deficits and stiff knee gait patterns compared to healthy controls [1]. We hypothesized that a 12-week training intervention counteracts the muscular deficits and that the muscular improvements contribute to more physiologic knee joint kinematics during downhill hiking.

METHODS: Thirty-five participants (266 ± 87 days post surgery) with uKA (INT) conducted a 12-week muscle strength training intervention (3 training sessions á 45 minutes per week). Before (PRE) and after (POST) the intervention, the following measurements took place: Participants walked on a predetermined walking trail at a self-selected pace wearing an inertial sensor system (XSens, Awinda, Enschede, Netherlands) to record the 3d kinematics of the lower extremities. We evaluated the peak knee flexion (PKF) and the range of motion (ROM) of the affected leg during shock absorption (25% of the gait cycle) at two different down-slopes (10% and 25% gradient). In addition, we measured the concentric and eccentric lower extremity isokinetic muscle strength (Isomed2000, D. & R. Ferstl GmbH, Hemau, Germany) of the knee flexors and extensors of the affected leg at two angular velocities (50°/sec, 120°/sec). Fourteen controls with uKA, matched for age, BMI, and days since surgery, were also measured; however, they did not perform the training intervention program (CON).

RESULTS: Muscle strength (identified as body mass normalized peak torque; Nm/kg) improved significantly from PRE to POST for both muscle groups and all tested conditions by 10-47 % (INT) and by 3-25 % (CON) ($p < 0.05$). PKF and ROM while walking downhill at the moderate slope increased from 18.3 ± 8.6 to 22.6 ± 9.3 (PKF) and 11.8 ± 4.2 to 14.4 ± 4.2

(ROM) in INT and from 18.6 ± 7.3 to 21.9 ± 4.5 (PKF) and 12.1 ± 3.7 to 15.7 ± 3.2 in CON ($p < 0.01$). Concerning the steep slope, values developed from 25.6° ± 7.7° to 27.5° ± 6.8° (PKF) and 14.9° ± 4.0° to 16.6° ± 4.2° (ROM) in INT and from 22.9° ± 8.3° to 23.4 ± 5.5 and 13.8 ± 3.6 to 16.0 ± 2.3 in CON ($p < 0.01$). No interaction effect between time and group was found ($p > 0.05$). Improvements in hamstrings and quadriceps strength values were correlated positively with ΔPKF (PKF POST-PKF PRE) and ΔROM (ROM POST-ROM PRE) at both downhill slopes in INT. Parameters correlated less in CON.

CONCLUSION: Muscle strength improvements played a significant role in developing more physiologic knee kinematics during downhill hiking in persons with uKA. However, the lack of time by group interactions for strength improvements indicate that the additional strength training program might not have significantly increased strength capacities compared to standard rehabilitation, highlighting the potential for future studies using more intense or more prolonged training intervention. [1] Bleuel et al. (2024). Clin Biomech. Funding: Dr. Auguste-Schaedel-Dantscher-Stiftung, Deutsche Kniegesellschaft

CARDIAC FUNCTION DURING CARDIOPULMONARY EXERCISE TESTING IN PATIENTS WITH HEART FAILURE WITH PRESERVED EJECTION FRACTION

SCHOCH, R., KRÖPFL, J., GASSER, B., DIETERLE, T., SCHMIDT-TRUCKSÄSS, A.

UNIVERSITY OF BASEL

INTRODUCTION: Patients with heart failure with preserved ejection fraction (HFpEF) are commonly characterized by impaired exercise capacity, typically assessed through cardiopulmonary exercise testing. A key parameter in this assessment is maximal oxygen consumption (VO2peak), derived from the product of cardiac output (CO) and arterio-venous oxygen difference (a-vDO2). The ability to evaluate CO non-invasively during exercise enables the calculation of a-vDO2, thus providing comprehensive insights in circulatory function during cardiopulmonary exercise testing. This study aims to clarify the determinants contributing to reduced exercise capacity in patients with HFpEF.

METHODS: Forty patients with HFpEF underwent cardiopulmonary exercise testing. Gas exchange parameters were assessed via breath-by-breath analysis (MetaMax 2B, Cortex Biophysik GmbH, Leipzig, Germany), while CO was measured using Physioflow® (Manatec Biomedical, Poisy, France) and a-vDO2 was subsequently calculated. Patients were stratified into two groups based on the median of absolute VO2peak for further analysis.

RESULTS: Median of VO2peak was 1.50L/min. Group with patients with lower exercise capacity (<1.50 L/min) demonstrated lower CO (12.67(3.07) vs. 14.99(3.26) L/min, p=0.032), and lower stroke volume (92.1(23.5) vs. 107.2(18.0) mL, p=0.036), compared to the other group. However, there were no significant differences observed in age (73(10) vs. 69(11) years, p=0.233), BMI (24.8(4.9) vs. 27.8(5.3) kg/m2, p=0.068), a-vDO2 (11.0(3.5) vs. 12.8(3.3) mL/100mL, p=0.131), peak heart rate (139(17) vs. 145(19) bpm, p=0.306), or respiratory exchange ratio (1.06(0.06) vs 1.05(0.04), p=0.303).

CONCLUSION: The associations between reduced exercise capacity, lower cardiac output, and stroke volume among patients with HFpEF indicate an inability to increase stroke volume via the Frank-Starling mechanism while chronotropic incompetence or peripheral vascular dysfunction may not be as decisive as discussed elsewhere. These findings underline the potential utility of targeted exercise interventions aimed at improving cardiac function to increase exercise tolerance in patients with HFpEF.

POST-EXERCISE SERUM IMPROVED THE IGF-1 EFFECT ON PROTEIN SYNTHESIS OF TENDON CONSTRUCTS AND SHOWED NO CORRELATION WITH IGF-1/IGFBP3 SERUM LEVELS ON COLLAGEN SYNTHESIS.

GARRIDO, P.M., PAPADOPETRAKI, A., SVENSSON, R.B., MAGNUSSON, S.P., PHILIPPOU, A., BACKMAN, L.B., GIANNOPOULOS, A.

LOUGHBORUGH UNIVERSITY

INTRODUCTION: Insulin-like Growth Factor-1 (IGF-1) has a regulatory role in tendon healing and IGF-1 injections have been used as a treatment in tendinopathies. Exercise alters systemic responses which can have anabolic or catabolic actions. The purpose of this study was to assess if the baseline levels of IGF-1 or Insulin-like growth factor-binding protein 3, (IGFBP-3) in the serum would affect the bioactivity of exogenously added IGF-1 on tendon constructs regeneration capacity.

METHODS: Seven healthy females that were physically active but not professional athletes volunteered for this study (age: 30.86 ± 5.05 years, height: 1.66 ± 0.03 m, body weight: 61.93 ± 4.31 kg, body mass index: 22.55 ± 1.42 kg/m2). Participants conducted a cardiopulmonary exercise testing (CPET) protocol, consisting of a maximal incremental protocol on a cycle ergometer with 3-minute stages, aiming to last 8-12 minutes. During the test, gas exchange was monitored continuously, through a breath-by-breath exercise metabolic analyzer. On a separate day, the participants performed one exercise session on a cycle ergometer at 80% of their peak oxygen uptake (VO2peak) and serum was collected before and after the exercise session. Human tendon constructs (N=56) treated with serum from each participant consisting of the following conditions: Pre- (Pre-Ex+IGF-1) and post-exercise serum (Post-Ex+IGF-1) supplemented with IGF-1, pre- (Pre-Ex) and post-exercise (Post-Ex) serum without IGF-1. Enzyme-linked immunosorbent assays were used to evaluate serum levels of IGF-1 and IGFBP-3 and collagen type I in the cultured media. Protein concentration was measured with Bicinchoninic acid assay.

RESULTS: Free IGF-1 levels in the circulation showed a 30.6% increase as measured in post-exercise serum compared to pre-exercise values. IGFBP-3 remained unaltered after the exercise session. Treatment with IGF-1 had a significant negative effect on collagen type I overall secretion (p=0.03) with a 9.5 % decrease of Pre-Ex+IGF-1 and 28.6% of Post-Ex+IGF-1 compared to Pre-Ex and Post-Ex groups respectively, with no significant correlation with IGF-1 or IGFBP-3 serum levels.

Both exercise (p=0,014) and IGF-1 treatment (p<0.0001) altered the total protein concentration. The supplementation of IGF-1 resulted in increased protein synthesis at the pre-exercise (Pre-Ex+IGF-1>Pre-Ex, p=0.06) by 28.2% and the post-exercise (Post-Ex+IGF-1>Post-Ex, p=0.0005) by 31.8% compared to the relative groups before the exercise.

CONCLUSION: IGF-1 treatment caused a reduction of the secreted collagen type I indicating that more collagen was incorporated into the construct structure. The above process did not correlate with the amount of IGF-1 and IGFBP3 in the serum, suggesting that treatment efficacy depends more on the administrative dose. Post-serum systemic environment enhanced IGF-1 effect on protein synthesis of tendon constructs providing a useful condition that could be considered for designing treatment strategies targeting tendon regeneration.

INJURY INCIDENCE AMONG STUDENT-ATHLETES WHEN COMBINING ACADEMIC STUDIES AND ELITE SPORTS IN SWEDEN - A PROSPECTIVE COHORT STUDY.

TERVO, T., TENGMAN, E., MÅRS, T., FLATHOLM, E.

UMEÅ SCHOOL OF SPORTS SCIENCES

INTRODUCTION: Sports injuries are a widespread concern among collegiate athletes (1), sometimes leading to unexpected ends to athletic careers. Various models of dual career systems have been introduced for combining elite sports and academic studies, acknowledging the need for alternative pathways (2). However, managing dual careers can be demanding for students, particularly in the initial academic year due to elevated pressure and low academic function (3).

The purpose of the present study was to examine the injury incidence among student-athletes during the first year of studying as well as to identify risk factors for injury in this population.

METHODS: Two surveys were employed, one year apart, between 2018 and 2022 at a University in Sweden. Two-hundred and forty-three student-athletes (101 men, 142 women, mean age: 22,1 [18-36]) responded to a baseline survey in conjunction with their first semester of study. The one-year follow-up survey was answered by 111 student-athletes (47 men, 64 women, mean age: 22,9 [19-37]). The survey addressed the sports student's injury occasions, injury characteristics, sports participated in, experienced stress, recovery methods, management of leisure time and study pace. Independent samples t-test, chi-square test, univariate and multivariate regression were used in the analysis.

RESULTS: Fifty-one percent of the students reported having sustained an injury on some occasion the year before study start. Moreover, during the one-year follow-up, 54% of the students reported an injury during the first year of studying. The students reporting an injury prior to study start were more likely to sustain a new injury during the first year of studying (OR=3.174, p=>0.01). Sex, type of sport participated in, psychological stress, study pace, relaxation management, and leisure time management were not associated with an increased injury risk in this population.

CONCLUSION: Findings from the present study indicates that injury one year prior to study start aggravates injury risk during the first year of studies for these student-athletes. Experienced stress was not found as an injury predictor in this population which may emphasizes the importance of having a supportive environment around the student-athletes, however, more research is needed to investigate this further. Considering the high prevalence of injury incidence found in this study, developing preventive methods is key.

References:

1. Teahan C, OConnor S, Whyte EF. Injuries in Irish male and female collegiate athletes. Physical therapy in sport. 2021;51:1-7.

2. Wylleman P, De Brandt K, Defruyt S. GEES Handbook for Dual Career Support Providers. Gold in Education and Elite Sport consortium; 2017:256.

3. Bruffaerts R, Mortier P, Kiekens G, et al. Mental health problems in college freshmen: Prevalence and academic functioning. Journal of affective disorders. 2018; 225:97-103.

A FUNCTIONAL APPROACH IN AN ELITE SPORT PERFORMANCE CENTRE: FROM THE MOVEMENT ASSESSMENT TO THE INJURY PREVENTION USING A NEW TESTING PROTOCOL

GARGAGLI, M., BAUDRY, T.

CREPS TOULOUSE

INTRODUCTION: According to the observations conducted in an elite sport performance centre, 71% of athletes experience injury during the sporting season. Joining the centre implies an increase of training load, thereby elevating the risk of injury [1]. Additionally, downtime due to injuries is significantly linked with a decrease in performance [2]. We aimed to characterise the functional capacities of athletes to better prevent the occurrence of injury.

METHODS: Four hundred and fifty French elite athletes from thirteen sports development programmes participated in this three-year retrospective study. Each athlete was evaluated through the Mobility and Stability Screen (M2S), a functional assessment consisting of thirteen exercises (seven exercises were lateralised). The binary notation system led to a twenty-point score. Each athlete was evaluated twice: at the beginning and at the end of the season. Corrective protocols of five exercises performed at least three times a week were set up for each athlete, aiming at improving an anatomical location mobility or stability. Injury reports were collected by the centre' doctors, reporting 1353 de-identified injuries. Functional tests' scores and blinded injury reports were analysed considering different variables: sport, status (new or old in the structure), moment of the season and injuries details.

RESULTS: The average M2S score was 9.54±4.06 over 20 points. Sport (Kruskal-Wallis-chi-squared=115.23; p=2.2e-16) and status (F=12.12;p=5.67e-05) had a significant impact on the M2S score. Rugby league achieved the lowest scores (6.77 ± 2.66), while aerobic received the highest scores (16.15 ± 3.05). New athletes had an average score two points lower than old athletes. Each athlete increased their mean score by two points between pre-test and post-test (F-value=1.73;p=0.10) on the body part trained as part of the routine protocol (Z-value=4.76;p=1.94e-06). Considering location, 54% of the injuries were located on the lower limbs, 23% on the upper limbs, 23% on the back, head and trunk. September, October and November concentrated 46% of all injuries, representing the riskiest period. Finally, logistic regression showed that athletes with less than 10 points had a 76% chance of being injured, while those with more than 15 points had a 50% chance of being injured.

CONCLUSION: Various factors could influence the functional score of each athlete. However, the progression of the M2S score over the season showed that the routines and regular training were effective in developing functional qualities and that high functional scores led to a significant decrease in the probability of injury.

[1] Buchheit et al. (2022) ; [2] Eliakim et al. (2020)

Conventional Print Poster Presentations

CP-PN01 Nutrition I

INGESTION OF A SINGLE BOLUS OF MEALWORM-DERIVED PROTEIN DOES NOT INCREASE MUSCLE PROTEIN SYNTHESIS RATES DURING RECOVERY FROM RUNNING EXERCISE IN HEALTHY, YOUNG MALES AND FEMALES

HERMANS, W., PAPPA, S., KUIN, L., HENDRIKS, F., VERDIJK, L., VAN LOON, L.
MAASTRICHT UNIVERSITY

INTRODUCTION: It has been well-established that milk protein ingestion following resistance-type exercise stimulates muscle protein synthesis. Recently, we have shown that also mealworm–derived protein ingestion further increases muscle protein synthesis rates following a single bout of resistance-type exercise. Less work has been performed on the proposed efficacy of protein ingestion to augment muscle protein synthesis rates during recovery from endurance-type exercise. Here, we assessed the impact of ingesting mealworm-derived protein on muscle protein synthesis rates during recovery from a single bout of running exercise in healthy, young males and females.

METHODS: In this randomized, double-blind, cross-over intervention trial with a 4±2 week washout between treatments, 10 males and 10 females (Age 23±3 y, BMI 23.3±2.4 kg/m2, VO2max 49±7 mL/kg) ingested a drink with either 0.38 g protein/kg body mass (22-35 g) lesser mealworm-derived protein (69% protein concentrate; MDP) or flavoured water (placebo; PLA) following a 40-minute treadmill run at 85±6% of maximal heart rate. Primed, continuous intravenous L-[ring-13C6]-phenylalanine infusions were combined with frequent collection of blood and muscle tissue samples to assess 0-3, 3-6, and 0-6 h post-exercise muscle protein synthesis rates. The main outcome, 0-6 h post-exercise muscle protein synthesis rate, was analyzed with a paired t-test. Time-dependent variables were analyzed using repeated measures ANOVA with time and treatment (MDP vs PLA) as within-subjects factors, an α-level of 0.05, and appropriate post-hoc testing in case of significant interactions. Data represent means±SD; ηp and cohen's d are reported for effect size.

RESULTS: Ingestion of MDP strongly increased plasma total amino acid and leucine concentrations (both Time: P<0.001), with peak values being reached 30 minutes after ingestion after which they returned back to baseline, while no changes in plasma amino acid concentrations were observed in the PLA treatment (both: Time*Treatment: P<0.001; ηp=0.9). Muscle protein synthesis rates averaged 0.054±0.023 vs 0.055±0.025 %/h during the 0-3 h post-exercise recovery period, and 0.044±0.020 vs 0.049±0.018 during the 3-6 h post-exercise recovery period with MDP vs PLA, respectively, with no differences between treatments (Time*Treatment: P=0.52; ηp<0.1; Time: P=0.16; ηp=0.1; Treatment: P=0.44; ηp<0.1). Overall, muscle protein synthesis rates averaged 0.050±0.016 vs 0.052±0.017 %/h during the entire 6 h post-exercise recovery period with MDP vs PLA, respectively, with no difference between treatments (P=0.46; d=0.2).

CONCLUSION: Ingestion of 0.38 g protein/kg body mass of a mealworm-derived protein does not increase muscle protein synthesis rates during recovery from a single bout of running exercise in healthy, young males and females.

This collaboration project was funded through the PPP Allowance made available by Health-Holland, Top Sector Life Sciences & Health, to stimulate public-private partnerships.

MILK PROTEIN GLYCATION DOES NOT COMPROMISE THE POST-PRANDIAL MUSCLE PROTEIN SYNTHETIC RESPONSE DURING RECOVERY FROM RESISTANCE EXERCISE IN MEN

VAN LIESHOUT, G., TROMMELEN, J., HENDRIKS, F., NYAKAYIRU, J., VAN KRANENBURG, J., SENDEN, J., GOESSENS, J., GIJSSEN, A., VERDIJK, L., BRAGT, M., VAN LOON, L.
MAASTRICHT UNIVERSITY

INTRODUCTION: Industrial processing and storage of milk products can strongly increase protein glycation level. Previously, we have reported that a high protein glycation level compromises protein digestion, resulting in an attenuated post-prandial rise in circulating plasma lysine concentrations. The compromised post-prandial lysine availability may restrict

the anabolic properties of such a highly glycated protein. The present study assessed the impact of the level of milk protein glycation on post-prandial plasma amino acid availability and subsequent muscle protein synthesis rates during recovery from a single bout of exercise.

METHODS: 45 recreationally active, healthy young men participated in this randomized parallel study. Immediately after performing a single bout of whole-body resistance-type exercise, subjects ingested either 20 g milk protein with a low (4%; LOW) or high (47%; HIGH) glycation level plus 2 g free leucine, or a non-caloric placebo (PLA). Continuous intravenous infusions of L-[ring-13C6]-phenylalanine were applied, with blood and muscle tissue samples being collected during a 6 h post-prandial period to evaluate plasma amino acid concentrations and post-prandial muscle protein synthesis rates. Incremental area under the curve and peak concentration for plasma amino acid concentrations and muscle protein synthesis rates were compared between treatments using a one-way ANOVA with a Bonferroni correction. Plasma amino acid concentrations were compared between treatments by two-factor repeated-measures ANOVA with time as within-subject factor and treatment as between-subject factor.

RESULTS: Protein ingestion increased plasma total and essential amino acid concentrations compared to placebo (time*treatment effect: P<0.001), with no significant differences between the milk protein with the low or high glycation level. Post-prandial plasma lysine concentrations were higher following protein ingestion (time*treatment effect: P<0.001), with on average 28% lower peak lysine concentrations following ingestion of the protein with the high versus low glycation level (191±23 vs 266±47 mmol·L-1, respectively, P<0.001). Post-prandial plasma lysine availability, assessed over the full 6 h period, was substantially lower following ingestion of the protein with the high versus low glycation level (-5±7 vs 10±9 mmol·L-1·6 h-1, respectively, P<0.001). Post-prandial muscle protein synthesis rates did not differ between treatments (0.059±0.016, 0.061±0.012, and 0.061±0.018 %·h-1, in LOW, HIGH and PLA, respectively, P=0.939).

CONCLUSION: Ingestion of a protein with a higher glycation level compromises the post-prandial increase in plasma lysine availability. Milk protein glycation does not seem to modulate the post-prandial muscle protein synthetic response during recovery from resistance exercise in healthy men.

FOUR WEEKS OF MEDIUM-CHAIN TRIGLYCERIDES INTAKE WITH/WITHOUT MODERATE-INTENSITY AEROBIC EXERCISE ADVANCES WORKING MEMORY IMPROVEMENT IN HEALTHY YOUNG MEN

YUUKI, I.W., DORA, K.1,2, MATSUMURA, T.1, FUKUZAWA, K.1, MURAKAMI, Y.1, HASHIMOTO, K.1, HASHIMOTO, T.1, TSUKAMOTO, H.3

RITSUMEIKAN UNIVERSITY. 1>, TOYO UNIVERSITY. 2>, WASEDA UNIVERSITY. 3>

INTRODUCTION: Cognitive function can be improved by the antioxidative effects of some oil consumption habits (1-3). Among them, compared to regular long-chain triglycerides (LCT; e.g., olive oil) consumption, medium-chain triglycerides (MCT; e.g., coconut oil) are quickly absorbed and promote the production of ketone bodies which are an important energy substrate for the brain (4). Indeed, the positive MCT impact on cognitive function has been observed in various populations (1,5). Along with the aforementioned advantages, it is possible that the positive MCT impact on cognitive function is greater than the LCT impact but there is a lack of research directly comparing the long-term effects of LCT and MCT on cognitive function in healthy young individuals. Meanwhile, it is well known that long-term aerobic exercise (AE) improves cognitive function (6). Given the additive effect of AE to dietary intervention on cognitive improvement (7), it is assumed that compared with MCT alone, a combination of MCT and AE (MCT-AE) further improves cognitive function. Here, we compared the long-term effect of LCT, MCT, and MCT-AE on working memory (WM) which is one of the major cognitive functions.

METHODS: Thirty healthy young men were randomly allocated into the LCT [n = 10, age 21 ± 1], MCT [n = 10, age 21 ± 1], and MCT-AE [n = 10, age 21 ± 1] groups. All participants took the 16.3 ml oil (LCT: Olive oil; MCT and MCT-AE: MCT oil, containing 12 g MCT) every morning for four weeks in a single-blind manner. During four weeks of oil intervention, participants in the MCT-AE group performed moderate-intensity cycling AE (30 min/time, 3 times/week). Exercise intensity was determined using heart rate reserve (HRR), and moderate intensity at the onset of AE was defined at 50%HRR (but the workload was decreased if HR during AE exceeded 70%HRR due to cardiac drift). WM was assessed before and after the intervention using the face n-back task. The number of errors (ERR) and reaction time (RT) of the face n-back task were measured. The changes in ERR and RT from pre- to post-intervention were compared using the Kruskal-Wallis test and Mann-Whitney U test for post-hoc. The statistical significance level was defined at $P < 0.050$ and the Bonferroni correction was applied for post-hoc analysis.

RESULTS: The changes in ERR were similar between all groups ($P > 0.050$). Compared with the LCT group (22 [-5 – 42] ms; median [IQR]), the changes in RT were shorter in the MCT-AE group (-63 [-91 – -31] ms, $P = 0.044$) and MCT group (-29 [-50 – -6] ms; $P = 0.035$). However, regarding the changes in RT, there were no significant differences between the MCT-AE and MCT groups ($P = 0.371$).

CONCLUSION: Compared with LCT intervention, four weeks of MCT advances WM improvement in healthy young individuals. On the other hand, AE during MCT intervention did not cause further WM improvement.

1) Ashton et al. 2021

2) Espina et al. 2023

3) Fazlollahi et al. 2023

4) Page et al. 2009

5) Juby et al. 2022

6) Kelly et al. 2014

7) Blumenthal et al. 2019

POST-EXERCISE INGESTION OF 200 G OF ICE SLURRY DOES NOT DELAY THE RATE OF GASTRIC EMPTYING

YAMAGUCHI, H., HIROE, Y., YAMAMOTO, Y., MORI, T., HANANO, H., OISHI, K., IKEUE, K., ISHII, K.

DOSHISHA UNIVERSITY

INTRODUCTION: Ice slurry ingestion has attracted attention as an effective way to suppress the exercise-associated rise in core body temperature [1]. Heat countermeasures, including heat stroke, control excessive increase in body temperature and ensure efficient absorption of ingested fluids by the body. Gastric emptying rate (GER) is indicative of fluid absorption, and delayed GER results in delayed absorption of water and nutrients, leading to decreased performance. After exercise, taking measures to avoid delaying GER is crucial to replenish lost fluids and electrolytes. Previous studies have reported transient and minor effect of the ingested beverage temperature (4–50°C) on GER [2,3]; however, thus far, the effect of ingesting ice slurry (–1°C) on GER remains unclear. Understanding the effect of ice slurry ingestion on GER could inform recommendations for optimal fluid intake methods during exercise. This study aimed to determine the effect of ice slurry ingestion after exercise on gastric emptying.

METHODS: Nine healthy male students (22.3 ± 2.0 years, 169.3 ± 2.7 cm, 64.9 ± 11.2 kg) were recruited. They performed cycling exercises in the laboratory for 20 min at 60% VO2max and then ingested either 200 g of ice slurry (–1°C) or fluid (4°C) prepared with sports drinks on separate days. GER (evaluated by 13C excretion after 13C labeled sodium acetate ingestion), thermal sensation (TS), thermal comfort (TC), and gastric discomfort (GD) were evaluated after consuming each beverage.

RESULTS: No significant interaction (condition × time) was observed for changes in 13C excretion (interaction: p=0.100, condition: p=0.290, time: p<0.001). The time to maximal 13C excretion rate (Tmax) (an indication of GER) did not significantly differ between ice slurry (33.3 ± 11.9 min) and fluid (32.8 ± 7.5 min) ingestion (p=0.834). No systematic error in Tmax was found between ice slurry and fluid ingestion (95% confidence interval [CI]: –14.503–15.614, B=0.507, p=0.081). Additionally, the TS, TC, and GD did not differ significantly (TS, interaction: p=0.368, condition: p=1.000, time: p<0.001; TC, interaction: p=0.395, condition: p=0.672, time: p<0.001; GD, interaction: p=0.100, condition: p=0.218, time: p=0.100).

CONCLUSION: These findings suggest that ice slurry ingestion (200 g) after 20 min of cycling exercise does not cause a delay in gastric emptying compared to that with fluid ingestion.

REFERENCE:

1. Siegel, R, and PB. Laursen. Keeping your cool: possible mechanisms for enhanced exercise performance in the heat with internal cooling methods. Sports Med, 2012. 42: 89-98.

2. Shi, X, et al. Gastric emptying of cold beverages in humans: effect of transportable carbohydrates. Int J Sport Nutr Exerc Metab, 2000. 10(4): 394-403.

3. Sun, W.M, et al. Effect of meal temperature on gastric emptying of liquids in man. Gut, 1988. 29(3): 302-305.

EFFECTS OF EITHER A SHORT-TERM VEGAN OR OMNIVOROUS DIET WITH RESISTANCE TRAINING ON THE EXPRESSION OF GENES REGULATING MITOCHONDRIAL BIOGENESIS, INFLAMMATION, AND PROTEIN TURNOVER IN YOUNG MALES

CAMERA, D., AL REFAI, W., COOKE, M., KEENAN, S.

SWINBURNE UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Appropriate nutritional support is essential to maximize the beneficial effects of exercise training. Protein ingestion can positively regulate expression of genes implicated in skeletal muscle protein turnover and metabolism. However, a limitation to the current knowledge of gene expression responses after exercise with protein intake is that most studies have been confined to the ingestion of free/ intact amino acids and/ or animal-based proteins. In contrast, little is known about changes in gene expression in response to plant-based proteins which is surprising considering the majority of dietary protein intake worldwide is derived from plant-based sources. The primary aim of this study was to compare the effects of either a short-term (i.e., 2-weeks) vegan or omnivorous diet on the expression of select genes implicated in skeletal muscle mitochondrial biogenesis, inflammation, and protein turnover in recreationally active males.

METHODS: Twenty, recreationally active and otherwise healthy male participants were recruited. A between-subjects design was employed where participants were pair-matched for leg press and extension strength as well as body mass and allocated to either a vegan (n = 10; Age: 25.6 ± 5.2 years; BMI: 25.9 ± 4.8; Leg Press 1-Rep Max: 170.6 ± 61.3 kg; mean ± standard deviation) or omnivorous (n = 10; Age: 26.2 ± 3.9 years; BMI: 25.0 ± 2.1; Leg Press 1-Rep Max: 166.0 ± 71.3 kg; mean ± standard deviation) group. Following preliminary testing, participants consumed a dietary control meal the evening prior to commencing the 14-day diet and exercise intervention period. For this intervention, participants consumed either a vegan diet (54% Carbohydrate, 26% Fat, 19% Protein; 1.6g protein/kg body mass/day) or omnivorous diet (48% Carbohydrate, 32% Fat, 18% Protein; 1.6g protein/kg body mass/day) and undertook six sessions of resistance exercise throughout the 14-day period. Skeletal muscle samples from the vastus lateralis were collected pre-, mid-, and post-intervention.

RESULTS: Taqman gene expression primers will be used to measure the expression of genes implicated in skeletal muscle mitochondrial biogenesis (PGC-1alpha, Tfam), inflammation (IL-6, TNF-alpha) and protein turnover (MuRF-1, Atrogin-1,

Myostatin, IGF-1). The expression of these markers will be analyzed pre-intervention, as well as mid- and post-intervention. Changes in expression will be normalized to GAPDH.

CONCLUSION: Findings from this work will be the first to report changes in gene expression in human skeletal muscle comparing the short-term effects of either a vegan or omnivorous diet in young, recreationally trained individuals. Such findings will be important to provide a mechanistic basis to physiological adaptation responses with each diet when combined with resistance training. Moreover, this work will advance knowledge of the capacity for vegan diets to mediate changes in gene expression pertinent to skeletal muscle adaptation responses with exercise.

FIVE WEEKS OF HIGH-CALORIE KETOGENIC DIET PROGRAM AND STRENGTH TRAINING: PERFORMANCE, BODY COMPOSITION, BIOCHEMICHEMISTRY, HORMONE AND MICRORNA EVALUATION.

CANNATARO, R., CIONE, E., ZOTTOLA, D., LEVI-MICHELI, M., GRIMALDI, A., KREIDER, R.B., BONILLA, D.A.

UNIVERSITY OF CALABRIA

INTRODUCTION: The ketogenic diet (a nutritional program that provides for a minimal carbohydrate intake, i.e., <30g or 5% of caloric intake per day) is now used not only with the aim of weight loss but also to support the management of various pathologies (headaches, GLUT1 deficiency, epilepsy, PCOS, lipedema even cancer), therefore also used for medium-long periods and not in caloric restriction¸ our idea is to be able to prove that it is possible (even if it is probably not the best way) to obtain positive results in terms of strength training even in a ketogenic regime.

METHODS: 12 subjects, six males and six females, with training experience of at least two years, aged between 20 and 50, followed a high-calorie ketogenic diet protocol (set based on a food diary) combined with weight training based on cluster sets of bioelectric parameters (bioimpedance) and fat percentage (ultrasound) were evaluated; strength assessment (1RM, CMJ tight pull on force deck); blood tests with biochemical and hormonal profiles at the beginning of the study and after five weeks; ketonemia was measured every five days at the fingertip; training and nutritional plans were constantly supervised.

RESULTS: Subjects reported, on average, a 2.3% weight decrease (most likely due to glycogen and associated water depletion), a 5% increase in phase angle, and 3.6% in LMI (bioelectric parameters positively correlated with fitness and muscle mass); a 7.7% decrease in fat percentage; an increase in the 1RM of squat, deadlift, and bench press, respectively of 8.7%, 29.7%, and 11.1%, while the CMJ is practically unchanged and there is a 3% improvement in the tight isometric pull; there is a marked increase in total cholesterol of 17.6% cos+ as well as in TGA and GOT (+29 2 and +22%); GH shows an increase of 162%, testosterone increases in men by 6% while decreases in women by 22%; insulin and cortisol show a decrease of 1.5 and 2.1%; finally the reticulocyte shows an increase of 14%; the TSH decreases by 3%; miR-206 showed an upregulation.

CONCLUSION: It can be concluded that the proposed scheme allowed the subjects to report significant improvements in terms of strength and body composition; in our opinion, the most interesting data concerns the increase in GH (recorded for both sexes) and testosterone (only in males) which could explain the effectiveness of the program even in the almost complete lack of carbohydrates; another interesting finding is the upregulation of miR-206 confirming a positive action on myogenesis, myofusion, and satellite cells differentiation; the only point to re-evaluate is the increase in cholesterol (even with a ratio with HDL still within the norm), but this occurred mainly in males, as the caloric intake exceeded 3000kcal of which at least half was fat.

DIFFERENT CARBOHYDRATE INGESTION PATTERNS DO NOT EFFECT SUBSTRATE OXIDATION, PHYSIOLOGICAL RESPONSES, GASTROINTESTINAL DISCOMFORT AND EXERCISE CAPACITY IN ENDURANCE CYCLING

JONES, R.O., ARETA, J.L., PUGH, J.N., VAZ DE OLIVEIRA, M., LOUIS, J.B.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Carbohydrate (CHO) intake during prolonged moderate-high intensity cycling is essential for endurance performance, with current research advocating high CHO intake equal to or >90 grams/hour (g/h) in long duration events [1,2]. High CHO intake can be a challenge in race conditions, requiring regular feedings per hour, likely impacting race 'flow'. However, the effects of different CHO ingestion patterns on substrate oxidation, physiological responses to exercise, gastrointestinal (GI) discomfort and exercise capacity have never been reported in cycling.

METHODS: 20 recreationally active males (maximal oxygen uptake 50.4±3.8 mL/kg/min) completed 2 experimental trials consisting of 180 min cycling (Lode, Netherlands) at an intensity equivalent to lactate threshold (LT; 139±29 W). 24 h pre-trial, a meal plan providing high CHO availability and standardised fat and protein intake was followed (8, 1 and 2 grams per kg of body mass respectively). Trial order was randomised with participants consuming 90 g/h of CHO, either as a 22.5g CHO gel every 15 min (CHO-15) or a 45g CHO gel every 30 min (CHO-30) of exercise. Blood glucose, lactate and GI discomfort symptoms were measured every 15 min using capillary blood samples and a visual analogue scale, respectively. Respiratory gases were collected in the last 2 of every 15 min with a metabolic cart (Vyntus CPX, UK). Stoichiometric equations were used to determine substrate oxidation [3]. Participants then completed an exercise capacity test to exhaustion at an intensity equivalent to 150% LT (209±43 W). Two-way repeated measures ANOVA was used to determine main effects and interactions for physiological data. Paired t-tests were used for exercise capacity and sum of scores for each GI symptom. Significance was set at $P<0.05$. All data is presented as mean ±SD.

RESULTS: Mean CHO oxidation was similar (2.38±0.06 vs 2.33±0.07 g/min for CHO-15 and -30) for both conditions ($P=0.25$), which stayed consistent over time ($P=0.09$). Fat oxidation increased ~2-fold by 180 min of exercise (time effect,

P<0.001) in both trials (treatment effect, P=0.09). Absolute oxygen uptake, blood glucose and lactate responded similarly in both trials (P=0.79, P=0.92 and P=0.34 respectively). Oxygen uptake gradually increased throughout exercise, reaching significance in the final 45 min (P<0.05), whilst glucose and lactate changed from baseline (time main effect, P<0.001). There was no significant difference between conditions for any GI discomfort symptoms (P>0.30) and exercise capacity did not differ (P=0.51) between CHO-15 and -30 (552±400 vs 612±512 seconds respectively).

CONCLUSION: Ingesting larger CHO quantities at less regular intervals during prolonged cycling can provide a more practical approach to fuelling, with minimal impact on substrate oxidation, physiological responses to exercise, GI discomfort symptoms and exercise capacity.

References

1. Thomas et al. 2016

2. Hearris et al. 2022

3. Jeukendrup and Wallace, 2005

EFFECT OF DIFFERENT ENERGY AVAILABILITY LEVELS ON NOCTURNAL INTERSTITIAL FLUID GLUCOSE CONCENTRATIONS IN ELITE TRIATHLETES

HIROMATSU, C., GOTO, K.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: Triathletes are exposed to higher energetic demands, leading to increased risk of lowered energy availability (EA) compared with other types of athletes (Jesus et al., 2022). Sustained low EA (LEA) distributes both impairments of health and exercise performance (Mountjoy et al., 2023). Sedentary women in LEA state caused substantial decrease in nocturnal blood glucose and 24 h average blood glucose concentrations compared with those in sufficient energy balanced state (Loucks et al., 2003). However, the effect of different EA levels on 24 h glucose changes in elite endurance athletes is not clear. We examined the effect of different EA levels on 24 h changes in interstitial fluid glucose concentrations (IGC) in elite male triathletes during training camp.

METHODS: Three elite male triathletes (athlete A, B, C) were continuously evaluated IGC changes for four consecutive days (days 1-4). Subjects recorded daily activities in detail. Training log was classified using METs, and exercise energy expenditure (EEE) were then estimated. To prevent overestimation, EEE was adjusted to remove calories contributed by resting energy expenditure for the duration of the exercise (Jesus et al., 2022). All subjects completed same training from days 1-3. On day 4, subjects conducted different training regimen individually. Energy and macronutrients intakes were evaluated by dietary survey. We could not measure IGC between 21:00 and 23:00 due to the error of measuring device.

RESULTS: No significant relationship was found between EA and average nocturnal (0:00-7:00) IGC ($r^2 = 0.039$, $p = 0.538$). During 4 days, the relative time (%) of IGC above 100 mg/dL during the nocturnal time was substantially high, 100% for athlete A, 94% for athlete B, and 75% for athlete C, respectively. However, among the 4-day measurements of the three athletes, the lowest EA was observed concomitantly with the lowest average nocturnal IGC (EA, 18 kcal/kg FFM/day; IGC, 98±5mg/dL, athlete C on day 3).

CONCLUSION: Sufficient IGC during night were maintained in male elite triathletes during training camp regardless of EA levels.

REFERENCES

Jesus F, Sousa M, Nunes CL, et al. Energy Availability Over One Athletic Season: An Observational Study Among Athletes From Different Sports. Int J Sport Nutr Exerc Metab. 2022;32(6):479-490.

Mountjoy M, Ackerman KE, Bailey DM, et al. 2023 International Olympic Committees (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs) . Br J Sports Med. 2023;57(17):1073-1097.

Loucks AB, Thuma JR. Luteinizing hormone pulsatility is disrupted at a threshold of energy availability in regularly menstruating women. J Clin Endocrinol Metab. 2003;88(1):297-311.

EFFECT OF TRAINING ENVIRONMENTS ON GLUCOSE LEVEL VARIABILITY IN ELITE FEMALE ROWERS

MALÁ, M., MILEK, J., STRÍTECKÁ, H., NOVÁKOVÁ, M.

CASRI; DEPARTMENT OF PREVENTIVE MEDICINE, FACULTY OF MEDICINE IN HRADEC KRÁLOVÉ, CHARLES UNIVERSITY

INTRODUCTION: Sports performance is complexly influenced by a variety of factors, including training environments. This pilot study focuses on the analysis of glycemic variability in female elite rowers in the context of three different training environments: regular training, training camp and training in a hypoxic environment. In order to assess the effect of these environments on glycemic variability, the Mean Amplitude of Glucose Excursions (MAGE) values was examined over a four-day follow-up. The aim of this pilot study was to identify differences in glycemic variability across training environments and find out the effect of carbohydrate intake.

METHODS: The sample consists of three experienced female elite rowers (aged 25-28) with a history of glycemic recording. Each athlete underwent four days of monitoring in each training environment. During this time blood glucose level was monitored by using of FreeStyle Libre 2 continuous glucose monitors. Dietary diaries and energy expenditure were also recorded to examine the potential impact of energy balance and diet on glycemic stability. Students paired t-test and descriptive statistics were used to compare MAGE values in each environment.

RESULTS: The statistical analysis showed no significant diference in the mean of MAGE value between regular training condition (1.22 mmol/L ± 0.14) and training camp (1.27 mmol/L ± 0.54), but a significant difference was found between regular training and training conducted at elevated altitudes (1.58 mmol/L ± 0.35 ; $p < 0.01$). Notably, no statistically significant difference was detected across the aforementioned environments in carbohydrate intake (1254 kcal vs. 1105 kcal). However a significant difference ($p < 0.01$) in energy expenditure values emerged between these environmental contexts, with a mean of 3387 kcal during regular training and 2641 kcal during training at higher altitudes.

CONCLUSION: The results suggest that despite similar carbohydrate intake levels between changes in environmental conditions and increased energy expenditure, glycemic variability varies notably. However the precise influence of energy expenditure versus training environment alterations on this variability remains inconclusive and other factors can play a role. Further investigation demands a larger participant pool and higher amount of monitored days to elucidate the nuanced interplay between environmental factors, energy expenditure, and glycemic variability in athletic performance.

PLACEBO EFFECT ON ENDURANCE PERFORMANCE: UNDER-RESEARCHED AND WOMEN FORGOTTEN

VALERO MARTINEZ, F., GONZÁLEZ-MOHÍNO, F., AGUDO-ORTEGA, A., SALINERO, J.J.
UNIVERSIDAD DE CASTILLA LA MANCHA

INTRODUCTION: The potential for enhancing sports performance through the placebo effect has been studied from several perspectives including nutritional and mechanical ergogenic aids (Hurst et al. 2020). Most of the research has been conducted on strength and power-based exercises, while endurance performance has received less attention. However, the occurrence and magnitude of the placebo effect may be affected by sex, although the evidence is limited and sometimes conflicting and these studies have been conducted in medical settings (Enck & Klosterhalfen, 2019; Shafir et al. 2022). The aim of this study was to analyze the existing literature on the placebo effect and endurance sports, with a special focus on the presence of women.

METHODS: The search for published studies on the topic was conducted in the databases Pubmed and Scopus on 10th January 2024. Search terms included Mesh terms and free-text words, for key concepts related to placebo effect and endurance sports. Titles and abstracts were screened for subsequent full-text review. Thirteen studies were selected from the search results based on the following inclusion criteria: inclusion of at least one endurance test and a comparison between a placebo-deceptive condition and a control condition. All studies involved cycling (n=7) or running (n=6) tests and included a total of 229 participants (208 men, 21 women).

RESULTS: Contradictory results were found regarding the effects of placebos on endurance performance. Out of the 13 studies reviewed, 8 reported positive placebo effects. Endurance cycling performance was analyzed in tests from 1 km to 40 km time trial, and 3 out of 7 found a significant placebo effect. Endurance running performance was studied in tests from ≈ 3 to 50 min, where 5 out of 6 found a significant placebo effect. Overall, only 3 studies included women (all were running studies), and no one reported sex-analysis or individual data. In addition, only 9.2% of the total sample were women. The mean sample size in individual studies was 17.6±10.9 participants (median=13) with women comprising only 1.6±3.7 (median=0).

CONCLUSION: There is limited research on endurance performance, with varying test durations, and women are almost excluded.

REFERENCES:

1. Hurst, P., Schipof-Godart, L., Szabo, A., Raglin, J., Hettinga, F., Roelands, B., Lane, A., Foad, A., Coleman, D., & Beedie, C. (2020). The Placebo and Nocebo effect on sports performance: A systematic review. European Journal of Sport Science, 20(3), 279–292

2. Enck, P., & Klosterhalfen, S. (2019). Does Sex/Gender Play a Role in Placebo and Nocebo Effects? Conflicting Evidence From Clinical Trials and Experimental Studies. Frontiers in Neuroscience, 13.

3. Shafir, R., Olson, E., Colloca, L. (2022). The neglect of sex: A call to action for including sex as a biological variable in placebo and nocebo research. Contemporary Clinical Trials, 116.

Conventional Print Poster Presentations

CP-SH01 Physical Education

LONGITUDINAL RELATIONSHIP BETWEEN ORGANISED AND NON-ORGANISED PHYSICAL ACTIVITIES, MOTOR COMPETENCE, AND OVERALL PHYSICAL ACTIVITY IN CHILDREN AGED 3–11 YEARS

LUUKKAINEN, N.M., LAUKKANEN, A., NIEMISTÖ, D., SÄÄKSLAHTI, A.
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION

Little is known how different types of physical activity (PA) in early years predict subsequent PA and motor development. This study aimed to find out how outdoor time and participation in sport in early childhood (T1) predicted motor competence (MC) and overall physical activity three years later in school age (T2).

METHODS

The participants (n=627, 51.0% girls) were Finnish, 3-8 years old at T1 (mean 5.5 yrs.), and 6-11 years old at T2 (mean 8.7 yrs.). The participation rate in sports and outdoor time on weekdays and weekends was queried via a parental questionnaire at T1. At T2, children's MC was assessed using a shortened version of the Test of Gross Motor Development – 3rd edition, including locomotor skills (hopping, skipping), and object control skills (one-hand stationary dribbling, overhand throwing), and a total score of these skills. Additionally, the jumping sideways test of the Körperkoordinationstest Für Kinder instrument was used. PA was measured with accelerometers at T2. Associations were analysed using linear regression models with the enter method and interactions using a two-way analysis of variance.

RESULTS

Children's participation in more than two (multisport) organised activities sports at T1 predicted better MC at T2 in locomotor skills ($p < 0.001$), object control skills ($p = 0.003$), total skills ($p < 0.001$), and jumping sideways ($p < 0.001$). Outdoor time on weekdays at T1 predicted better object control skills ($p = 0.004$) and total skills ($p = 0.019$) in all participants. Both higher outdoor time ($p = 0.006$) and participation in multisports ($p = 0.002$) in early childhood predict higher subsequent moderate-to-vigorous PA in middle childhood. However, there were no interactions between organised sports participation and outdoor time on MC or PA.

CONCLUSION

Participation in more than two sports and spending more time outdoors during the weekdays predicted better MC and higher levels of PA. It is essential for adults who work with children and in sports clubs to understand that multisport and different types of outdoor activities play an important role in developing a childs MC and PA.

PERSPECTIVES OF TEACHERS ON (ANTI-) RACISM AND WHITENESS IN PHYSICAL EDUCATION: A (REFLEXIVE) THEMATIC ANALYSIS

ABEL, L., GALLE, A.C., VOGT, T.
GERMAN SPORTS UNIVERSITY COLOGNE

Introduction

Sport, across various social contexts, exhibits inherent racist structures and incidents, impacting children and youth. Physical Education (PE) has the potential to fight racism, yet simultaneously serves as a setting where racist elements may be (re)generated. Given that teachers are central figures in education with a direct impact on students, their experiences and perspectives are extremely valuable in research. The objective of this study was a thematic analysis (TA) of both national (i.e., German) and international (i.e., English language) publications addressing racism and anti-racism within PE with a particular focus on teachers' perspectives.

Methodology

A systematic review adhered to the PRISMA standard and employed a four-step methodology: (1) Search was conducted in eleven electronic databases using twelve keyword combinations in both German and English language. (2) Study selection: Criteria for inclusion comprised (a) peer-reviewed journals, (b) English or German language, (c) participants being pupils, teachers, or researchers, (d) publications addressing (anti-) racism in PE and considering a teachers' perspective. (3) Quality assessment through Appraisal Skills Programme (CASP) and Mixed Methods Appraisal Tool (MMAT). (4) In dept analysis and interpretation of data through reflexive TA and template analysis. Critical Race Theory was utilized as a lance for analysis and discussion.

Results

A total dataset of 5,213 publications was identified of which subsequently 20 (including one German publication) qualified for inclusion. Every publication was assigned to the top quality level out of three using CASP and MMAT. Using TA on the extensive qualitative dataset, four overarching themes were constructed with the two most prominent being (i) "unveiling whiteness", a critical analysis of racial and gender hierarchies in PE that exposes a pervasive dominance of white individuals in roles like educators, students, and faculty members. This asymmetry tends to normalize the experiences of whiteness while marginalizing others, emphasizing the imperative for inclusive narratives in the field. (ii) "Addressing gaps in anti-racist training", which emphasizes a lack of specific courses on race and multiculturalism, with suggestions for integrating such training through pilot projects and reflective learning experiences to raise awareness of race, critical whiteness and tailor interventions to local contexts.

Discussion

Racist experiences of teachers are pervasive in PE, emphasizing the need for structural changes, anti-bias training, and inclusive curricula to address inequalities, male dominance, whiteness and foster diversity in the field.

Given the localized variations in the global phenomenon of racism, it appears crucial to initiate a national survey, to gain insights on developing anti-racism training based on the experience and needs of the intended recipients.

HONG KONG PE TEACHERS' VIEWS ON STUDENTS' MANIFESTATIONS OF MOTIVATION: A QUALITATIVE STUDY

YIP, H.T., LEUNG, K., BALAGUER, I., DUDA, J.
UNIVERSITY OF BIRMINGHAM

INTRODUCTION

Research reveals children and youth in Hong Kong to have low physical activity and physical fitness levels and a high prevalence of obesity. Physical education (PE) in schools can serve as a crucial outlet to promote students' motivation toward and participation in physical activity. However, students are not always optimally engaged in PE, with 2ry school students prone to amotivation. Studies have demonstrated that students motivation in PE is greatly influenced by the views and practices of PE teachers. Past work in this area have primarily adopted quantitative methods and examined students perceptions of their motivation. This study aimed to examine, via an in-depth qualitative methodology, Hong Kong PE teachers' perceptions of the characteristics (thoughts, emotions, and behaviours) of 'motivated' and 'unmotivated' secondary students during PE class.

METHODS

Semi-structured online interviews were conducted with 15 Hong Kong local secondary school PE teachers [n = 7 males; mean age = 34.2 (SD = 9.4); mean years of teaching = 10.7(SD =10.2)] from 3 regions (New Territories, Kowloon and Hong Kong Island) and bandings (grouping students by academic levels or abilities). They were asked to share their experiences and observations in teaching 'motivated' and 'less motivated' 2ry school students in PE classes. The data were analysed using a six-step thematic analysis technique, including creating, reviewing, and defining themes.

RESULTS

Seven themes emerged in the characterisations of 'motivated' students: (a) high proficiency in sports, (b) high interest in sports, (c) higher openness to try (love to engage in new tasks), (d) higher resilience (do the best, never give up, self-assurance), (e) extrovert (outgoing and socially competent), (f) higher relatedness (Give support towards both teachers and peers), and (g) comfortable (experience a sense of ease). Five themes captured teachers' views of 'unmotivated' students: (a) low engagement (frequently seeking means to evade the lesson), (b) unconfident (not willing to try to prevent failure), (c) social exclusion (poor peer relationships), (d) introvert (shy and reticent), and (e) feeling powerless (always fail in doing the tasks).

DISCUSSION

This study is an initial endeavour to qualitatively explore the perspectives of teachers regarding students motivational engagement in PE in Hong Kong. Findings can provide instructors with vital insights to devise effective motivational strategies and create more optimal learning environments in physical education classes in Hong Kong.

THE RELATIONSHIP BETWEEN EMPOWERING MOTIVATIONAL CLIMATE, SELF-DETERMINED MOTIVATION, AND SOCIAL RESPONSIBILITY IN PHYSICAL EDUCATION

DONG FANG, J.D., WANG, C.M., WU, Y.T.

SOOCHOW UNIVERSITY

Introduction

School is a places for education, socializing, and interdisciplinary learning, where teachers and student have interaction. Therefore, studies seek strategies to improve relationships between teacher and students in physical education. Teaching-learning process can assist in personal development and social responsibility. This study attempted to construct a motivational climate model by combining the empowerment motivational climate, self-determined motivation and social responsibility models, with the purpose of verifying the appropriateness of this model.

Methods

The study distributed 450 questionnaire among university students in Taiwan were selected as the sample for the purpose of this study after elimination a total of 410 valid questionnaire was used. A 5-point Likert scale was used in this study, with 5 being the highest agreeable scale and 1 being the least agreeable. The collected survey consist of 157 male and 253 female with age 20.39 ± .This study analyzed using structural equation modeling with CFA to test for reliability and validity and to test the relationship among the variables.

Results

The analysis showed that the measurement model has a good fitness indicator where the $\chi 2/df$ value was smaller than the value of 5, and the RMSEA was at .10 which met the criteria. This study showed that GFIand AGFI was both greater than the value of 0.80. Additionally, the self-determined motivation had the exploratory power of relatedness R2 was .34 giving an exploratory power of 34% and competence R2 was .14 with an exploratory power of 14% and autonomy of R2 was.36 which made up 36% exploratory power. Furthermore, social responsibility showed that helping other R2 was .40 with an exploratory power of 40%, cooperating R2 was .34 with an exploratory power of 34% and leadership R2 was .38 with an exploratory power of 38%.

Discussion

The empowering motivational climate to relatedness showed the highest positive relationship. Moreover, relatedness also showed strong positive relationship toward helping others. All empowering motivational climate had an overal positivel relationship on the self-determined motivation and self-determined motivation also had a positive relation on social responsibility of helping others, cooperating, and leading. In terms of the effect value in the case of a positive overall effect of basic needs on the social responsibility variables of helping others, cooperating, and leading, relatedness showed the overall highest in helping others. Based on the research results, empowerment and self-determined motivation is vital for teaching-learning process for student in physical education, as it can assist in students in self-development and a sense of social responsibility.

A STUDY ON THE PATH TO IMPROVING COLLEGE STUDENTS ECOLOGICAL LITERACY THROUGH OUTDOOR SPORTS ACTIVITIES IN YUNNAN PROVINCE UNDER THE BACKGROUND OF BIODIVERSITY

HUA, X., YANG, X., YIN, G.
YUNNAN UNIVERSITY

Objective: This study aims to investigate the status quo of ecological environment and health literacy among university students in Yunnan Province, as well as to examine the potential impact of participation in outdoor physical activities on the development of ecological environment and health literacy.

Methods: Through questionnaire method, and mathematical and statistical methods, 1681 college students were randomly selected from universities and colleges in Yunnan Province in June-July 2022. Statistical chi-square test and regression analysis were conducted to investigate the participation of college students in outdoor physical activities and the score of a 47-question ecological environmental and health literacy questionnaire based on the "Citizens Environmental and Health Literacy Test Guide (Trial)" issued by Environment Not.

Results: The number of college students in Yunnan Province who had ecological and health literacy (70 points and above) was 493, accounting for 29.35%, and the number of students who did not have ecological and health literacy was 1187, accounting for 70.66%. Among them, 16.6% (279) of college students never participated in outdoor sports activities, 17.74% (298) participated less than once a month, 44.64% (750) participated 1-2 times a month, 9.94% (167) participated 3-4 times a month, and 11.13% (187) participated more than 4 times a month, and the results were analyzed by statistical chi-square test. The results showed that the frequency of outdoor physical activity affecting the ecological environment and health literacy of college students was 1-2 times per month ($X2 = 209.635$, $p<0.05$), 3-4 times per month ($X2 = 43.448$, $p<0.05$), and more than 4 times per month ($X2 = 7.186$, $p<0.05$) with statistically significant differences.

Conclusion: The advancement of ecological civilization is a long-term, sustained process, and the promotion and implementation of ecological and environmental literacy is a crucial aspect of this endeavor. To achieve this, social sports organizations can play a key role in increasing individuals ecological knowledge and raising awareness of the importance of environmental protection. Eco-environmental organizations can leverage their power and influence by conducting environmental protection public welfare activities, providing educational materials, and delivering lectures to college students. Additionally, they can create environmental protection projects and guide college volunteers in carrying out environmental volunteer activities, thus encouraging them to actively participate in and become advocates for ecological protection. Community streets can also utilize social sports organizations to conduct engaging sports activities and promote ecological concepts and policies.

Colleges and universities, as key institutions, should make full use of their role as a primary channel to improve the quality of college students and carry out systematic and planned ecological literacy education. By doing so, university students can enhance their sense of responsibility for nature protection in their daily lives and form an emotional and value identity for environmental protection.

This study has several limitations:(1) The survey conducted in more than 10 universities inevitably suffers from the problem of insufficient coverage and limited representativeness in Yunnan Province. (2) The classification of outdoor physical activities is further subdivided to define the nature of physical activities at a narrow level, which does not fully represent the types of outdoor physical activities and needs to be further validated. (3) There is no way to accurately assess the seriousness of doing the questions in conducting realistic electronic questionnaires, resulting in hierarchical performance results, and more research is needed to continuously improve it.

PREDICTORS OF ATTITUDINAL BELIEFS TOWARDS VIOLENCE IN THE PHYSICAL EDUCATION CONTEXT

BELTRAN-CARRILLO, V.J., JIMÉNEZ-LOAISA, A.2, LEÓN-ZARCEÑO, E.1, JIMÉNEZ-BARBERO, J.A.3, CHILLÓN-GARZÓN, P.4, GONZÁLEZ-CUTRE, D.1
1 MIGUEL HERNÁNDEZ UNIVERSITY OF ELCHE, 2 UNIVERSITY OF CASTILLA-LA MANCHA, 3 UNIVERSITY OF MURCIA, 4 UNIVERSITY OF GRANADA

Introduction

Since school physical education (PE) can be sometimes a site of bullying perpetration (Jiménez-Barbero et al., 2020), to identify the profile of students who tend to be aggressors in PE could be an important step for bullying prevention. The aim of this study was to analyse whether gender, age, physical fitness, sedentary and physical activity level were predictors of attitudinal beliefs towards violence in school.

Methods

A correlational study was carried out with 289 adolescents (152 boys and 137 girls; Mage = 13.98 years, SD = 1.27) from a secondary school located in Elche (Spain). The following variables were measured: Gender and age (sociodemographic questionnaire); aerobic fitness (20 m shuttle run test); strength (hand dynamometer); agility and movement skill (CAMSA test); height and weight to calculate body mass index (BMI); sedentary, light, moderate and vigorous activity (GT3X accelerometers); and attitudinal beliefs towards violence in educational centres (CAHV–25 questionnaire). Two multiple regression analysis were performed, with attitudinal beliefs towards violence as dependent variable, and the rest of variables as predictors. A first model included gender, age, aerobic fitness, strength, agility and movement skill, and BMI as predictors. A second model included the same previous variables as predictors, but adding accelerometer variables.

Results

The first regression was significant (F(6, 282)= 4.065, p < .01, adjusted R2 = 0.060). Boys (β = -.194, p < .01) and students with higher agility and movement skill (β = .143, p < .05) showed higher attitudinal beliefs towards violence.

The second regression was also significant (F(10, 108)= 2.698, p < .01, adjusted R2 = .126). Boys showed more attitudinal beliefs towards violence than girls (β = -.444, p < .001), being higher the effect of gender than in the first regression, but no other significant predictors were found.

Conclusion

Our findings suggest that boys and students with higher agility and movement skill tend to show higher attitudinal belief towards violence. These results are congruent with previous research which had pointed out that skilful boys are the ones who usually tend to harass other students in physical education and school sport (Beltrán-Carrillo et al., 2012). This information could be useful for bullying prevention in these contexts.

References

Beltrán-Carrillo, V. J., Devís-Devís, J., Peiró-Velert, C., & Brown, D. H. K. (2012). When physical activity participation promotes inactivity: Negative experiences of Spanish adolescents in physical education and sport. Youth and Society, 44(1), 3-27. https://doi.org/10.1177/0044118X10388262

Jiménez-Barbero, J.A., Jiménez-Loaisa, A., González-Cutre, D., Beltrán-Carrillo, V.J., Llor-Zaragoza, L., & Ruiz-Hernández, J.A. (2020). Physical education and school bullying: a systematic review. Physical Education and Sport Pedagogy, 25(1), 79-100. https://doi.org/10.1080/17408989.2019.1688775

PREDICTORS OF BULLYING VICTIMIZATION IN ADOLESCENTS: CONSIDERING THE ROLE OF AGE, GENDER, PHYSICAL FITNESS, AND SEDENTARY AND PHYSICAL ACTIVITY

JIMÉNEZ-LOAISA, A., BELTRÁN-CARRILLO, V.J., GONZÁLEZ-CUTRE, D., VALENCIANO-VALCÁRCEL, J., LEÓN-ZARCEÑO, E.
UNIVERSITY OF CASTILLA-LA MANCHA. MIGUEL HERNÁNDEZ UNIVERSITY OF ELCHE.

Introduction

Bullying victimization is defined as a situation in which a student is frequently and intentionally attacked by one or several students, who are in a position of power in comparison with the victim. Prior research has shown that students who are bullied suffer multiple negative consequences that affect their proper development and well-being (e.g., social isolation, anxiety, lower school performance). Physical education and sports are sensitive spaces where these negative outcomes can worsen, especially during adolescence. However, no previous studies have systematically analyzed the set of variables linked to physical education and sports that could predispose an adolescent to be a victim of bullying. This correlational study addresses this gap. Concretely, we examine the associations between bullying victimization and several variables related to adolescents' age, gender, physical fitness, and sedentary and physical activity.

Methods

A total of 289 adolescents (152 boys and 137 girls; Mage = 13.98 years, SD = 1.28) from a secondary Spanish school completed the Adolescent Peer Relations Instrument (APRI questionnaire) to assess the frequency they experienced bullying victimization. Adolescents also completed several measures to assess their aerobic fitness (multistage 20-meter shuttle run test), strength (manual dynamometer), agility and movement skills (CAMSA test) and body mass index. Sedentary and physical activity were measured with accelerometers. Pearson's correlations were calculated to test the associations among these variables. A hierarchical regression analysis with bullying victimization as dependent variable was also performed. Age, gender (0 = male, 1 = female), and physical fitness were introduced as independent variables in a first model. Physical activity was added in a second model.

Results

Correlation analyses showed that bullying victimization was negatively associated with age (r = -.15, p = .010), aerobic fitness (r = -.17, p = .003), and strength (r = -.15, p = .013), and positively with sedentary activity (r = .26, p = .004). Results of the hierarchical regression analyses showed that the explained variance (adjusted R2) for the second model (.232) was greater than that found in the first model (.051). Specifically, the second model showed that gender (β = -.49, p < .001) and aerobic fitness (β = -.32, p < .01) negatively predicted bullying victimization, and sedentary activity (β = .33, p < .001) positively predicted it.

Conclusion

Bullying victimization could be greater among boys, and in those adolescents with lower aerobic fitness and higher sedentary activity. Physical education and sport educators could consider these findings to promote more respectful and inclusive environments during their interventions. More studies exploring the association between bullying victimization and other "vulnerable characteristics" (e.g., socioeconomic status, sexual orientation, gender identity) are pertinent.

THE EFFECT OF EMPOWERING MOTIVATIONAL CLIMATE, PSYCHOLOGICAL NEEDS ON SELF RESPONSIBILITY

WANG, C.M., LIN, M.S., LU, Y.F.
SOOCHOW UNIVERSITY

Introduction

In recent years' individual responsibility has become a popular topic in sport education, providing students self-responsibility. Universities in Taiwan has a mandatory PE Course of 2 hours per week. Students may complete the four semester pe course during any of their four years in university. Thus, physical education is crucial for students as it can provide psychological and physical benefits. With the use of the empowering motivational climate from Duda et al. (2013), the current study aims to understand the relationship of psychological needs between self-responsibility among physical education students.

Methods

The study consists of 510 University students in Taiwan after elimination of invalid response 501 questionaires were used in the study. This study consist of 210 male and 291 female participants, with an average age of 18.86..The current research recruited to participate in the study, with the use of structural equation modeling with the confirmatory factor analysis (CFA), and the test for reliability to examine consistency and validity including the test of association between the variables.

Results

The analysis showed that Structural equation modeling was implemented to verify the model fit of empowerment motivational, and self-responsibility. The study model validated that relatedness was positively related to respect (β = 0.43 ***); relatedness was positively related to hard word (β = 0.45 ***) relatedness was also positively related to self-direction (β = 0.80 ***).Competence was negatively related to respect (β = -0.12 **); Competence was positively related to hard word (β = 0.2 *); Competence was positively related to self-direction (β = 0.22 **); Moreover, autonomy was was positively related to respect (β = 0.28 **); autonomy was was positively related to hard work (β = 0.24 **);and autonomy was was positively related to self-direction (β = 0.25 **). Discussion

Teachers providing an empowering motivational climate had a positive relationship with self-respect promoting more motivation and reflecting higher self responsibility behaviors. An empowering motivational climate has a positive relationship on hard work. This study establishes a causal relationship between empowering motivational climate, psychological needs, and individual responsibility, it is suggested that teachers, should implement empowering motivational climate in physical education classes, allowing student to feel related is one of the keys to bringing positivity, it can enhance strategies to build an empowering climate, which can meet psychological needs, and promote individual responsibility behaviors.

THE IMPACT OF EXERCISE HEALTH KNOWLEDGE EDUCATION INTERVENTION IN PHYSICAL EDUCATION COURSES ON UNIVERSITY STUDENTS IN THE CONTEMPLATION STAGE OF THE TRANSTHEORETICAL MODEL: EFFECTS ON COGNITIVE PERFO

HSU, K.C.1, WANG, C.A.1, HO, Y.P.2, WEN, H.J.1

1TZU CHI UNIVERSITY, 2NATIONAL TAITUNG UNIVERSITY.

Introduction: The benefits of regular exercise are plentiful; however, individuals with sedentary lifestyles are often advised to begin with exercise health education interventions. This study aims to examine the impact of exercise health knowledge interventions implemented in physical education classes on university students in the contemplation stage. Specifically, we investigate the effects on their cognitive performance in exercise and health, exercise behavior, and levels of physical activity.

Method: The study comprised 33 university students enrolled in mandatory physical education courses who were classified as being in the precontemplation or contemplation stages of the Transtheoretical Model (TTM) of exercise behavior. They were divided into an education group (EG, n=18) and a control group (CG, n=15). The EG underwent a 9-week exercise and health knowledge course utilizing a smartphone-based real-time feedback system, while the CG received conventional skill-based instruction for 2 hours once a week. Both groups completed questionnaires assessing exercise and health cognitive performance, exercise behavior stages, and levels of physical activity in the first week (pre-test) and the tenth week (post-test), comprising 40 items approved by expert scholars. Repeated measures ANOVA were conducted, with significance set at $p \leq 0.05$.

Result: There was a significant interaction effect of time × group ($F(1,31) = 36.45$, $p < 0.001$, $\eta^2 = 0.540$) on exercise and health cognitive performance, along with main effects of time ($F(1,31) = 40.61$, $p < 0.001$, $\eta^2 = 0.567$) and group ($F(1,31) = 9.02$, $p = 0.005$, $\eta^2 = 0.225$). The exercise and health cognitive performance in the EG was significantly better than that in the CG ($p = 0.005$). Furthermore, the EG exhibited a significant improvement within the group in exercise and health cognitive performance (pre: 38.1 ± 3.79 vs. post: 57.89 ± 9.25, $p < 0.01$), while no change was observed in the CG (pre: 39.73 ± 10.98 vs. post: 40.27 ± 10.36). The exercise behavior in the contemplation stages of the Transtheoretical Model (TTM) significantly changed (EG: pre: 1.8 ± 0.4 vs. post: 3.1 ± 1.0; CG: pre: 1.7 ± 0.4 vs. post: 2.4 ± 1.1). Physical activity levels showed no significant change in the EG (pre: 1568.5 ± 276.3 vs. post: 1664.0 ± 511.67 kcal/day) or in the CG (pre: 1760.02 ± 613.48 vs. post: 1653.27 ± 581.51 kcal/day).

Conclusion: The 9-week cognitive intervention did lead to significant improvements in exercise and health cognitive performance and exercise behavior among university students in the precontemplation/contemplation stages of the TTM. While the increase in physical activity did not reach statistical significance, there was a noticeable trend of enhancement. These findings offer valuable insights for experts and educators in physical education, physical activity, and health promotion when formulating policies and arranging physical education curriculum. (Supported by MOE10950B-02.)

INVOLVEMENT OF EXPERIENCED ELEMENTARY SCHOOL PHYSICAL EDUCATION TEACHERS WITH COLLEAGUE TEACHERS —FOCUSING ON THINKING IN ADVISING ON LESSON PREPARING —

UMEMURA, T., KAWAMOTO, T., MURAKAMI, M., NAKAJIMA, T.
HOKUSHO UNIVERSITY

INTRODUCTION: Recently, there has been attention to the importance of collaborative training among teachers within schools to enhance physical education classes [1]. While reports on mentoring by senior teachers within the school can be found [2], there is a need for accumulated insights regarding the involvement of experienced teachers with their colleagues within the school.

The purpose of this study was to clarify the thinking of experienced elementary school physical education teachers when interacting with non-specialized colleagues within the school context.

METHODS: The subject of this research was 11 experienced elementary school teachers in physical education classes. We selected teachers with extensive teaching experience and those holding leadership roles in the physical education community as experienced teachers. We conducted semi-structured interviews to investigate teacher's thinking toward the involvement with colleague teachers. The text date of interviews was analyzed by text-mining (KHcoder) in terms of interpretation and outputted a list of frequently occurring terms and a co-occurrence network. We got permission for this research from the principals of each elementary school. Furthermore, we explained to participants about the concept of this research and protecting privacies.

RESULTS: As a result of a text-mining analysis, it would be classified into major categories: "grasp of each child's condition,", "collaboration among teachers,", "the desired image of children to cultivate throughout the unit," and "valuation of positive teaching experiences."

Discussion:

The analysis of interviews revealed that experienced teachers were more conscious of eliciting their colleague teachers intentions and thoughts about teaching when they were planning their physical education lessons. Cooperative conversations between mentors and novice teachers are suggested not only to minimize the isolation of novice teachers during school training but also to connect overall perspectives on childrens learning in both learning theories and practical teaching [3]. Therefore, it was observed that experienced teachers are striving to share the desired image of children while standing on the same perspective as their surrounding colleagues.

References:

1. Takahiro Sato, Emi Tsuda, Douglas Ellison & Samuel R. Hodge (2020) Japanese elementary teachers' professional development experiences in physical education lesson studies, Physical Education and Sport Pedagogy, 25:(2), 137-153.

2. Kenji Kubo, Seiichiro Kihara & Kazuki Osedo (2008) A Study of Transformation of the Teacher's 'Reflection' Skill on Teaching in Physical Education of the Elementary School. Japan J. Phys. Educ. Hlth. Sport Sci. 53: 159–171.

3. Penny Lamb & Graham King (2021) Developing the practice of pre-service physical education teachers through a dyad model of lesson study. European Physical Education Review 27, (4): 944-960.

Conventional Print Poster Presentations

CP-PN02 Physiology and Molecular Biology

ASSESSING THE REPEATABILITY OF A RUNNING HEAT TOLERANCE ASSESSMENT IN TRAINED AND UNTRAINED POPULATIONS.

PALIN, T., SNAPE, D., WOODS, D., WAINWRIGHT, B., STACEY, M., OHARA, J.
LEEDS BECKETT

INTRODUCTION: Increasing hot weather and global temperatures place athletes and outdoor workers at increasing risk of Exertional Heat Illness (EHI). Heat Tolerance Assessment (HTA) has been used in surrogate for future EHI risk, in order to inform decisions on athletic return-to-play and occupational readiness, with protocols often attempting to dichotomise HTA outcomes as pass/fail. However, no international consensus exists in this area of preventative sports medicine. Furthermore, heat tolerance falls on a spectrum that may vary with individual factors including aerobic fitness and heat adaptation (acclimation or acclimatisation). In our experience, concerns arise for fitter individuals, who may pass HTA conducted at relative exercise intensity, but go on to suffer EHI with subsequent exercise-heat stress (i.e. false negative HTA result). We report data concerning metabolic responses to HTA tailored to individual factors in elite, well-trained and recreationally active athletes, and our progress towards better prognosticating EHI risk in the more highly trained.

METHODS: Comprehensive observations of exercising heat tolerance in the elite class of athlete were made before and during a structured laboratory acclimation protocol. Results were used to construct HTA based on the work of Mee et al,(1) with an extension phase of the protocol tailored to lactate thresholds. Two groups of athlete were then recruited from well-trained (WT) and recreationally active (RA) groups. Each participant performed running HTA (30 min at LT1 followed immediately by 30 min at LT2, 1% gradient, 40°C and 40% relative humidity) on two days one week apart (HTA1 and HTA2), without intervening heat adaptation.

RESULTS: Development of the HTA in elite running will be presented. As applied to WT and RA groups, HTA1 vs HTA2 showed no significant differences (P<0.05) at end exercise in core temperature (39.20 ± 0.44°C vs HTA2: 39.13 ± 0.46°C), skin temperature (38.83 ± 0.73°C vs. 38.44 ± 0.73°C), heart rate (181.20 ± 10.76 b·min-1 vs 178.00 ± 10.07 b·min-1), sweat rate (1.46 ± 0.48 kg·hour-1 vs1.25 ± 0.49 kg·hour-1), blood lactate (3.21 ± 1.41mmol·L-1 vs. 3.08 ± 1.34 mmol·L-1) or perceptual scores. Robust agreement between HTA1 and HTA2 was reflected in significant correlations and minimal participant variability on repeatability scoring. Nevertheless, the coefficient of variation was consistently lower for the WT group than the RA group, despite WT achieving significantly higher core body temperature than RA (WT: 39.50 ± 0.00, RA: 38.94 ± 0.42).

CONCLUSION: Our results imply that the HTA is a reliable indicator of physiological and perceptual strain in hot conditions, with increased reliability in fitter individuals. Further work is required to understand its repeatability with heat acclimation and accuracy in predicting recovery from, and future susceptibility to, EHI.

1. Mee, J. A., Doust, J. and Maxwell, N. S. (2015) Repeatability of a running heat tolerance test. Journal of Thermal Biology, 49, pp. 91-97.

INVESTIGATING THE IMPACT OF MENOPAUSE ON FUEL UTILISATION AND ENERGY EXPENDITURE DURING EXERCISE

RATTLEY, K., DEWHURST, S., FELTON, M., NEAL, R.

BOURNEMOUTH UNIVERSITY

INTRODUCTION: There is a decrease in daily energy expenditure in women during mid-life regardless of menopause stage, but oestrogen deficiency also leads to reduced resting, sleeping, exercise and total energy expenditure. Identifying the deficit in exercise energy expenditure that can be attributed to menopause will aid the development of specific exercise prescription guidance, which may support healthy ageing in and after menopause. This study aimed to evaluate the impact of perimenopause and postmenopause on exercise energy expenditure and respiratory exchange ratio during exercise to maximal intensity.

METHODS: 53 women (PRE: 27 ± 4 yr; PERI: 47 ± 5 yrs; POST: 55 ± 3 yrs; 167.8 ± 5.2 cm, 69.3 ± 9.8 kg), categorised as premenopausal (PRE, n=16), perimenopausal (PERI, n=17) and postmenopausal (POST n=20), completed a maximal aerobic capacity (VO2 max) ramp test on a cycle ergometer, with expired gases measured throughout. Body composition was assessed by bioelectrical impedance. Resting plasma oestradiol, measured by enzyme linked immunosorbent assay (ELISA), was used to confirm menstrual status. Naturally menstruating premenopausal and perimenopausal women were tested during the early follicular phase (1-7 days after starting menstruation), and postmenopausal or hormonal contraceptive users at earliest convenience. Respiratory exchange ratio (RER), energy expenditure, and fat-carbohydrate oxidation crossover point were evaluated between groups using mixed-effects analysis of variance.

RESULTS: Throughout the test, there were differences in energy expenditure between groups (p = 0.02), with the PRE group demonstrating a higher energy expenditure (9.6 ± 3.1 kcal·min-1) than the POST group (8.2 ± 2.7 kcal·min-1) (p<0.05). Body fat mass was different between groups (PRE: 15.6 ± 5.9kg; PERI: 19.8 ± 7.0kg; POST: 22.5 ± 10.1kg, p = 0.05). When normalised for body fat mass, differences in energy expenditure remained (PRE: 0.72 ± 0.22 kcal·min-1·kgBFM; PERI: 0.53 ± 1.9 kcal·min-1·kg·BFM; POST: 0.43 ± 0.14 kcal·min-1·kg·BFM; p<0.01), with PRE energy expenditure greater than POST energy expenditure throughout (p<0.05). There were no differences in the RER (PRE: 0.97 ± 0.13; PERI: 0.96 ± 0.13; POST: 0.96 ± 0.13, p = 0.49) or the exercise intensity at which fat-carbohydrate oxidation crossover occurred between the groups (PRE: 49.6%; PERI: 52.1%, POST: 54.0% of VO2 max, p>0.05).

CONCLUSION: Menstrual status did not impact RER during exercise; this is the first study to evidence that menopause has no effect on RER throughout a maximal exercise test. However, in postmenopause energy expenditure may be limited across all intensities during a maximal exercise test suggesting a ceiling effect potentially linked to increased body fat mass. Further research should evaluate the responses to ecologically valid doses of exercise of women across the lifecycle to better understand the changes that occur and the role of oestrogen deficiency in menopause.

SEX-RELATED DIFFERENCES IN MUSCLE OXYGEN SATURATION IN TRAINED RUNNERS

RODRÍGUEZ-BARBERO EXPÓSITO, S., GONZÁLEZ-RAVÉ, J.M.1, MUÑOZ DE LA CRUZ, V.1, RODRIGO-CARRANZA, V.1, AGUDO-ORTEGA, A.1, SALINERO, J.J.1, GONZÁLEZ-MOHÍNO, F.1,2

1SPORT PERFORMANCE RESEARCH GROUP, FACULTY OF SPORT SCIENCES, UNIVERSITY OF CASTILLA-LA MANCHA, TOLEDO, SPAIN. 2 FACULTAD DE CIENCIAS DE LA VIDA Y DE LA NATURALEZA, UNIVERSIDAD NEBRIJA, MADRID, SPAIN.

INTRODUCTION: Near-infrared spectroscopy (NIRS) is a non-invasive method to measure and evaluate muscle oxygenation in local tissue (1). It is important to note that possible sex-related differences affect the oxygen transport system depending on exercise intensity (2). However, there is a lack of information on possible sex-related differences in muscle oxygenation responses in other exercise modes such as running. Therefore, the present study aimed to analyze possible sex-related differences in muscle oxygen saturation in trained runners.

METHODS: Twelve male and sixteen female trained runners participated in the study. A maximal graded exercise test (GXT) (HP Cosmos Pulsar, HP Cosmos Sports & Medical GMBH, Nussdorf-Traunstein, Germany) was performed. The test started at 8 km·h-1 and 10 km·h-1 for females and males, respectively, and the speed was then increased by 1 km·h-1 every minute until voluntary exhaustion. Two portable NIRS devices (Moxy Monitor) were placed to measure muscle oxygen saturation (SmO2) in the vastus lateralis (VL), at 2/3 of the distance between the line from the anterior spina iliac superior to the lateral side of the patella; and at the most prominent bulge of the medial gastrocnemius (GN). During GTX,

respiratory variables were measured using a gas analyzer (CPX Ultima Series MedGraphics). First (VT1) and second (VT2) ventilatory thresholds and maximal oxygen uptake (VO2max) were identified for each participant. A repeated measures ANOVA was used to compare the differences in SmO2 produced at each threshold with sex as an inter-subject factor.

RESULTS: There were no significant differences in the interaction threshold (VT1, VT2 and VO2max) × sex (men vs. woman) in SmO2. The mean values in SmO2 of VL and GN were significantly lower ($p<0.001$) at VT2 and VO2max in comparison with VT1. Woman presented higher values ($p<0.001$) in SmO2 of VL at VT1 (76.5 vs. 45.5%), VT2 (56.4 vs. 28.0%) and VO2max (41.1 vs. 12.5%) compared to men. The percentage of reduction in SmO2 between VT2 and VO2max were significantly higher ($p<0.004$) in men (56.0 vs. 27.4%) compared to women.

CONCLUSION: The measurement of SmO2 in GN and VL allow to identify a breaking point between the oxygen supply and consumption through NIRS. However, SmO2 had a different behavior in both muscles. Thus, women had higher SmO2 in the three points analyzed in VL but not in GN. Both sexes showed similar patterns of decrease in SmO2 as metabolic demand increases. However, men displayed a strong decline in the VL at VT2 which indicates a better oxygen supply in the active tissues. This fact can be related to a higher muscle vasodilation capacity in females that leads to a redistribution of oxygen to the active tissues and to a higher estrogen concentration.

REFERENCES

1. Kitada T, Machida S, Naito H. BMJ Open Sport Exerc Med. 2015;1(1):e000062.

2. Sendra-Perez C, Priego-Quesada JI, Salvador-Palmer R, Murias JM, Encarnacion-Martinez A. J Appl Physiol (1985). 2023;135(5):1092-101.

MODULATION OF ACE2 AND THE MAIN COMPONENTS OF THE RENIN-ANGIOTENSIN SYSTEM IN HUMAN SKELETAL MUSCLE BY BLOOD FLOW RESTRICTION WALKING TRAINING.

GARCIA-GONZALEZ, E.1, THOMPSON, K.M.A.2, GALVAN ALVAREZ, V.1, MARTINEZ-CANTON, M.1, GALLEGO-SELLES, A.1, GARCIA-PEREZ, G.1, MORALES-ALAMO, D.1, SKATTEBO, Ø.3, DE PAZ, J.A.4, BOUSHEL, R.5, HALLEN, J.3, MARTIN-RINCON, M.1, BURR, J.F.2, CALBET, J.A.L.1,3

1 IUIBS AND ULPGC, SPAIN; 2 UNIV. OF GUELPH; 3 NIH, NORWAY; 4 IBIOMED, ULE, SPAIN; 5 SCHOOL OF KINESIOLOGY, UBC, CANADA.

INTRODUCTION: Blood Flow Restriction (BFR) added to any intensity endurance training improves the aerobic capacity of young healthy individuals and trained athletes, likely by acting as a major stressor on fluid regulating systems, as well as on vessel and cardiovascular function. An acute BFR session increases the concentration of blood volume (BV) regulating-hormones such as renin and copeptin, which could be mediated by changes in the main components of the Renin Angiotensin System (RAS). Furthermore, Angiotensin-converting enzyme 2 (ACE2) is a critical modulator of the hyperemic response to exercise and/or BFR. The aim of the study was to assess the changes in maximal aerobic capacity (VO2max) and to determine the effects on basal skeletal muscle (SM) expression of ACE2, its regulatory protein ADAM17 and key components of the RAS elicited by BFR added to walking training in highly trained athletes.

METHODS: Ten highly trained athletes (31.5 ± 5.1yr; 59.2 ± 8.9ml.kg-1, min-1; 7M/3F) were divided into BFR training group (BFR, 100% lowest occlusion pressure) (N=6) and control (CON) (N=4). Both groups performed 6 weeks (3x/week) of 5x3min at 5km/h and 5% incline separated by 1min rest. Resting biopsies were taken from m. vastus lateralis at PRE and POST. Protein expression was measured by WB. Statistics analysis: ANOVA and t-test.

RESULTS: At POST, BFR group showed a significant increase in VO2max (+4.1%, $p=0.017$), that was not present in CON. The protein levels of ACE2 were upregulated in BFR by 25% ($p=0.05$), while remained unchanged in CON (time*group; $p=0.026$). The protein levels of ACE were not modified by training (t-test; $p>0.05$), regardless of group (time*group; $p=0.72$). Similarly, there were no significant changes from PRE to POST for AT1R or AT2R in any groups (t-test; $p>0.05$), with a similar response across groups (time*group; $P>0.31$). The levels of ADAM17 were not significantly reduced by 12.6% in BFR ($p=0.16$), while remained unchanged in CON (time*group; $p=0.26$).

CONCLUSION: This study shows that BFR added to walking improves VO2max and increases the expression levels of ACE2, without apparent changes in other components of the RAS nor ADAM17 in SM of highly trained athletes. We have recently shown a linear association between SM ACE2 and VO2max, which might imply that high levels of ACE2 are present in this population. Nonetheless, data shows that BFR training during walking can be a sufficient stimulus to increase ACE2 in SM, which may facilitate muscle perfusion, oxygen delivery and explain the observed increase in VO2max. Besides a higher ACE2 expression, increasing the conversion of Angiotensin 2 to Angiotensin 1-7 may limit the BV expansion stimulation elicited by activation of the RAS in the context of BFR. It remains to be elucidated what are the effects of BFR training on the expression of ACE2 in less fit individuals and whether it plays role in performance or hemodynamical adaptations.

GRANTS: PID2021-125354OB-C21, CSD EXP_75097

GENOME-WIDE ASSOCIATION STUDIES IN ELITE JAPANESE ATHLETES

KOZUMA, A., ZEMPO, H.2, SAITO, M.1, HOMMA, H.1, DE ALMEIDA, K.Y.1, DEGUCHI, M.1, MATSUMOTO, S.1, MATSUMOTO, R.3, OKAMOTO, T.1, NAKAZATO, K.1, KIKUCHI, N.1

1 NIPPON SPORT SCIENCE UNIVERSITY, 2 TOKYO SEIEI COLLEGE, 3 IKUEI UNIVERSITY

INTRODUCTION: The heritability of athlete status is estimated at 66% (De Moor et al., 2007). In addition, 253 gene polymorphisms have been reported to be associated with athlete status (Semenova et al., 2023). In this study, we aimed to perform genome-wide association studies (GWAS) in elite Japanese wrestlers to identify novel gene polymorphisms (Study 1) and to replicate the novel gene polymorphisms in another cohort of Japanese wrestlers and elite Japanese weightlifters (Study 2).

METHODS: Study 1 enrolled 41 highly elite wrestlers (35 men and 6 women) who participated in the Olympic games and senior international competitions, and 306 controls (143 men and 163 women). Total DNA was extracted from saliva samples using an Oragene-DNA kit. The subject's gene polymorphisms were genotyped by the Japonica Array v2. This study was a case-control study, with $p < 5\times10^{-8}$ considered statistically significant and the $p < 5\times10^{-5}$ was considered as a suggestive line. Study 2 of the replication cohort included 40 elite wrestlers (31 men and 9 women) from the national competition level and 69 elite weightlifters (38 men and 31 women) from the international competition level (including Olympic games). Targeted controls and genotyping used the same methods as in Study 1. Statistical significance was set at $p < 0.05$.

RESULTS: The GWAS results of Study 1 identified 31 gene polymorphisms that reached $p < 5\times10^{-8}$ and 487 SNPs that reached $p < 5\times10^{-5}$. The identified gene polymorphisms were then divided into 69 regions. The top gene polymorphism was the RBPMS gene rs3116007 polymorphism ($p = 8.67\times10^{-9}$, T allele), located on chromosome 8 and encoding a member of the RNA recognition motif family. Replicated in Study 2, the RBPMS gene rs3116007 polymorphism showed a trend indicating a potential association in elite wrestlers ($p = 0.081$, T allele) and a significant difference in elite weightlifters compared to controls ($p = 0.022$, T allele).

CONCLUSION: Our results identified novel gene polymorphisms associated with high elite Japanese wrestlers. In addition, RBPMS gene rs3116007 polymorphism was similarly trended in elite wrestlers and elite weightlifters.

CONCUSSION-ASSOCIATED GENE VARIANTS AND HISTORY OF CONCUSSION IN ELITE RUGBY ATHLETES.

ANTROBUS, M., BRAZIER, B., CALLUS, P., HERBERT, A., STEBBINGS, G., KHANAL, P., DAY, S., KILDUFF, L., BENNETT, M., ERSKINE, R., RALEIGH, S., COLLINS, M., PITSILADIS, Y., HEFFERNAN, S., WILLIAMS, A.

UNIVERSITY OF NORTHAMPTON

INTRODUCTION: Occurrence of and outcomes following a concussion are probably affected by the interaction of multiple genes in a polygenic manner. This study investigated whether suspected concussion-associated polygenic profiles of elite rugby athletes (RA) with a history of previous concussion differed from RA with no history of previous concussion. We hypothesised that concussion-associated risk genotypes would be underrepresented in RA with no history of concussion compared to RA with a history of previous concussion.

METHODS: Participants were from the RugbyGene project, comprising elite male rugby athletes (141 White males; mean (standard deviation) height 1.86 (0.07) m, mass 102 (12) kg, age 26 (5) yr) competing at an elite level in rugby union (n = 121) and league (n = 20) in the UK, Ireland, Italy and South Africa. Concussion history was collected using a self-reported concussion history questionnaire. PCR of genomic DNA was used to determine genotypes using TaqMan probes, and total genotype scores (TGS) were calculated, then groups were compared using $\chi 2$ and odds ratio (OR) statistics. In addition, multifactor dimensionality reduction (MDR) was used to identify genetic interactions.

RESULTS: Seventy-six percent of rugby athletes reported a history of sustaining at least one concussion and 52% of rugby athletes reported sustaining multiple (≥2) concussions from rugby. For APOE rs405509, the GG genotype was more common in RA with a history of at least one concussion compared to RA with no history of concussion (26.7% vs 12.5%, $P \leq 0.001$, OR = 2.10, 95% CI = 0.58-7.5). The TT genotype of APOE rs405509 was more common (30.8% vs. 26.0% P = 0.036), in rugby athletes with a concussion recovery duration of >10 days (30.8% vs. 26.0%, P = 0.03, OR ≥ 4.14, 95% CI = 1.14-15.06). For COMT rs4680, the AA genotype was more common in RA with history of at least one concussion compared to RA with no history of concussion (37.5% vs 28.3 % OR ≥ 2.10 $P \leq 0.001$, 95% CI = 0.84-10.04). However, TGS did not differ between RA with no previous history of concussion and RA with a previous history of concussion ($p \geq 0.018$).

CONCLUSION: These findings presented support the growing evidence that incidence and recovery from concussion could be influenced by an athlete's genetic predisposition. Such knowledge could be used, in future and when additional relevant variants have been identified, to inform individualised management strategies for athletes in possession of risk genotypes.

TENDON AND LIGAMENT INJURY-ASSOCIATED GENE VARIANTS AND HISTORY OF SOFT TISSUE INJURY IN ELITE RUGBY ATHLETES

BRAZIER, J., ANTROBUS, M.R., RALEIGH, S.M., CULLEN, T., STEBBINGS, G.K., DAY, S.H., HERBERT, A., HEFFERNAN, S.M., CALLUS, P., KILDUFF, L.P., ERSKINE, R.M., WILLIAMS, A.G.

UNIVERISTY OF HERTFORDSHIRE

INTRODUCTION: There is a genetic component to tendon and ligament injuries which is highly likely to be polygenic in nature. Elite rugby has one of the highest reported injury incidences of any professional sport with some of the most severe injuries affecting tendons and ligaments. Thus, this study investigated if suspected tendon and ligament injury-associated polygenic profiles of elite rugby athletes (RA) with a history of prior tendon and ligament injury differed from RA with no history of injury. We hypothesised that tendon and ligament injury-associated genotypes and polygenic profiles would be overrepresented in RA with a history of soft tissue injury compared to RA with no history of injury.

METHODS: Participants from the RugbyGene project were elite white male RA (n = 133; mean (standard deviation) height 1.86 (0.07) m, mass 102 (12) kg, age 26 (5) yr), including 111 rugby union athletes and 22 rugby league athletes. Soft-tissue injury history was collected utilising a self-reported questionnaire. PCR of genomic DNA was used to determine genotypes using TaqMan probes, then groups were compared using X2 and odds ratio (OR) statistics, with alpha set at $P<0.05$. Total genotype scores, SNP-SNP epistasis and inferred haplotypes were used to quantify the combined influence of the polymorphisms.

RESULTS: For COL5A1 rs12722, the CC genotype, proportion of C-allele carriers and C allele were overrepresented in the non-injured ligament group (NIL) (34.3%, 85.9% and 58.6%, respectively) compared to ligament rupture (LR) (19.6%, 66.6% and 43.1%, $P < 0.02$). Furthermore, C-allele carriers were overrepresented, whilst the TT genotype was underrepresented in NIL (86.9% and 17.1%) compared to ligament sprain (LS) (69.8% and 30.2%, $P < 0.02$). NIL had 3.5 times the odds of carrying the CC genotype compared to LR. For MMP3 rs679620, the T allele was overrepresented and C-allele carriers underrepresented in non-injured tendon group (NIT) (23.5%, 44.7% and 76.5%, respectively) compared to the tendinopathy group (TY) (5.7%, 28.6 and 94.3%, $P < 0.03$). Additionally, the C-C inferred haplotype frequency of COL5A1 rs12722 and COL5A1 rs3196378, respectively, was higher in NIL and the all non-injured athlete group compared to LR, LS and the all-injured athlete group ($P < 0.01$). Furthermore, the C-A-G inferred haplotype frequency of MMP3 rs591058, rs650108 and rs679620 was lower in NIT than tendon rupture group ($P < 0.01$).

CONCLUSION: The current data suggest that elite rugby athletes with no history of soft-tissue injury appear to have inherited more resistance to soft tissue injury than their injured peers. The current study provides further insight into the detailed aetiology of musculoskeletal soft tissue injuries within elite rugby and may, in future, be worthy of consideration for managing the interindividual variability of injury risk in rugby.

A GENETIC ASSOCIATION STUDY OF TENDON AND LIGAMENT INJURIES IN ATHLETES: A SYSTEMATIC REVIEW AND META-ANALYSIS

FUKUYAMA, Y., MURAKAMI, H.1, IEMITSU, M.1

1. RITSUMEIKAN UNIVERSITY 2. AINO UNIVERSITY

INTRODUCTION: Athletes train not only for maximum performance, but also to prevent sports injuries. However, athletes cannot avoid sports injuries during intense training and competitions. Among sports injuries, tendon and ligament injuries occur at a rate of 20–30% [1]. In recent studies, one of the intrinsic risk factors that has been identified includes genetic factors that influence the risk of tendon and ligament injuries [2, 3]. Previous studies have not included integrated analyses of multiple genetic factors and tendon and ligament injuries owing to limited sample sizes, differences in athletic competitions, and sex differences. This systematic review and meta-analysis aim to identify the association between gene polymorphisms and tendon and ligament injuries in athletes.

METHODS: A literature search for systematic reviews and meta-analyses was conducted using five databases: PubMed, Web of Science, EBSCO, Cochrane Library, and MEDLINE. All articles were published before July 7, 2023. Eligible articles included genetic studies on tendon and ligament injuries and comparisons between groups of injured and non-injured (control) athletes. Independent reviewers extracted the data. The quality of each article included in the meta-analysis was assessed using the Newcastle-Ottawa Scale (NOS). The odds ratio (OR) and 95% confidence interval (95% CI) were calculated from the sample size of each article. DerSimonian and Laird random-effects model was used, and the heterogeneity between articles was determined using the Q-statistical and I2 test. A $p < 0.05$ was considered statistically significant.

RESULTS: This review comprised 31 articles, comprising 1,687 injuries and 2,227 controls in a meta-analysis of 12 articles. We identified 144 candidate gene polymorphisms, and the meta-analysis included vascular endothelial growth factor A (VEGFA) rs699947, collagen type I alpha 1 rs1800012, collagen type V alpha 1 rs12722, and matrix metalloproteinase 3 rs679620 polymorphisms. The VEGFA rs699947 polymorphism showed a lower risk of injuries in athletes with the C allele ([C vs. A]: OR = 0.80, 95% CI: 0.64–0.99, I2 = 5.0%, p = 0.04). However, the other polymorphisms were not significantly affected. All gene polymorphisms showed no significant publication biases.

CONCLUSION: The VEGFA rs699947 polymorphism is associated with the risk of tendon and ligament injuries in athletes. This result indicates that insights into genetic variations partially contribute to our comprehension of the risk factors for such injuries in athletes.

[1] Clifton DR et al. (2018), [2] Westin M et al. (2016), [3] Lulińska-Kuklik E et al. (2018)

GENOTYPE SCORE RELATED TO HEPCIDIN REGULATION IS ASSOCIATED WITH IRON STATUS IN JAPANESE MALE ATHLETES

TAKARAGAWA, M., MIYAMOTO-MIKAMI, E., NAGATO, S., NAKAMURA, A., YAMAZAKI, K., FUKU, N.
JUNTENDO UNIVERSITY

INTRODUCTION: Athletes are likely to be more susceptible to iron deficiency and anemia than the general population, due to the fact that they lose more iron as a result of hemolysis and sweating (Rodenberg et al., Corr Sports Med Rep, 2007). Athletes are therefore advised to increase their iron intake. However, factors involved in interindividual differences of intestinal iron absorption have received little attention in general instruction. Iron levels in the body are tightly regulated by hepcidin hormones, which alter the rate of intestinal iron absorption: high levels of hepcidin lead to lower iron absorption, while lower levels of hepcidin lead to higher iron absorption. Previous studies have reported that hepcidin levels are influenced by genetic factors. Therefore, this study examined the association between genetic factors involved in hepcidin regulation and iron status in athletes.

METHODS: A total of 147 Japanese male collegiate track and field athletes were enrolled. These athletes were subjected to a fasting blood draw, a diet and iron supplements survey questionnaire, and saliva collection. Serum ferritin and iron levels were evaluated using latex agglutination turbidimetry and direct colorimetry methods, respectively. Serum hepcidin was measured in duplicate using the Hepcidin-25 ELISA kit according to the protocol provided by the manufacturer. Genetic polymorphisms associated with hepcidin regulation (TMPRSS6 rs855791 T/C, KDM3AP1-SLC40A1 rs12693541 C/T, KDM3AP1-SLC40A1 rs744653 C/T, TFR2 rs7385804, and HFE rs1799945) were analyzed using the TaqMan SNP Genotyping Assay. An individual's genotype score was calculated as follows: a score of 0, 1, and 2 was assigned to each genetic polymorphism, starting with the allele predicted to have high hepcidin levels, from which the total score of the five genetic polymorphisms was calculated.

RESULTS: In linear models, higher genotype scores exhibited a significantly lower hepcidin concentration normalized by ferritin concentration ($R2 = 0.22$, $P = 0.030$). In addition, the higher genotype scores indicated significantly higher serum iron and ferritin concentrations ($R2 = 0.06$, $P = 0.003$ and $R2 = 0.06$, $P = 0.005$, respectively). No significant correlation was observed between the genotype score and the iron or vitamin C intake. The daily iron intake of the athletes was 17.6 g/day, which was more than double the mean iron intake (7.4 g/day) of Japanese general males aged 20-29 years. However, the daily iron intake indicated a significant negative correlation with iron status (serum iron: $r = -0.18$, $P = 0.03$ and ferritin: $r = -0.17$, $P = 0.04$, respectively).

CONCLUSION: Genetic factors involved in hepcidin regulation are associated with iron status in Japanese male collegiate athletes. Our results suggest that genetic information could be used to develop a novel dietary approach that considers iron absorption from the intestinal tract.

SKELETAL MUSCLE GENES ASSOCIATED WITH INFLAMMATION AND INSULIN RESISTANCE ARE INCREASED IN A 'COMPLEX' HUMAN MUSCLE DISUSE MODEL

ALOTHMAN, S., JAMESON, T., KILROE, S., WALL, B., STEPHENS, F.
PRINCESS NOURAH BINT ABDULRAHMAN UNIVERSITY

INTRODUCTION: Human models of muscle disuse are associated with muscle atrophy, insulin resistance of carbohydrate metabolism, and lipid accumulation. However, in practice, muscle disuse is often preceded by injury or trauma causing an inflammatory response. The aim of the present study was to characterize the changes in expression of skeletal muscle genes associated with inflammation and carbohydrate and lipid metabolism in a 'complex' human muscle disuse model that has been preceded by muscle damaging exercise.

METHODS: Twenty-one healthy males (20±1yr, BMI 24±1 kg/m2) completed a 7-day period of knee immobilization that either proceeded by no exercise (CON; n=11) or a bout of 300 bilateral and maximal eccentric muscle contractions (DAM;n=10) immediately before immobilization. At days 0, 2, and 7 muscle biopsies were obtained. Muscle mRNA expression of 12 genes that encode inflammatory proteins known to respond to damaging exercise, and proteins that are rate limiting steps in muscle carbohydrate and lipid metabolism, was determined by Real-Time PCR. Muscle mRNA expression was calculated using the $2^{-\Delta\Delta CT}$ method, with the log2 fold change in mRNA abundance calculated relative to the non-immobilized leg at day 0 for each participant. The study was approved by the Sport and Health Sciences Ethics Committee of the University of Exeter (171206/B/08). Data were analysed using repeated-measure two-factor ANOVA tests (with condition (CON vs. DAM) and time as within-participant factors.

RESULTS: Immobilization increased expression of the inflammation related genes monocyte chemoattractant protein 2 (CCL8), interleukin 18 (IL18), and a tumor necrosis factor alpha receptor (TNFRSF12A) in both groups after 7 days ($P<0.01$), whereas an interleukin 1 receptor (Il1RL1) did not change. Prior eccentric exercise in DAM resulted in greater upregulation of IL18 ($P<0.05$) and TNFRSF12A ($P<0.05$) at day 2. Carbohydrate metabolism associated genes for pyruvate dehydrogenase 4 (PDK4) showed upregulation earlier at day 2 of immobilisation in DAM ($P<0.01$) compared to D7 in CON ($P<0.05$), while both glycogen phosphorylase (PYGM) and lactate dehydrogenase (LDHA) genes were downregulated in response to immobilization similarly in both groups ($P<0.05$). No significant change was observed in hexokinase 2 (HK2) expression. The expression of genes associated with fat oxidation (HADHB, ACAT1, and CPT1B) was decreased ($P<0.05$), and a gene associated with lipid storage (PNPLA2) was increased ($P<0.05$), to a similar degree in both groups after 7 days.

CONCLUSION: Observed changes in genes expression involved in fat and carbohydrate metabolism after immobilisation are consistent with a decrease in oxidation expected with reduced energy demand. Damaging eccentric exercise induced an inflammatory response after 2 days of immobilisation that was associated with a pattern of earlier reduction in carbo-

hydrate (PDK4), but not fat oxidation, suggesting that inflammation may exacerbate the insulin resistance of physical inactivity.

Conventional Print Poster Presentations

CP-BM02 Neuromuscular Physiology

IMPACT OF CHRONIC SLEEP RESTRICTION ON PERFORMANCE AND NEURAL CONTROL OF SUSTAINED CONTRACTIONS: AN EEG-EMG APPROACH

SEYNAEVE, M., MANTINI, D., VANWANSEELE, B., DE BEUKELAAR, T.T.
KU LEUVEN

INTRODUCTION: In modern society insufficient sleep is increasingly prevalent, with one in three adults being chronically sleep-deprived. While the effect of this chronic sleep restriction (CSR) on cognitive functioning is well-established, the effects on motor control remain less clear. Some studies suggest a negative effect of insufficient sleep on tasks requiring higher sensorimotor control, such as balance tasks or submaximal contractions. However, we are still not able to pinpoint the exact underlying neural mechanisms behind this phenomenon. Therefore, this study aimed (i) to examine the effect of CSR on the ability to sustain submaximal plantarflexion (PF) and dorsiflexion (DF) contractions and (ii) to identify the underlying neural mechanisms using high-density electroencephalography (hdEEG) and electromyography (EMG).

METHODS: Using actigraphy, we monitored the sleep pattern of healthy, young male participants for 15 consecutive nights. Motor control was evaluated after four different sleep periods: a baseline period consisting of three nights of habitual sleep (M1), a control period of four nights with normal sleep duration (M2), a period of CSR lasting four nights during which participants slept for only five hours per night (M3), and a recovery sleep period spanning three nights (M4). Motor control assessments consisted of a series of submaximal DF and PF contractions. More specifically, participants performed 6 DF and 6 PF contractions of one minute at 40% of the maximal voluntary contraction (MVC) and 1 submaximal DF and PF contraction until failure. During these contractions, brain activity was measured using hdEEG, and muscle activity of soleus, gastrocnemius, and tibialis anterior muscle using EMG. Complexity and variability of the torque and EMG signals, co-contraction ratios, time until failure, and power in different EEG bands were statistically analyzed using a repeated-measures ANOVA design.

RESULTS: Data is currently being collected and analyzed. We hypothesize that participants ability to resist fatigue will be diminished after the period of CSR. Therefore, markers of fatigue will manifest earlier and to a larger extent. These fatigue markers include (i) a decrease in torque complexity based on detrended fluctuation analysis and entropy measures, (ii) an increase in torque variability, (iii) a decrease in median frequency of the EMG signal, (iv) increased muscle activity co-contraction ratios, (v) decreased time until failure and (vi) increase in EEG power bands. We anticipate that these markers will return to baseline levels following three nights of recovery sleep.

CONCLUSION: A better understanding of the effect of CSR on motor control can offer important insights for clinicians, coaches, and athletes to improve performance, injury prevention programs, and overall health.

MUSCLE ACTIVATION WITHIN HAMSTRING MUSCLES DURING STRENGTHENING EXERCISES: A SYSTEMATIC REVIEW

GUILHEM, G., POIRIER, C., AMEN, X., HEGYI, A., MACCHI, R., GIROUX, C., LACOURPAILLE, L.
FRENCH INSTITUTE OF SPORT

INTRODUCTION: Hamstring muscles play a crucial role in lower limb movement with potential impact on performance, e. g. sprint running [1,2]. The distribution of electromyographic (EMG) activity within hamstrings is highly variable across individuals, influences motor performance and is affected by previous injury [3,4]. Therefore, having an exhaustive understanding of the distribution of muscle activity within hamstring muscles may be particularly useful to design individualized training programs. The aim of the present systematic review was to evaluate hamstring EMG activity during strengthening exercises.

METHODS: Databases used were PubMed, Cochrane Library, and Web of Science with publication date before First January 2023. The references list from the studies included were checked. The search (PICO) strategy selected studies including healthy adults without lower extremity injury, reporting biceps femoris long heads (BFlh) and semitendinosus (ST) activation during hamstring strength exercises. No comparison was considered due to specific cross-sectional study designs. The root mean square (RMS) expressed as a percentage of maximal voluntary isometric contraction and activation ratio (BFlh/ST) were primary outcomes. Nine inclusion criteria and six exclusion criteria were checked by two distinct investigators. Hierarchical ascending classification was applied to cluster strengthening exercises according to BFlh and ST activation.

RESULTS: The search strategy found 302 studies after checking for duplicates. After inclusion screening, 58 studies analysing 23 different exercises were considered. Muscle activations were highly variable across studies, ranging from 5 to 145% for BFlh and 3 to 220% for ST. Hierarchical ascending classification provided 3 different clusters. Cluster 1 exercises included exercises eliciting low activation levels (<40% MVC) preferentially oriented towards BLfh (leg raise, sit-up, leg press, lunge, squat, good morning, kettlebell swing). Cluster 2 included exercises eliciting high activation levels (>80%

MVC) preferentially oriented towards BFlh (sprint, knee curl and leg curl). Custer 3 included exercises with moderate activation levels (40 to 60% MVC) oriented towards ST (sidewise jump, bridge, hip thrust, Sorenssen, Nordic hamstring, unilateral bridge, drop jump, forward jump, hip hinge, cable pulley, deadlift, glider and hip extension).

CONCLUSION: A substantial amount of literature describes medial and lateral hamstring activation across various types of exercises. Significant variability in muscle activation is reported, likely due to differences in movement amplitude, exercise intensity (loading) and posture or execution variations. Independently from these factors, the present systematic review demonstrates that exercise modality can be used to modulate muscle activation in specific muscle heads. These findings can be used by coaches and practitioners to target BFlh or ST for athletic, prevention or rehabilitation purposes.

EFFECTS OF ELECTRICAL MUSCLE STIMULATION AND VOLUNTARY CONTRACTION COMBINED WITH HYPOXIA ON MUSCLE STRENGTH AND NEUROMUSCULAR ACTIVITY

UCHIMARU, J., SON, D.L., SATO, J.

SENDAI UNIVERSITY

INTRODUCTION: Electrical muscle stimulation (EMS) also has been proved to be an alternative method or comparable therapy to traditional strength training by voluntary contractions [1]. Furthermore, both training combined with hypoxia increase muscle strength and induce hypertrophy compere to normoxia [2]. These types of training would be similar effects in skeletal muscle function [3] [4], but the fatigue process and/or muscle fibers' activation seem to be different. Also, hypoxia would be more influence on muscle contractions, muscle fatigue and neuromuscular activations. To our knowledge, there is no research explained why the different mechanisms induce similar effects and what the specific difference is in these exercise modes. We evaluate the effects of voluntary contraction and EMS combined with hypoxia on strength and neuro-muscular activity.

METHODS: Nine healthy and physically active male people participated in this study. Participants completed the four trials; 1) voluntary contraction with normoxia (N-VOL), 2) EMS with normoxia (N-EMS), 3) voluntary contraction with hypoxia (14.5% O2) (H-VOL) and 4) EMS with hypoxia (H-EMS) separated by one-week wash out period. VOL and EMS trial composed of 50 repetitions of 5 seconds tetanic contraction of the thigh. Also, the stimulation intensity with EMS was set to the maximum intensity that they could tolerate. Voluntary contraction was defined as the participants maximum effort. We measured the following measurements before and after trials: knee extent maximal isometric strength (MVC) and EMG activity of rectus femoris muscle (RF), vastus lateralis muscle (VL) and vastus medialis muscle (VM) during tetanic contraction of the thigh, and at 20%, 40%, 60%, 80% and 100%MVC. The root mean square (RMS) and integral electromyogram (iEMG) were analyzed from the EMG data. Additionally, blood lactate concentrations (BLa) were measured before and after trials. Two-way ANOVA with Tukey's test were performed to identify any significant ($P<0.05$).

RESULTS: MVC did not change after each trial. RMS and iEMG at maximum tetanic contraction decreased in N-EMS and increased in H-VOL and H-EMS. RMS and iEMG of VL and VM muscles at submaximal and maximal strength increased (4-10%) after the N-VOL and H-VOL trials. However, N-EMS trial decreased in RMS and iEMG of all muscles, and no change was observed in H-EMS. BLa was significantly increase after H-VOL (from 1.3 to 1.8 mmol/L), N-EMS (from 1.4 to 2.0 mmol/L) and H-EMS trials (from 1.2 to 2.1 mmol/L) ($P<0.05$).

CONCLUSION: From these results, our main findings were as follows: 1) the decrease in EMG activity after EMS may be affected by force production and muscle fatigue with blood lactate accumulation, 2) exercise in a hypoxic environment may induce neuro-muscular activation to maintain force production, regardless of voluntary and involuntary contractions such as EMS.

EXAMINATION OF CHRONOLOGICAL CHANGES IN NEUROMUSCULAR COOPERATIVENESS BEFORE AND AFTER MUSCLE FATIGUE LOADING USING SILENT PERIOD AS AN INDEX.

TAKEMURA, M., KANAMORI, A., MIYAKAWA, S.

リハビリテーション健康科学部学科

INTRODUCTION: It is said that sports injuries are more likely to occur during fatigue. In addition, the function of neuromuscular cooperativeness is important for smooth switching and turning movements that cause sports injuries. The silent period (SP) is a pause in muscular electrical activity observed in a surface electromyography, before a muscular activity is started, leading up to a rapid response movement. The SP contains a pre-motion silent period (PMSP) and a switching silent period (SSP). The SSP is a muscular electrical activity silent period that appears in both the agonist and antagonist muscles, prior to motion when the voluntary movement is performed as quickly as possible. It is defined as the period from the disappearance of muscle discharge in the agonist muscle to the onset of muscle activity in the antagonist muscle. Its appearance mechanism is such that the SP preceding a voluntary movement is thought to involve efferent impulses from the cerebral cortex of the frontal lobe, the cerebellum, and the brain stem repression domain. The period of SSP is also said to be an index that reflects neuromuscular cooperativeness. Therefore, the purpose of this study was to examine chronological changes in neuromuscular cooperativeness before and after muscle fatigue loading using the SP and to examine neuromuscular cooperativeness functions using muscular electrical discharge pauses, or SSP.

METHODS: The chronological changes in neuromuscular cooperativeness before and after muscle fatigue loading of 15 female university athletes (height, 161.8 ± 9.7 cm; weight, 55.2 ± 7.2 kg; age, 20.4 ± 1.4 years) were examined using the indicators of SSP and pre-motor time (PMT) before muscle fatigue loading and immediately after, 5 minutes after, 10 minutes after, and 15 minutes after muscle fatigue loading. The muscle fatigue loading made use of BIODEX (180deg/s),

conducting knee flexion and extension exercises up to a reduction of 50% of maximum muscle strength on one side. This was accompanied by five jump repetitions each on the left and right side before, immediately after, 5 minutes after, 10 minutes after, and 15 minutes after the loading, at which time PMT and SSP were calculated from surface electromyography of the rectus femoris (RF) and the biceps femoris (BF) muscles taken each time.

RESULTS: The results showed no significant differences between the loading side and the non-loading side, and between measurement times, for the RF PMT. However, SSP of the loading side showed significantly prolonged durations for the period immediately following loading and 5 minutes after ($p<0.05$) as compared with the period before loading.

CONCLUSION: These results suggest that fatigue of the knee flexor and extensor muscles immediately decreases neuromuscular coordination during jumping. During muscle fatigue, neuromuscular coordination is impaired and athletes may be more susceptible to injury. The results of this study also show that most of that coordination is restored within 10 minutes.

LATERAL SHUFFLE-INDUCED FATIGUE EFFECTS ON ANKLE PROPRIOCEPTION AND COUNTERMOVEMENT JUMP PERFORMANCE

LYU, M., CHEN, Z., TANG, R., DING, L., DENG, S., ADAMS, R., HAN, J., LI, Y.

1 SCHOOL OF ATHLETIC PERFORMANCE, SHANGHAI UNIVERSITY OF SPORT, SHANGHAI, CHINA; 2 RESEARCH INSTITUTE FOR SPORT AND EXERCISE, UNIVERSITY OF CANBERRA, BRUCE, AUSTRALIA ; 3 COLLEGE OF REHABILITATION S

INTRODUCTION: To determine how lateral shuffle (LS) induced fatigue affects ankle proprioception and countermovement jump (CMJ) performance.

METHODS: Eighteen male college athletes (age: 21.3±1.8 yrs, body mass: 72.8±8.5 kg, height: 177.4±5.8 cm; mean±SD) performed 6 modes of a repeated LS protocol with 2 distances (2.5, 5m) and 3 speeds (1.6, 1.8, and 2.0 m/s) on separated days. The number of change of directions (CODs) in each protocol was recorded. Ankle inversion proprioception (AIP) was measured using the active movement extent discrimination apparatus (AMEDA) after LS. Lower limb neuromuscular performance was evaluated by CMJ. Fatigue measures, including Blood lactate (BLa), rating of perceived exertion (RPE), and heart rate (HR), were assessed before and after LS.

RESULTS: LS-induced fatigue was consistently evident in BLa ($F =23.109$, $p \leq 0.001$, $\eta2= 0.405$), HR ($F =4.575$, $p < 0.05$, $\eta2= 0.119$), and RPE ($F =8.426$, $p \leq 0.001$, $= 0.199$), increasing with shorter distance and faster speed. RM-ANOVA showed a significant distance main effect on both AIP ($F=7.351$, $p < 0.01$, $\eta2= 0.178$) and CMJ ($F=5.265$, $p < 0.05$, $\eta2= 0.134$), but the speed main effect was only significant on CMJ performance ($F =5.265$, $p \leq 0.001$, $\eta2= 0.273$), not AIP scores ($p = 0.87$). While CMJ performance was significantly correlated with Bla, HR and RPE (r range from -0.62 to -0.32, all $p \leq 0.001$), AIP was only correlated with CODs ($r=-0.251$, $p <0.01$).

CONCLUSION: In LS, shorter distance, regardless of speed, was associated with worse AIP, whereas subsequent CMJ performance was affected by both LS distance and speed. Here, AIP performance was not related to physiological fatigue, but CMJ performance was. These results suggest that LS movements affect proprioceptive input and muscular output differently; and that these two aspects of neuromuscular control are affected by physiological fatigue to varying degrees. These findings have implications for injury prevention and performance enhancement.

EFFECT OF SUBMOTOR TIBIAL NERVE STIMULATION ON ANKLE PLANTAR FLEXION IN HEALTHY ADULTS AND ADULT PATIENTS WITH MULTIPLE SCLEROSIS: A PILOT STUDY

MOŠKON, S., ŠINKOVEC, L.1, TOMAŽIN, K.1, AMON, R.2, STROJNIK, V.1, SPUDIC, D.1

1 UNIVERSITY OF LJUBLJANA, FACULTY OF SPORTS, 2 UNIVERSITY CLINICAL CENTRE LJUBLJANA

INTRODUCTION: Multiple sclerosis (MS) is chronic, autoimmune disease expressed with demyelination of neurons of central nervous system (1), resulting in muscular weakness, spasticity and impaired voluntary muscle activation (2). Strength and aerobic training have beneficial effects for managing the symptoms (3), but people with MS often struggle to reach the intended exercise intensity due to decreased voluntary muscle activation. Potential solution is the submotor electrical stimulation (SES), which stimulates sensory neurons, influencing the alpha motor neurons, thereby enhancing voluntary muscle activation (4). The aim of the study was to determine whether SES of the tibial nerve during isometric ankle plantar flexion (PF) affects the produced torque in the ankle, the amplitude and median frequency (MF) of the electromyogram (EMG) of the soleus muscle in healthy adults and adult patients with MS.

METHODS: A pilot study included 10 healthy adults and 10 adult patients with MS. Both groups performed 6 repetitions of PF of the ankle at three different levels (20 %, 60 % and 100 %) of maximal isometric voluntary contraction (MVC) with electrical impulses superimposed on the tibial nerve at frequencies of 20 Hz and 80 Hz (train duration one second). Surface EMG electrodes were applied to the soleus. To observe differences in PF torque, amplitude of the EMG and MF before, during and after SES, three-way ANOVAs were performed separately for each intensity of muscle contraction (20 %, 60 % and 100 %).

RESULTS: Differences in PF torque before, during and after SES were observed (60 %: $p < 0,001$; 100 %: $p < 0,001$). However, contrary to expectations, the PF torque decreased, with a more distinct reduction at 80 Hz SES. MF was found to be dependent on the frequency of SES (20 %: $p < 0,001$; 60 %: $p < 0,001$; 100 %: $p = 0,001$). Generally, the increase of MF was more pronounced during 80 Hz SES. SES did not affect the amplitude of the EMG signal. No differences in the effects of SES on PF torque, MF, or EMG amplitude of the soleus muscle were observed between the groups.

CONCLUSION: The results of the pilot study suggest that SES (1 second, 20 Hz, 80 Hz) has limited potential for acutely increasing ankle PF torque. Most likely and in accordance with previous studies (4, 5), longer SES with higher frequencies would be needed to potentially observe the differences between and within the groups. Due to heterogeneous results in the MS group, further studies are needed to confirm our findings.

REFERENCES:

1) Amatya- et al., Cochrane Database Syst. Rev., 2018

2) Andreu-Carava et al., Physiol. Behav., 2022

3) De Souza-Teixeira et al., Int. J. Sports Med., 2009

4) Alenazy et al., J Electromyogr Kinesiol, 2018

5) Dean et al., Front. in Hum. Neurosci., 2014

VARIATION IN NORDIC HAMSTRING EXERCISE FORCE-ANGLE RELATIONSHIP MEASURES DURING A PROFESSIONAL SENIOR SOCCER SEASON

VAZOUKIS, A., WEAVING, D., WALKER, J., EMMONDS, S.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Peak eccentric hamstring force is a popular measure during the Nordic hamstring exercise (NHE) to estimate injury risk [1]. However, peak force alone doesn't fully reflect hamstring function during active lengthening. Hamstring injuries are associated with a shift in peak torque at a more flexed knee joint angle [2]. Therefore, examining the full force-angle relationship of the hamstrings can consider the interaction between knee joint angle and force production. This study aimed to construct the force-angle curve of hamstrings during the NHE and quantify the variability of the measures derived from this curve.

METHODS: Twenty-three male soccer players participated from the same English Championship club (age: 27±5 y; stature: 1.83±0.06 m; body mass: 83.2±7.2 kg). A repeated-measures design was conducted during a competitive season whereby force- (NordBord [Vald Performance, Newstead, Australia]) and angle-time (video camera [Sony HXR-NX3/1 NXCAM]) data were collected during the NHE. Force- and angle-time data were synchronised and combined into force-angle profiles. Peak force (N), optimal angle (degrees; deg.), break-point angle (deg; BPA), and eccentric work done (J) were obtained from the force-angle curve of each limb. Players were assessed every 2-5 weeks across the season (8±2 [5 to 12] observations per player). They were instructed to perform the NHE at the slowest pace possible, while the video camera was capturing the movement in the sagittal plane. Data were analysed using mixed-effect models incorporating week as a fixed effect to account for any seasonal trend and player as random effect. Variance permitted to differ across players using a constant variance function structure, enabling estimation of individual standard deviations. Bootstrap resampling was then applied to calculate the overall coefficient of variation (CV; %) and corresponding 90% confidence intervals (CIs).

RESULTS: The overall peak force, optimal angle, BPA, and eccentric work were 476.6±47.7 N, 114.3±6.4 deg,. 121.8±10.1 deg., and 13851±4127 J, respectively. The observed within-player variability expressed as CV (%, 90%CI) was 5.4% (4.4 to 6.4), 5.1% (4.4 to 5.7), 4.6% (4.0 to 5.2), and 17.7% (15.3 to 20.4) for these measures, in order.

CONCLUSION: Peak force, optimal angle, BPA, and eccentric work presented very good (<10%) and good (10-20%) reliability respectively. This approach offers a novel yet reliable method for evaluating hamstring work capacity that extends beyond sole measurement of peak force. Given the nature of hamstring strains and their common occurrence during sprinting, practitioners should incorporate the suggested measures into player monitoring for a better understanding of overall hamstring capacity.

EFFECTS OF REGULAR USE OF POST-EXERCISE INFRARED SAUNA ON DEVELOPMENT OF NEUROMUSCULAR PERFORMANCE AND HYPERTROPHY

AHOKAS, E., HANSTOCK, H.G.2, KYRÖLÄINEN, H.1, IHALAINEN, J.K.1

1> FACULTY OF SPORT AND HEALTH SCIENCES, UNIVERSITY OF JYVÄSKYLÄ, FINLAND; 2> SWEDISH WINTER SPORTS RESEARCH CENTRE, DEPARTMENT OF HEALTH SCIENCES, MID SWEDEN UNIVERSITY, SWEDEN

INTRODUCTION: Long-term exposure to heat has been observed to enhance muscle hypertrophy both in animals (1) and humans (2). Meanwhile, sauna bathing has gained popularity as a post-exercise recovery method among athletes. The aim of this study was to investigate the effects of regular use of an infrared sauna (IRS) after exercise on neuromuscular performance and hypertrophy.

METHODS: A total of 36 female team sport athletes completed the study. The athletes were pair matched into two groups: IRS and control (CON). Physical performance tests and body composition measurements (dual-energy X-ray absorptiometry and ultrasound of m. vastus lateralis) were performed before (PRE) and after (POST) 6-weeks of strength and power training. Performance tests included a 20-m sprint, countermovement jump without extra weight (CMJ) and with extra weight, which were 15%, 25%, and 50% of body weight (CMJ15, CMJ25, and CMJ50), and a maximal isometric leg press (MVC). Participants in the IRS-group used IRS immediately after training three times per week (10 min, 50 °C). A generalized estimating equation (GEE) approach was used to analyze main (group and time) and interaction (time*group) effects. Following the GEE-models, paired and independent t-tests were used to assess main and interaction effects.

RESULTS: There were no time, group, or interaction effects on 20-m sprint time, MVC, or CMJ, CMJ25 and CMJ50. There were group (p=0.002) and time*group interaction effects (p=0.002) for CMJ15 whereby jump height was higher POST-IRS (p=0.006) and PRE-CON (p=0.023) compared to PRE-IRS. There was a time effect (p=0.003) for lean mass which increased in CON (p=0.050). Furthermore, a time effect (p<0.001) was found for lower body lean mass and m. vastus lateralis cross-sectional area (CSA) which increased in both groups (IRS: p=0.002-0.041, CON: p=0.011-0.03).

CONCLUSION: While six weeks of IRS following strength and power training improved performance in CMJ15, no significant improvements were observed in other measures of physical performance following regular IRS use. Consequently, regular IRS bathing after exercise does not appear to have a marked effect on training adaptations in strength and power. Training also improved lower body hypertrophy in female team sport athletes but the regular use of IRS after exercise did not potentiate further hypertrophy.

References:

1. Rodrigues, P, Trajano, GS, Wharton, L, and Minett, GM. 2020. Effects of passive heating intervention on muscle hypertrophy and neuromuscular function: A preliminary systematic review with meta-analysis. Journal of Thermal Biology 93: 102684.

2. Goto, K, et al. 2011. Responses of muscle mass, strength and gene transcripts to long-term heat stress in healthy human subjects. European Journal of Applied Physiology 111: 17–27.

ASSOCIATION BETWEEN THE RECOVERY OF MUSCLE DAMAGE AND CHANGES IN TORQUE OF MAXIMAL ECCENTRIC EXERCISE

DEGUCHI, M., HOMMA, H., DE ALMEIDA, K., SAITO, M., KOZUMA, A., TSUCHIYA, Y., KOZAKI, K., OCHI, E., OKAMOTO, T., NAKAZATO, K., KIKUCHI, N.

GRADUATE SCHOOL OF NIPPON SPORTS SCIENCE UNIVERSITY

INTRODUCTION: Previously, it has been reported that torque loss immediately after the eccentric exercise reflects the peak of creatin kinase (CK) and other muscle damage response that occurs in the following few days (Nosaka et al., 2006). However, the association between torque changes during eccentric exercise on muscle damage responses at the recovery period, including inflammation response (IL-6, etc.), is unknown. The purpose of present study is to investigate the association between the recovery of muscle damage and changes in torque of maximal eccentric exercise.

METHODS: A total of 95 participants (age: 22.2±2.5 years), including 50 men and 45 women, who had not history of participation in daily resistance exercise of biceps, were enrolled in the study. Participants performed five sets of six maximal eccentric elbow flexion exercises. Maximum voluntary contraction torque (MVC), range of motion (ROM), muscle soreness, serum CK and interleukin-6 (IL-6) concentration were assessed immediately before and after, as well as 1, 2, 3, and 5 days after eccentric exercise. The torque loss (TL2, TL3, TL4, TL5) in sets 2-5 relative to the first set of eccentric exercises was also calculated. Furthermore, deviations were calculated from MVC, ROM, muscle soreness, CK and IL-6 after 5 days of exercise, respectively, and averaged to calculate the Total DV.

RESULTS: Multiple regression analysis using MVC and TL2, 3, 4, 5 immediately after eccentric exercise as a model significantly predicted MVC, ROM, CK, IL-6 and Total DV in the recovery period (after 5 days of exercise) (MVC: 50.3%, ROM: 8.9%, CK: 22.1%, IL-6: 7.9%, Total DV: 32.2%, p<0.05). The predicted probability of each muscle damage response during recovery period was higher than immediately after MVC only (+4.3%, +1.2%, +2.4%, +4.1% and +5.3% respectively compared to MVC only). These results suggest that the assessment of performance changes during exercise may contribute to more accurate prediction of the response at the recovery period.

CONCLUSION: The use of torque loss during exercises in combination with torque loss after the eccentric exercises allowed a more detailed prediction of the recovery process of the muscle damage response.

NEURAL CONTROL OF LEG EXTENSION FORCE IN AN UPRIGHT WEIGHT-BEARING POSTURE AT DIFFERENT KNEE ANGLES

KRÄTSCHMER, R., SCHWIRTZ, A.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Assessment of neural control of skeletal muscles is achieved by analyzing motor unit (MU) discharge properties. Typical testing scenarios involve force modulation in non-weight bearing tasks, e.g. isolated knee extension in a seated position. However, humans evolved to stand and move in an upright posture where the leg extending muscles generate force against gravity (1). To address this gap, we devised a setup to measure MU activity during force modulation in different knee angles in an upright weight-bearing scenario.

METHODS: Five participants underwent measurements while standing with both feet on a force plate, with a loaded barbell fixed above their necks, providing immovable resistance. Shin position was standardized to ensure identical ankle angle for all trials. Measurements involved isometric maximal voluntary contractions (MVC) and biofeedback-controlled submaximal force modulation (15 seconds at body weight (BW) followed by 15 seconds at BW+20%MVC) against the immovable barbell in three knee angles (30°, 60°, 90° adjusted by barbell height). High-density EMG signals from vastus lateralis (VL) and vastus medialis (VM) were recorded and decomposed (2,3) into MU discharge rates (DR). Mean DR was calculated for low-threshold (LT, already firing at BW) and high-threshold MUs (HT, start firing above BW). Two-way ANOVA for factors muscle and angle and RM ANOVA for force modulation of LT was performed. Linear regression for relative MVC vs. LT modulation (from BW to BW+20%MVC) was calculated.

RESULTS: While the MVCs increased with a more upright position (90°: 164±51N/kg; 60°: 238±67N/kg; 30°: 341±106N/kg; p<0.001), there was no difference in DR between angles or muscles for LT. At BW+20%MVC, LT showed higher discharge rate than HT (11.90±2.25 and 10.71±2.08pps; p>0.001). During force modulation from BW to BW+20%MVC, LT increased firing rate from 10.06±2.42 to 11.90±2.25pps (p<0.001). There was a significant correlation between relative MVC (averaged across angles) and the difference of DR in LT from low- to high-force (R=0.8630; p=0.0225).

CONCLUSION: As the first study to introduce force modulation in a weight-bearing task, we observed that LT are already firing when bearing own bodyweight, which reveals a functional importance not reflected by isolated non-weight bearing setups. Despite the force differences between angles, the firing rate of MUs at submaximal force did not change indicating that the neural control of VL and VM is regulated independently of muscle length. However, we observed that stronger individuals have a higher ability to increase LT firing rate during force modulation, indicating an association between submaximal neural modulation ability and maximal force generation capacity.

REFERENCES:

1) Winter, Gait Posture, 1995

2) Holobar & Zazula, IEEE Trans signal Process, 2007

3) Holobar et al., J Neur Eng, 2014

Conventional Print Poster Presentations

CP-SH02 Psychological well-being and mental health

GENDER DIFFERENCES IN PERCEIVED TRAINING STRESS AND THE IMPACT OF MOTIVATIONAL CLIMATE IN COMPETITIVE ATHLETES

RUSNAKOVA, K., HARBICHOVA, I.1, STEHLIK, M.2, KOMARC, M.1

1 FACULTY OF PHYSICAL EDUCATION AND SPORT, CHARLES UNIVERSITY; 2 SPORTS RESEARCH INSTITUTE OF CZECH ARMED FORCES, PRAGUE, CZECH REPUBLIC

Introduction

High training stress is known to precipitate overtraining and performance decline, yet the nuanced impact of gender differences among athletes remain underexplored. The motivational climate created by the coach can contribute to negative psychological outcomes, including stress and overtraining. Understanding gender differences in how athletes perceive training stress and the impact of motivational climate can help in devising more effective strategies. The aim of this study is to investigate gender differences in perceived training stress and examine their relationships with the motivational climate.

Methods

A total of 178 athletes, aged between 18 to 30 years who are actively engaged in competitive sports across diverse disciplines, participated in the online survey. This survey consisted of standardized instruments such as the Training Distress Scale to assess athletes psychological and physical symptoms and the Empowering and Disempowering Motivational Climate Questionnaire-Coach for assessing the athletes perceptions of the motivational environment created by their coach.

Results

Female athletes reported higher levels of training stress compared to male athletes. Specifically, female athletes exhibited elevated scores in 16 out of 19 overtraining symptoms assessed than male athletes. Statistically significant differences were noted in the overall perception of symptoms, particularly in symptoms like "not being able to remember things" and " a quick temper" . Furthermore, an elevated incidence of overtraining symptoms was associated with an ego-involved motivational climate for both genders (female r = 0.25, male r = 0.27). For female athletes, a controlling coaching climate was also associated with a higher prevalence of overtraining symptoms (r = 0.26), highlighting the role of coaching style in athlete well-being.

Discussion

The observed higher incidence of overtraining in female athletes compared to male athletes emphasizes the importance of gender-specific vulnerabilities in the context of overtraining. While the social dimension of overtraining seems to be significant for all elite athletes regardless of gender, the connection between overtraining and a disempowering motivational climate is somewhat more noticeable in female athletes. This association suggests that the nature of the coaching climate, especially aspects that undermine the autonomy and competence of athletes, can disproportionately affect female athletes and contribute to greater training stress. The results of this investigation underscore the need for gender-sensitive approaches in training practices to mitigate the risk of overtraining and optimize the well-being and performance of athletes.

This work was supported by the following projects: GAUK no. 165023, COOP SPOS and GAČR 23-02573S.

BACK TO COMPETITIVE SPORT

PLESTED-ALVAREZ, M.C.1, ALVAREZ-DUQUE, M.E.2

1.GITT, EDUCATION FACULTY, UNIVERSITY OF ANTIOQUIA, MEDELLIN, COLOMBIA, 2. UNIVERSITY UNAD, MEDELLIN, COLOMBIA

INTRODUCTION: The studied group consisted of 12 female athletes, between 20 and 72 years old, who, before the sports break, were in excellent physical condition and sporting athletic activities; that is, working with maximum weights in the gym or capable of maintaining infernal rhythms in running and various modalities of athletics. The applied analyses gave important results for the conclusions presented, because findings allowed us to ratify a qualitative change in each vision of life. METHODS: Three analytical modalities were applied: interviews with the participants and their coach; the study of group videos as a whole; and twice for each of the participants (at the beginning and end of the six months of training). As well as a bibliographic review of these processes. In all cases, there is informed consent. The corpus studied is made up of some who were high performers and competitive, and others returned to sport to get out of a sedentary lifestyle and recover, as far as possible, adequate sporting ability, according to their age. Also, video records (technique, resistance, and post-training behavior) and interviews as authentic and daily exchange activities were analyzed. RESULTS: In each participant, the difference was auscultated from the decline produced without training, which was greater or lesser in each person (especially if they did not take care of themselves and forgot good maintenance and sustainability practices "at rest"). The latter is understood as the time between the stoppage and the resumption of the sport. The above was compared with the tasks and competencies on the end date of the process. The interviews also took into account specific questions about the state of mind, motivation and prospect of return, because self-appreciation is essential for strengthening ones being. The improvement in the capacity of the various exercises that included the regulated practices was confirmed in the first two months; as well as the training for the initial competitions and the clear improvement in the last two months of this segment of the process of returning to the systematic sporting life of athletics. DISCUSSION: The analysis of behavior, based on gestures, posture, breathing and voice are aspects that set very important guidelines for the specific context and the correlation with the psychosocial mood of each participant. We found that as capacity was gained, joy and euphoria also increased, in some cases; as well as the motivation to continue training in the second half of the year. CONCLUSION: Returning to sport after months or years of being sedentary, especially returning to high-performance athletics, is not an easy task despite having returned to training consistently. The elderly who performed this physical activity were more coordinated. They remembered and recognized the value of the technique. Another advantage of being active again is that their mood improved, because it reduced stress and insomnia.

DOES BASIC PSYCHOLOGICAL NEEDS SATISFACTION DURING THE DAY ENHANCE ATHLETES' SLEEP QUALITY AND REDUCE THEIR SLEEP DEFICIT?

ELBE, A.M., FRYTZ, P.

LEIPZIG UNIVERSITY

Athletes need sufficient restorative sleep to meet the demands of competitive sports. However, due to late competitions, intense training sessions, and dual demands, athletes often experience a sleep deficit (Walsh et al., 2021). Behavioral strategies aimed at enhancing sleep hygiene are frequently employed to reduce this sleep deficit (Bartel et al., 2015). In addition to these strategies, studies indicate that psychological determinants like the satisfaction of basic psychological needs (autonomy, competence, relatedness; Ryan & Deci, 2000) during the day may also improve sleep quality (Campbell et al., 2015).

This study is the first to investigate this relationship in a cohort of competitive athletes (N=48). Thirty-two female and 16 male athletes (M=20.00 years, SD=4.44) from individual and team sports wore actigraphs (Motionwatch 8) for 14 days to measure objective sleep parameters (sleep onset latency, sleep duration, sleep efficiency). Individual sleep deficit and subjective sleep quality were recorded via morning sleep logs. In daily evening logs, athletes reported their basic needs satisfaction, pre-sleep arousal and training load. One-time questionnaires at the beginning of the study also captured general sleep quality (PSQI), chronotype (D-MEQ), and satisfaction of needs in sports (PNSEG) and sleep. Data collection for the study is completed, and the data analysis is ongoing.

Multilevel analysis will determine whether daily basic needs satisfaction has the expected positive impact on athletes sleep quality and reduces their individual sleep deficit. The results aim to unravel the sleep dynamics of athletes and to highlight potential interventions for optimizing athletes sleep.

Bartel, K. A., Gradisar, M., & Williamson, P. (2015). Protective and risk factors for adolescent sleep: A meta-analytic review. In Sleep Medicine Reviews (Vol. 21, pp. 72–85). W.B. Saunders Ltd. https://doi.org/10.1016/j.smrv.2014.08.002

Campbell, R., Vansteenkiste, M., Delesie, L. M., Mariman, A. N., Soenens, B., Tobback, E., van der Kaap-Deeder, J., & Vogelaers, D. P. (2015). Examining the role of psychological need satisfaction in sleep: A Self-Determination Theory perspective. Personality and Individual Differences, 77, 199–204. https://doi.org/10.1016/j.paid.2015.01.003

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Walsh, N. P., Halson, S. L., Sargent, C., Roach, G. D., Nédélec, M., Gupta, L., Leeder, J., Fullagar, H. H., Coutts, A. J., Edwards, B. J., Pullinger, S. A., Robertson, C. M., Burniston, J. G., Lastella, M., le Meur, Y., Hausswirth, C., Bender, A. M., Grandner, M. A., & Samuels, C. H. (2021). Sleep and the athlete: Narrative review and 2021 expert consensus recommendations. British Journal of Sports Medicine, 55(7), 356–368. https://doi.org/10.1136/BJSPORTS-2020-10202

OPTIMIZING YOUTH ATHLETES WELL-BEING: THE REVOLUTIONARY I7W FRAMEWORK IN SPORTS

HEJLA, M., WILCZYNSKA, D.
GDANSK UNIVERSITY OF PHYSICAL EDUCATION AND SPORT

Introduction

Coaching attitude is a crucial element influencing the development of athletes, shaping their skills, motivation, and attitude towards sports. The i7W model, based on seven principles (inspiration, explanation, expectation, support, reward, appreciation, growth, and winning), is a coaching framework presenting tools that can be utilized in working with athletes. The model focuses on supporting the mental resources of athletes, fostering a positive coach-athlete relationship, and strengthening group cohesion.

Presentation of articles

Workshops for coaches based on the i7W model enhance the experiences and psychological well-being of adult athletes. The latest work on the model also adapts it for working with young sports athletes. Three studies have been conducted so far, examining the effectiveness of training for coaches and its impact on the minds and bodies of young athletes. The research focused particularly on the coach-athlete relationship, sports motivation, anxiety related to sports competition, as well as stress tolerance and motor balance. The studies demonstrated a significant impact of the model on selected psychological factors in children engaged in sports, including motivation and psychomotor performance.

Discussion and future steps

All the tools within the i7W model are mental techniques that a coach can utilize to achieve progress and growth among young athletes. The coachs attitude and coaching environment significantly shape the physical and mental development of young athletes. Implementing the i7W model for coaches results in numerous benefits for young athletes. Further research based on a larger number of coaches and children representing different sports disciplines is necessary.

EXPLORING THE LONGITUDINAL RELATIONSHIPS BETWEEN REGULAR PHYSICAL ACTIVITY, SPORTS, AND WELL-BEING IN YOUTH USING RANDOM FORESTS

WANG, L., LIN, W.
COLLEGE OF LIFE AND ENVIRONMENTAL SCIENCES, UNIVERSITY OF EXETER

ABSTRACT: Well-being is significantly impacting youth developmental trajectory and overall life outcomes which is crucial. Sports, exercise, and physical activity are universally recognized for their beneficial effects on well-being. However, disentangling their individual contributions poses a persistent challenge for researchers. The objective of this study is to employ innovative methods to assess sports and explore the relationship between sports participation, regular physical activity (RPA), and well-being in both cross-sectional and longitudinal studies.

Method: this study utilizes the random forest approach to investigate the intricately interconnected variables of sports and RPA, alongside factors associated with well-being. The assessment of sports, using objective assessment of table tennis skill learning and performance, and subjective assessment of table tennis engagement. The evaluation of RPA, employing a self-reported questionnaire, emphasizing the frequency and duration of moderate to vigorous physical activities (MVPA).

Results: this study encompassed 163 participants, predominantly males (n=133) compared to females (n=30), with an average age of 18.99 years (SD=0.88), The random forest analysis yielded two models with satisfactory fits. The cross-sectional model, which includes baseline sports and regular physical activity, showed a root mean squared error (RMSE) of 14.66 and an R-squared (R^2) value of 0.12. The longitudinal model, examining well-being changes over 8-month period, demonstrated an RMSE of 14.76 and an R^2 of 0.06. Post-adjustment for gender, age, and BMI, the decision tree from Model 1 identified sports and RPA as the most significant factors, accounting for 16.19% of the variance in well-being. Individually, sports accounted for 16.13% of the well-being variance, followed by RPA, which contributed 7.97%. In Model 3, the decision tree similarly highlighted sports and RPA as pivotal, responsible for 16.77% of the well-being variance, with sports alone contributing 13.44% and RPA 7.73%.

Conclusion: this study elucidates that sports have a more substantial correlation with well-being compared to RPA. Moreover, when combining sports with RPA, the correlation with well-being is higher than considering these two factors separately. Future research needs to clarify which aspects of sports participation are more closely associated with well-being. Also, its important to identify which patterns of RPA that most robustly associate with improved well-being.

Discussion: This research is the first to discuss the relationship between sports, RPA, and the well-being of youth using the random forest method. It is also the first study to assess the effects of sports through the evaluation of motor skills, engagement, and performance in sports activities. It suggests that participating in organized sports to develop motor skill, engagement, and performance could be more effective for the well-being of youth than engaging RPA.

ASSOCIATIONS BETWEEN TEST ANXIETY AND PHYSICAL ACTIVITY, SEDENTARY BEHAVIOR, NUTRITION AND SLEEP IN UNIVERSITY STUDENTS

KE, H., DOU, W., LUO, D., CHEN, X., SHI, Y.
BEIJING SPORT UNIVERSITY

INTRODUCTION: Test anxiety is leading to failure or a low academic performance in university students. The sustained low academic performance increases academic pressure and remains considerable physiological and psychological im-

pacts. Consequently, test anxiety is becoming one of the major mental problems among university students. Understanding the relationship between different lifestyle factors and test anxiety is critical to develop intervention strategies and promote students' motivation and academic performance. Therefore, we explored the association between moderate-to-vigorous physical activity (MVPA) time, sedentary time, fruit and vegetable consumption, sleeping time and test anxiety.

METHODS: 138 undergraduate students (mean age = 19.3y, 60.8% females, 39.2% males) participated in this study and completed questionnaires on the week before the formal examination. MVPA, sedentary time and sleeping time were measured via the International Physical Activity Questionnaire (IPAQ). Test anxiety was evaluated by Sarason's test anxiety Scale (TAS). Fruit and vegetables consumption was accessed by Food Frequency Questionnaire (FAQ). Multiple linear regressions were performed to evaluate the associations between MVPA time, sedentary time, fruit and vegetable consumption, sleeping time and test anxiety.

RESULTS: According to the scores of TAS, 84.7% of participants were found to experience moderate to severe test anxiety. A linear regression revealed a negative relationship between physical activity levels and test anxiety levels (r=-0.30, p=0.0003). Similarly, a negative relationship was also detected between vegetables and fruit intake (r=-0.18, p=0.04), sleeping hours (r=-0.20, p=0.02) and test anxiety levels. However, no relationship was observed between sedentary time and test anxiety (r=-0.04, p=0.58).

CONCLUSION: Our results revealed a serious test anxiety problem in university students and negative relationship between test anxiety and physical activity, sleep, fruit and vegetables consumption but no sedentary time. These findings suggest that that sedentary behavior may not contribute to test anxiety. However, healthy lifestyles (enough MVPA, fruit and vegetable consumption and sleeping time) contribute to alleviate test anxiety. Accordingly, our work provides valuable advice for universities to help students overcoming test anxiety.

ANXIETY AND FEAR IN GYMNASTICS: A SYSTEMATIC LITERATURE REVIEW

MALÍR, R., LAROËRE, B.M., CHRUDIMSKÝ, J., CERNÁ, J., TREBICKÝ, V.
FACULTY OF PHYSICAL EDUCATION AND SPORT, CHARLES UNIVERSITY, VAT 00216208

INTRODUCTION: Gymnastics is a highly demanding sport, taxing both physically and mentally. The emotional load during gymnastics events particularly highlights the role of fear and anxiety (1, 2). Although often used interchangeably, some argue that anxiety, unlike fear, arises in response to unknown and vague issues (3). In contrast, fear is a response to a concrete and identifiable danger, such as the fear of failure (4), injury (5), or coach criticism (1). Though experiencing anxiety and fear affects sports performance (3, 6), the literature is mixed on whether they enhance (6) or impair it (7). This study aims to provide a systematic review of current evidence on the role of anxiety and fear in gymnastics.

METHODS: Following the PRISMA 2020 guidelines, we searched scientific article databases (Web of Science, PubMed, EBSCOhost, and Scopus) to identify available full-text peer-reviewed empirical articles in English investigating anxiety and fear in gymnastics. Basic information (authors, year of publication, study design) and details about participants, methods, and results were extracted. The selected studies were assessed for bias after the final selection.

RESULTS: Out of 788 initially collected studies, 39 met the selection criteria after a single round of screening. Predominantly focused on artistic gymnastics (33 studies), the results revealed a higher prevalence of anxiety and fear during competitions compared to training, with no discernible difference in their perceptions across performance levels. Fear of injury, often linked to participants' injury history, emerged as a common cause. However, evidence on how aspects like athletes sex or performance level affect the perception of fear and anxiety remains mixed.

CONCLUSION: Fear and anxiety are frequent concerns in gymnastics, particularly during competitions. However, the available research mainly focuses on artistic gymnastics, leading to insufficient insights into other gymnastic sports. Future research should focus on better distinguishing fear and anxiety and explore more diverse groups of gymnasts.

REFERENCES:

1. L. H. Duarte, M. Nunomura, M. Carbinatto. ScGYM 7, 7–21 (2015).

2. S. B. Martin, C. M. Polster, A. W. Jackson, C. A. Greenleaf, G. M. Jones. J. Clin. Sport Psychol. 2, 299–316 (2008).

3. S. Zhang, T. Woodman, R. Roberts (2018).

4. S. Taylor, R. Eklund, C. Arthur. Int. Rev. Sport Exerc. Psychol. 0, 1–29 (2021).

5. M. A. Chase, T. M. Magyar, B. M. Drake. J Sport Sci 23, 465–475 (2005).

6. R. E. Smith, F. L. Smoll (1990).

7. E. O. Tingaz, S. Solmaz, M. A. Ekiz, M. Atasoy, Sport Sci Health 19, 657–663 (2023).

THE POTENTIAL ROLE OF YOGA FOR DISASTER PREPAREDNESS (BOSAI YOGA)

AKIKO, K.
AOYAMA GAKUIN UNIVERSITY

Mental and physical stress increased by COVID-19, but yoga has been reported to be effective against such stress and to enhance immunity.

To test the hypothesis that yoga enhances human immunity and reduces mental stress in a major infectious disease disaster (COVID-19).

A descriptive questionnaire was administered to 27 Japanese university students aged 19-23 years who practice yoga, regarding the types of stress and the use of yoga in COVID-19.

The results of the questionnaire indicated that stress was caused by restrictions on ones activities, such as not being able to go outside due to fear of corona infection, and anxiety about the lack of relationship building and communication due to the shift to online classes. Many respondents stated that "yoga allowed me to move my body anywhere and anytime without having to go outside, which reduced my physical stress." Others stated that yoga has helped them to notice small changes and discomforts in their own bodies on a regular basis, which has been helpful for the ailments they are currently treating. Many understood that yoga improves metabolism, increases basal body temperature, and boosts immunity. On the mental side, some said that meditation and breathing exercises and improved mental health, and that it not only reduces stress, but also makes one more tolerant of stress afterwards. Some thought that yoga could be used not only for physical and mental health, but also to meet new people through online yoga classes, to reduce friction among family members by practicing yoga with them as a communication tool, and to create a new community. The lack of physical and physical exercise, which prevented them from going out and being physically active due to the fear of coronary infection and the voluntary curfew, contributed to the stress of the survey participants. Many of them were beginners to yoga, but they were willing to embrace yoga as a lifestyle because they realized that yoga could alleviate their lack of exercise under the self-restraint from going out.

Fear of viral infections, decreased physical exercise due to self-restraint, anxiety about relationships and communication due to the shift to online classes, and uncertainty about their adaptation to the new social environment and their future were thought to have physically and mentally repressed them. Yoga postures and breathing techniques have been shown to be effective in relieving such oppression, and the fact that the college students themselves were aware of and understood these benefits indicates that yoga can be used as a tool to overcome various stresses in the future.

The various anxieties brought about by COVID-19, the unprecedented large-scale infectious disease disaster that began in 2020, caused great mental and physical stress for the survey participants, and yoga was thought to reduce such mental stress.

EXERCISE ADDICTION IN ADOLESCENT SAMPLE

JAROCH-LIDZBARSKA, M., WILCZYNSKA, D.

AKADEMIA WYCHOWANIA FIZYCZNEGO I SPORTU W GDAŃSKU

29th Annual ECSS Congress Glasgow/Scotland 2024, July 4-7 2024

Exercise addiction in adolescent sample

Jaroch-Lidzbarska, M., Wilczynska, D.

Gdansk University of Physical Education and Sport

Introduction

Involvement in physical activity provides numerous benefits for both physical and mental health. However the immoderate exercising would have negative consequences, influencing the everyday life, and can lead to the behavioral addiction. The obligatory exercise can exist as primary (driven by motivation associated with dedicated exercise) or secondary problem (with the simultaneous co-occurrence of eating disorders). It is meaningful to check the scale of this phenomenon in the group of adolescents, with special regard to the teenagers diagnosed with eating disorders and those involved in professional sport.

Methods

Ninety individuals in the age range from 14 to 20 (one group of 45 adolescent psychiatric patients diagnosed with eating disorders and 45 teenagers training in the sports sections (15 from track and field, 15 from judo and 15 from the gymnastics section) took part in the study, conducted with an author's online questionnaire. This was a sub-sample from an observational study. The inductive thematic analysis was applied to analyse data. The inclusion and exclusion criteria were defined and scrupulously upheld to ensure trustworthiness of the research.

Results

The leading subjects to investigate in both research groups were: emotions connected with exercises, exercise preoccupation, withdrawal symptoms, need of exercise to control the body mass and problematic eating behaviours among the competitors of each sports section.

Discussion

The findings indicated the preliminary dimension of exercise dependency in Polish adolescent sub-sample. The research process in both groups has varied due to different motivation of the examined youth and, in addition, the environment of research (the psychiatric hospital vs. the coach's office).

The group of respondents with eating disorders demonstrated another attitude to physical activity than the group of adolescent competitors. Both the indicators of the exercise addiction and the problematic eating behaviours diversified among the test subjects from the individual sports sections.

EFFECTS OF COVID-19 PANDEMIC ON ELITE ATHLETES SLEEP BEHAVIOR: A META-ANALYSIS

ZHANG, X., CUI, D.
CAPITAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS

Effects of COVID-19 pandemic on elite athletes sleep behavior: A Meta-Analysis

Zhang Xiangning1, Cui Dandan2

1 Capital University of Physical Education and Sports, 2 China Institute of Sport Science

INTRODUCTION: Sleep serves as an indicator of mental health [1], while physical activity is considered to be related to both sleep and mental health [2]. In the early stages of the COVID-19 pandemic, most countries implemented lockdown restrictions [3]. The reduction in physical activity and the secondary psychological issues that arose from the lockdown have significantly affected the sleep quality of elite athletes, ultimately resulting in an indirect impact on their athletic performance. Although a large number of studies have examined the impact of the COVID-19 pandemic on the sleep behavior of individuals at different levels of physical activity, a systematic and targeted evaluation of elite athletes is still lacking. Thus, this meta-analysis aims to assess the influence of the COVID-19 pandemic on the sleep behavior of elite athletes.

METHODS: This meta-analysis was performed by the PRISMA guidelines. A comprehensive search was conducted in online databases including PubMed, Web of Science, and CNKI to detect articles exploring the impact of the COVID-19 pandemic on the sleep behavior of elite athletes. Studies were included if they examined sleep duration among elite athletes without any pre-existing health conditions or no disease risks. In this study, the standardized mean difference (SMD) and the corresponding 95% confidence interval (95% CI) values were pooled using a random effects model. Additionally, a Leave-One-Out sensitivity analysis was performed to ensure the reliability of the results.

RESULTS: A total of nine studies met the criteria with n = 7379 included in this study. The pooled effect showed an increase in sleep duration in elite athletes under lockdown (SMD = -0.56; 95% CI = -0.66 ~ -0.47) and significantly affected by the COVID-19 pandemic ($P < 0.01$), with moderate heterogeneity between results ($I^2 = 69\%$); a decrease in sleep quality (SMD = -0.62; 95%CI =-0.7 ~ -0.54) and significant ($P < 0.01$) with low heterogeneity ($I^2 = 4\%$), and sleep latency was prolonged (SMD = 0.30; 95%CI = 0.13 ~ 0.46) and significant ($P < 0.01$) with moderate heterogeneity ($I^2 = 71\%$). All the results were stable after sensitivity analyses.

CONCLUSION: The COVID-19 pandemic has a significant negative impact on the sleep behavior of elite athletes, which is mainly manifested in the decrease of sleep quality, and an increase in sleep duration and sleep latency of elite athletes. More research on the sleep behavior of elite athletes is needed in the future, supporting decision-making in addressing the challenges posed to the mental health of elite athletes by the ongoing mutation of viruses in current contexts.

[1] Reid et al., AM J GERIAT PSYCHIAT, 2006

[2] Hosker et al., CHILD ADOL PSYCH CL, 2019

[3] Van Hoof, World Economic Forum, 2020

THE RELATIONSHIP BETWEEN SCREEN TIME, PHYSICAL ACTIVITY AND MENTAL HEALTH LEVELS IN ADOLESCENTS

DELIANG, X., XINGMEI, Z., ZHANJIA, Z.
PEKING UNIVERSITY, EAST CHINA NORMAL UNIVERSITY

Adolescence is a critical period in human growth, during which the development of mental health plays a key role. It has been demonstrated that physical activity (PA) significantly contributes to mental health (MH) of adolescents by reducing stress, alleviating anxiety, and relieving the depressive symptoms. Moreover, research has also shown that the amount of screen time (ST) influenced MH of adolescents. However, it remains largely unexplored how PA and ST jointly impact MH of adolescents.

purpose: This study aimed to examine the associations between ST, PA and MH in adolescents.

Methods: A cross-sectional study was conducted with 558 middle school students (mean age =13.12, 54.1% females) from 9 provinces in China. Participants were asked to complete questionnaires measuring ST encompassing television, computer, mobile phone, electronic game console, tablet, e-reader, and other screen devices, PA using Physical Activity Questionnaire for Adolescents (PAQ-A), and multiple indicators of MH including the Brief Multidimensional Student Life Satisfaction Scale (BMSLSS-PTPB), Subjective Happiness Scale (SHS), and Kutcher Adolescent Depression Scale (KADS-11). A series of multiple regression models were performed with MH variables as the dependent variable and ST as the predictor. Subsequently, PA was introduced as additional predictor of these models. Gender, age, and maternal education level (MEL) were included in all models as covariates.

Results: ST significantly predicted all MH variables, including life satisfaction ($\beta = -0.114$, $p = 0.02$), subjective happiness ($\beta = -0.137$, $p = 0.01$) and adolescent depression ($\beta = 0.169$, $p < 0.001$). After including PA as additional predictor, ST still significantly predicted MH, but with a reduced level of significance, including life satisfaction ($\beta = -0.086$, $p = 0.08$), subjective happiness ($\beta = -0.102$, $p = 0.03$) and adolescent depression ($\beta = 0.145$, $p = 3.34e-03$). PA was also a significant predictor of all MH variables such that life satisfaction ($\beta = 0.267$, $p < 0.001$), subjective happiness ($\beta = 0.326$, $p < 0.001$) and adolescent depression ($\beta = -0.239$, $p < 0.001$). Regarding covariates, age showed a significant correlation with all MH variables, indicating that higher age is associated with lower life satisfaction ($\beta = -0.101$, $p = 0.04$), lower subjective happiness ($\beta = -0.114$, $p = 0.02$), and higher depression levels ($\beta = 0.108$, $p = 0.03$), while MEL showed a significant correlation with depression ($\beta = -0.126$, $p = 0.01$).

Conclusion: ST and PA Individually influence life satisfaction, subjective happiness, and depression in adolescents with ST having a negative impact and PA having a positive effect. This implies that the regular engagement of PA may act as a protective factor, effectively buffering adolescents against the adverse MH outcomes experienced after screen use. Our findings underscore the suggestion that schools should simultaneously intervene by actively promoting PA and reducing ST to effectively enhance MH.

Conventional Print Poster Presentations

CP-AP05 Monitoring I

FACTORS INFLUENCING COACHES´ USE OF WEARABLE TECHNOLOGIES FOR INDIVIDUALIZING TRAINING PROCEDURES

DÜKING, P., FORSTER, A., WICKER, P., SPERLICH, B.
TECHNISCHE UNIVERSITÄT BRAUNSCHWEIG

INTRODUCTION: Due to significant inter- and intra-individual variability in response to training, individualization of training procedures is necessary. For this individualization, wearable technologies (wearables) might be supportive in some scenarios, yet it is unknown if coaches use these technologies and what factors affect usage. Based on the Technology Acceptance Model, here we aim to: i) assess the use of wearables and influencing factors of wearables usage among coaches; ii) evaluate the impact of wearables on coaching decisions related to training procedures; and iii) identify factors that could enhance the willingness to use wearables in the context of training individualization.

METHODS: A quantitative online survey which was based around the "Technology Acceptance Model" was conducted among German speaking coaches (n=36, including 15 females) of different performance levels. Questions included i) respondents' socio demographics, ii) current use of, and factors influencing current use of wearable technologies to individualize aspects of training, as well as iii) factors which influence future intention to use wearable technology to individualize training procedures iv) impact of wearables on decision making regarding training procedures. Statistical analysis included correlation analysis including Bonferroni correction

RESULTS: 24 out of 36 coaches use wearables to individualize training procedures. Correlations exist between the current use of wearables with "job relevance" (0.84;$p<0.005$), "subjective norm" (0.57; 0.005), and "perceived usefulness" (0.49;$p<0.005$). Current decisions regarding training procedure only correlate with "output quality" (0.511;$p<0.005$), and "result demonstrability" (0.47;$p<0.005$). Future intention to use wearables to individualize training correlate with "perceived usefulness" (0.644;$p<.005$), "acquire knowledge about sensor technologies" (0.56;$p<0.005$), "result demonstrability" (0.53;$p<0.005$), and "whish for guidelines" (0.50;$p<0.005$).

CONCLUSION: Various factors are associated with the current and future intention to use wearables, as well as their impact on coaches decisions in individualizing training procedures. Our data suggests that it is advisable i) for manufacturers to produce wearables with high output quality and clear demonstrability of results, in order to influence coaching decisions and ii) to equip coaches with comprehensive knowledge and guidelines regarding the use of wearables for the effective individualization of training procedures.

RESEARCH ON THE APPLICATION AND VALUE OF DIGITAL TWIN OPTIMIZATION IN PHYSICAL EDUCATION TEACHING

ZHOU, L., SU, Q., WU, J., LIU, Y.
HARBIN ENGINEERING UNIVERSITY

INTRODUCTION: Digital twins, as a new technology and paradigm, have been applied in large-scale and complex industrial scenarios. It is not just about simple modeling and data collection, but also bi-directional mapping between physical objects in the real world and twins in digital space. Its purpose is to construct a mirror of the real world in virtual space, so as to observe, control, analyze, verify, and deduce at low cost and in multiple dimensions, The physical education teaching scenario is a complex system that requires the application and development of multiple abilities such as physical fitness, skills, thinking, emotions, and intelligence. Exploring the deductive ability of digital twins in analyzing this complex system has theoretical and practical significance.

METHODS: A comprehensive literature review was conducted, collecting papers and industry documents related to the application of digital twin technology in PE and other subject education. An analysis was conducted on the collected data, and a specific university badminton class was used as an example to evaluate the actual implementation ability of digital twins in PE teaching and to determine the current situation, challenges, and solutions of digital twin technology application in PE teaching.

RESULTS: Digital twin technology can adapt to the real-time, dynamic, and interactive characteristics of PE teaching. It can obtain multi-scale and multi-source data through various perception methods, and construct high-precision, high-fidelity, and high-reliability teaching twin scenes. Firstly, high-precision and visual teaching process simulation. It can monitor the present, trace history, and make forward-looking predictions. The second is to improve the quality of teaching and athletic performance. Real-time multimodal data can reflect real-time changes in physical indicators, helping teachers dynamically adjust their training plans. The third is training simulation and prediction. Teachers simulate the whole process of courses in the digital twin world to evaluate the effectiveness of teaching programs and use future data to adjust plans and

emergency drills in advance to improve teaching quality and reduce risks. The fourth is remote monitoring, which simulates game scenes in different environments, to improve its tactical adaptability.

CONCLUSION: Digital twins can provide comprehensive simulation, prediction, and analysis of the PE teaching process from multiple perspectives, improving the efficiency and effectiveness of physical education teaching. However, we still need to address challenges such as technological maturity, data privacy protection, cost, and user acceptance. We should gradually strengthen technological innovation, user education, cost control, and effectiveness verification. By combining digital twins and other emerging technologies, we aim to improve the accessibility and fairness of PE and build an intelligent, universal, and personalized physical education environment.

A COMPARISON OF THE INTERSTITIAL GLUCOSE AND BLOOD GLUCOSE RESPONSES TO CONSUMPTION OF CARBOHYDRATE-CONTAINING BEVERAGES IN HUMANS.

HAMILTON, R., BRACKEN, R.

SWANSEA UNIVERSITY

INTRODUCTION: Continuous Glucose Monitoring (CGM) has gained rapid interest in sports nutrition. CGM measures interstitial glucose as a proxy for blood glucose concentrations. However, consumption of large volumes, high concentration, or high glycaemic index carbohydrate containing solutions may alter the accuracy of the blood to interstitial glucose relationship observed when fasted or post-prandial due to the rapidly changing glucose environments. Thus, this study compared interstitial glucose and blood glucose responses to consumption of carbohydrate-containing beverages in humans.

METHODS: Ten healthy adults (9 males, age 22 ± 1, height 177±12 cm, body mass 75±14 kg) attended the laboratory on seven occasions to consume 0g, 10g & 25g dextrose in 500 ml water, 10% & 20% carbohydrate solutions, and 10% low- (isomaltulose) or 10% high- (dextrose) glycaemic index carbohydrates in a double-blind, randomised, counterbalanced fashion. Capillary blood was collected at rest and over a subsequent 2-h period and analysed for glucose concentration (EKF Diagnostics). Concurrently, interstitial glucose concentrations were recorded (SupersapiensTM, TT1 Products Inc., Atlanta, GA, USA). Glycaemic parameters were compared between both fluid compartments. Mean absolute relative difference (MARD) was determined for periods of hypoglycaemia (<4mM), euglycaemia (4-7.88 mM) and hyperglycaemia (>7.88mM). Plasma volume changes were estimated (Dill & Costill 1974). Data were analysed using ANOVA with Bonferroni correction, and P≤0.05 accepted as significant.

RESULTS: There was a slower time to reach peak glucose concentration in interstitial fluid than blood in 3 of the above carbohydrate consumption trials. Point concentration differences were lower in interstitial fluid than blood in the 25g (iG: 3.47±0.32 vs. BG: 3.75±0.20 mM , P=0.035) and 20% carbohydrate trials (iG: 3.35±0.29 vs. BG: 3.81±0.46 mM, P=0.015). MARD values were 14±16% across all timepoints, 20±28% in hypoglycaemia, 12.2±11.4% in euglycaemia and 14±16% during hyperglycaemia. MARD was greater during hypoglycaemia than during Euglycaemia (p>0.001) and all collective timepoints (p>0.001). Plasma volume changes were similar between carbohydrate trials.

CONCLUSION: These data reveal differences in the interstitial glucose to blood glucose concentrations following carbohydrate beverage consumption. Further, there is a time lag between interstitial and blood glucose concentrations. Finally, mean absolute relative differences were highest in hypoglycaemia. These data suggest caution in the use of continuous glucose monitoring during fast changing glucose environments such as carbohydrate beverage consumption.

Dill DB, & Costill DL. (1974). Calculation of percentage changes in volumes of blood, plasma, and red cells in dehydration. Journal of Applied Physiology, 37(2), 247-248.

AN INITIAL EXPLORATION OF AN INSTRUMENTED MOUTHGUARD TO ESTIMATE HEART RATE

AUSTIN, K., JONES, C.M., LOOSEMORE, M.

UNIVERSITY OF CHICHESTER

INTRODUCTION: Heart rate (HR) monitoring is critical in making informed decisions on training load and recovery prescription [1, 2]. Advancements and miniaturization of sensors have allowed for the monitoring of HR during sports performance, typically at the wrist or chest [3, 4]. There are however multiple sports where these sensors are not permitted, such as combat sports. The inclusion of an LED proximity sensor in some instrumented mouthguards (iMG), typically used for quantifying head impacts in sport, could estimate HR utilising photoplethysmography (PPG). Validation of such sensors is required before performance can be evaluated within combat sports. The aim of this study is to present an initial methodology and evaluate validity for estimating HR through an iMG mounted sensor under controlled conditions.

METHODS: Study methodology was devised in line with the INTERLIVE network recommendations [5]. Four healthy active completed a single laboratory trial of three conditions: five minutes of seated rest, five minutes of low intensity (1.5 W/Kg) and medium intensity (3 W/Kg) cycling (Wattbike, Nottingham, UK). Participants were instrumented with the PROTECHT iMG (Sport and Wellbeing Analytics, Swansea, UK) and a Polar H10 chest strap (Polar Electro, Kempele, Finland) as a gold standard measure [6]. The iMG contains an LED sensor positioned to sit firmly against the gum [7]. The iMG samples at 100Hz and utilizes red light PPG. A novel processing pipeline was devised to accounts for significant baseline noise present within the raw PPG signal. For both methods, the final three minutes of each condition was analysed, with HR averaged over five second intervals. Agreement was assessed using mean absolute percentage error (MAPE; %), root mean square error (RMSE; beats per minute [bpm]) and Lin's concordance correlation coefficient (CCC), with cutoffs of 10% and 0.9 generally accepted for MAPE and CCC, respectively.

RESULTS: Average MAPE was 6.7%, 6.8% and 4.6%, average RMSE was 6.7bpm, 8.1 bpm and 7.5 bpm and average Lin's CCC was 0.93, 0.92 and 0.73 for sitting, low and medium intensity exercise respectively.

CONCLUSION: The initial exploration of an iMG mounted HR sensor found that valid measurements of HR can be obtained from the mouth during sitting and low intensity exercise. Although agreement during medium intensity exercise fell below the pre-determined 0.9 threshold for CCC, average MAPE was the lowest of all conditions and RMSE 7.5 bpm. Although further data is required in sports specific scenarios, findings indicate that sufficient physiological signal can be collected from an iMG, which could allow for HR quantification in sports where traditional sensors are not viable.

1) Schneider et al., Front Physiol, 2018; 2) Halson, Sports Med, 2014; 3) Ruiz-Malagón et al., Proc Inst Mech Eng P J Sport Eng Technol, 2021; 4) Biswas et al., IEEE Sens J, 2019; 5) Mühlen et al., Br J Sports Med, 2021; 6) Gilgen-Ammann et al., Eur J Appl Physiol, 2019; 7) Park et al., Front Physiol, 2022

GARMIN FÉNIX 7® UNDERESTIMATES PERFORMANCE AT THE LACTATE THRESHOLD IN COMPARISON TO STANDARDIZED BLOOD LACTATE FIELD TEST

SCHLIE, J., HEIBER, M., SCHITTENHELM, A., BECKERT, M., GRAF, P., SCHMIDT, A.

UNIVERSITY OF THE BUNDESWEHR MUNICH

INTRODUCTION: The lactate threshold (LT) is a critical performance measure traditionally obtained using costly laboratory-based tests. Wearables offer a practical and noninvasive alternative for LT assessment in recreational and professional athletes. However, the comparability of these estimates with the regular field tests requires further evaluation.

METHODS: In our sample of 26 participants (nf=7 and nm=19), we compared the estimated running pace and heart rate (HR) at LT with two subsequent tests. First, participants performed the Fenix 7® threshold running test after a calibration phase. Subsequently, they were tested in a standardized, graded blood lactate field test. Age was 25.97 (± 6.26) years, body mass index (BMI) was 24.58 (± 2.8) kg/m2. After the calibration phase, pace and HR at LT were obtained using the Fenix 7® threshold running test. Subsequently, participants underwent a graded blood lactate field test.

RESULTS: Pace at LT calculated by Fenix 7® (M=11.87 km/h ± 1.26 km/h) was 11,8 % lower compared to the field test (M=13.28 km/h ± 1.72 km/h), which was significant ($p < .001$, $d = -1.19$). HR estimated by the Fenix 7® at LT was 1,72 % lower ($p > .05$). LT data obtained in the field test showed greater overall variance.

CONCLUSION: Our results suggest sufficient accuracy of Fenix 7® LT estimates for recreational athletes. It can be assumed that for professional athletes, it would fail to provide the nuanced data needed for high-quality training management.

BALANCE PERFORMANCE OF HEALTHY YOUNG INDIVIDUALS IN REAL VERSUS VIRTUAL ENVIRONMENTS – A SYSTEMATIC REVIEW

SCHEDLER, S., MUEHLBAUER, T.

UNIVERSITY OF DUISBURG-ESSEN

INTRODUCTION: Due to the development of relatively low-cost but high-tech head mounted displays (HMDs), virtual reality (VR) is used more and more frequently in postural control research. However, it remains unclear whether balance performance is affected by for instance the physical characteristics of the hardware used or the application of a virtual visual stimulus. Further, balance performance has been shown to be age-dependent, especially in youth [1]. Therefore, VR may have different effects on balance performance in youth compared to young adults. Thus, the present systematic review aimed to analyse the influence of VR on balance performance in healthy children, adolescents, and young adults.

METHODS: A systematic literature search was performed in the databases of PubMed, Web of Science, and SPORTDiscus. Inclusion criteria were as follows: (i) healthy, young (age ≤ 30 years) participants, (ii) at least one measure of balance had to be tested in the real as well as in a virtual environment, and (iii) the virtual scene was applied using a HMD. To minimize the effect of different VR-scenarios, only studies using a VR environment which resembled the respective real-world condition were included.

RESULTS: A total of nine studies with 171 young adults (19–30 years, 50% females) met the inclusion criteria. Five studies investigated static balance, three studies analysed dynamic balance and one study examined static and dynamic balance performance. Regarding static balance, three studies did not find differences between performances in the real and the virtual scenario, whereas three studies found worse performances under virtual and more challenging (e.g., reduced base of support) conditions. Concerning dynamic balance, three studies reported declined performances in VR compared to the real condition, while one study did not find significant performance differences. No studies investigating children or adolescents met the inclusion criteria.

CONCLUSION: In healthy young adults, declined balance performances under demanding (e.g., reduced base of support) static and dynamic conditions indicate that VR has detrimental effects on postural control, especially when task difficulty increases. Consequently, results from balance assessments in the real world should not be equated with those obtained in VR, even if the VR-scenario resembles the real world surrounding. Future studies should investigate whether balance training difficulty in VR has to be reduced compared to real world training due to decreased balance performance in VR. Additionally, there is a high need for studies on the influence of VR on balance performance in healthy children and adolescents as no such studies met the predefined inclusion criteria.

Reference

[1] Granacher U. et al., Gerontology, 2011.

Contact
Email: simon.schedler@uni-due.de

AN ONTOLOGICAL REASONING-BASED TRAINING RECOMMENDATION SYSTEM FOR TABLE TENNIS AMATEURS

HUANG, W., REN, F.
THE UNIVERSITY OF SYDNEY

INTRODUCTION: The Chinese Table Tennis Association (CTTA) 2023 released the programme "CTTA Table Tennis Sport Level Testing Standards and Guidelines (Trial)", which is divided into four to nine levels, and each testing level can be selected for testing according to their skills, which provides a standardised guideline for professional training to amateur table tennis enthusiasts. This paper develops a table tennis training recommendation system based on the newly released test programme to provide professional training and level assessment goals for amateur table tennis players. This article also uses Ratings of Perceived Exercise (PRE) for subjective fatigue measurement after training to detect the entire training intensity for table tennis enthusiasts in mass sports. In this post, we first presented the system architecture and needs, after which we built a training knowledge base using ontological reasoning. The method was chosen to be used for training and testing by two amateur table tennis enthusiasts who attained a rating standard of level 5 and sought to improve to level 4. The outcomes demonstrated the systems potential as a guiding framework for table tennis aficionados training.

METHODS: The study reported here used a training programme detection system. For this purpose, following the workflow consisting of the collection and processing of the recommended data of not going, first we briefly introduced the use of the system, then we table tennis amateurs first logged into the table tennis recommendation system platform, clicked to enter the platform, the data of this self-testing input, clicked to carry out the recommendation of the training plan to view, you can click to enter the library of material or to the data in the period of The data can be visualised to give better feedback to the amateur table tennis player.

RESULTS: The first and second tests are similar, and the last two tests are very close to passing. If other enthusiasts dont meet the requirements for a tee, you can also use the system to find a fixed partner based on the time that two people attend training sessions together. The results showed that according to the system, there was a difference of 6 points in the final scores between those who trained with the coach and those who trained themselves. According to the self-fatigue tests of two table tennis enthusiasts, it can be seen that at the beginning, the fatigue level was relatively high, and later, they gradually adapted to the training load. This system has certain reference significance for table tennis enthusiasts.

CONCLUSION: This paper focuses on the recently standardized rules that serve as a knowledge base for table tennis enthusiasts searching for professional coaches in popular sports. It also helps to organize and improve the training load for these enthusiasts, provides them with professional and scientific training guidance, and enables real-time monitoring of their training abilities.

TABLE TENNIS PERFORMANCE INDICATORS RELATIONSHIP UNDER FATIGUE CONDITION. A PRELIMINARY ANALYSIS

DELUMEAU, T., PLOT, C., LE CARPENTIER, E., MOUSSEAU, P.
NANTES UNIVERSITÉ

INTRODUCTION: Table tennis player performance has already been defined in the literature by several aspects such as tactics, equipment, and technique. Ball quality of stroke could be one of them, especially ball speed, rotation, or even precision. Few studies have investigated the relationship between those indicators on different stroke conditions and under neuromuscular or mental fatigue which has been proven to be an influential factor in stroke performance. This study aims to observe the effect of fatigue on the relationship between these performance indicators and their evolution in fatigue.

METHODS: Nine young table tennis players men (age :15 ±1.5y; French ranking points: 2103±344) from a French table tennis national centre were selected to perform three experimental trials in a randomized order: a control session, a neuromuscular fatigue session, and a mental fatigue session. Neuromuscular fatigue was induced in biceps brachii. Participants realized ten biceps eccentric contractions with a load of 90% of their 1RM until they reached a 15% loss of their reference MVC. Mental fatigue session consisted of a mentally fatiguing task (90 min AX-CPT test), while the control session required participants to watch a 90 min neutral movie. Each session, athletes had to realize a pre/post table tennis performance test. Players had to perform four exercises using backhand and forehand strokes with backspin and topspin balls. They had to hit thirty balls thrown by a ball launcher. Players must hit the ball cross-court aiming for targets on either side of the table. Ball speed, spin, impact position, and racket acceleration profile were measured during the tests. Subjective feeling of Fatigue and perceived exertion levels were assessed during the sessions.

RESULTS: . Measured RPE and feeling of fatigue were significantly higher post Neuromuscular and Mental fatigue protocols. First results, shows that the ball spin appears to be highly correlated with ball speed ($r=0.96$, $p<0.001$) even under fatigue conditions. Ball speed was also observed slightly correlated with maximum racket acceleration ($r=0.62$, $p<0.001$). Ball speed and spin determine stroke conditions and ranges. Results suggest that forehand topspin produces a fastest ball speed and spin (12 $m{\cdot}s^{-1}$,100 rps to 16.6 $m{\cdot}s^{-1}$, 130 rps) , contrary to the backhand backspin which shows the lowest values (8.33 $m{\cdot}s^{-1}$,60 rps to 10 $m{\cdot}s^{-1}$,80rps). No significant effects of neuromuscular or mental fatigue on group performance were observed, possibly due to individual differences among players.

CONCLUSION: These first results suggest that mental or neuromuscular fatigue was induced with success. Observation of the preliminary results implies that the ball speed /spin relationship seems not affected by the player's fatigue. The determination of the range of speed/spin combination could lead to the design specific of training programs for the players. Further analysis may be needed to conclude properly the effect of fatigue on performance indicators.

DIFFERENCES IN RESPONSE TO A LOW ALTITUDE FOOTBALL TRAINING CAMP SUPPLEMENTED WITH ADDITIONAL HYPOXIC TRAINING

HAMLIN, M., MANIMMANAKORN, A., MANIMMANAKORN, N., SIMPSON, C.

LINCOLN UNIVERSITY

INTRODUCTION: Living and training at altitude is a popular training method for athletes, however, there is considerable individual variation in subsequent sea-level performance improvement where some athletes adapt successfully, while others do not adapt and fail to improve. Since such training is expensive, time consuming, and normally requires considerable logistical planning, coaches and athletes do not want unsuccessful altitude training experiences. Therefore, the aim of this study was to investigate possible physiological measures that might recognise athletes that respond positively to altitude training compared to those that do not.

METHODS: This longitudinal study included 20 male football players (20.6 ± 1.1 years, 173.9 ± 4.8 cm, 67.7 ± 8.3 kg, mean ± SD) who undertook an 8-week training camp at 825 m above sea-level (Khonsan, Chaiyaphum Province, Thailand). Players were also supplemented with intermittent hypoxic training via a hypoxicator (Altitude Training Systems, Australia) 15 min/day 3 times/week at FIO2 of 0.15 while cycling at an exercise intensity between 100-120 W. Based on the players 2800-m running performances between baseline and 14 days post training camp, players were separated into responders (improved by 10.7 ± 8.1%, mean ± 95% CI, n=14) and non-responders (decreased by 6.1 ± 12.8%, n = 6). Changes in the 2800 m run performance along with other physiological variables (resting heart rate, arterial oxygen saturation, heart rate variability, haematology and blood lactate) from the 3 trials (baseline, 1, and 14 days post training camp) and standard deviations representing the between-and within-subject variability were estimated using a mixed modelling procedure (Proc Mixed) in the Statistical Analysis System (Version 9.3, SAS Institute, Cary, North Carolina, USA). The effect size statistic (ES) was also calculated.

RESULTS: Compared to baseline, the responders had a lower heart rate at 1 (-4.6 ± 2.7 bpm, Effect Size = 1.2) and 14 days (-6.7 ± 3.3 bpm, ES = 1.7) post training camp, whereas the non-responders resting heart rate did not change substantially. Compared to the non-responders, the responders had higher pNN50 at 1 (12.2 ± 11.5, p = 0.04, ES = 1.6) and 14 days (10.1 ± 11.7, p = 0.09, ES = 1.4) post training camp. As a result of the training camp, the responders decreased their LF/HF ratio at day 1 (-1.1 ± 0.6, p < 0.01, ES = 1.0) and day 14 post camp (-0.9 ± 0.6, p < 0.01, ES = 0.8), whereas the non-responders LF/HF ratio moved in the opposite direction (0.8 ± 0.9 and 0.9 ± 0.9), with large effect sizes found between groups (ES = 1.7-1.8). Between-group differences in other variables measured were not substantive.

CONCLUSION: Reduced resting heart rate and increased cardiac parasympathetic tone was associated with improved run performance after the altitude training camp and may be used to differentiate athletes that respond to altitude training compared to those that do not.

STUDY ON THE CHANGE RULE OF INTERSTITIAL FLUID GLUCOSE (IFG) IN CYCLISTS DURING TRAINING WITH DIFFERENT LOAD

YU, J., YONG, L.

BEIJING INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: This study aimed to explore the regularity of interstitial fluid glucose (IFG) changes during different load training and the correlation between IFG and training load, to provide new ideas for training monitoring and precise sugar supplementation.

METHODS: 10 male cyclists from Beijing cycling team, with average age of 15.9±0.7 years old, height of 179.08±4.60cm, weight of 69.33±7.54kg, subjected to take part in this study. All of them had more than 2 years of cycling training experience. Continuous glucose monitoring sensor (CGMs) was placed on the back of the upper arm which area has thicker fat and monitored IFG for 14 days. Body composition, Rest metabolic rate (RMR) and maximum oxygen uptake (VO2max) were measured before training sessions (COSMED K5,America and SRM,Germany). During track cycling, road cycling, treadmill training (Rodby 3500, Sweden) and interval high intensity training (Wattbike, England), athletes' heart rate(HR) and IFG were monitored. Athletes began exercise between 1.5-2h after meals and had no sugar intake during training and testing. SPSS 26.0 statistics was applied to analyse data. Repeated-measures ANOVA was used to analyse the results of VO2max and IFG over time with $p < 0.05$ being a significant difference. One-way ANOVA was used to detect the differences of heart rate, RPE and IFG results, with $p<0.05$ being considered a significant difference. All data are expressed as mean±SEM.

RESULTS: The results showed that IFG was significantly correlated with RMR ($p<0.01$). IFG was also significantly correlated with VO2 ($p<0.01$) and VCO2 ($p<0.01$). During the VO2max test, IFG values were obtained by scanning every minute. The average IFG value at 6min, 7min and 8min was significantly higher than that at 1min ($p<0.05$, $p<0.05$, $p<0.05$). Athletes' average IFG during incremental load exercise ranges from 7.6-8.6 mmol/L. The IFG reached its maximum value at the 8th minute and decreased in the following time. Results showed that the average heart rate of high-intensity interval training on wattbike was significantly higher than that of road cycling class ($p< 0.05$). Athletes' RPE after track cycling

and Wattbike training were significantly higher than those of road cycling. The mean value of IFG of track cycling was significantly higher than those of treadmill training, road training and Wattbike training ($p < 0.05$, $p < 0.01$, $p < 0.01$).

CONCLUSION: IFG value is positively correlated with RMR, VO2 and VCO2 in the resting state. IFG could reflect the level of basal energy metabolism of athletes. During exhaustive exercise with increasing load, IFG value increased with time and reached the highest level at an average heart rate 161 rpm, then decreased. The results indicated that IFG changed regularly with training load.It was also found that the average value of IFG in track cycling was the highest, suggesting that this training schedule may stimulate the highest carbohydrate-supplying energy efficiency in the body.

Conventional Print Poster Presentations

CP-SH04 Psychology

THE EFFECT OF THREE-WEEK MULTIPLE-JOINT EXERCISE COMBINED WITH SELF-EFFICACY THEORY ON SELF-EFFICACY IN OVERWEIGHT/OBESE OLDER ADULTS

KANLAYAWUT, O., KRITPET, T., MAPHONG, R.

CHULALONGKORN UNIVERSITY

The effect of three-week Multiple-joint exercise combined with self-efficacy theory on self-efficacy in obese older adults.

Kanlayawut, O.1, Kritpet, T.2, Maphong, R.3

Faculty of Sports Science, Chulalongkorn University, Bangkok, Thailand

INTRODUCTION: Multiple-joint exercise tends to be more effective in improving a variety of health outcomes across demographics, and self-efficacy theory can increase self-efficacy in older adults. However, the effectiveness of multiple-joint exercise combined with self-efficacy theory on self-efficacy in elderly people with obesity is unknown. This study measured and compared the self-efficacy changes to multiple-joint exercise (MJ) vs. multiple-joint exercise with self-efficacy theory (MJS) in obese older adults.

METHODS: The study included 45 obese seniors (MJ group; n = 22, BMI = 25.65±2.61 kg/m2; MJS group; n = 23, BMI =25.91±3.17 kg/m2) aged 60-75 years. MJ consisted of 8 exercises of 2 sets per exercise alternating with resting 1 minute between sets (MJ 60 minutes/day; exercise 40 minutes, warm-up, and cool-down 10 minutes) for 3 day/week. Self-efficacy theory consisted of four primary source: (a) master experiences: giving knowledge of multi-joint exercise; (b) modeling: 30-minute conversation with a model (c) verbal and compliment: encouraging and complimenting; (d) emotional arousal: giving awards for leaders. The MJ group received MJ only, but MJS group received MJ combined with self-efficacy theory. Self-efficacy was assessed by questionnaire.

RESULTS: Both groups had significantly greater knowledge (pre vs. post; MJS = 5.91±1.8 vs. 8.13±1.3; MJ =6.41±1.3 vs. 7.54±1.7) and self-efficacy for multi-joint exercise knowledge (pre vs. post; MJS = 20.74±3.2 vs. 29.13±1.45; MJ = 21.45±2.0 vs. 28.09±2.2; all $p<0.05$), but no significant differences were observed following the intervention. After receiving the intervention, both groups recognized an increase in personal efficacy following intervention (pre vs. post; MJS = 27.21±3.4 vs. 29.04±1.3; MJ = 27.68±2.3 vs. 27.86±2.0; all $p<0.05$), while the MJS group had a greater expectation (29.04±1.3 vs. 27.86±2).

CONCLUSION: In obese older adults, combining MJ with self-efficacy theory is possible and can be utilized to promote exercise self-efficacy and personal efficacy expectations. Future research is needed to assess the effects of MJS on physical function and blood chemistry in obese elderly people.

ADAPTATION AND SUPPORT METHODS OF CHINESE STUDENT-ATHLETES IN JAPANESE HIGH SCHOOL

LI, Y., NAMIKI, N., HORINO, H.

WASEDA UNIVERSITY

As the globalisation of sports progresses, it is not limited to professional sport. More and more international student-athletes（ISA）are playing sports in other countries. ISA in Japan are mainly concentrated in high schools and universities. While studying at Japanese schools, they compete for their school teams at various levels of competitions to win honours for their school. This paper uses interviews to explore the challenges encountered by Chinese student-athletes（CSA） who have studied in Japan during their high school years. It clarifies their problems in (1) economy, (2) academic, (3) social, (4) competitive, (5) personal emotional and (6)institutional attachment. We also discussed the direction of support for the challenges they encountered. The results of the survey show that CSA in Japan do not receive much pressure in terms of economic and academic pressure in Japan. However, there are greater troubles in socialising, and in managing personal emotions. In addition, CSA indicated that playing sports in Japanese schools is indeed competitive and challenging. However, there are many deficiencies in the rehabilitation and dietary support provided by the school for their injuries and illnesses.Also, because they do not know much about how to enter universities through sport selection in Japan, they do not enter their desired universities after graduation. Therefore, it is important to provide necessary psychological counselling and more timely guidance and assistance to them, and more information on how to enter universities after graduation.

THE EFFECT OF EXERCISE ON IDEAL SELF, EXPECTANCY VALUE AND PURCHASE INTENTION OF APPLE WATCH

WU, Y.T.
SOOCHOW UNIVERSITY

Introduction

Self-concept is linked to an individual's assessment of goods and services. Where the evaluation of products through themselves when using the product can be described as the self-congruence theory. This study attempts to understand consumers value when considering the smart wearable product with cognitively dominated attitude and intention theory model. Therefore, this study focuses on identifying the expectancy-value model (EVM) of attitude to adequately capture the effect of expected value toward the Apple Watch.

Methods

The current research consists of 350 participants recruited to participate in the study, after elimination of invalid questionnaire 325 questionnaires were used Firstly, questionnaires need back and forth translation from English to Traditional Chinese. Secondly, structural equation modeling was used to stipulate the phenomenon of the reason and consequence variables with the confirmatory factor analysis (CFA) using partial least square analysis. Lastly, reliability was tested to examine consistency and validity including the test of association between the variables. Results

The study consisted of 150 female participant 46.3%, and 174 male participants 53.7% from Taiwan who exercise at least once a week.. A good model fit was accepted with confirmatory fit index CFI >.9 was at .89, Tucker& Lewis index TLI >.9 was at .875. The squared multiple correlation was .10 for hedonic value and .12 for utilitarian value accounting for 10% and 12% of ideal self. Moreover, behavior intention was seen with .47 which is 47% variance accounted by hedonic value and utilitarian value. The study found positive relationship of ideal self and hedonic value b=.313: and positive relationship of ideal self and utilitarian value.345. Hedonic value and utilitarian both showed positive relationship for behavior intention b=.369; b=.538. Discussion

This study showed ideal self has a positive relationship with hedonic value as its emphases on the appealing characteristics of a product and produces desire, on the other hand ideal self also showed a positive relationship on the utilitarian value since the basics of utilitarian values consist of task related, and rational decision making. Hedonic value and utilitarian value have their differences in value, where one is personal value such as fun and playfulness and the other is more of completion of goal. According to the values this study focuses on the relationship it has of hedonic and utilitarian value toward the the behavior intention of buying a apple watch which all showed positive relationship between the variables.

IMPLICIT MOTIVES IN PROFESSIONAL FOOTBALL AND THEIR CONCLUDED NEEDS FOR COACHING PROCESSES

SPRECKELS, C.
UNIVERSITY OF HAMBURG

Introduction

Investigation showed that not only talent (Kang et al 2015) but certain personality traits could be predictive for a successful sports career (Kazén & Quirin 2018). As shown in other investigations confidence in success or fear of failure could be seen as states and not traits (Kazén, Kuhl & Quirin 2015). According to the Personality System Interaction Theory (PSI, Kuhl 2001) to hit the implicit motives support the confidence in success. Aim of this study was to explore if implicit motives of professional football players differ from the normal population and if certain clubs differ from others, so that it would a big point to coach them due to their individual personality. It also could be an explanation why certain coaches are successful within a certain club and others are not, because besides their football expertise their personality is matching.

Methods

N= 207 footballplayer of five clubs of the first and second league in Germany, aged 25 ± 7 years, were tested with the implicit personality test ViQ. This test includes the four main characters (worker, teamplayer, creative and dominant) as well as four motivational factors, which sums up to 16 different types. Comparing with the normal population of a mass media example (N= 24.000) and within different clubs the null hypothesis was, that the footballplayers don't differ from normal population and within different clubs and the hypothesis according to this is that they differ. The chi^2-Test was used for calculation.

Results

Results show that there is no significant difference from normal population to professional football players in the worker type ST (p=0,185) but differences in the three other types, TeamplayerType SF, Creative Type NF and Dominant Type NT, all significant (p<0,005). Differences between Clubs are also significant (p<0,005) within certain personality dimensions due to the PSI-Theory (Kuhl 2001).

Conclusions

Soccer coaches with their own combination of implicit motives should consider that their players may have different motives than other players in other clubs and themselves in order to be able to motivate them well, because the explicit motives have a directing effect and the implicit ones have an energizing effect, which determine the degree of motivation. Furthermore, it should be noted that this differs between clubs due to a specific club culture.

References

Kang et al, Temperamental Predictive Factors for Success in Korean Professional Baseball Players. Psychatric Investig, 2015, 12(4)

Kazén, Kuhl & Quirin, Personality Interacts with Implicit Affect to Predict Performance in Analytic Versus Holistic Processing. Journal of Personality, 2015, 83(3)

Kazén & Quirin, The integration of motivation and volition in Personality Systems Interactions (PSI) theory, 2018

Kuhl, Motivation und Persönlichkeit, 2001

INVESTIGATING YOUTH PLAYERS PERFORMANCE UNDER COACH-CREATED MOTIVATIONAL CLIMATES IN HONG KONG: AN EMPOWERING COACHING THEORY PERSPECTIVE

CARMAN LEUNG, K.M., DUDA, J.L., SHI, Y., YIP, H.D.

THE EDUCATION UNIVERSITY OF HONG KONG

Introduction

Motivational climates are arguably to generate diverse outcomes in terms of youth players' psychological states as well as actual behaviors during sport participations. These outcomes can be explained by the theory of empowering coaching, reflecting the coach-created motivational climates which are characterized as either empowering or disempowering (Duda et al., 2017). To date, limited studies have examined the perceptions of Hong Kong sport coaches regarding the coaching environments they created. The present study aimed to examine perceptions of coaches regarding motivational climates, specifically what they witness of their players' participation attitudes and behaviors under empowering or disempowering climates and what elements can be associated with motivated and demotivated themes.

Methods

A semi-structured interview guide based on the Empowering Coaching Theory of Duda et al. (2017) was designed for adaptation to the local context. A total of 30 coaches with an age range from 19 to 63 years old (M=35.5; SD=11.94) were recruited. They were stratified by sex (50% male and 50% female) and coaching experience (60% with over six years and 33.3% with less than five years of coaching experience). Coaches were asked to recall their experience in carrying out specific coaching strategies that they thought were effective or ineffective in motivating young players, as well as young sport participants' attitudes and behaviors that they have coached during the training and competition. A six-step thematic analysis procedure was performed to process the data.

Results

With respect to the motivation and experiences of youth players during sport participation, eight themes were identified, namely (a) hunger to achieve more, (b) commitment, (c) team cohesion, (d) expectations regarding excellence, (e) lifelong progression were recognized as optimally motivated attributes reflecting an empowering climate, while (f) passive coping, (g) fear of being a liability, and (h) discouragement from further development were recognized as demotivated attributes reflecting a disempowering climate.

Discussion

The results revealed that players who were motivated and had experience in empowering climates exhibited empowered characteristics, including autonomy support, task involvement, and social support, whereas the attitudes and behaviors of demotivated players tended to exhibit psychological need thwarting features, such as ego involvement and controlling behaviors. This study embraces the Empowering Coaching Theory as the theoretical framework to produce contributions to the theoretical literature, which extends our understanding of the attributes that can reflect specific coach-created motivational climates.

Duda, J. L., Appleton, P. R., Stebbings, J., & Balaguer, I. (2017). Towards more empowering

and less disempowering environments in youth sport: Theory to evidenced-based practice. In Sport psychology for young athletes (pp. 81-93). Routledge.

EFFECTS OF SIDE-BY-SIDE PARTNER ON ENJOYMENT AND MOTIVATION IN HIGH-PACED TREADMILL RUNNING

HOSHINO, S., NARUSE, Y., HAMAURA, M., ARAUCHI, K., KOMORI, Y.

NARA WOMENS UNIVERSITY

INTRODUCTION

The phenomenon in which performance is improved by the presence of others is called social facilitation (Zajonc, 1965). For runners the interaction with running partner influences the appeal to run. We reported the importance of running partner regarding their enjoyment with a comfortable self-paced running (Hoshino et al, 2023). A theoretical approach that has shown evidence of how motivational factors can support enjoyment of a physical activity is self-determination theory (SDT) (Deci and Ryan, 1985). According to SDT, we investigated how different elements of "autonomy", "competence", and "relatedness" are influenced a running with the presence of a partner during high intensity running.

METHOD

Subjects: 14 female university and graduate students (20.9 ± 1.6 yr.) .

Tasks and conditions: Flat treadmill self-paced running for 30 minutes under two conditions (1) Solo condition (SC): running alone and (2) Partner condition (PC): running side by side with a partner. In both conditions, subjects were instructed to

"run as far as you can in 30 minutes. The rate of increase/decrease from the initial speed (each subjects lactate threshold) was presented as the feedback information on the screen.

Measurements: (a) Behavioral indices: total running distance, running speed, and rate of speed increase every 5 minutes (actual speed/initial speed), (b) physiological index: heart rate, and (c) psychological indices: Feeling Scale: FS, Exercise Enjoyment Scale: EES, Excitement, Anxiety, RPE (Borg's scale) reported at the base line (BL), every 5 minutes (R5-R30), and 20 minutes after the end of running (A20).

RESULT and DISCUSSION

The total running distance for 30 minutes in PC (4.12±0.536km) was significantly longer than in SC (3.96±0.544km) ($t(13)=1.787$, $p<.049$). The running speed was significantly higher in the PC after 15 minutes running (R15-R25). As a result of two-way ANOVA for heart rate, a significant main effect was shown for time factor ($F(1,13)=10.306$, $p<.007$, $\eta^2=.442$). In PC heart rate was higher than in SC. But there were no differences between groups in RPE.

At 20 min after running (A20) in PC was shown to be significantly higher in enjoyment (EES) than in the SC. The anxiety in PC was significantly declined to get lower from the BL to A20 compared with the SC.

Additionally, we divided participants into the leader and the follower groups based on feedback information and examined elements of SDT. As a result of three-way ANOVA, "relatedness" in PC at post-running compared with pre-running. In other words, relatedness got significantly higher on running with partner. Especially motivation was higher in the leader group.

CONCLUSION

We found that 30-minute high-paced running with a partner lowers perceived exertion and socially enhances running performance, increasing enjoyment and reducing anxiety after running. The running influenced on the "relatedness". From the point of the relationship between leader and follower, this phenomenon particularly observed in the leader. Since it is said that experiencing positive emotion during exercise enhances intrinsic motivation (Teixeira et al., 2012), increased relatedness due to the presence of a partner is thought to be effective in facilitating exercise behavior.

RELATIONSHIP OF EMPOWERING AND DISEMPOWERING MOTIVATIONAL CLIMATES TO INDICATORS OF HONG KONG YOUTH PARTICIPANTS' SPORT CHARACTERS

SHI, Y., LEUNG, K.M., CHI, L., DUDA, J.L.

THE EDUCATION UNIVERSITY OF HONG KONG

Introduction

Coach-created motivational climates are assumed to hold significant impact on young players' sustained engagement in sport as well as their well-being and enjoyment of sport activities. It has been suggested that sport participation can promote youth participants' character development and thus contribute to their future lives in adulthood. To date, some works have been done on assessing features of the coach-created motivational climates through the theoretical lens of empowering coaching theory and in regard to indices of prosocial/character development, particularly in non-Western regions. Guided by the theoretically-integrated Empowering Coaching conceptual framework, this study aimed to assess the relationships of empowering and disempowering motivational climates to indices of youth participants' sport character, including confidence, leadership, resilience, mental toughness, and social inclusion.

Methods

651 participants were 12 to 15 years old male and female students who attended sport training offered by five partnered sport associations in Hong Kong. They responded to scales which were translated into Mandarin for Cantonese speakers from the Empowering and Disempowering Motivational Climate Questionnaire-Coach (EDMCQ-C), Self-Description Questionnaire II (SDQ II), Youth Experience Survey 2.0 (YES 2.0), and Connor-Davidson Resilience Scale (CD-RISC). Structural equation modelling (SEM) was utilized to test the hypothetical relationships among empowering, disempowering, and five aspects of sport character.

Results

The goodness of fit to the data were satisfactory ($x2/df = 2.44$, $p < .001$, RMSEA = 0.06, TLI = 0.91, and CFI = 0.92). Youth participants perceived empowering motivational climate created by coaches positively predicted their leadership, resilience, mental toughness, and social inclusion. Moreover, the empowering motivational climate has a large effect on resilience, a medium effect on leadership and mental toughness, and a small effect on social inclusion, respectively.

Discussion

This study's results support and extends the Empowering Coaching framework in regard to the prediction of youth players' indicators of character and mental strength, particularly mental toughness, resilience, and social inclusion. Based on present findings, sport coaches should be encouraged to build a more empowering climate with an emphasis on promoting greater task involvement, feelings of autonomy, and belonginess.

THE EFFECT OF EXTRINSIC MOTIVATION, ESPORT FANDOM AND IMPULSIVE BUYING BEHAVIOR OF ESPORT PERIPHERALS AMONG ESPORT FANS

WU, Y.F.
MING CHI UNIVERSITY OF TECHNOLOGY

Introduction

In recent years the popularity of esport participation has changed the way people live. With this popularity of eSport it is important to acknowledge the behaviors of eSport fans. To sustain esport fan behavior, marketing psychology is an important topic that needs to be addressed. esport fans have multiple experiences such as overlapping behavior, feelings and thoughts. To understand this phenomenon, this study will adopt social identity theory and organismic integration theory.

Methods

Purposive sampling was administered to deliver questionnaires to eSport fans that attend eSport exhibitions. The Google online questionnaire recruited 300 esport fans and after deletion of invalid data 206 were analyzed. Item analysis and convergent validity analysis was conducted using Amos. Reliability and construct validity was analyzed with SPSS 23. The purpose of this study was to investigate the relationship of extrinsic motivation, esport fandom and impulsive buying behavior of esport fans using confirmatory factor analysis (CFA) with structural equation modeling (SEM). Results

The results showed that most of the esport fans that attended the esport exhibition were males, accounting for 167 (81.1)% and females accounting for 39 (18.9)%;the age of the participants who participated in this study were between 20 to 66 years old. The results showed that identified regulation is positively relevant to esport fandom; integrated regulation is positively relevant to esport fandom; identified regulation is positively relevant to impulsive buying behavior; integrated regulation is positively relevant to impulsive buying behavior; eSport fandom is positively related to impulsive buying behavior. Discussion

The findings in this study found that organismic integration theory (OIT) and social identity theory can explain consumer regulatory styles for different forms of motivation and that greater levels of identified and integrated regulation can be affected when an individual is provided with external recognition and internal choices through contextual support. For example, if an individual identified that eSport supports their psychological needs, then they will attend more eSport events and engage in impulse buying of eSport peripherals. Therefore, these findings suggest that antecedents of eSport fandom may be affected by individuals identifying and integrating regulation reflected in their impulsive buying behavior of purchasing eSport peripheral products.

Conventional Print Poster Presentations

CP-MH03 Sports Medicine and Physiotherapy

ASSESSING VARIABILITY IN HAMSTRING MUSCLE STIFFNESS AFTER ECCENTRIC EXERCISE: A SHEAR-WAVE ELASTOGRAPHY STUDY

SCHWIETE, C., BROICH, H., MESTER, J., BEHRINGER, M.
GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: Shear-wave elastography is an increasingly used method to evaluate muscle stiffness after exercise-induced muscle damage [1]. Research indicates that shear-wave speed variations are not uniform across a muscle group, with notable differences between [2] and even within muscle heads [3]. This study aimed to explore the uniformity of muscle stiffness changes across and within muscle heads following maximal eccentric exercise.

METHODS: Fourteen trained male participants (26.6 ± 3.1 years, 81.8 ± 8.2 kg, 180.5 ± 7.3 cm) underwent muscle stiffness evaluation at six distinct sites within the hamstring muscle utilizing shear-wave elastography. Subjects performed 5 x 15 maximal eccentric leg curls at 210°/s on an isokinetic dynamometer and muscle stiffness was assessed before, immediately after training, and on the consecutive four days (24 h – 96 h post).

RESULTS: There was no time-by-point interaction for shear-wave elastography ($F_{25, 360} = 0.60$, $p = 0.93$). The main effects of time ($F_{4.01, 288.9} = 2.98$, $p = 0.02$) revealed a significant increase in muscle stiffness from pre (2.04 ± 0.15 m/s) to post (2.11 ± 0.14 m/s) and 24 h post (2.11 ± 0.14 m/s). A significant main effect was also observed for the specific points of measurement ($F_{5, 72} = 4.85$, $p = 0.0007$).

CONCLUSION: Maximal eccentric exercise induced an immediate and sustained increase in hamstring muscle stiffness, observable up to 24 hours post-exercise. The findings suggest spatial heterogeneity in stiffness changes across the different hamstring measurement locations, possibly due to non-uniform muscle damage [4] or fiber activation [5].

References:

[1] Licen, U; Kozinc, Z. (2022). Using Shear-Wave Elastography to Assess Exercise-Induced Muscle Damage: A Review. Sensors, 22, 7574. https://doi.org/10.3390/s22197574

[2] Kawama, R; Yanase, K; Hojo, T; Wakahara, T. (2022). Acute changes in passive stiffness of the individual hamstring muscles induced by resistance exercise: effects of contraction mode and range of motion. European Journal of Applied Physiology, 122: 2071-2083. https://doi.org/10.1007/s00421-022-04976-6

[3] Kisilewicz A, Madeleine P, Ignasiak Z, Ciszek B, Kawczynski A, Larsen R. (2020) Eccentric Exercise Reduces Upper Trapezius Muscle Stiffness Assessed by Shear Wave Elastography and Myotonometry. Frontiers in Bioengineering and Biotechnology 8: 928. https://doi.org/10.3389/fbioe.2020.00928

[4] Green, M; Sinkus, R; Gandevia, S; Herbert, R; Bilston, L. (2012). Measuring changes in muscle stiffness after eccentric exercise using elastography. NMR Biomed, 25, 852-858. doi: 10.1002/nbm.1801

[5] Kinugasa, R; Kawakami, Y; Fukanaga, T. (2006). Quantiative assessment of skeletal muscle activation using functional MRI. Magn. Reson. Imaging, 24, 639-644. doi: 10.1016/j.mri.2006.01.002

INFLUENCE OF SUBCUTANEOUS FEMORAL FAT ON THE ACCURACY OF SMO2 MEASUREMENT BY MOXY NEAR-INFRARED SPECTROSCOPY

BARAWI, S., HAPP, K.A., BEHRINGER, M.

GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: The MOXY is an innovative muscle oxygen monitor that uses near-infrared spectroscopy (NIRS) to measure local oxygen saturation (SmO_2) and total haemoglobin (THb). It continuously measures muscle oxygen saturation by emitting light beams into the muscle. The reflected light is collected by two sensor in near distance [1]. Since hemoglobin and myoglobin change their absorption of infrared light due to oxygenation, NIRS measurements can be used to estimate the oxygen saturation of the muscles (SmO_2). This study investigates the effect of subcutaneous femoral fat (SFF) on the accuracy of SmO_2 measurements, addressing a significant factor that can affect NIRS readings.

METHODS: Forty participants (25.4 ± 3.5 years, 68.4 ± 13.1 kg, 173 ± 8.9 cm) had the Moxy device (Idiag AG, Switzerland) placed on the rectus femoris muscle. At 50% of the distance between the spina iliaca anterior inferior and the base oft the patella. Resting SmO2 values were recorded for 5 minutes, and the average of the last 2 minutes was analyzed. SFF thickness was measured using ultrasound (ACUSON Redwood, Siemens, USA). The linear transducer (2.9 – 9.9 MHz) head was placed vertically with as minimal pressure to prevent compression of the underlying tissue. SFF thickness was defined as the distance from the subcutaneous fat tissue-muscle interface to the subcutaneous fat tissue-skin interface. Three images were taken, and the average SFF in centimeters (cm) was used for further calculations.

RESULTS: Linear regression analysis showed a moderate positive correlation between SFF in cm and SmO2 values ($r = 0.437$, $p < .001$). SFF in cm explained approximately 19.1% of the variation in SmO2 values. The regression coefficients showed that for every cm increase in SFF, SmO2 levels decreased by -1.67 % (intercept = 91.65, $p < 0.001$; SFF = -1.67, $p = 0.005$).

CONCLUSION: These results show a clear influence of SFF on the SmO2 values, that needs to be taken into account when interpreting SmO2 values. The linear relationship shows that the data of MOXY device are impaired with increasing fat layer, reducing the validity of the information about the muscular SmO_2.Further research is needed to investigate whether the influence of subcutaneous adipose tissue can be mathematically calculated out to improve the accuracy of muscular SmO_2 measurements in people with elevated subcutaneous fat layers.

[1] Miranda-Fuentes, C.; Chirosa-Ríos, L.J.; Guisado-Requena, I.M.; Delgado-Floody, P.; Jerez-Mayorga, D. Changes in Muscle Oxygen Saturation Measured Using Wireless Near-Infrared Spectroscopy in Resistance Training: A Systematic Review. Int. J. Environ. Res. Public Health 2021, 18, 4293. https://doi.org/10.3390/ijerph18084293

SPORTS PARTICIPATION AND PREVALENCE OF FREQUENT UPPER RESPIRATORY TRACT INFECTION

SAWADA, S., SHIMIZU, S., TSUNEDA, U., NAKAZAWA, Y., SUZUKI, K., HIRAYAMA, K., LEE, D.C.

WASEDA UNIVERSITY

INTRODUCTION: Limited data on the relationship between sports participation and health are available. In particular, few studies have investigated the relationship between contact sports such as rugby, American football, wrestling, boxing, and karate and the prevalence of frequent upper respiratory tract infection (URTI). Therefore, we conducted a cross-sectional study to investigate the relationship between contact sports and the prevalence of frequent URTI among Japanese adults.

METHODS: This study was conducted using an Internet survey between July 30, 2021 and August 3, 2021 in Japan. The study participants consisted of 2,500 adults (mean age = 26.1 years, 50% women) Participants were asked about the frequency of URTI before the COVID-19 pandemic, and were asked to select the most appropriate answer among the following options: 'a few times each year', 'about once every year', 'once every few years' and, 'rarely.' Participants were also asked if they had ever participated or are currently participating in contact sports: 'have participated in the past and currently participating [CS]'; 'have participated in the past, but not currently [Past-CS]'; and 'have never participated [Neven-CS].' We combined 'a few times each year' and 'about once each year' and defined it as frequent URTI (case) and 'once every few years' and 'rarely' as non-frequent URTI (non-case). Multivariable-adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) for the prevalence of frequent URTI were obtained using logistic regression models while adjusting for age, sex, marital status, household income, and education levels.

RESULTS: There was a total of 487 (29.3%) frequent URTI cases. Compared to the Never-CS, the ORs (95% CIs) were 1.50 (1.16 – 1.94) for Past-CS, and 2.11 (1.70 – 2.63) for CS, respectively.

CONCLUSION: This study showed a higher prevalence of frequent URTI in adults who have participated or are currently participating in contact sports. However, prospective studies are needed to find a causal relationship between contact sports participation and URTI.

WARM-UP AND INJURY PREVENTION HABITS IN AMATEUR PADEL PLAYERS

ARRIAZA, R., HERNÁNDEZ VÁZQUEZ, C., FERNÁNDEZ ROMERO, J.J.
UNIVERSITY OF A CORUÑA

INTRODUCTION: Padel is considered as the fastest-growing sport in the world. It is considered to have over 25 million players across 110 countries. Female players make up 37.5% of recreational players and 54% of padel players are 26 years old and above. It is fun, and easy to play, which makes it very attractive for people who either has never practiced sport or who quit sport long time ago and consider it as a sport without risk of injury or physical requirements. The study from Sánchez-Alcaraz (2021) showed that the total time of a match is approximately 90 minutes, while the actual playing time is slightly over 30% of the total playtime). Regarding movement analysis, the distance covered is about 2000 meters per match, although this can vary depending on the match duration and player level

There is a lack of knowledge about the injuries and injury prevention habits of amateur padel players.

METHODS: A survey was conducted with 105 amateur paddle players, who play between 1 and 3 matches of 90 minutes duration per week and compete at a low level, about their warm-up and injury prevention habits, in order to understand the reality of the sport among regular, non-professional practitioners. There were 31 male and 74 female players.

RESULTS: 46 respondents declared that they practiced also other sporting activity other than padel. Only 53 players declared that they performed some kind of warming up. The duration of the warm-up was 10 minutes or less (in one case, "one minute"), and mostly in the court, practicing different types of shots, in 32 cases; 10-15 minutes in 14 cases; and more than 15 minutes in 7 cases.

The players reported a total of 69 injuries, most of them in the lower limbs (35), and more frequently triceps surae injuries and ankle ligament sprains, followed by elbow tendinopathies (17). There were only 5 shoulder injuries (4 tendinopathies and one clavicle fracture due to a fall). There were 6 fractures (5 of them due to falls and one due to the impact of the partner's racquet in the face). In 50 cases, the injured players required more than 21 days to return to sport, and in 14 cases the injuries recurred.

CONCLUSION: Even while the frequency of the triceps surae and ankle ligament injuries is high in amateur padel tennis players, their warming-up and injury prevention habits should improve, as only 50% of the survey respondents include them into their sport protocols

EFFECT OF ACUTE INTERVENTION OF FLOSS BAND ON CHRONIC KNEE PAIN IN BOXERS

CHEN, J., WANG, Q.R., LI, Y.Z., WANG, W., WANG, D.
SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Epidemiological data reveal that knee injuries constitutes 53% of all lower limb injuries among Chinese elite boxers, with an incidence rate of 80.9% in athletes at national level one and above. The boxing technique requires the rotation inward of knees to enhance the range of motion and power in each striking. However, this abnormal knee position leads to knee injuries and causes knee pain. Recovery from knee injuries typically spans approximately 21 days. Nonetheless, due to the systematic and protracted nature of training, athletes often struggle to get adequate rest to recover and treatment after an injury, which may ultimately result in chronic knee pain (CKP). CKP refers to knee pain that persists for more than three months. Its primary symptom is pain, which can partially impede athletes ability to compete and train normally, thus negatively influencing performance and decreasing training motivation. Floss band are a novel tool for managing injuries, functioning primarily through the application of compressive force to muscles and joints to improve function and promote recovery. Current research on floss band mainly focuses on long-term interventions. Very few studies used floss band specifically targeting at the immediate release of knee joint pain. Therefore, this study was to investigate the acute effect of floss band on boxers with CKP.

METHODS: Nine boxers (6 males: 19.3±1.6 y, 183.5±11.4 cm, 78.7±22.1 kg, trained for 3.4±1.4 y, suffering from CKP for 15.8±7.1 month; 3 females: 18.0±0.0 y, 168.8±6.8 cm, 57.2±8.7 kg, trained for 3.0±1.0 y, suffering from CKP for 9.7±5.9 month) were recruited from a provincial boxing team. After 5-minute jog and 5-minute dynamic stretching of warm-up, visual analogue scale (VAS) of knee joint pain, Lysholm knee joint function score, range of motion (ROM) of knee joint flexion, maximal isometric muscle strength of knee joint extensors and knee joint stability were measured pre- and post-intervention (a 3-minute floss band intervention with the pressure ranged 150mmHg ± 10mmHg).

RESULTS: After acute intervention of floss band, score of knee pain in boxers with CKP decreased from 4.9 (2.7, 6.0) to 2.9 (1.9, 3.5) ($Z = 2.668$, $P = 0.008$); the Lysholm knee joint function score increased from 68.2 ± 14.0 to 77.4 ± 10.2 ($t = 3.530$, $P = 0.008$); knee joint range of motion increased from 117.4 ± 7.6° to 123.7 ± 6.0°($t = 4.094$, $P = 0.003$); the maximal isometric muscle strength of knee extensors increased from 40.7 ± 12.3 kg to 50.2 ± 14.4 kg ($t = 6.070$, $P < 0.001$); and the knee joint stability increased from 15.2 (9.2, 73.0) s to 31.4 (17.5, 78.1) s ($Z = 2.310$, $P = 0.021$).

CONCLUSION: Acute intervention of floss band in boxers with CKP can significantly release the pain, reduce knee joint pain, improve Lysholm knee joint function score, increase ROM of knee joint flexion, increase maximal isometric muscle strength of knee joint extensors and enhance knee joint stability.

THE IMPACT OF ENDOMETRIOSIS ON PROPERTIES OF SKELETAL MUSCLES: A SCOPING REVIEW

HERZOG, K.M., BERNSTEIN, C., BEHRINGER, M.
GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: Endometriosis is a chronic estrogen-dependent gynecological disorder characterized by the presence of endometrial tissue outside the uterus that affects approximately 10 to 15% of women of reproductive age worldwide [1]. Research suggests that the symptoms of endometriosis are due to a localized inflammatory peritoneal response triggered by ectopic implants experiencing cyclic bleeding [2,3]. Although there is evidence that physical activity can alleviate symptoms via anti-inflammatory processes, it is still unclear whether endometriosis affects the function of the skeletal muscles [4,5]. This review therefore provides a comprehensive overview of the data available to date on the influence of endometriosis on muscle contractility and muscle stiffness.

METHODS: We conducted a literature review on the influence of endometriosis on skeletal muscle characteristics. For this purpose, articles in English or German were searched in PubMed and Web of Science.The search strategy included the combination of key words 'endometriosis' and 'skeletal muscles' and 'physical activity'. The search included all topic-specific papers published during the year 1970 to 2024. Then, the findings were classified in order to summarize the evidence.

RESULTS: Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, 12 studies were included in this review. We grouped the studies into two major categories based on the influences of endometriosis on the skeletal muscle function that were studied: (1) endometriosis in animal studies and (2) endometriosis in human studies.

CONCLUSION: Our data indicate that endometriosis can impact muscle stiffness. Preliminary results have shown that there is an alteration in muscle stiffness due inflammatory processes. However, proposed mechanisms are often deduced from animal studies and still remain to be verified in humans with endometriosis. Although the data available to date indicate that endometriosis increases oxidative stress, consequently affects muscle elasticity and stiffness, we need high quality randomized controlled trials to confirm these results.

1. Yang, W.C., Chen, H.W., Au, H.K., Chang, C.W., Huang, C.T., Yen, Y.H., & Tzeng, C.R. (2004). Serum and endometrial markers. Best Pract res Clin Obstet Gynaecol. 18:177-200.

2. Cuevas, M., Flores, I., Thompson, K.J., Ramos-Ortolaza, D.L., Torres-Reveron, A., & Appleyard, C.B. (2012). Stress exacerbates endometriosis manifestations and inflammatory parameters in animal model. Reprod Sci. 19:851-62.

3. Witz, C.A., Cho, S., Montoya-Rodriguez, I.A., & Schenken, R.S. (2002). The alpha(2)beta(1) and alpha(3)beta(1) integrins do not mediate attachment of endometrial cells to peritoneal mesothelium. Fertil Steril. 78:769-803.

4. Vitonis, A.F., Hankinson, S.E., Hornstein, M.D., & Missmer, S.A. (2010). Adult physical activity and endometriosis risk. Epidemiology. 21:16-23.

5. Montenegro, M.L., Bonocher, C.M., Meola, J., Portella, R.L., Ribeiro-Silva, A., Brunaldi, M.O., Ferriani, R

MEDIUM-FREQUENCY NEUROMUSCULAR ELECTRICAL STIMULATION IN CRITICALLY ILL PATIENTS PROMOTED LARGER FUNCTIONAL CAPACITY IMPROVEMENT DURING RECOVERY THAN LOW-FREQUENCY NEUROMUSCULAR ELECTRICAL STIMULATION

GUERRA-VEGA, P.1, GUZMÁN, R.2, BETANCOURT, C.2, GRAGE, M.1, VERA, C.2, ARTIGAS-ARIAS, M.3, MUÑOZ-COFÉ, R.3, VITZEL, K.F.4, MARZUCA-NASSR, G.N.3
1 CLÍNICA ALEMANA OSORNO, OSORNO, CHILE; 2 HOSPITAL BASE SAN JOSÉ OSORNO, OSORNO, CHILE; 3 UNIVERSIDAD DE LA FRONTERA, TEMUCO, CHILE; 4 MASSEY UNIVERSITY, AUCKLAND, NEW ZEALAND.

INTRODUCTION: Low-frequency neuromuscular electrical stimulation (NMES) attenuates the loss of functional capacity of Intensive Care Unit (ICU) patients. However, it has been shown that medium-frequency may be better than low-frequency NMES for the maintenance of strength, skeletal muscle mass and physical performance in healthy subjects. This study compares the effects of low- and medium-frequency NMES, along with a standard physical therapy (SPT) program, on functional capacity in critically ill patients.

METHODS: Fifty-four critically ill patients admitted into ICU and on mechanical ventilation participated in this randomized clinical trial. Participants were allocated to one of the following groups: Control Group, received a standard lower limb SPT program, 2x/day; Low-frequency NMES Group, received lower limb SPT+NMES in the quadriceps muscle at 100 Hz, 2x/day; and Medium-frequency NMES Group, received lower limb SPT+NMES in the quadriceps muscle at 100 Hz and carrier frequency of 2500 Hz, 2x/day while at ICU. Interventions were concluded when sedation cessation procedures were implemented. The functional capacity outcomes were muscle strength (MRC-SS), handgrip strength (dynamometry), thickness and quality of the quadriceps muscle (ultrasonography), functional status (FSS-ICU), degree of independence for activities of daily living (Barthel Index), functional mobility and dynamic balance (Timed Up and Go Test), and quality of life (SF-36) during hospital stay. Total days of hospitalization were also recorded.

RESULTS: Both low- and medium-frequency NMES in combination with SPT were effective strategies to improve functional capacity when compared with control group during hospital stay. Compared with low-frequency, medium-frequency NMES provided additional improvements on dynamic balance (TUG test, P<0.001), in the degree of independence to perform activities of daily living (Barthel Index, P<0.001) and quality of life (SF-36, P<0.001) prior to hospital discharge. It also promoted larger gains on functional status (FSS-ICU, P<0.05) prior to ICU discharge and in knee extension strength (MRC-SS, P<0.05) prior to intermediate care unit discharge. Finally, medium-frequency NMES induced a persistent improvement in handgrip strength earlier than low-frequency NMES (prior to intensive and intermediate care unit discharges and prior to hospital discharge) when compared with control group. Those effects could explain why the medium-frequency NMES was the only intervention to reduce total duration of hospital stay (from ICU admission to hospital discharge) in comparison to control group (P<0.05). Quadriceps muscle thickness and quality did not decrease in ICU when using either of the two NMES protocols.

CONCLUSION: Medium-frequency NMES along with a SPT program in critically ill patients showed greater benefits on functional capacity during recovery than low-frequency NMES, despite similar effects on the prevention of quadriceps muscle mass loss.

Clinical trial registration: NCT05287919.

PREDICTED RISK FACTORS FOR PATELLAR TENDINOPATHY IN ADOLESCENT BADMINTON PLAYERS USING DEEP LEARNING: A PROSPECTIVE PRELIMINARY STUDY

CHAN, Y.H., LIN, W.C.2, WU, K.P.2, LIN, C.Y.3, HUANG, T.S.1

1NATIONAL YANG MING CHIAO TUNG UNIVERSITY; 2NATIONAL YANG MING CHIAO TUNG UNIVERSITY; 3TAIPEI MUNICIPAL DATONG HIGH SCHOOL

INTRODUCTION: Badminton players frequently suffer from patellar tendinopathy (PT). Identifying the underlying risk factors of the injury is essential to mitigate the occurrence or recurrence of PT. Previous studies have not investigated the potential risk factors of PT in badminton players. Furthermore, previous prospective studies on sports injury risk factors have typically involved only a single measurement, ignoring the complex and ever-changing nature of injury risk. Regular measurements and continuous data monitoring are essential to capture changes in the data. Deep learning techniques have been used to analyze time series and process the collected data. The purpose of this prospective study was to explore the risk factors of PT by utilizing deep learning methods in adolescent badminton players. Concurrently, the deep learning analysis findings were compared with those obtained through traditional analytical methods.

METHODS: Forty-nine adolescent badminton players who exhibited no PT at the beginning of the study were recruited. The prospective study involved regular assessments twice weekly with eight measurements for four months. Measurement items included (1) training load, (2) ankle dorsiflexion range of motion (ROM), (3) thigh muscle length, (4) Y-balance test, (5) countermovement jump, and (6) agility test. The occurrence of PT within four months was evaluated. This study employed the gated recurrent unit (GRU) in deep learning to analyze time series data as a predictive model and employed SHapley Additive Explanation (SHAP) analysis to elucidate the significance of features. In traditional analysis, baseline data was utilized for logistic regression analysis, with the significance level set at 0.05.

RESULTS: Out of the 49 participants, five players experienced PT. The GRU model had an accuracy of 91.84% of prediction. The top 3 SHAP features were dominant and non-dominant ankle dorsiflexion ROM and the performance of the Y-balance test. The logistic regression analysis did not find any significant risk factors for predicting the development of PT.

CONCLUSION: This research employed deep learning methods with SHAP analysis to develop a novel predictive model. Our findings showed that essential features of developing PT were bilateral ankle dorsiflexion ROM and the performance of the Y-balance test. There were trends of decreased ankle dorsiflexion ROM and a disparity in the measurements of both legs in the Y-balance test before developing PT. The utilization of deep learning has the potential to improve the efficacy of injury prevention for PT compared to traditional analysis.

References:

1. Kimura, Y., et al., Trunk motion and muscular strength affect knee valgus moment during single-leg landing after overhead stroke in badminton. Br J Sports Med, 2014. 48(7): p. 620-620.

2. Sprague, A.L., et al., Modifiable risk factors for patellar tendinopathy in athletes: a systematic review and meta-analysis. Br J Sports Med, 2018. 52(24): p. 1575-1585.

1H-NMR URINARY METABOLOMIC ANALYSIS IN RECREATIONAL ATHLETES: EFFECT OF PHYSICAL EXERCISE AND WHOLE BODY CRYOSTIMULATION.

DOUZI, W., BON, D., BIEUZEN, F., DUGUÉ, B.

UNIVERSITE DE POITIERS FACULTE DES SCIENCES DU SPORT

INTRODUCTION: Physical exercise induces various metabolic changes, influencing energy expenditure and substrate utilization. Metabolomics provides a comprehensive understanding of the metabolic adaptations occurring in response to physical exercise and recovery

METHODS: Urine metabolomics with 1H-NMR spectroscopy was used to investigate the impact of sub-maximal cycling bout (SMC) in healthy young athletes at 60 % of their peak aerobic power on urine metabolome before and after a 4-week

of high intensity interval training (HIIT) with or without the use of whole-body cryostimulation (WBC) as a recovery technique after each training session (WBC group, N=11; control group (CTL), N=12).

RESULTS: Principal component analysis (PCA) revealed a distinct separation between the urine NMR profiles of WBC and CTL groups induced by SMC. However, these changes appeared to be more pronounced in the CTL group. Targeted analyses revealed that, prior to HIIT, SMC significantly increased lactate and adenine levels in CTL group compared to WBC group. SMC resulted also in a substantial reduction in citrate and formate levels only in CTL group before HIIT. Post-HIIT, alanine level increased only in WBC group, while N-phenylacetylglutamine decreased in the WBC group compared to CTL group. However, in both groups, there was a notable increase in lactate, acetate and adenine levels accompanied by a significant decrease in formate level.

CONCLUSION: The SMC-induced changes following HIIT seem to be influenced by the repeated exposure to cryostimulation. The metabolic adaptations associated with SMC and HIIT contribute to a more comprehensive understanding of their combined effects and offer a distinctive perspective for unraveling the effects of physical activity and recovery on metabolic pathways.

DEVELOPMENT OF A VIRTUAL REALITY SYSTEM FOR EVALUATING CERVICAL SENSORIMOTOR FUNCTIONS

LIM, P.L., LAI, Y., CHENG, K., TSAI, Y.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Neck pain is increasingly prevalent due to factors such as poor posture associated with use of computers and smart phones and workplace conditions (Mahmoud et al., 2019). It affects a significant portion of the population and ranks as the second leading cause of musculoskeletal disability (Fejer et al., 2006). Sensorimotor control impairments including proprioceptive deficits, loss of eye-head coordination, poor balance and increased motion variability have been identified in patients with neck pain. In addition, visual symptoms or disturbances, such as blurred vision, words jumping on the page, or difficulty concentrating to read, often accompanied by symptoms of dizziness and unsteadiness are also often reported in patients with neck pain. Traditional clinical tests for assessing cervical sensorimotor control face challenges in setup and reliability (Kristjansson et al., 2001). Virtual Reality (VR) assessment systems offer a promising alternative, simplifying testing procedures and potentially improving reliability. However, the VR application in assessing cervical sensorimotor control is still developing. Therefore, the purpose of this study was to develop a VR system capable of assessing sensorimotor control function in the cervical spine, and investigate its test-retest reliability.

METHODS: This observational study involved 28 healthy volunteers, comprising 13 males and 15 females. All participants underwent four sensorimotor control tests including cervical range of motion, figure of eight, modified subjective visual vertical, and head tilt response using the VR system (HP Reverb G2 Omnicept, Tobii, Sweden) and self-designed virtual scenarios. All participants received the same assessment twice and test-retest reliability was evaluated using the Intraclass Correlation Coefficient (ICC).

RESULTS: The results demonstrated that all of the tests conducted with the VR system exhibited high to excellent reliability. The ICC values for cervical range of motion in directions of flexion, extension, side bending to left and right, and rotation to left and right were ranged from 0.611 to 0.870. The ICC value for the figure of eight, modified subjective visual vertical and the head tilt response tests was 0.780, 0.734, and 0.801, respectively.

CONCLUSION: This self-designed VR assessment system demonstrated high to excellent reliability in evaluating cervical sensorimotor control function. Notably, this VR system provides precise measurements, simplifies testing with its single-device capability, and enhances operational efficiency. Future applications may include clinical assessments of patients with neck pain and interactive therapeutic interventions.

Conventional Print Poster Presentations

CP-PN03 Nutrition II

THE EFFECT OF A BODYBUILDING CARBOHYDRATE-LOADING PROTOCOL ON ANTHROPOMETRY: PRELIMINARY FINDINGS FROM A RANDOMISED CROSSOVER TRIAL.

HOMER, K., JUKIC, I., CROSS, M., HELMS E.

AUCKLAND UNIVERSITY OF TECHNOLOGY

INTRODUCTION: To acutely enhance appearance and thus performance, bodybuilders implement carbohydrate (CHO) loading protocols in the week before the competition (known as peak week [PW]) to increase muscle size through the supercompensation of muscle glycogen. While the use of such strategy is seemingly prevalent, experimental designs in the context of bodybuilders are lacking, whereby the only existing trial is limited. Thus, the aim of this study was to assess the effect of an ecologically valid bodybuilding CHO-loading protocol on anthropometric measures.

METHODS: Four dieting, resistance-trained males who met the inclusion criteria of ∑8 skinfolds (SF) ≤48mm (range: 34.5-45mm) participated in this randomised crossover design. This criterion was used to replicate the very low body fat levels of male bodybuilders during PW. Participants were also dieting for ≥8 weeks to represent the physiological conditions of bodybuilders during competition preparation. Each experimental period, separated by a 9-day wash-out, consisted of

data collection on days 1, 4, and 5 which correspond to baseline, post-depletion, and post-loading phases of the protocol, respectively. During depletion, participants followed a standardised training regime and diet (2.2-2.6g/kg protein, 1-2g/kg CHO, 0.5g/kg fat relative to body mass (BM)) representative of the practices of bodybuilders during PW. This diet was maintained on day 4 with the addition of placebo (PLA) or CHO shakes which contained 9g/kg CHO for the post-loading data collection on day 5. Outcomes comprised of BM, SF, and ∑5 ultrasound muscle thickness (MT) which were obtained at each data collection in the morning at the same time (±1hr) after an overnight fast. Descriptive data at the group level from each day was used to assess changes.

RESULTS: From baseline, BM (CHO: 76 to 75.5kg; PLA: 75.4 to 75.1kg), SF (CHO: 38.9 to 37.6cm; PLA: 38.8 to 38.8mm), and MT (CHO: 23.9 to 23.7mm; PLA: 24.3 to 24.1mm) mostly decreased following depletion in both conditions. After loading, all outcomes increased in the CHO condition (BM: 76.1kg, SF: 38mm, MT: 24.4cm) but not in PLA (BM: 74.7kg, SF: 38.6mm MT: 24.1cm) from post-depletion. However, these changes were not as pronounced in comparison to the baseline in both conditions.

CONCLUSION: The implementation of a bodybuilding CHO-loading protocol may not meaningfully change BM, SF, and MT following the ingestion of 10-11g/kg of CHO in a day. While small group level changes seemingly favour CHO-loading, it is difficult to interpret these differences as large enough to exceed potential measurement error and daily biological fluctuations, and thus may not represent a meaningful change. Based on the preliminary findings, it can be interpreted that it may not be worthwhile for competitors to implement such a drastic protocol. However, outcomes such as change in visual appearance need to be quantified to fully elucidate the effects of the protocol on bodybuilding performance.

EFFECT OF TIME RESTRICTED EATING (16/8) AND AEROBIC EXERCISE ON FAT MASS AND WAIST CIRCUMFERENCE IN FEMALES WITH OBESITY: A PILOT RANDOMIZED CONTROLLED TRIAL

DAI, Z., WAN, K., ZHANG, S., WONG, S.H.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: This pilot randomized controlled trial aimed to investigate the effects of time-restricted eating (TRE), aerobic exercise, and their combination on fat mass and waist circumference in females with obesity. Additionally, the study aimed to determine whether the combination of TRE and aerobic exercise produces superior changes in body composition compared to each intervention alone.

METHODS: A total of 48 female participants with obesity were randomly assigned to one of four intervention groups: (1) TRE group (≤8-hour daily eating window, with ad libitum energy intake), (2) aerobic exercise group (three moderate-intensity exercise sessions per week), (3) combination group (TRE plus aerobic exercise), or (4) control group. The interventions were conducted over a 12-week period in free-living settings. Fat mass and waist circumference were measured at baseline and after the intervention.

RESULTS: Of the 48 participants who underwent randomization, 47 completed the 12-week intervention. After the intervention, fat mass and waist circumference decreased in the aerobic exercise, TRE, and combination groups, but there were no significant differences between the groups. However, participants in the combination group showed a statistically significant reduction in fat mass from 25.07 ± 2.31 kg to 23.33 ± 2.31 kg compared to the control group (p=0.047). In terms of waist circumference, both the aerobic exercise group (-6.02 cm; 95% CI -0.01 to -12.03) and the combination group (-6.50 cm; 95% CI -0.64 to -12.40) showed significant decreases compared to the control group (p=0.049 and p=0.021, respectively).

CONCLUSION: This pilot randomized controlled trial suggests that both TRE and aerobic exercise interventions are effective in reducing fat mass and waist circumference in females with obesity. Moreover, the combination of TRE and aerobic exercise appears to have an additive effect on fat loss. Further research with larger sample sizes and longer intervention durations is warranted to confirm these findings and explore the impact on fat mass and waist circumference.

EFFECTS OF TIME-RESTRICTED EATING COMBINED WITH ENDURANCE OR RESISTANCE TRAINING ON BODY COMPOSITION IN MALES

CORREIA, J.M., PEZARAT-CORREIA, P., MINDERICO, C., MENDONÇA, G.

POLITÉCNICO DO PORTO

INTRODUCTION: Improving body composition by increasing muscle mass and decreasing fat mass is a common approach for eliciting positive health outcomes and augmenting athletic performance. Many people aiming at modifying body composition combine dietary strategies with regular exercise. We sought to explore the effects of four weeks of time-restricted eating (TRE) vs. regular diet, combined with endurance or resistance training, on body composition of trained young males.

METHODS: The order of dieting was randomized and counterbalanced, and participants served as their own controls. As in one previous study, a two-week washout period (no specific diet or exercise) separated both conditions. The experimental design consisted of two dietary interventions: (1) four weeks of TRE, in which 100% of energy intake was restricted to a time window of 8-h each day, and (2) four weeks of regular diet (non-TRE), in which 100% of energy intake were freely distributed throughout the 24-h day. Height and body mass were used to calculate body mass index (BMI). Each participant was scanned with dual-energy X-ray absorptiometry at baseline and post-intervention. The participants followed structured training routines during each dietary intervention, with a frequency of 3 times/wk (endurance group: 10 km of continuous heavy-outdoor running + 1 severe running bout of 1000 m; resistance group: 4 sets of maximum repetitions at

85% one-repetition maximum - five multi-joint dynamic full body exercise routine). One-way repeated measures ANOVA was used to determine baseline differences between conditions on body composition variables. ANCOVAs were computed for the change in each variable over time, using baseline measures as covariates.

RESULTS: There were no significant differences between groups or conditions at baseline. The results from ANCOVA indicate that, in both groups, TRE elicited a greater magnitude of decrease in BMI than the non-TRE condition (F=4.2, p=0.048; ES=0.128). Moreover, we found a significant group main effect on fat-free mass (FFM) (p=0.024) indicating that, regardless of diet, the resistance training group exhibited greater magnitude of change in FFM at post-intervention time point. No other variable (i.e. fat-free mass, absolute or relative fat mass) was affected by either intervention over time.

CONCLUSION: In conclusion, four weeks of TRE can be used with endurance running or resistance training to elicit BMI reductions in trained young males. However, when compared to that seen with a regular diet, TRE does not offer any additional benefit for potentiating meaningful changes in body composition during the course of 4 weeks of endurance or resistance training.

EFFECTS OF INTERMITTENT FASTING AND EXERCISE WINDOW ON WEIGHT LOSS AMONG OBESE WOMEN

HANIM HAMZAH, S., MD AKIR, S., SELVANAYAGAM, V.S., JAAFAR, Z., MUSTAFA, N.

UNIVERSITI MALAYA

INTRODUCTION: Intermittent Fasting (IF) is reported to produce significant weight loss for long-term intervention and promotes adherence. In addition, its combination with the right exercise plan may produce a greater impact on weight loss. Therefore, it is important to identify the suitable exercise window to address the desired outcome when designing IF and exercise intervention program for weight loss. The aim of this study was to examine the effect of exercise during fasting and eating state among obese and sedentary women performing IF on body weight status.

METHODS: Thirty-four women aged between 30-55 years old with BMI ≥25 were recruited in this 6-week weight loss intervention program. In this randomised control trial design, the participants performed the modified alternate day fasting (MADF) and exercise (functional training). They were divided into exercise during MADF fast-state (FastE, n=17) and exercise during MADF eating-state (EatE, n=17) groups. The exercise were designed in a form of circuit training of 7-8 different stations or movements during the intervention. Body weight, body mass index (BMI), fat mass (FM) and fat free mass (FFM) were measured at pre- and post-intervention. A statistical level of $p < 0.05$ was accepted. All data are expressed as mean ± SD.

RESULTS: Seventeen participants (FastE, n=8, age 41.9±6.0 yrs, BMI 31.3±5.6,) and (EatE, n=9, age 41.3±6.5 yrs, BMI 29.5±2.5) completed the intervention. The results of this study showed that body weight was significantly reduced by 1.89 ± 2.26 kg in the FastE group and by 1.21±0.96 in the EatE group after 6-week intervention. We found that BMI, FM and FFM were significantly reduced in the EatE group but not significant in the FastE group. However, the reduction of BMI and FM were higher in FastE (by 0.75 ± 0.94 and by 1.00 ± 1.79 kg, respectively) compared to EatE (by 0.40 ± 0.38 and by 0.71 ± 0.84 kg, respectively). However, greater FFM reduction in FastE (by 0.79 ± 1.64 kg) compared to EatE (by 0.50 ± 0.44 kg).

CONCLUSION: The exercise during IF (fast-state) intervention program produced a comparable improvement in body weight, BMI and FM to exercise during IF (eating-state). However, this conclusion cannot be established based on the small number of participants who completed the intervention due to the high rate of dropout. Improving the adherence of this IF and exercise intervention program may provide more pronounced results.

COMPARING ACCEPTANCE AND WEIGHT CHANGES OF PROVIDED INTERMITTENT FASTING, OMNIVOROUS OR VEGAN DIETS: A SECONDARY OUTCOMES ANALYSIS.

KEENAN, S., AL-REFAI, W., COOKE, M., CAMERA, D.

SWINBURNE UNIVERSITY

INTRODUCTION: Control of dietary variables, in particular intake of dietary energy (and subsequently energy balance) and protein, is important when undertaking human nutrition research studies. To adequately control energy balance and reach a certain level of protein intake, food and beverages are sometimes provided to participants, and in order to maintain high rates of adherence, these diets need to be effective, palatable and acceptable. This research reports on secondary diet acceptability and weight outcomes following short-term (i.e., 2-week) intermittent fasting, vegan, and omnivorous diets in recreationally active males.

METHODS: Participants were randomly allocated to one of three dietary groups: Intermittent Fasting (IF, n=6, 26.7±2.1yrs, BMI 26.0±1.2), Omnivorous (Omni, n=7, 25.9±1.5yrs, BMI 24.6±1.4), and Vegan (n=9, 25.3±2.2yrs, BMI 25.8±1.3). Each group underwent a 2-week dietary intervention, where all meals and snacks were provided on a 3-day rotating menu, with changes made only to breakfast, lunch, and dinner (snacks provided were consistent). Food provision included frozen main meals, pre-packaged snacks, and protein supplements. The IF group consumed ~30% of their energy requirements via protein supplements on two, non-consecutive days per week, while the other 2 groups (euenergetic) consumed 100% of their estimated requirements daily. All 3 groups consumed an average of 1.6 grams of protein per kilogram of bodyweight per day. Weight was recorded daily, and diet acceptability was determined at the end of the study utilising the Food Acceptability Questionnaire, which consists of 7 questions utilising 7-point Likert scales.

RESULTS: The IF group exhibited a significant weight loss of -1.8kg ± 0.5kg post-intervention, while the other groups did not show significant changes in weight (Omni = -0.6 ± 0.7kg, Vegan = 0.0 ± 0.5 kg), indicating a negative energy balance in the IF group, and neutral energy balance in the remaining two groups. There were no statistically significant differences in

ratings of acceptability of the diets, although those in the IF group rated the diet as requiring less effort to maintain (median [range] = 6 [4-7] vs Omni = 3 [3-7] and Vegan = 4.5 [1-6]).

CONCLUSION: Dietary acceptability was equal across all diets over a short-term intervention, with the addition of 2 fasting days per week having no significant impact on these outcomes. Furthermore, changes in weight indicated that the intended energy balance was achieved over this 2-week period. These results indicate that controlling energy and protein intake via provided food is equally acceptable to participants across the three diets studied when pre-packaged food was provided, and effective for controlling participant weight over a short-term intervention.

ASSOCIATIONS AMONG ENERGY AVAILABILITY AND SLEEP QUALITY IN ELITE SWIMMERS

DE SOUZA, M.J., LUNDSTROM, E., WILLIAMS, N.
PENN STATE UNIVERSITY

INTRODUCTION: There is a high prevalence of poor sleep quantity and quality in athletes, and similarly, there is often a high prevalence of low energy availability (EA) in endurance athletes. Poor sleep quality during high training loads has been identified as an early sign of overreaching, which may result in improper recovery and limit training adaptations. Similarly, adequate energy availability (EA) is necessary to sustain physiological function and prevent training maladaptation in athletes. Previous data support worsened sleep quality during periods of heavy training in swimmers and low EA has been demonstrated in athletes during periods of heavy training. Endurance athletes during heavy training may experience both poor sleep quality and low EA, which may affect a range of training metrics. As well, emerging evidence supports a role of EA in sleep quantity, however, it is still unclear how EA affects sleep quality among athletes. Therefore, our objective was to determine the interrelationships between EA and sleep quality, where we assessed EA via 3-day diet log and daily exercise energy expenditure, and matched data collection for sleep quality (sleep duration (hrs), sleep debt (hrs), and hours and % of: slow wave sleep (SWShrs and SWS%), rapid-eye movement (REMhrs and REM%)), via a wearable device.

METHODS: In 26 elite male (n=10) and female (n=16) collegiate swimmers, data were collected over 2-weeks of heavy training. Frequency analysis was used to determine the number of athletes meeting or exceeding current athlete sleep duration recommendations. Pearson correlations were utilized to determine relationships between variables unless sex effects existed in which case linear regression analyses were utilized to control for sex-differences.

RESULTS: In all swimmers, 42% (11/26) had a sleep duration ≥ 7hrs. 38% (6/16) female swimmers and 50% (5/10) male swimmers achieved a sleep duration ≥ 7hrs. There was a trend toward a correlation between EA and sleep duration in all swimmers (R=0.33; P=0.06). EA positively correlated with REMhrs (R=0.64; p=0.001). EA was not related to sleep debt. Regression analyses revealed that when controlling for sex, EA was a predictor of SWShrs (R2 = 0.448; F=9.35, p<0.001). Controlling for sleep duration, EA was a significant predictor of REMhrs (R2 = 0.425; F=8.509, p<0.002). Similarly, when controlling for sleep duration, EA was a significant predictor of sleep debt (R2 = 0.261; F=4.055, p<0.031).

CONCLUSION: Significant relationships were found between EA and sleep quality in all swimmers, where elite swimmers with lower EA exhibited worse sleep quality. To avoid negative consequences of poor sleep quality and low EA, athletes should consume adequate calories to support energy needs and optimize sleep quality. Future research should explore underlying mechanisms and whether low EA causally impacts sleep quality.

THE INTERPLAY BETWEEN RESISTANCE EXERCISE AND TIME-RESTRICTED EATING: STRONGER TOGETHER THAN ALONE?

STIRCU, V., SAMPIERI, A., PAOLI, A., MORO, T.
UNIVERSITÀ DEGLI STUDI DI PADOVA

INTRODUCTION: The 16/8 method of intermittent fasting (IF), also known as time-restricted eating (TRE), is often associated with positive health effects. However, the role and interplay of TRE and exercise remain unclear. Building on the results of a study that investigated the effects of the TRE protocol in association with resistance training (RT), this study aims to explore the differences between combining training and TRE versus diet alone.

METHODS: We selected 40 subjects and divided them into a total of four groups of 10 people each. Twenty subjects (age 29.1±4.1; weight 83.5±5.9 kg) were part of a previous study by Moro et al. (2016), who had undergone resistance training. These were further divided into two groups: one followed a time-restricted eating (TRE) regimen (n=10), and the other followed a standard diet (SD; n=10). We compared these twenty trained subjects against 20 other subjects (age 42.05±13.6; weight 73.11±14.8 kg) who did not engage in physical exercise. This new group was also divided into two: one followed time-restricted eating (TRF; n=10) and the other a standard diet (SD; n=10). The TRE groups fasted for 16 hours and consumed three meals over an 8-hour period at 1 p.m., 4 p.m., and 8 p.m., while the SD groups ate at 8 a.m., 1 p.m., and 8 p.m. Subjects were tested before and after 8 weeks of their assigned intervention. We measured body composition (fat mass, fat-free mass) using dual-energy X-ray absorptiometry and conducted blood analysis for total and free testosterone, insulin-like growth factor 1, blood glucose, insulin, leptin, triiodothyronine, thyroid-stimulating hormone, interleukin-6, interleukin-1β, tumor necrosis factor α, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides.

RESULTS: After 8 weeks, a significant effect of intermittent fasting on weight was observed, with TRE pre compared to TRE post showing a significant difference (p=0.002). A 2-way ANOVA (Time * Diet interaction) revealed a decrease in fat mass (p< .001), %FAT (p< .001), and BMI (p=0.003) in TRE pre compared to TRE post, while fat-free mass was maintained in all groups. Testosterone and insulin-like growth factor 1 levels decreased, considering the interaction of time * diet (p=0.075;

p=0.033), and glucose levels also decreased in the group combining exercise and TRE compared to their levels post-exercise and TRE (p=0.010).

CONCLUSION: These preliminary data suggest that physical exercise, particularly resistance training in relation to TRE, appears to improve glucose levels in subjects. Furthermore, intermittent fasting is confirmed as an interesting strategy for weight loss and muscle mass maintenance.

THE EFFECT OF ACUTE MODERATE-INTENSITY CONTINUOUS RUNNING ON OXYNTOMODULIN CONCENTRATIONS IN HEALTHY MEN AND WOMEN.

JIN, Z., LI, J., THACKRAY, A., KING, J., STENSEL, D.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Oxyntomodulin (OXM) is an appetite-related gut hormone, implicated in weight management through its roles in reducing energy intake, and increasing energy expenditure. This study examined 1) the effect of acute moderate-intensity continuous running on oxyntomodulin concentrations; and 2) whether exercise-induced oxyntomodulin fluctuations are correlated with subsequent energy intake.

METHODS: 20 healthy-weight individuals (10 men, 10 women; age: 25 ± 4 years; BMI: 22 ± 2 kg·m-2 (mean ± SD)) completed two, 3.5-hour trials, exercise (EX) and control (CON), in a randomised order. Participants were required to fast overnight and engaged in a 60-minute treadmill run at 70% of their peak oxygen uptake (EX) or rested (CON) for the first hour of each trial. Participants then remained in the lab for an additional 2.5 hours and were served an ad libitum pasta meal one-hour after completion of exercise/rest i.e., at 2 hours. Blood samples were collected to measure oxyntomodulin concentrations at baseline (t = 0 minute), immediately after-exercise/rest (t = 60 minutes), and every 30 minutes thereafter up to 210 minutes (3.5 hours).

RESULTS: Linear mixed model analysis indicated no significant main effect of exercise on OXM concentrations ($p = 0.227$). However, a significant trial by time interaction was noted ($p = 0.041$). At t = 60 minutes, control was associated with a decrease in OXM concentrations relative to baseline, while the exercise trial exhibited an increasing trend. No significant differences were observed in time-averaged total area under the curve (tAUC) or incremental area under the curve (iAUC) for OXM between the exercise and control trials. Absolute energy intake (EI) remained unaffected by exercise. However, exercise led to a significant reduction in relative EI ($p < 0.001$) when considering the energy expended during exercise. No significant correlations were identified between OXM tAUC or iAUC and absolute EI.

CONCLUSION: Acute moderate-intensity exercise transiently modulates OXM concentrations. However, these exercise-induced alterations in OXM do not last and do not translate into changes in subsequent energy intake, at least in the short term.

EFFECTS OF REPEATED SPRINT CYCLING DURING THE LUTEAL PHASE ON FOOD REWARD IN FEMALE ATHLETES

KAMEMOTO, K., MIYAGUCHI, A., WANIFUCHI, M., HIRAMATSU, J., HAYASHI, N., SAKAMAKI-SUNAGA, M.
NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: Increased appetite before menstruation is a symptom of premenstrual syndrome, and is observed in many female athletes (Kamemoto K et al., 2021). While appetite can be divided into homeostatic and non-homeostatic system, premenstrual increase in appetite also includes changes in the reward system of appetite control, which is classified as non-homeostatic appetite (Strahler J et al., 2020). Although a recent study revealed acute exercise altered food reward in healthy males (Thackray AE et al., 2023), no study has investigated the influence of acute exercise on food reward in females. This study examined the effects of acute high-intensity exercise on the food reward system during the luteal phase (the premenstrual phase) in female athletes.

METHODS: Four female athletes (age: 21.8 ± 1.0 years; VO2 peak: 39.6 ± 9.7 mL/kg/min) with normal menstrual cycles, completed a resting trial (RE) and exercise trial (EX) in the luteal phase. In the exercise trial, after consuming a standard breakfast (29.3 kj/kg body weight) and seated rest for 45 min, participants performed repeated sprint cycling (consisting of two sets of 8 × 6-second maximal pedalling with a 30-second recovery period). Blood samples, subjective appetite and food reward data were obtained and assessed before exercise (PRE) and immediately post-exercise (POST). Food reward and subjective appetite were assessed by the Leeds Food Preference Questionnaire in Japanese (LFPQ-J) and a visual analogue scale (VAS), respectively. The LFPQ-J is a computer-based task that directly measures explicit liking and wanting, and indirectly measures implicit wanting using images of 16 foods familiar to the Japanese, including high-fat savoury, low-fat savoury, high-fat sweet and low-fat sweet foods (Hiratsu A et al., 2022). The luteal phase was confirmed by serum progesterone and estradiol concentrations. All participants were asked to record their food intake for the trial day. Statistical significance was set at $P < 0.05$. Effect sizes (ES) (Cohen's d) were calculated to indicate the magnitude of the differences between trials.

RESULTS: Overall, subjective appetite scores were higher in EX than RE ($P < 0.05$, ES = 0.58), indicating that participants were hungrier in RE than EX. The results of LFPQ-J showed that relative preference for high-fat foods was higher in RE than EX in POST ($P < 0.05$, ES = 0.52), but with no significant differences between the trials in PRE ($P = 0.23$, ES = 0.13). There was a main effect of trial on taste appeal bias, with EX having higher values than RE ($P < 0.01$, ES = 0.34). It means that participants were more likely to prefer sweet foods during exercise trials. Energy, protein, and fat intake after the trial were significantly higher in RE than EX (all for $P < 0.01$).

CONCLUSION: Repeated sprint exercise by female athletes during the luteal phase decreases appetite, particularly the preference for high-fat foods.

A SURVEY OF PREVALENCE, KNOWLEDGE, AND PRACTICES TOWARD IRON-DEFICIENCY AND IRON-DEFICIENCY ANEMIA AMONG AMATEUR FEMALE LONG-DISTANCE RUNNERS IN POLAND

GREN, A., KASZUBA, M.1, PIATKOWSKA, E.2, SADOWSKA-KREPA, E.1, FILIP-STACHNIK, A.1
1THE JERZY KUKUCZKA ACADEMY OF PHYSICAL EDUCATION IN KATOWICE; 2UNIVERSITY OF AGRICULTURE IN KRAKOW

INTRODUCTION: In recent years, long-distance running has become a popular sport, while iron deficiency (ID) and iron deficiency anemia (IDA) are common in long-distance runners. Although there has been a recent and rapid growth in understanding of the negative impact of ID and IDA on the health and physical performance of female runners, there is a lack of data about athletess knowledge in this field. This study aimed to evaluate the prevalence, knowledge of long-distance runners about ID and IDA and their causes, prevention, and treatment.

METHODS: A sample of 167 Polish amateur female long-distance runners completed a survey focused on dietary habits, knowledge of ID and IDA, prevention, and treatment practices.

RESULTS: The occurrence of ID and IDA was reported by 60% and 38% of women, respectively. 19% of the subjects followed a vegetarian or vegan diet, and 52% of them reported ID or IDA. Women who reported IDA believed that iron was important in their diet in comparison to those without IDA ($p < 0.02$). There was a statistically significant correlation between lack of knowledge of the iron role ($p < 0.009$), iron sources ($p < 0.001$), iron absorption ($p < 0.001$), vegan or vegetarian diet ($p < 0.009$), weight loss practices ($p < 0.016$), and the occurrence of ID or IDA. 74% of the women did not know the difference between heme and non-heme iron, which influenced the wrong identification of their sources ($p < 0.005$). Only 37% of women who reported IDA correctly indicated the difference between heme and non-heme iron ($p < 0.048$).

CONCLUSION: IDA and ID are important health issues among amateur female long-distance runners. Insufficient knowledge and nutrition practice among them may lead to ID or IDA, especially in vegans and vegetarians. Women who have experienced IDA present greater awareness of iron in their diet. These results highlight the need for education to ensure proper prevention practices and minimize the risk of ID and IDA among amateur female long-distance runners.

Conventional Print Poster Presentations

CP-MH06 Health and Fitness/Cardiovascular

THE EFFECTS OF 8 WEEKS POST EXERCISE HOT WATER IMMERSION ON CARDIORESPIRATORY FITNESS, VASCULAR HEALTH AND CARDIOMETABOLIC HEALTH IN PHYSICALLY INACTIVE MIDDLE-AGED ADULTS

STEWARD, C., HILL, M., MENZIES, C., RUSSELL, S., PUGH, C., THAKE, D., CULLEN, T.
COVENTRY UNIVERSITY

INTRODUCTION: Heat therapy can replicate some of the long-term adaptations of exercise training which underpin improvements in cardiovascular health [1]. It is estimated that 25% of adults do not meet the minimum recommended physical activity guidelines [2]. However, many take part in irregular, less intense and infrequent bouts of physical activity within their weekly routines. The use of hot water immersion after exercise has the potential to augment the cardiovascular health benefits from smaller amounts of exercise. Therefore, this study investigated whether post exercise hot water immersion (EX+HWI) can improve cardiovascular health by a greater extent than post exercise thermoneutral water immersion (EX+TNWI).

METHODS: After ethical approval, twenty-four physically inactive middle-aged adults (14 females and 10 males; age: 58 ± 5 years; weight: 78 ± 12 kg; height: 1.67 ± 0.08 m; VO2 peak: 18 ± 3 ml/kg/min-1) were randomised to either 8-weeks of EX+HWI (n=12) or EX+TNWI (n=12). Volunteers visited the laboratory 2-4 times per week to take part in exercise plus immersion sessions (total 24 sessions). The exercise component was for a duration of 30 minutes and consisted of 10 minutes cycling, rowing and brisk walking at 65%-75% of heart rate maximum. Water immersion was for 30 minutes at a temperature of either 40 °C or 34 °C. A range of cardiovascular health parameters were measured pre, midway and post intervention, including cardiorespiratory fitness, blood pressure, brachial artery endothelial function, carotid to femoral arterial stiffness and serum cardiometabolic/inflammatory biomarkers.

RESULTS: A time × condition interaction was detected for mean arterial pressure (P=0.039) and diastolic blood pressure (P=0.044). EX+HWI resulted in a greater reduction in mean arterial pressure and diastolic blood pressure at midway (MAP: P<0.001, mean difference= 5 mmHg and DBP: P=0.001, mean difference=5 mmHg) and post (MAP: P=0.011, mean difference= 4 mmHg and DBP: P=0.007, mean difference=4 mmHg) intervention in comparison to EX+TNWI. Furthermore, a main effect of condition was apparent for systolic blood pressure (P=0.003, mean difference=4 mmHg) and central arterial stiffness (P=0.048, mean difference=2.08 m/s). There were no differences between conditions for cardiorespiratory fitness, brachial artery endothelial function and serum cardiometabolic/inflammatory biomarkers (P>0.05).

CONCLUSION: Eight weeks of post exercise hot water immersion improved vascular health through reducing blood pressure and central artery stiffness to a greater extent than exercise followed by thermoneutral water immersion in physically inactive middle-aged adults.

THE EFFECTS OF SIMULTANEOUS ISOMETRIC AND ECCENTRIC EXERCISE ON CARDIOVASCULAR FUNCTION IN YOUNG NORMOTENSIVE INDIVIDUALS.

BAROSS, T., BAXTER, B., WRIGHT, B., LANGDON, D., KAY, A.
UNIVERSITY OF NORTHAMPTON

INTRODUCTION: The World Health Organisation has reported hypertension, a major risk factor for stroke, coronary heart disease and cardiovascular-related mortality to be near epidemic levels globally with over 30% of the world's population affected. Individually, isometric resistance training (IRT) has been established as one of the most efficacious nonpharmacological interventions for the prevention and treatment of hypertension, whilst eccentric exercise has also demonstrated improved cardiometabolic health in older populations (1). Simultaneous training (aerobic and isometric) produces larger reductions in resting blood pressure (BP) compared to single exercise protocols (2), however the effects of simultaneous isometric and eccentric training on cardiovascular parameters remain unknown. Therefore, the purpose of this study was to determine the effects of a 6-week simultaneous IRT and eccentric or concentric exercise intervention on resting cardiovascular parameters in young normotensives.

METHODS: Fifty-four normotensive individuals (33 men, age = 21 ± 1 yr; 21 women, age = 20 ± 1 yr) were randomly assigned to four groups: simultaneous isometric exercise and stair descent (ISO-ECC, n = 14), simultaneous isometric exercise and stair ascent (ISO-CON, n = 13), isometric handgrip exercise (ISO, n = 13), or a passive control (CTRL, n = 14). Resting BP and haemodynamics (cardiac output, stroke volume, systemic vascular resistance) were measured prior to and after an incremental 6-week (3 day/week) training period. Initially participants completed 9 reps (1 repetition = 108 steps) of either stair ascending or descending in each session with the number of reps increasing by three each week. Sessional rate of perceived exertion was measured following each training session.

RESULTS: The two-way ANOVA revealed a significant interaction effect ($F_{3,48} = 3.198$, $P = 0.032$, $\eta_p^2 = 0.167$) for resting systolic BP (SBP), with significant ($P < 0.05$) reductions in all training groups (ISO, 8 ± 9 mmHg; ISO-ECC, 8 ± 5 mmHg; ISO-CON, 6 ± 4 mmHg). SBP was significantly lower post-training in ISO compared to CTRL (10 ± 16 mmHg). No significant changes were revealed for all other measures ($P > 0.05$).

CONCLUSION: All three training modalities were identified as efficacious therapeutic exercise interventions to lower SBP, however the magnitude of the change in SBP was greater in both the ISO and ISO-ECC groups, which were also perceived to be less demanding than the ISO-CON exercise. Although these results support the limited published data highlighting the hypotensive effects of eccentric exercise, as there was no difference in the reported decreases in SBP between the ISO and ISO-ECC groups, it may be more appropriate and time efficient to use the established isometric intervention if BP reduction is the main goal of the therapeutic exercise intervention.

1. Chen, TC. et al. (2017). Med. Sci. Sports Exerc. 49(8), 1614–1622.

2. Baross, AW. et al. (2017). J. Sport. Med. 2017, 1–6.

DESPITE IMPAIRED MICROVASCULAR FUNCTION IN MALES OF BLACK-AFRICAN DESCENT, ACUTE HOT WATER IMMERSION ELICITS SIMILAR BLOOD PRESSURE AND MICROVASCULAR RESPONSES AS IN SOUTH-ASIANS AND WHITE-EUROPEANS

BELLINI, D., LLOYD, A., HAVENITH, G., LEICHT, C.A., BAILEY, S.J., ROBERTSON, A., MALEY, M.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Impaired microvascular function in individuals of Black-African (BA) and South-Asian (SA) descent compared to White-Europeans (WE) suggests greater endothelial dysfunction, contributing to an increased risk of cardiovascular disease (CVD). The associated reduction in CVD risk from chronic passive heating (e.g., hot baths or sauna bathing) has been suggested to be underpinned by the repeated strain from acute exposures. Therefore, we investigated the effect of acute hot water immersion (HWI) on blood pressure and microvascular responses compared to a thermoneutral control (CON) between BA, SA, and WE individuals.

METHODS: Thirty-one recreationally active males (10 BA, 11 SA, 10 WE) completed a submaximal cycling test to determine VO2peak. Thereafter, two experimental visits of HWI (39.0°C) or CON (36.0°C) were completed, involving 30-minutes of shoulder-height, then 30-minutes of waist-height immersion. Venous blood samples were collected immediately pre- and post-immersion, and blood pressure was assessed throughout immersion. Following an additional 60-minutes of seated thermoneutral rest, forearm and toe cutaneous vascular conductance (CVC) responses to occlusion (OC) and local heating (LH) were investigated.

RESULTS: After both immersion protocols, baseline CVC was similar between racial groups. During OC, peak forearm CVC was lower in BA (0.51 ± 0.21 flux/mmHg) than SA (0.87 ± 0.21 flux/mmHg) and WE (0.85 ± 0.21 flux/mmHg; $p < 0.001$). Peak toe CVC was also lower in BA (2.46 ± 0.74 flux/mmHg) than SA (3.32 ± 0.74 flux/mmHg) and WE (3.80 ± 0.74 flux/mmHg; $p < 0.013$), in addition to a reduced area under the curve (BA: 8983 ± 4835, SA: 14087 ± 4836, WE: 18005 ± 4836 flux/s; $p < 0.023$). Furthermore, toe CVC responses to 42°C LH were attenuated in BA (1.08 ± 0.82 flux/mmHg) compared to SA (2.00 ± 0.82 flux/mmHg) and WE (2.13 ± 0.78 flux/mmHg; $p < 0.033$), as well as to 44°C LH (BA: 1.26 ± 0.78, SA: 2.29 ± 0.78, WE: 2.13 ± 0.78 flux/mmHg; $p < 0.020$). During immersion, HWI reduced both systolic (-7 ± 7 mmHg; $p < 0.019$) and diastolic (-16 ± 5 mmHg; $p < 0.001$) blood pressure compared to CON, with no differences observed between racial groups. HWI increased toe CVC during 44°C LH (2.07 ± 1.07 flux/mmHg) compared to CON (1.72 ± 0.7 flux/mmHg; $p = 0.039$), despite no change in plasma [nitrite] or differences between racial groups ($p > 0.05$).

CONCLUSION: Between racial groups, microvascular reactivity to OC and LH were lower in BA than SA and WE individuals. Despite this racial difference in microvascular function, the beneficial effects of HWI on blood pressure and CVC were similar between individuals of BA, SA, and WE descent.

EFFECTS OF ACUTE AEROBIC EXERCISE FOR UPPER OR LOWER LIMBS ON SEGMENTAL ARTERIAL STIFFNESS

NISHIWAKI, M., KUME, D., KIKUCHI, K.
OSAKA INSTITUTE OF TECHNOLOGY

INTRODUCTION: Many previous studies have demonstrated that acute or regular exercises reduce Pulse Wave Velocity (PWV) as an index of arterial stiffness. The increased arterial stiffness is an independent risk factor for future cardiovascular diseases or mortalities, so preventing arterial stiffness by exercise is of paramount importance, regardless of age. In recent, one-legged physical exercise (aerobic, resistance, and stretching) has been shown to acutely reduce arterial stiffness in the exercised limb, but not in the none-exercised limb. These findings thus raise the possibility that arterial stiffness responses and adaptations to exercise are mainly involved in physical exercise-induced local factors as exercise stimuli. However, the influences of acute exercise types on segmental arterial stiffness are now well unknown. Therefore, this study aimed to examine the effects of acute aerobic exercise for upper or lower limbs on segmental arterial stiffness.

METHODS: Twelve young adults (22 ± 1 years) participated in three separate trials of 40 min in random order and on different days: (1) resting and sitting on a comfortable chair, as a control (CON); (2) aerobic mock gardening activity exercise for upper limbs (UE); (3) aerobic cycling exercise for lower limbs (LE). Both exercises were performed at the same heart rate levels (target heart rate: 117 ± 17 beats/min), as determined beforehand by a pretest for each participant. Before (Pre) and after (Post) the exercises, heart-brachial PWV (hbPWV), which reflects arterial stiffness of the upper limbs from the aorta to the brachium; brachial-ankle PWV (baPWV), which reflects arterial stiffness of central (large arteries in the cardiothoracic region) and leg from the femoral to the ankle; and heart-ankle PWV (haPWV), which reflects systemic arterial stiffness, were measured as an index of segmental arterial stiffness.

RESULTS: No significant differences in baseline parameters were observed among trials. After the exercise, hbPWV significantly reduced in both UE (-11.4 ± 9.7%) and LE (-6.6 ± 8.1%) trials, but did not in CON (5.1 ± 6.0%) trials. On the other hand, interestingly, baPWV was significantly reduced only in the LE (-2.9 ± 5.2%) trials. In addition, baPWV in UE (3.1 ± 5.6%) trials significantly increased after exercise regardless of no significant changes in CON (1.8 ± 4.6%) trials. Finally, haPWV significantly reduced in both UE (-5.0 ± 5.7%) and LE (-4.7 ± 6.1%) trials, but did not in CON (3.4 ± 3.6%) trials.

CONCLUSION: Therefore, our data indicate that cycling exercise for lower limbs induces reductions in relatively systemic arterial stiffness (i.e., exercise-related direct and indirect regions). However, the influences of upper limb exercise on arterial stiffness are relatively limited and have a strong locality.

EFFECTS OF NOS3 GENE POLYMORPHISM ON CARDIO-ANKLE VASCULAR INDEX AS AN INDEX OF ARTERIAL STIFFNESS

YASUI, T., OI, N., TAGA, K., KUME, D., OKUDA-ASHITAKA, E., NISHIWAKI, M.
OSAKA INSTITUTE OF TECHNOLOGY

INTRODUCTION: Endothelial nitric oxide synthase 3 (NOS3) is involved in the production of nitric oxide (NO) in the endothelium, and the NOS3 gene polymorphism T-786C (rs2070744) is reported to reduce NOS3 promoter activity by mutation. However, in the general population, the effects of NOS3 gene polymorphisms on arterial stiffness using the Cardio-Ankle Vascular Index (CAVI), which is theoretically adjusted by blood pressure, have not been reported. This study thus aimed to examine the effect of the T-786C (rs2070744) gene polymorphisms on CAVI.

METHODS: Saliva sampling, CAVI assessment, and physical tests were conducted on 217 Japanese adult participants (18-84 years). DNA was extracted from saliva, and T-786C polymorphism (rs2070744) was screened using a TaqMan allelic discrimination assay. The subjects were also divided into three groups according to age: 122 young (18-37 years), 46 middle-aged (38-57 years), and 49 elderly (58 years and older).

RESULTS: In the Japanese group, the frequency of NOS3 gene polymorphism rs2070744 was TT type in 184 participants (84.8%), TC type in 30 participants (13.8%), and CC type in 3 participants (1.4%). No significant differences in CAVI value were observed between TT and TC+CC. However, the CAVI value tends to be higher in TC+CC than in TT (TT young: 6.0 ± 0.1 unit, TC+CC young: 6.0 ± 0.1 unit, TT middle-aged: 7.3 ± 0.1 unit, TC+CC middle-aged: 7.6 ± 0.2 unit, TT elderly: 9.0 ± 0.2 unit, TC+CC elderly: 9.3 ± 0.2 unit; Two-way ANOVA indicates Factor of Polymorphism: $P = 0.2132$, Factor of Age: $P < 0.001$, and Interaction: $P = 0.5675$).

CONCLUSION: These findings indicate that the tendency towards higher CAVI is found due to the mutations, but the gene polymorphism in NOS3 could not significantly affect age-related increases in arterial stiffness as assessed by CAVI in the Japanese general group, suggesting that the impacts of gene polymorphism in NOS3 may be a lesser magnitude compared to the polymorphism of monogenic disorders.

INCREASED ARTERIAL STIFFNESS GRADIENT IN BADMINTON PLAYERS WITH DOMINANT UNILATERAL ARM MOVEMENTS IS DIFFERENT FROM THE INCREASE IN ARTERIAL STIFFNESS GRADIENT WITH ADVANCING AGE

KIM, D.Y., LEE, R., HWANG, M.
INCHEON NATIONAL UNIVERSITY

INTRODUCTION: Pulse wave velocity (PWV), a validated measure of arterial stiffness, is a clinical indicator for cardiovascular disease risk. Arterial stiffness gradient, a novel marker of cardiovascular morbidity and mortality, is the ratio of central (aortic or carotid to femoral, cf) PWV to peripheral (arm or leg) PWV. Increased central arterial stiffness is a negative feature seen in the aged vasculatures. Regular physical activity reduces central arterial stiffness in various populations including the aged adults and chronic disease patients. But its effect on peripheral PWV is still controversial. In addition, to date, few studies have investigated changes in peripheral PWV in response to unilateral exercise, and no studies have investigated changes in arterial stiffness gradient. Therefore, the purpose of this study was to compare the differences in arterial stiffness gradient as well as to analyze the difference in armPWV between both arms according to the degree of unilateral arm exercise participation.

METHODS: Twenty-six young women participated in this study; eight elite-level badminton players (ELIT), ten club-level badminton players (CLUB), and eight age-matched sedentary participants (CONT). Central blood pressure and carotid-femoral PWV (cfPWV) as the central artery stiffness were measured using SphygmoCor Xcel system. Brachial-radial PWV (armPWV) as the peripheral stiffness was measured using Doppler Flowmeters and the associated data was collected and analyzed by PowerLab data acquisition system including Labchart Pro V8 software. Arterial stiffness gradient was calculated as the ratio of cfPWV to armPWV at both dominant and non-dominant arm, respectively. Body composition was assessed by using a segmental bioelectrical impedance analyzer.

RESULTS: In the dominant arm, the arterial stiffness gradient of ELIT and CLUB were significantly higher than CONT (0.73 vs. 0.46, ELIT vs. CONT, $P<0.001$; 0.59 vs. 0.46, CLUB vs. CONT, $P=0.04$). The arterial stiffness gradient of ELIT was also significantly higher than CLUB (0.73 vs. 0.59, ELIT vs. CLUB, $P=0.03$).

In the non-dominant arm, the arterial stiffness gradient of ELIT was significantly higher than CONT (ELIT: 0.59 vs. CON: 0.44 $P= 0.01$), but there was no significant difference between ELIT and CLUB, and CLUB and CONT (0.59 vs. 0.53, ELIT vs. CLUB, $P=0.36$; 0.53 vs. 0.44, CLUB vs. CONT, $P=0.09$).

The dominant and non-dominant armPWV were positively correlated with cfPWV and central blood pressures ($r\geq0.41$, $P\leq0.04$). The dominant and non-dominant armPWV were also inversely associated with the dominant arm muscle mass and whole-body muscle mass ($r\leq-0.49$, $P\leq0.01$).

CONCLUSION: The more unilateral exercise accumulated in the dominant arm, the higher the arterial stiffness gradient. Since the increased arterial stiffness gradient in active young adults is caused by decreased armPWV rather than increased cfPWV, an increase in arterial stiffness gradient may be associated with a reduced cardiovascular disease risk in the future.

CARDIAC DIFFERENCES BETWEEN PHYSICALLY ACTIVE AND NON-ACTIVE HYPERTENSIVE AND NORMOTENSIVE OLDS

KNEFFEL, ZS., PAVLIK, G., TÓTH, M., RADÁK, ZS.
HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: Hypertension is one of the most frequent diseases, approximately 40% of the adult population is involved, in the older adults its incidence is even higher, nearly 70%-80%. It is responsible for more than 50% of the risk factors of cardiovascular diseases, such as stroke, atherosclerosis and coronary diseases. With aging, either with or without hypertension, the cardiac condition becomes impaired; its main manifestation is left ventricular (LV) hypertrophy and a worsened function. Regular physical training is recognized for its positive impact on both hypertension and age-related cardiac issues. Given the limited research on older individuals with hypertension, this study aimed to focus on the cardiac advantages of an active lifestyle in this specific population.

METHODS: Cardiac morphology and function in 199 normotensive (NT) and hypertensive (HT), active and sedentary individuals, (male, n=111), were assessed at age >60 yrs. Echocardiography was performed in all subjects including two-dimensional guided M-mode, Doppler- and tissue Doppler measurements. Results were compared either by ANOVA, or by Kruskall-Wallis test.

RESULTS: LVM was referred to the body dimension by an index in which the exponent of the numerator and denominator is matched. Left ventricular muscle index (LVMI), is higher in active young than in sedentary ones, in our sample this variable was smaller in actives except in HT females (male NT: 82.9 vs. 98.3 g/m3; HT: 87.7 vs. 107 g/m3; female NT: 76.7 vs. 89.1 g/m3, HT:80.6 vs.91). Diastolic function was better in the following active groups (male, NT: 1.03 vs. 0.76, HT: 0.98 vs. 0.77 ns; female, NT: 1.21 vs. 0.9, HT: 1.04 vs. 0.88). Tissue Doppler results were also better in the active groups.

CONCLUSION: Our results indicates that at the older age the LV hypertrophy, which is a characteristic of the athlete's heart at the young age, becomes inverted between active and sedentary groups indicating that active lifestyle can prevent pathologic LV hypertrophy. The diastolic function, was also better in the active groups, the difference between the active and sedentary groups was more marked in the normotensive male groups than in the hypertensive ones.

ACUTE EFFECTS OF HIGH-INTENSITY INTERVAL EXERCISE DURING DIFFERENT MENSTRUAL STAGES ON PULSE WAVE VELOCITY AND BLOOD PRESSURE

YU, T.A.1, WANG, C.W.2, CHEN, L.Y.1, WANG, C.K.3, FANG, S.H.2, WANG, S.C.1, HE, C.S.1

1 NATIONAL CHUNG CHENG UNI, CHIAYI COUNTY, TAIWAN, 2 NATIONAL TAIWAN UNI OF SPORT, TAICHUNG CITY, TAIWAN 3 GRADUATE INSTITUTE OF EDUCATION NATIONAL CHUNG CHENG UNI, CHIAYI COUNTY, TAIWAN

INTRODUCTION: High-Intensity Interval Exercise (HIIE) has been proven to have positive effects on improving cardiovascular function (1). However, disparities in arterial stiffness improvement may exist among premenopausal women in different menstrual phases (2). Therefore, this study aimed to investigate the acute effects of HIIE on cardiovascular function in healthy young women during different menstrual phases, aiming to clarify the benefits on cardiovascular function.

METHODS: Thirteen female college students with regular exercise habits were recruited, and their menstrual cycle status was determined through a menstrual cycle questionnaire. One week before formal HIIE, the participants peak heart rate (HRpeak) was measured. Subsequently, one HIIE session was conducted during both the follicular and luteal phases of the same menstrual cycle. Each session comprised 10 sets of 1-minute exercise at 90% HRpeak intensity with 1-minute rest intervals. Blood pressure and finger-toe pulse wave velocity (ftPWV) were measured at Rest, immediately post-exercise (T0), and at 15 (T15), 30 (T30), 45 (T45), and 60 (T60) minutes post-exercise. Repeated-measures two-factor analysis of variance was employed for statistical analysis.

RESULTS: ftPWV at Rest, T0, T15, and T30 was significantly lower in the luteal phase group compared to the follicular phase group ($p < 0.05$). Systolic blood pressure (SBP) at Rest was significantly lower in the luteal phase group ($p < 0.05$), while the follicular phase group showed a significant decrease in SBP at T30, T45, and T60 compared to Rest ($p < 0.05$). Diastolic blood pressure (DBP) at Rest, T30, T45, and T60 was significantly lower in the luteal phase group ($p < 0.05$). The area under the curve (AUC) of ftPWV, AUC SBP, and AUC DBP during Rest-T0 was significantly lower in the luteal phase group ($p < 0.05$).

CONCLUSION: The acute effects of HIIE vary among different population groups. In healthy young women, cardiovascular stability is observed in the luteal phase following HIIE, potentially associated with elevated estrogen levels, suggesting a lower cardiovascular risk. Conversely, despite poorer vascular function, the follicular phase exhibits a significant decrease in SBP post-exercise, indicating a more pronounced vascular response, and implying a higher cardiovascular risk during HIIE in the follicular phase. Future exercise programs should consider the influence of different menstrual phases on vascular function to select appropriate exercise timing.

TONGUE'S THE WORD: EXERCISE TRAINING ALTERS THE NO2- PRODUCING MICROBIOME OF THE TONGUE DORSUM AND IMPACTS NO METABOLITE LEVELS IN SALIVA, SERUM, AND PLASMA.

SIMPSON, A., PILOTTO, A., BROCCA, L., MAZZOLARI, R., ROSIER, B., CARDA-DIÉGUEZ, M., CASAS-AGUSTENCH, P., BESCOS, R., PORCELLI, S., MIRA, A., EASTON, C., HENRIQUEZ, F., BURLEIGH, M.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Nitric oxide (NO) is a multifunctional signalling molecule, produced by NO synthase (NOS) enzymes or the stepwise reduction of nitrate (NO3-) to nitrite (NO2-) by commensal oral bacteria(1). Exercise training upregulates NOS expression, improving systemic health(2). Physical activity is also associated with oral health in the general population(3). This may be underpinned by actions of oral NO2- producing bacteria which increase oral resilience to acidification, preventing tooth demineralisation(4). We provide novel data exploring the effect of exercise training on the oral microbiome and NO metabolites.

METHODS: An exercise training and detraining study was used to explore changes to the oral microbiome and systemic and oral NO metabolite levels. Eleven untrained males (age 25±5 years, body mass 64.0±11.2kg, stature 171±6 cm, VO2peak<45ml·min−1·kg−1) underwent 8-weeks of high-intensity interval training (HIIT), followed by 12-weeks of detraining. Samples were collected at baseline, after training and after detraining. The tongue dorsum microbiome was examined using long-read 16S rRNA sequencing. Changes in NO3- and NO2-in saliva, serum and muscle were measured with high-performance liquid chromatography.

RESULTS: Multiple alterations were seen in the microbiome following changes in activity level (all p≤0.049). These changes were relevant to systemic and oral NO availability. At the genus level, post-HIIT, NO2producing Rothia and Prevotella increased in abundance and Neisseria decreased in abundance. Five of the nine species which increased in abundance post-HIIT demonstrate NO2producing capacity. These were Rothia mucilaginosa, Streptococcus salivarius, Streptococcus parasanguinis, Prevotella salivae and Prevotella melanginogenica. NO3- increased in plasma post-training (Δ 14.15, 95%CI 1.44-26.85uM, p≤0.03) and decreased post-detraining (Δ-9.91, 95%CI -1.10-18.73μM, p≤0.033). NO2- increased in saliva post-training (Δ+78.27, 95%CI 16.21-140.3μM p=0.016) but decreased in plasma (Δ-182.0, 95%CI -20.26343.7nM, p<0.029) and muscle (Δ-0.57, 95%CI -0.250.89 μMol.kg-1, p≤0.002), before returning to baseline post-detraining (both p≤0.011).

CONCLUSION: Structured exercise training altered the composition of the tongue dorsum microbiome, increasing the abundance of several NO2producing species. While NO3- levels in the muscle and saliva remained unchanged following HIIT, plasma NO3- increased. Exercise training also elevated salivary NO2- while decreasing NO2- levels in the plasma and muscle. These changes did not persist after detraining. When taken together, these results may have implications for general and oral health due to the potential impacts of oral NO2- production on NO availability.

1.Hezel MP, et al. Oral Dis. 2015

2.Nosarev AV, et al. Front Cell Dev Biol. 2015

3.Chan CCK, et al. Front Oral Health. 2023

4.Rosier BT, et al. J Dent Res. 2022.

HEART RATE VARIABILITY RESPONSE TO LOW-FREQUENCY SOUND VIBRATIONS IN REGULARLY ACTIVE MALE SUBJECTS

HAUSER, R., BESSON, C., GREMEAUX, V., DEGACHE, F.

CHUV: CENTRE HOSPITALIER UNIVERSITAIRE VAUDOIS

INTRODUCTION: Heart Rate Variability (HRV) exhibits a strong association with the autonomic nervous system (ANS) activity. In recent years, HRV has been used as an effective and reliable method of measurement to assess different fatigue status and recovery in athletes [1]. Low-frequency sound vibration (LFV) has been proved to increase the reactivity of cardiac vagal regulation and physical relaxation [2]. LFV is perceived through the auditory pathway and through skin mechanoreceptors. This study analyzed a unique pattern of LFV (RubesaSounds), which are highly structured and designed to create a neural saturation to enhance recovery. The aim of this study was to assess the acute effects of LFV on vagally-related HRV variables in regularly active male.

METHODS: 27 participants went through 2 different randomly chosen sessions in the exact same conditions. A conventional relaxation session (CRS) with no sounds nor vibrations and another LFV session. The LFV session consisted of 50 minutes of sounds (40-80Hz) inducing whole body vibrations. The duration of each session was 50 minutes. R-R intervals were collected in a supine position during the entire experience and lasted until 30 minutes post-session. HRV data was acquired using a heart rate monitor (Polar H10) and analyzed with Kubios Premium software.

RESULTS: A significant intervention effect (P=0.003) for HR between pre-session (63±8.5) and 30 minutes post-session (59.2±8.2) was observed in the LFV group only. Another significant intervention effect (p=0.035) was found in the ratio of low and high frequency powers in relation to heart rate ((LF+HF)/HR) which increased between pre-session (81.7±80.8) and 30 minutes post-session (135.1±130.3) in the LFV group only. No significant time effect was observed in RMSSD and LnRMSSD between pre- and post-30 in both groups. The recovery HRVs (between during and post-30) were significant in LFV for LnRMSSD (p=0.015), (LF+HF)/HR (p=0.007) and RMSSD (p=0.02) and non-significant in all variables for the CRS session.

CONCLUSION: This study was able to describe evidence of increased vagal tone post-intervention in LFV vs conventional relaxation session. A major finding of the study was a 1.5-fold increase in recovery speed compared to a conventional recovery session. Positively influencing vagal tone with LFV could offer a new perspective in sports-related recovery technologies. Our results are congruent with previous studies on the effect of vibrations on the ANS.

1 – Bestwick-Stevenson T, Toone R, Neupert E, Edwards K, Kluzek S. Assessment of Fatigue and Recovery in Sport: Narrative Review. Int J Sports Med. 2022 Dec;43(14):1151-1162.

2 - Bartel L, Mosabbir A. Possible Mechanisms for the Effects of Sound Vibration on Human Health. Healthcare (Basel). 2021 May 18;9(5):597.

IMPACT OF A SCHOOL HEALTH EDUCATION PROGRAM ON PHYSICAL ACTIVITY AND FITNESS IN CHILDREN AGED 10 TO 13

BLACKBURN, P., LAROUCHE, A., PLOUFFE, J.

UNIVERSITÉ DU QUÉBEC À CHICOUTIMI

INTRODUCTION: School-based interventions combining nutritional education, physical activity, reduced sedentary activities and a behavioral management component have been reported to promote a healthy body weight, cardiometabolic health, and the acquisition of a healthy lifestyles. It also appears that school health education programs are associated with higher levels of physical activity and a better physical fitness among children. Interventions in which parents are involved also appear to be more effective than those performed without parents. Indeed, parents play an important role in acquiring a healthy lifestyle for their children, such as a balanced diet and a physically active lifestyle.

METHODS: Thirty-three children (6 boys / 27 girls) aged between 10 and 13 years were included in this study. They participated in two to three workshops per week for 25 weeks. One to two sessions were devoted to physical activity and the last weekly meeting was specific to nutrition. Anthropometric measurements and physical fitness were measured at the beginning as well as at the end of intervention.

RESULTS: Based on body mass index, our participants were not considered as overweight or obese. Furthermore, participants had a good perception of their sports skills. Indeed, participants indicated that they perceived themselves as having excellent or good sports skills. In terms of motivation, we asked the students what motivated them to be active. Here are the three reasons encouraging our participants to practice a sport or physical activity. These reasons remain similar from the beginning to the end of the program. The first motivation is to be in better shape (19 (70.3%) at the beginning and 21 (77.8%) at the end), the second is to maintain good health (19 (70.3%) at the beginning and 21 (77.8%) at the end), and the third motivation is to spend more time with their friends (15 (55.6%) at the beginning and 16 (59.3%)). During the intervention, participants reported more hours of moderate and high-intensity physical activity per week (+2.34 hours/week). However, this increase was not significant. We found a significant improvement in most of the physical tests performed during the study: grip strength (p=0.0015), seated sit-ups (p<0.0001), arm extensions (p<0.0001) and flexibility (p=0.0099).

Cardiorespiratory fitness, measured with the 20-m shuttle run, was also significantly improved during the intervention (p=0.0002).

CONCLUSION: This study demonstrates that a 25 weeks school intervention program is sufficient to improve physical fitness of children.

Conventional Print Poster Presentations

CP-MH09 Obesity/Weight loss/Elderly

EXAMINATION OF CUT–OFF VALUES FOR DETERMINING JAPANESE MALE UNIVERSITY ATHLETES WITH VISCERAL FAT OBESITY

TOMOMI, T.H., ASAKO, Z.M., YUKA, K., TOMOHIRO, K., SHUICHI, M.

JOSAI INTERNATIONAL UNIVERSITY

INTRODUCTION: Excessive visceral fat accumulation, which leads to lifestyle-related disease, causes the risk of cardiovascular disease. We have reported that approximately 40% of overweight Japanese male university athletes have a visceral fat area (VFA) ≥100 cm2, and the markers of liver function and lipid metabolism are higher than those of their peers with VFA < 100 cm2.

In Japan, visceral fat obesity is defined as VFA ≥100 cm2, and the cut-off value for determining visceral fat obesity is 85 cm in waist circumference (WC) for ordinary men. However, it is unknown whether it is appropriate to use WC as a criterion for determining visceral fat obesity in daily training athletes.

This study aimed to obtain cut-off values for determining visceral fat obesity in Japanese male University athletes.

METHODS: The participants were 200 male university athletes. Body measurements were taken in the early morning after an overnight fast. The body mass index (BMI) was calculated based on height and body weight. The VFA and WC were measured using abdominal bioelectrical impedance analysis (Panasonic, EW-FA90). Spearmans correlation analysis was used to examine the relationship between anthropometric parameters and VFA. Then, logistic regression analysis was performed with VFA ≥ 100 cm2 as the objective variable, and correlated anthropometric parameters as the explanatory variable. Furthermore, cut-off values were calculated using ROC curves.

RESULTS: Aged 18-24 years, the participants had a median (interquartile range) height of 175.3 cm (170.7 - 179.2 cm), body weight of 69.4kg (62.9 – 77.8 kg), BMI of 22.5 kg/m2 (21.0 – 24.9 kg/m2), VFA 44.0 cm2 (29.0 - 65.0 cm2) and WC 78.9cm (75.0 – 84.7cm). Those with VFA ≥ 100 cm2 accounted for 11.5% (23/200) among participants, with physical characteristics of height 176.9 cm (171.7 – 181.7 cm), body weight 99.0kg (89.3 – 103.9 kg), BMI 31.1 kg/m2 (30.1 – 32.2 kg/m2), VFA 122.5 cm2 (103.5 – 142.0 cm2) and WC 98.4 cm (93.9 – 103.8 cm). Positive correlations were found between VFA and body weight ($r = 0.851$, $p < 0.0001$), BMI ($r = 0.822$, $p < 0.0001$), and WC ($r = 0.937$, $p < 0.0001$), among which WC had the strongest correlations. Results of logistic regression analysis showed that the odds ratio (95% confidence interval) for body weight was 0.81 (0.59 - 1.10、$p = 0.172$), BMI was 1.88 (0.89 - 3.97、$p = 0.097$), and WC was 2.02 (1.13 - 3.62、$p < 0.05$), indicating WC was the only parameter associated to visceral fat obesity.

The area under the curve for WC 0.994 (0.987 - 1.00, $p < 0.001$) was the largest compared to body weight 0.977 (0.958 - 0.996、$p < 0.001$) and BMI 0.989 (0.978 - 1.00、$p < 0.001$). The cut-off values were body weight 82.7kg (sensitivity 95.7%, specificity 91.5%), BMI 26.4kg/m2 (95.7%, 93.8%), and WC 89.7cm (100%, 96.6%).

CONCLUSION: It is suggested that the cut-off value of WC for determining Japanese male university athletes with VFA ≥100 cm2 was 89.7 cm.

IS HIGH-INTENSITY INTERVAL TRAINING IN HYPOXIA MORE EFFECTIVE THAN IN NORMOXIA TO IMPROVE CARDIOMETABOLIC HEALTH IN SEDENTARY AND OVERWEIGHT/OBESE ADULTS? A META-ANALYSIS

DENG, S., YIN, M.1, CHEN, Z.1, GIRARD, O.2, LI, Y.1

1 SHANGHAI UNIVERSITY OF SPORT, SHANGHAI, CHINA; 2 UNIVERSITY OF WESTERN AUSTRALIA, PERTH, WA, AUSTRALIA

INTRODUCTION: Obesity is becoming a critical global public health concern [1]. Recently, high-intensity interval training in hypoxia (HIHT) has presented an innovative therapeutic approach to optimize fat loss strategies and mitigate cardiometabolic risks among inactive and obese populations [2, 3]. To date, currently available studies have produced mixed results [4]. This systematic review and meta-analysis aimed to determine the effects of HIHT compared with high-intensity interval training in normoxia (HINT) to improve cardiometabolic health outcomes in sedentary, overweight/obese adults.

METHODS: A systematic search was conducted on PubMed/MEDLINE, Web of Science, EBSCOhost, Embase, and Cochrane Library databases (up to January 2024) to identify original articles assessing cardiometabolic health outcomes in sedentary and overweight/obese adults following both HIHT and HINT. Subsequently, a meta-analysis was performed to determine the standardized mean difference (SMD) between the effects of HIHT and HINT on cardiometabolic health outcomes.

RESULTS: Eight studies with a total of 218 participants were included. HIHT induced greater improvement in maximal oxygen uptake (VO2max) (SMD = 0.53; 95% confidence interval [CI]: 0.22, 0.83; $I2 = 0\%$; $p < 0.001$) compared with HINT. There

were no significant differences in fat mass (SMD = -0.01; 95%CI: -0.42, 0.39), systolic blood pressure (SMD = -0.16; 95%CI: -0.54, 0.23), diastolic blood pressure (SMD = 0.02; 95%CI: -0.36, 0.41), triglycerides (SMD = -0.15; 95%CI: -0.45, 0.14), total cholesterol (SMD = 0.27; 95%CI: -0.03, 0.57), glucose (SMD = 0.06; 95%CI: -0.51, 0.64), as well as high-density (SMD = 0.20; 95%CI: -0.17, 0.56) and low-density lipoprotein cholesterol (SMD = 0.07; 95%CI: -0.30, 0.43) between HIHT and HINT.

CONCLUSION: Based on current evidence, HIHT induces greater VO2max improvements compared with HINT in sedentary and overweight/obese adults. However, due to the limited research, further investigation of this novel nonpharmacological therapeutic intervention is warranted with larger sizes, standardized protocols, and exploration of potential mediators (e.g., exercise intensity, hypoxic severity, sex, and age) to substantiate and expand the evidence across diverse populations.

References:

1. Elmaleh-Sachs A, Schwartz JL, Bramante CT, Nicklas JM, Gudzune KA, Jay M. Obesity Management in Adults: A Review. JAMA. 2023;330(20):2000-2015.

2. Brocherie F, Millet GP. Hypoxic exercise as an effective nonpharmacological therapeutic intervention. Exp Mol Med. 2020;52(3):529-530.

3. Girard O, Matic Girard I, Peeling P. Hypoxic conditioning: a novel therapeutic solution for load-compromised individuals to achieve similar exercise benefits by doing less mechanical work!. Br J Sports Med. 2021;55(17):944-945.

4. Millet GP, Girard O. Editorial: High-Intensity Exercise in Hypoxia: Beneficial Aspects and Potential Drawbacks. Front Physiol. 2017;8:1017.

PHYSICAL ACTIVITY LEVEL OF UNDERGRADUATE STUDENTS

GUERRIERO, M., BRUNO, A.3, MESSINA, G.4, MOSCATELLI, F.3, POLITO, R.1, DIPACE, A.3

1 UNIVERSITY OF FOGGIA, ITALY; 2 IUL TELEMATIC UNIVERSITY, FIRENZE, ITALY; 3 PEGASO TELEMATIC UNIVERSITY, NAPOLI, ITALY; 4 UNIVERSITY OF CAMPANIA

INTRODUCTION: The WHO emphasizes the value of regular exercise in preventing various health issues and enhancing general wellbeing [1]. Global recommendations regarding physical activity (PA) understood both as exercise but also as everyday moments involving movement or activity, agree in identifying at least 150 minutes per week of moderate to vigorous intensity exercise. The risk of incurring chronic diseases, for who meet or exceed these recommendations, is reduced by 20 to 30 per cent [2]. Sedentary lifestyles and low levels of PA are increasingly common in modern culture, and peaks are reached among young people, compared to children and adults, especially among university students away from home. The aim of this study was to investigate the habits and lifestyles among students living in ADISU-Puglia facilities, through the use of a questionnaire aimed at assessing how the choice to live away from home, impacted on their lifestyle and PA habits during a particular period of life.

METHODS: Eighty students, aged between 18 and 28, were recruited from ADISU Puglia (Agenzia per il Diritto allo Studio Universitario). The questionnaire was provided via Google Forms and accepted both multiple and open-ended responses. One of the researchers supervised the procedure. The variables were evaluated using descriptive statistics. The frequencies and distribution of the parameters sought were documented. Every participant gave written, informed consent prior to participation.

RESULTS: The results show the following: 1) 52.5% of the study subjects claimed to practice PA, while 38% claimed not to practice PA; 2) 45% of the students claimed not to practice any PA; 11.3% claimed to practice PA less than once a week; 6.3% claimed to practice PA one to two times a week; 25% claimed to practice PA two to three times a week; and 12.5% claimed to practice PA more than three times a week; Three points stand out in this survey: 3) 60% of the included students smoke; 4) non-smoking students claim to practice PA more than smoking students; 5) male students claim to practice PA more than female students.

CONCLUSION: The results show low levels of PA among students and habits such as smoking. This pilot study shows that, despite the limitations of this survey, research of this type is fundamental to carrying out actions to promote well-being among university students and their academic achievements, as well as becoming prevention tools among younger people.

REFERENCES:

[1] World Health Organization-WHO. WHO | The Ottawa Charter for Health Promotion. First International Conference on Health Promotion, Ottawa, 21 November 1986 2013:3-5.

[2] Myers J, McAuley P, Lavie CJ, Despres J-P, Arena R, Kokkinos P. Physical activity and cardiorespiratory fitness as major markers of cardiovascular risk: their independent and interwoven importance to health status. Prog Cardiovasc Dis 2015;57:306-14.

THE EFFECT OF VOLUNTARY EXERCISE ON COLLEGE STUDENTS IN TAIWAN

CHUANG, Y.T., YANG, P.C., CHIU, Y.H., CHUANG, P.H., CHEN, I.T.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: In recent years, college students do not have enough time for exercise after class on Taiwan, resulting in a downward trend in physical fitness levels. Currently, there is no objective record and evaluation method for the analysis

of voluntary exercise performance on college students, and finding an exercise method that can improve physical fitness is an important issue. This study used wearable devices to collect data of voluntary exercise on college students, factor analysis was employed to extract a limited number of indexes factors from the parameters to analyze and identify objective exercise performance factors for college students. The developed indexes will be applied to a new voluntary exercise performance factor for voluntary exercise and physical education in physical fitness assessment.

METHODS: The 33 college students who completed the "100 Days and 100 Kilometers" running or brisk walking of exercise implementation plan; with pre and post running test, and voluntary running group activities once every week; the total 824 exercise data were selected for analysis; factor analysis was employed to extract a limited number of factors from the parameters to analyze and identify objective exercise performance factors.

RESULTS: 1. The The endurance fitness has improved on male and female college students who completed the "100 Days and 100 K" goal; 2. The "new voluntary exercise performance factors" extracted through factor analysis namely "exercise volume capacity", "exercise speed capability" and "exercise intensity", and based on this, a "sports performance radar chart" is constructed which can provide comprehensive performance evaluation; 3. For regular exercisers, the performance of each factor in the exercise performance radar chart is better than or equal to the mean value; 4. Group running activities can effectively to help students maintain the amount of exercise and intensity.

CONCLUSION: Promoting voluntary exercise implementation plan can effectively improve their endurance fitness level on college students; regular exercisers and those participating in running group activities can maintain a certain amount of exercise, speed and intensity; this study used wearable devices and the exercise record data to constructed exercise performance radar chart which can obtain comprehensive exercise performance results, and the developed new voluntary exercise performance factors for college students are feasible.

RISK FACTORS FOR SUDDEN CARDIAC DEATH DURING RACING IN JAPANESE THOROUGHBRED RACEHORSES

SUGIYAMA, F., MUKAI, K., TAKAHASHI, Y., EBISUDA, Y., YOSHIDA, T.

JAPAN RACING ASSOCIATION

INTRODUCTION: Thoroughbred flat races involve distances of 1,000-2,600 m and an approximate speed of 60 km/h, such that they are completed in only 1-3 minutes. Similar to human athletes, sudden cardiac death (SCD) has been reported in Thoroughbred racehorses, and it is one of the most common causes of fatality during races, second only to musculoskeletal disorders. Previous studies have identified some risk factors for SCD, such as age and season, whereas the results regarding other potential factors, such as race distance, have been conflicting (1, 2). Given the variation in horse populations and racing systems among horse-racing jurisdictions, individual assessments of these risk factors for SCD are essential. However, there have been no studies of the risk factors for SCD in Japan. Therefore, we aimed to analyze the incidences of SCD and the associated risk factors in Japanese Thoroughbred flat racing.

METHODS: Race information and the veterinary records for thoroughbred horses competing in flat races held by the Japan Racing Association (JRA) between 2001 and 2022 were collected from the official database, and a retrospective unmatched case-control study was conducted to identify the risk factors for SCD. Horses that were diagnosed with "acute heart failure" or "heart failure" at JRA racecourses were defined as SCD cases, whereas horses that were not were regarded as controls. Age, sex, body weight, track condition, surface type, race class, race distance, season, and training center were included as variables in the analysis. Variables were initially analyzed by a combination of forward- and backward-stepwise procedures and were included in the final model if $P \leq 0.2$. Multivariable logistic regression analysis was then performed to identify the risk factors for SCD, and variables with $P < 0.05$ were considered to be statistically significant.

RESULTS: During the study period, data for 1,039,096 race starts were extracted, and 81 cases of SCD were identified (prevalence 0.006%). Of the nine variables considered, five were included in the final model. Body weight was significantly associated with SCD ($P = 0.047$), but age ($P = 0.051$), race class ($P = 0.069$), sex ($P = 0.141$), and surface type ($P = 0.146$) were not. Compared with horses weighing ≤ 449 kg, the odds ratio for SCD for horses weighing ≥ 490 kg was 2.33 (95% confidence interval 1.08-5.05).

CONCLUSION: In Japan, the incidence of SCD during flat races is comparable to that previously reported (1, 3). In contrast to previous studies (3, 4), age and race distance were not found to be significant risk factors for SCD. However, body weight was significantly associated with SCD, which may provide a novel perspective regarding the etiology of SCD in Thoroughbred racehorses.

References

1. Lyle, et al, Equine Vet J (2010)

2. Bennet et al, J Am Vet Med Assoc (2022)

3. Gibson, et al, Animals (2023)

4. Nath et al, Animals (2022)

EFFECT OF EXERCISE INTENSITY RELATIVE TO THE VENTILATORY THRESHOLD ON AFFECTIVE RESPONSES DURING EXERCISE: A SYSTEMATIC REVIEW AND META-ANALYSIS

KINGHORN, D., PAVAL, D.R., GALLAGHER, I.J., VOLLAARD, N.B.J.
THE UNIVERSITY OF STIRLING

INTRODUCTION: Affective valence (AV; i.e., feelings of pleasure (positive affect) or displeasure (negative affect)) can be modified by exercise. Whether exercise makes someone feel 'good' or 'bad' may influence exercise enjoyment, and subsequently the uptake of, and adherence to, exercise routines. The dual-mode theory (DMT; Ekkekakis et al., 2008) proposes a homogenous increase in affective valence during exercise at intensities below the ventilatory threshold (VT), and a decreasing level of pleasure above the VT. This has led to an increase in studies investigating the effect of exercise at intensities prescribed relative to the VT on AV. The aim of the present study was to analyse the relationship between exercise intensity relative to the VT and the change in affective valence during exercise.

METHODS: A systematic review and meta-analysis (PROSPERO ID: CRD42022331507) was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The databases PubMed, Web of Science, Scopus and PsycInfo were searched up to August 2022 for the 4 possible combinations of the search terms "affective valence" OR "feeling scale" AND "ventilatory threshold" OR "lactate threshold". Studies were eligible if they investigated affective responses to exercise in apparently healthy adults with intensities set relative to the VT or lactate threshold (LT). Bayesian meta-analysis using linear and non-linear modelling was conducted to examine the relationship between exercise intensity relative to the VT and the greatest change in affective valence from baseline (pre-exercise) to any time points during exercise. Studies missing baseline affect data and trials implementing interventions in addition to exercise were excluded.

RESULTS: The search yielded 18 trials, involving n=533 participants, and exercise intensities equivalent to 80-110% of VT. Four of eight trials at intensities ranging from 80% to 96% of VT, four of five trials at 100% of VT, and all trials at intensities >100% of VT resulted in decreases in affective valence. Meta-regression analysis demonstrated a considerable effect of exercise intensity (effect size=1.41, 95% highest density interval (HDI): 0.41-2.39). No meaningful moderating effects of age, sex, BMI, and VO2max were observed at 95% HDI. The DMT proposes a non-linear relation between exercise intensity and the change in AV during exercise, but over the (limited) range of intensities in the available trials, the best fitting non-linear model was not superior to a linear model.

CONCLUSION: Although the analysis provides some support for the role of the VT as a turning point for changes in AV during exercise, there was no evidence for a homogenous positive response at intensities at or below the VT. Future research should identify factors explaining the variance in the change in affective valence during exercise at intensities at or below the VT.

ADHERENCE TO, AND SATISFACTION WITH, BALLISTIC RESISTANCE TRAINING VERSUS CONVENTIONAL RESISTANCE TRAINING: FINDINGS FROM THE REPROOF STUDY

BROOKE-WAVELL, K., MARQUES, E.A., CALISKAN, O., FOLLAND, J.P.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Resistance training (RT) has been endorsed as a key component in the prevention and management of osteoporosis and osteoarthritis, both being prevalent in postmenopausal women. Both low-load ballistic (high-velocity, propulsive; BRT) and high-load conventional (low velocity) RT (CRT) are generally acknowledged as safe and effective in improving physical fitness outcomes in young adults. However, little is known about the feasibility of BRT in older populations. Assessing the adherence and satisfaction of postmenopausal women to this RT approach compared to CRT is thus crucial for understanding its acceptability and potential for wider implementation.

METHODS: The Resistance Exercise Programme on Risk of Osteoporosis and Osteoarthritis in Females (REPROOF) study was a randomised, three-arm intervention trial enrolling healthy postmenopausal women (mean age = 62.8 ± 3.8 years, mean BMI = 24.4 ± 3.4 years, with no recent RT participation), designed to compare the efficacy of BRT and CRT on several risk factors for osteoporosis and osteoarthritis relative to control. RT groups (38 BRT, 39 CRT) were prescribed similar training sessions (same exercises and repetitions, but different loads, velocities and ballistic intent) twice a week for 32 weeks. We assessed the retention rate and adherence to the RT programs via attendance records. Participants satisfaction was measured by questionnaire at the end of the study. Results are reported descriptively, and between-group comparisons of participants experiences were analysed using chi-square tests.

RESULTS: The same proportion of participants (74%) assigned to BRT and CRT completed the study (n=28 and n=29, respectively) and had a similar adherence rate of 98%, while 78% allocated to control completed the study (n=25). Overall satisfaction with the exercise programs was high and no differences were found between groups. Almost all participants (94.7%) would recommend the programme they completed to friends and family, and the endorsement was supported mainly by perceived health benefits (57.9%). Almost all participants in BRT and CRT enjoyed the sessions (96.4 vs 96.5%) and enjoyed exercising with other people (85.7 vs 96.6%). Similarly, they reported liking the exercise (100 vs 93%), feeling interested (89.3 vs 93.1%), feeling good physically while doing it (96.4 vs 89.7%), and that it gave them a strong sense of accomplishment (92.9 vs 96.6%).

CONCLUSION: These findings indicate that both BRT and CRT are feasible in a university research setting. Also, the success of a wider-scale application may benefit from considering some key aspects perceived by participants as positive such as

trained staff, one-to-one approach, flexible training schedule, and short sessions. The high intervention adherence and participant satisfaction suggest that a BRT is as acceptable and feasible as CRT in this population.

HEART RATE RESPONSE DURING MAXIMAL EXERCISE AND RECOVERY IS AFFECTED BY CHRONOLOGICAL AGE, AND NOT TRAINING AGE.

MELVIN, A., AUDET, A., NAAZ, S., KOZLOFF, K., LEPLEY, A.
UNIVERSITY OF MICHIGAN

INTRODUCTION: Habitual physical activity has numerous holistic benefits; however, some research suggests long-term participation in endurance exercise may lead to alterations in autonomic function. Existing research aiming to understand the relationship between endurance exercise exposure and heart rate control have focused primarily on older lifelong runners, elite athletes, and males. Evaluating the connection between cumulative years of regular endurance training (training age; TA) and heart rate (HR) response during and immediately following exercise provides an opportunity to understand autonomic control in a generalizable population of endurance exercisers. The purpose of this study was to determine if TA has an effect on HR response during exercise and recovery in healthy male and female endurance runners.

METHODS: 189 runners (94M, 95F; 35.9±12.1y; VO2max M: 51.9±8.8, F: 46.8±6.9ml/kg/min) training for an upcoming competition performed a graded maximal treadmill cardiopulmonary exercise test. Test protocol was dictated by self-selected half marathon race pace with 1kph increments every 3min until volitional fatigue. Metabolic data were collected breath-by-breath. HR at 10% increments of VO2max were calculated as five-breath moving averages corresponding to the first instance when five consecutive VO2 values met or exceeded the % value. Recovery HRs were recorded every min for 5min post-exercise. Participants self-reported TA and were grouped in 5y increments up to >20y. Pearson correlations assessed the relationships between chronological age (CA) and TA as continuous variables, with HR at each % VO2max and post-exercise HR recovery each min. Repeated measures ANCOVA (TA group x % VO2max stage) with CA as a covariate assessed the overall effect of TA on HR response at each stage during and after exercise.

RESULTS: CA and TA had significant, moderate negative correlations to HR at each stage (r^2 = -.17 to -.63, $p<.001$) and HR recovery at each min (r^2 = -.25 to -.49, $p<.001$). There was no significant interaction effect for TA group by stage ($p>.05$). A significant effect for stage showed that HR was different at all % VO2max and recovery intervals regardless of group ($p<.001$). There was a significant effect for group, where those with TA >20y had significantly lower HR than all other groups regardless of stage of exercise or recovery ($p<.05$), however the effect was insignificant when using CA as a covariate ($p=.95$).

CONCLUSION: CA is significantly related to lower HR at comparable workloads throughout an exercise test and recovery, regardless of TA. This suggests that autonomic HR control during and after exercise is driven more by CA than TA in a general healthy population of endurance runners.

This study received funding from Apple Inc. The funding source had no role in the analysis and interpretation of the data or in the submission of this abstract.

6-MONTHS MULTICOMPONENT TRAINING EFFECTS ON FUNCTIONAL CAPACITY, FRAILTY AND MUSCLE MASS IN SARCOPENIC AND NON-SARCOPENIC OLDER ADULTS.

VICENTE-RODRÍGUEZ, G., MORADELL FERNÁNDEZ, A., FERNÁNDEZ-GARCÍA, A.I., NAVARRETE-VILLANUEVA, D., SUBÍAS-PERIÉ, J., PÉREZ-GOMEZ, J., GONZALEZ-GROSS, M., ARA, I., CASAJÚS, J.A., GÓMEZ-CABELLO, A.
UNIVERSITY OF ZARAGOZA

INTRODUCTION: Sarcopenia and frailty are two geriatric syndromes that share the deterioration of functional capacity. Multicomponent training (MCT) appears to be an effective method for improving functional capacity, potentially serving as a tool for preventing and treating frailty and sarcopenia. The main aim was to evaluate the differences obtained by following a 6-month supervised MCT program in older adults at risk of sarcopenia and without sarcopenia in variables used to assess sarcopenia, functional capacity and frailty.

METHODS: A total of 66 older adults (80.4±5.6 y.) were conveniently divided into an intervention group (IG) and control group (CG) and were subdivided into two groups: at risk of sarcopenia (CG: N=11; IG: N=20) and no sarcopenia groups (CG: N=12; IG: N=23) according to the revised European consensus [1]. The IG underwent a supervised 6-month multicomponent exercise program, three days a week, while the CG continued with their usual activities. Skeletal muscle mass, handgrip strength, speed, and SPPB, Fried, and FTS-5 batteries were evaluated. A repeated measures ANOVA was conducted to study if there were significant changes after six months of training between groups (GxT) and within each group.

RESULTS: Those at risk of sarcopenia and without sarcopenia which belong to the intervention group show improvements in handgrip strength (from 15.7 ± 4.3 to 19.0 ± 4.4 kg and from 25.9 ± 9.0 to 27.9 ± 8.6 kg, respectively); walking speed (from 6.5 ± 2.1 to 4.4 ± 1.8 m/s and from 6.1 ± 3.9 to 4.4 ± 1.8 m/s, respectively); SPPB (from 7.2 ± 1.5 to 10.6 ± 1.7 and from 7.7 ± 1.4 to 11.1 ± 1.3 points, respectively); FTS-5 (from 21.7 ± 4.7 to 14.5 ± 6.2 and from 16.8 ± 5.5 to 11.5 ± 4.7 points, respectively) and Fried (from 1.7 ± 0.9 to 1.0 ± 0.8 and from 1.3 ± 1.1 to 0.7 ± 0.9 points, respectively) (all $p<0,05$). No GxT was observed when comparing these two groups, but it was observed for all these variables when compared to control and train pairs ($p<0,05$).

CONCLUSION: This MCT effectively enhances functional capacity and frailty in older adults with and without sarcopenia. However, further investigation is needed to determine if more specific exercise is required for skeletal muscle mass as those who improve muscle mass will probably improve their sarcopenic state.

1. Cruz-Jentoft, A. J. et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing 48, 16–31 (2019).

STUDY OF THE CHANGES IN THE SALIVARY PROTEOME PROFILE BY OBESITY AND PHYSICAL ACTIVITY IN CHILDREN

HOMS AVILA, J., VASILEVA, F., CAZORLA-GONZÁLEZ, J., PLANS-SALAS, E., FONT-LLADÓ, R., PRATS-PUIG, A.
UNIVERSITY SCHOOL OF HEALTH AND SPORT, UNIVERSITY OF GIRONA

INTRODUCTION: Obesity is a complex and multifactorial chronic disease caused by the interaction between the genotype and the environment. A sedentary lifestyle in children can lead to a decrease in physical activity, which can contribute to the development of obesity and other health related problems such as cardiovascular diseases, metabolic syndrome, and type 2 diabetes. The World Health Organization (WHO) recommends that children and adolescents accumulate 60 minutes of moderate or vigorous physical activity (PA) per day (1), therefore regular PA during childhood is one of the most effective means of improving and preserve health.

Saliva offers a promising diagnostic alternative to detect inflammatory, metabolic and cardiovascular risk factors in pediatric populations. Saliva sample collection offers advantages such as being an easy and non-invasive technique. Therefore, the use of saliva as a diagnostic and prognostic fluid is of interest for childhood obesity research.

Our aim was to study whether obesity and physical activity can influence the salivary proteome.

METHODS: BMI was calculated as follows: (Weight (kg))/〖Height (m)〗^2. Age- and sex-adjusted standard deviation scores (SDS) for body mass, height and BMI were calculated using regional normative data. Participants were classified as underweight, normal weight, overweight or obese (2). Physical activity level (sedentary, light, moderate, moderate to vigorous, and vigorous) was assessed using the triaxial accelerometer that allows determining the quantity and quality of physical activity (Actigraph GT3X). Salivary proteome analysis was performed on 20 saliva samples [7.53±0.33 years; 56% girls] by MALDI-TOF mass spectrometry using the positive linear mode and a mass range of 5 to 20 KDa. Differences in mass spectra (MS) and peaks (m/z) were analyzed using the Mann-Whitney U test.

RESULTS: By comparing the proteome profiles in saliva of normal-weight and obese children, a total of 20 MS peaks with significant intensity differences ($p < 0.01$) were identified. When children meeting and not meeting physical activity recommendations were compared, 2 peaks were identified ($p < 0.05$).

CONCLUSION: These results suggest that both, obesity and physical activity can change the salivary proteome profile in children, which would allow the identification of core salivary proteins and the correlation of salivary levels of these core proteins with obesity, cardiovascular parameters and a healthy lifestyle in children.

(1) WHO guidelines on physical activity and sedentary behaviour ISBN 978-92-4-001512-8

(2) Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. BMJ (Clinical research ed.) 2007-07-28. DOI: 10.1136/bmj.39238.399444.55

17:45 - 19:00

Plenary Session

PS-PL01 Mental health perspectives from the general population to elite level sport

PHYSICAL ACTIVITY AND EXERCISE FOR MENTAL HEALTH: HOW, WHY, AND IN WHOM?

HERRING, M.
UNI OF LIMERICK

Physical inactivity and mental illness are longstanding, interrelated global pandemics. Substantial evidence supports the prophylactic effects of regular physical activity and the efficacy of exercise for mental health, particularly anxiety and depression, across the lifespan in the general population. However, how, why, and in whom physical activity and exercise protect and improve mental health are less well known. Recent reviews from the World Health Organization Guidelines Development Group (DiPietro et al., 2021) revealed that knowledge on optimal/minimal physical activity dose has remained limited. Moreover, investigations of modifiable sources of variability in the physical activity—mental health relationship, which could prime or enhance implementation and benefits, are limited. For example, evidence of the efficacy of understudied exercise modes, including muscle-strengthening exercise, is comparatively scarce. To this end, Dr. Herring will discuss the protective associations of physical activity, including doses lower than those recommended for overall health, for mental health, effects of diverse modes of acute exercise and exercise training, particularly resistance exercise training, on mental health, and biopsychosocial factors that may predict/influence benefits of physical activity and exercise for mental health.

ELITE ATHLETES ARE HUMANS FIRST: THEIR MENTAL HEALTH CHALLENGES.

GOUTTEBARGE, V.

AMSTERDAM UNIVERSITY MEDICAL CENTERS

Mental health symptoms and disorders are common among elite athletes, may be induced by sport-related or environmental factors, and may impair performance. In June 2019, the International Olympic Committee (IOC) published its first consensus statement on mental health in elite athletes and created its Mental Health Working Group. These initiatives have been the foundation for prevention strategies that mitigate mental health symptoms and disorders in elite athletes. Prevention strategies include primary, secondary and tertiary prevention. This presentation touches the prevalence of mental health symptoms and disorders in elite sport, describes their contributing factors, stresses the importance of the prevention of mental health symptoms in athletes and introduces the various initiatives from the IOC Mental Health Working Group.

08:30 - 09:45

Invited Symposium

IS-PN04 Bone Health in Endurance Sports

EXERCISE FACTORS INFLUENCING THE BONE HEALTH OF ENDURANCE ATHLETES

SALE, C.
NOTTINGHAM TRENT UNIVERSITY

The career of competitive athletes is short, but it spans an important period for bone health, particularly in relation to the attainment of peak bone mass. For those athletes involved in high-intensity, high-impact activities, it is likely that involvement in their sport will positively influence their bone accrual during adolescence and early adulthood. The picture might not, however, be quite so positive for endurance athletes. Endurance athletes involved in both weight bearing sports, such as running, and non-weight-bearing sports, such as swimming and cycling, have been reported to have lower bone mass than other types of athlete or non-athletic controls. Although it is not necessarily straightforward to compare the bone health of athletes to population norms or even across sports, it is possible that the bone-loading characteristics and patterns experienced by endurance athletes during training and competition might place them at a relative disadvantage regarding their bone health. The major concern during the competitive years of an athlete is the potential for an increased risk of stress fracture injury, which can be significant injuries requiring a significant time off from training and competition. This is, of course, predominantly a concern for those athletes involved in weight bearing sports, since it is unusual to find large numbers of stress fracture injuries in non-weight-bearing sports, such as cycling and swimming. The major concern once an endurance athlete retires relates to an increased incidence of osteopenia and osteoporosis, which in turn increases the risk of fragility fracture occurrence. It is far from clear, however, whether the exercise training engaged in by endurance athletes during their competitive years significantly damages their bone health into later life in terms of an increased risk of these negative bone health outcomes. This talk will explore the relationship between the exercise factors, particularly in relation to loading characteristics, that might place different endurance athletes (e.g., distance runners, cyclists, swimmers, and triathletes) at an increased risk of poor bone health and its associated consequences. The talk will conclude by highlighting where future research efforts might best be employed to further our understanding of this vitally important issue for endurance athletes.

DIETARY FACTORS INFLUENCING THE BONE HEALTH OF ENDURANCE ATHLETES

DOLAN, E.
UNIVERSITY OF SAO PAULO

Bone is a nutritionally modulated tissue, requiring sufficient energy, macro and micro-nutrients for optimal metabolism, namely capacity to dynamically respond to fluctuating environmental demands, while simultaneously maintaining the structural integrity required to withstand habitual loading without injury. Endurance athletes face a number of challenges to meeting bone-specific nutritional requirements, which may contribute, at least in part, to the compromised bone health and high risk of bone injury reported for some groups of endurance athletes. Energy availability is a particular relevant issue to consider in this regard, given the high energetic demand of endurance training programs. Maintaining a lean phenotype is often considered desirable in many endurance sports, with athletes frequently restricting energy intake in an attempt to achieve or maintain a low body mass, further limiting the amount of energy available to support basic physiological processes, including bone metabolism. Low energy availability is often accompanied by an inadequate intake of macro and micro-nutrients that are key to bone health, including protein, carbohydrate and calcium. Furthermore, endurance exercise induces a range of acute metabolic perturbations, including to calcium, pH and redox status, all of which may increase bone catabolism and may potentially be counteracted with targeted nutritional strategies. This talk will summarize the bone-specific nutritional challenges that endurance athletes face, provide nutritional recommendations to support bone health in this group, and describe future research priorities within this area of investigation.

BREAKING MORE THAN RECORDS: BONE HEALTH IN ELITE CYCLING

VAN DIJK, J.
HAN UNIVERSITY OF APPLIED SCIENCES

Elite cycling, characterized by prolonged periods of low-impact activity in combination with high energy demands, presents unique challenges to maintaining bone health. This sport inherently lacks the high-impact mechanical loading found in weight-bearing activities, which is crucial for stimulating osteogenesis and preserving bone mineral density. Consequently, the skeletal system in cyclists is not subjected to the stresses that typically promote bone strength. Moreo-

ver, elite cyclists are prone to energy deficits due to the high energy demands of training and competition, often coupled with insufficient energy intake. This scenario can lead to a state of low energy availability, which may disrupt bone remodeling processes and accelerate bone loss. The interplay between suboptimal mechanical stress and inadequate dietary intake can thus create a perfect storm for bone deterioration, potentially heightening the risk of fractures during the career, and osteoporosis later in life. This presentation aims to dissect these intricate concerns and provide a blueprint for addressing them. The latest research on counteractive strategies will be presented, including nutritional strategies and exercise interventions to introduce necessary mechanical stimuli to the bones. Integrating these strategies will yield a framework aimed at preventing and addressing bone health issues among elite cyclists, with the dual benefit of not only extending their time in competition but also securing their bone health for life beyond their professional career.

Invited Symposium

IS-MH04 50 shades of adapted physical activity: Towards inclusive sport and exercise for all

HIGH INTENSITY ADAPTED PHYSICAL ACTIVITY FOR DIVERSE POPULATIONS, SUCH AS PEOPLE LIVING WITH CANCER OR DIABETES-2

KLAVINA, A.
LATVIAN ACADEMY OF SPORT EDUCATION

Positive effects from a healthy lifestyle are primarily derived from physical activity (PA), with secondary benefits encompassing psychosocial development and personal growth, along with a reduction of stress and unhealthy habits. While exercise statements have consistently recommended regular PA, the definition of health-promoting PA has shifted over time. Most PA guidelines recommend adults to engage in moderate-intensity aerobic physical activity (150 – 300 min), however, many health-related research studies have presented more beneficial effects of high intensity interval training (HIIT) in multiple patients' groups, including, breast cancer, type 2 diabetes, heart failure. Researchers play a crucial role in investigating the reliable potential of feasible and enjoyable high-intensity interval exercise (HIIT) interventions. This presentation aims to outline the evidence-based physiological, psychosocial health and quality of life benefits as a result from the HIIT interventions applied as part of health therapy programs. In addition, I will highlight the ecological model toward a healthier lifestyle as the rationale to demonstrate evidence-based examples of facilitating and limiting factors associated with technological innovations that may foster healthy lifestyle choices and well-being. I will elaborate on positive effects of HIIT on body mechanisms in people with cancer and using HIIT interventions to address cardiometabolic factors and quality of life in persons with type 2 diabetes (T2D). We have found that HIIT provides participants cardio-metabolic adaptations benefiting health and quality of life. Wearable technologies provide a promising opportunity to effectively assess functional capacities of the individual in an ecological environment. A major challenge is to apply innovative personalized technologies that can help individuals maintain healthy lifestyles and wellness by keeping track of their everyday activities in long term.

50 SHADES OF DATA USED IN ADAPTED PHYSICAL ACTIVITY

NG, K.
UNIVERSITY OF TURKU

Participants with specific impairments often do not meet the inclusion criteria in sport science studies. With an estimated 15% of the world's population living with disabilities, a sizable population where scientific knowledge is lacking. One of the challenges faced by researchers and practitioners is the awareness of how to identify people with disabilities in their own study. The aim of this presentation is to provide an overview of instruments used to measure various dimensions of adapted physical activity (APA), such as prevalence, functional and clinical tests. The individual's disability status can be captured through standardised self-report or proxy measures. Consistency between researchers during observations and classification tests is essential for understanding the range of movement, strength, and function in adapted physical activity. Furthermore, the boundaries in the use of technology to assist with data collection have been reduced since the COVID-19 pandemic, but may still exist in areas with low resources. Norms in functional tests, measured physical activity and overall movement could be inappropriate when participants have functional difficulties, and solutions to overcome these limitations are required. Despite these advances in understanding and measuring such dimensions, a myriad of ways to collect data is present in the field of adapted physical activity. This talk will go into a detailed review of the ways data is collected for prevalence rates, with emphasis on the Washington Group questions. The strengths and limitations of such methods are outlined. From the use of national datasets, a demonstration of the substantial changes to prevalence rates appears due to different cut-offs. Subsequently, selecting cut-offs has an important role when pooling data sets. Further discussions on what it means for data provision on adapted physical activity are brought up.

PHYSICAL ACTIVITY, EXERCISE AND SPORT IN PEOPLE WITH DISABILITIES AND/OR CHRONIC DISEASES

HETTINGA, F.

NORTHUMBRIA UNIVERSITY

People living with physical disabilities or chronic conditions experience many barriers to engage in physical activity. In particular in the period directly after rehabilitation discharge, we see that people struggle to integrate physical activity in their daily living. It is therefore that we started the Rehabilitation, Sport and Active Lifestyle (ReSpAct) research programme in 2012. This research programme aimed to use a prospective multi-center cohort study design to evaluate the nationwide implementation of the Rehabilitation, Sport and Exercise program (RSE, Dutch: 'Revalidatie, Sport en Bewegen') across eighteen rehabilitation centers/hospitals in the Netherlands. RSE is an evidence-based physical activity counselling programme involving multiple counselling sessions based on motivational interviewing during and after rehabilitation to stimulate a physically active lifestyle in adults with physical disabilities and/or chronic diseases. Since the start of ReSpAct in 2012, 14 publications have appeared providing insights into how we can optimize health and active lifestyle advice and support after rehabilitation discharge. I will shortly overview the main outcomes and highlight subsequent research we have conducted on physical activity and exercise in three particularly interesting populations in the field of adapted physical activity and sport: 1) wheelchair users, 2) people suffering from an invisible disability such as fatigue or pain and 3) people with intellectual disabilities.

Oral Presentations

OP-BM21 Neuromuscular Physiology III

BEYOND THE SURFACE: INVESTIGATING THE INFLUENCE OF BODY COMPOSITION AND ANATOMICAL FACTORS ON THE NUMBER OF IDENTIFIED MOTOR UNIT FROM HIGH-DENSITY SURFACE EMG RECORDINGS

SAMPIERI, A., SPINELLO, G., GOLDIN, E., MASARIN, A., FRANCHI, M.V., PAOLI, A., MORO, T., CASOLO, A.

UNIVERSITY OF PADUA, ITALY

INTRODUCTION: High-density surface EMG (HDsEMG) offers valuable non-invasive insights into individual motor unit (MU) activity and properties. However, large intersubject variability in the number of identified MU is often observed due to specific neural aspects and anatomical factors (e.g. volume conductor properties)1,2. A recent study3 on young males revealed that greater muscle electrode distance (MED), which includes skin, subcutaneous fat and superficial muscle aponeurosis, adversely affects HDsEMG signal decomposition in biceps brachii, especially at low force levels. Here, we investigated the influence of body composition and anatomical features on the number of identified MU in the human vastus lateralis (VL) muscle.

METHODS: To date, 48 healthy participants (17% female) representing two age categories (young adults (YG): 19-30 yr., elderly: 66-82 yr.) were enrolled in this study. They performed submaximal isometric knee extensions at 15%, 35%, 50%, and 70% of maximal voluntary contraction (MVC), while HDsEMG recorded the activity of the VL of the right leg (RL). HDsEMG signals were decomposed into individual MU for each force level. Multiple body composition features were evaluated using BIA and DXA, while ultrasonography (US) was used to measure MED precisely below the HDsEMG electrodes. Correlations and regression analyses were used to assess the relationships between the number of detected MU and body composition features according to force levels.

RESULTS: A total of 1476 unique MU were detected from the VL. Significantly negative correlations (Spearman's, $p<.05$ in all cases) were observed between MU number and fat mass (FM) estimated by BIA (15%: r=-.33; 50%: r=-.32; 70%: r=-.35) and DXA (15%: r=-.36; 35%: r=-.36; 50%: r=-.32; 70%: r=-.39), as well as FM RL estimated by DXA (15%: r=-.50; 35%: r=-.58; 50%: r=-.59; 70%: r=-.59), and MED (15%: r=-.69; 35%: r=-.72; 50%: r=-.72; 70%: r=-.72). Conversely, no associations were found between any other anthropometrical variable and the number of detected MU. When stratified by age group, simple linear regression analysis revealed that MED alone explained 79%, 66%, 61%, and 64% of the variance in the number of detected MU at 15%, 35%, 50%, and 70% MVC, respectively, in elderly, whereas 38%, 37%, 30%, and 32% at the same force levels in YG.

CONCLUSION: Our findings further confirm the influence of FM, and particularly MED (mainly composed of subcutaneous fat), on the quality of HDsEMG signal decomposition among healthy individuals with diverse characteristics. Specifically, greater body FM assessed by BIA and DXA were associated with decreased detectable MU. Notably, a more localized analysis of the anatomical area underlying HDsEMG electrodes enhanced the accuracy of MU number prediction. Our results highlight the importance of assessing MED using the US prior to HDsEMG recordings, as it emerges as the primary predictive parameter for MU number identification.

1Del Vecchio et al 2020

2Farina and Holobar 2016

3Souza de Oliveira et al 2022

TENDON VIBRATION-INDUCED MUSCLE SPINDLE DESENSITIZATION DECREASES EFFORT PERCEPTION DURING CYCLING

MARCHAND, F., PAGEAUX, B., MONJO, F.

UNIVERSITÉ SAVOIE MONT-BLANC

INTRODUCTION: Effort perception is a major regulator of physical activity engagement and pacing strategies for endurance races [1,2]. In this framework, reducing effort perception during physical activity could be beneficial to both performance and physical activity engagement. A study has demonstrated that muscle spindles desensitization induced by a 10-min tendon vibration protocol reduces effort perception during subsequent isometric contractions of elbow flexors [3]. However, the effects of tendon vibration on effort perception during ecological tasks such as cycling remains to be explored. Therefore, the present study aims to assess the effects of tendon vibration on effort perception during cycling. We hypothesized that, for a same perceived effort, power output and vastus lateralis electrical activity would be higher after a tendon vibration protocol.

METHODS: Fifteen participants attended the laboratory for 2 experimental visits, involving Vibration and Sham Vibration conditions. In each visit, participants completed two 3-minute cycling bouts on an ergometer before (PRE) and two 3-minute bouts after (POST) a 10-minute tendon vibration protocol administered bilaterally to the patellar and Achilles tendons (100Hz frequency 1mm amplitude for Vibration; 15 Hz frequency 0.5mm amplitude for Sham Vibration). For each individual bout, participants were instructed to maintain a constant perceived effort level. Specifically, they pedaled at either a moderate (23) or a strong perceived effort level (50), as determined by the CR100 scale. Relative changes in power output and vastus lateralis electromyography (EMG) between PRE and POST were analyzed with a 2-Condition × 2-Intensity repeated analysis of variances (ANOVAs). Effect sizes were expressed as partial eta-squared and when ANOVAs were significant, Bonferroni post hoc tests were performed. Significance was set at $p < 0.05$.

RESULTS: For mean power output, the ANOVA revealed a significant main effect of the condition ($F = 20.8$; $p < 0.001$; $\eta 2p = 0.598$). Relative power output changes in the Vibration condition were positive (+18% at 23 and in +2% at 50) but were negative in the Sham vibration Condition (~-7% for both intensities). The ANOVA revealed similar outcomes for vastus lateralis EMG.

CONCLUSION: In line with our hypothesis, we found that power output and VL electrical activity increased after the ten-minute vibration protocol at controlled perceived effort intensities. This suggests that the desensitization of muscle spindles actually leads to a reduction in the perception of effort during submaximal cycling exercises.

REFERENCES:

Behrens M. et al., (2023). Fatigue and Human Performance: An Updated Framework. Sports medicine, 53, 7–31.

Cheval B., & Boisgontier, M. P. (2021). The Theory of Effort Minimization in Physical Activity. Exercise and sport sciences reviews, 49, 168–178.

Monjo F. et al., (2018). The sensory origin of the sense of effort is context-dependent. Experimental brain research, 236, 1997–2008.

EVENT-RELATED SPECTRAL DYNAMICS IN CENTRAL MOTOR AREAS DURING PASSIVE AND ACTIVE KNEE EXTENSIONS: AN EXPLORATORY EEG STUDY

VISSER, A., BÜCHEL, D., LEHMANN, T., BAUMEISTER, J.

UNIVERSITY OF PADERBORN

INTRODUCTION: Passive movement in early injury rehabilitation aims to increase the range of motion and restore capabilities for active movement control. Passive movement activates motor brain areas [1], which may address the neurophysiological deficits associated with joint injuries. Comparing passive and active movement could provide insights into how passive movement contributes to the recovery of active motor control. This study aimed to describe differences in spectral brain dynamics in central motor areas between passive and active knee extension using a mobile electroencephalography (EEG) approach.

METHODS: A total of 22 healthy participants performed knee extensions in passive and active manners. Each participant completed 10 blocks of 12 trials with a pause of 3 seconds before each extension. Torque and EEG oscillations were recorded during the experiment. EEG data was analyzed using independent component analysis to identify independent sources of brain activity. For investigating the effects of passive and active knee extension on motor brain activity, event-related spectral perturbations (ERSPs) in the fronto-central cluster were computed. Statistical comparisons were conducted using permutation-based analysis with false discovery rate correction ($p < 0.01$).

RESULTS: ERSPs in the central motor cluster revealed significant differences between passive and active knee extension before and during movement. While alpha desynchronization in the active condition started 500 ms before movement initiation, it started with a delay of 250 ms in the passive condition. In the theta frequency band, a significant increase in synchronization was observed immediately after movement onset (50 to 250 ms) in the passive compared to the active condition.

CONCLUSION: The results show differences in movement-related spectral brain dynamics between active and passive knee extension in healthy adults. Active movements elicit significant alpha desynchronization before movement onset, potentially linked to movement planning. In contrast, passive movements lead to an increased theta synchronization after movement onset, suggesting augmented sensory processing related to motor control [2]. Considering the different cortical

patterns of passive and active movement, further studies should look deeper into the functional relevance of passive movements in musculoskeletal rehabilitation.

REFERENCES

[1] Onishi, H. (2018). Cortical excitability following passive movement. Physical Therapy Research, 21(2), 23–32.

[2] Varghese, J. P., Marlin, A., B. Beyer, K., Staines, W. R., Mochizuki, G., & McIlroy, W. E. (2014). Frequency characteristics of cortical activity associated with perturbations to upright stability. Neuroscience Letters, 578, 33–38.

STUDY ON THE MORPHOLOGICAL AND FUNCTIONAL PLASTICITY CHARACTERISTICS OF CEREBELLUM IN ATHLETES WITH DIFFERENT TRAINING YEARS

ZHANG, K., KAI, J., DONG, Z., CHUNMEI, C.

SOUTHEAST UNIVERSITY; CAPITAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS;TSINGHUA UNIVERSITY

Introduction

It is widely accepted that consistent engagement in motor training leads to plasticity in the cerebellum, a region intricately associated with motor skill learning and motor control. Nonetheless, a lack of evidence currently exists regarding the patterns of cerebellar adaptations over a prolonged period of motor training.

Methods

A total of 142 physically active adults were recruited into this study. Based on the years of exercise training, they were divided into three groups, namely group 1 (n = 25, training for less than 1 year, 15M/10F, 20.0 ± 3.8 years old), group 2 (n = 43, training for 1-5 years, 31M/12F, 21.0 ± 2.6 years old) and group 3 (n = 74, training for over 6 years, 47M/27F, 20.9 ± 2.8 years old).

The brain imaging data were acquired using a Philips 3T scanner equipped with a 32-channel standard head coil. The T1 weighted image (T1WI) sequence was used to capture brain structure signals. In addition, echo planar imaging (EPI) sequence was utilized to obtain the resting state blood oxygen level dependent (BOLD)signal. Voxel-based morphometry analysis was conducted on T1WI images to evaluate the morphological plasticity, specifically the gray matter volume (GMV). Simultaneously, BOLD images were processed to obtain such as fractional amplitude of low-frequency fluctuations (fALFF), degree centrality (DC), and regional homogeneity (ReHo) for the assessment of functional plasticity characteristics.

In order to extract the signal values for GMV, fALFF, DC, and ReHo within the specified brain region, a cerebellum template was employed as a mask and applied to the whole brain signal maps. Subsequently, an analysis of covariance (ANCOVA) was conducted among the three groups, with gender and age serving as covariates in these statistical analyses.

Results

(1) As the years of training increase, the GMV shows an increasing trend. ANOVA indicated a main effect ($p \leq 0.001$) with significant interactions for GMV of both the left ($F(2,139) = 8.148$, $\eta 2 = 0.106$) and right ($F(2,139) = 7.979$, $\eta 2 = 0.104$) cerebellum.

(2) fALFF, DC, and ReHo exhibit a remarkable consistent trend: as the years of training increase, there is an initial rise followed by a subsequent decline. ANOVA indicated a main effect ($p \leq 0.05$) with significant interactions for both bilateral cerebellum in fALFF and DC (F left fALFF (2,139) = 3.798, $\eta 2 = 0.053$, F right fALFF (2,139) = 3.455, $\eta 2 = 0.048$, F left DC (2,139) = 3.998, $\eta 2 = 0.055$, F right DC (2,139) = 4.186, $\eta 2 = 0.058$).

Conclusion

With the increase in training year, cerebellum structural plasticity shows a continuous upward trend, while functional plasticity exhibits an initial positive change followed by a negative change. The current findings offer new insights into the adaptive responses of the central nervous system during different stages of motor skill learning.

INTERLIMB CROSS-EDUCATION EFFECTS OF MOTOR SKILLS IN THE LEFT-HANDERS.

ZHANG, W., WANG, Y., ZHAO, J., NAGATOMI, R.

TOHOKU UNIVERSITY

INTRODUCTION: The phenomenon of training one limb and improving the motor skills of both the trained and untrained contralateral limb is defined as cross-education. It was demonstrated that a cross-education effect of a finger-tapping task was only observed from the right dominant hand to the left non-dominant hand in the right-handers. Whether cross-education effect is also limited to the dominant hand training to non-dominant untrained hand in the left-handers is not determined.

METHODS: Left-hand (n = 24) dominant participants (age = 22.50 ± 6.56 years, male: female = 10:14) were asked to complete a set of finger-tapping training tasks (two digits with five fingers). 12 of them performed left-handed finger tapping training and 12 of them performed right-handed finger tapping training. The task consisted of both left- and right-handed tests before and after the experiment and ten trials of 2-min practice each on the same apparatus. The speed and task errors were measured and analyzed.

RESULTS: All subjects who trained either left hand or right hand improved their performance of the trained hand. The task correctness, and speed were improved for both trained and untrained hands, regardless of the side of training. The completion time of the tasks before training of the non-dominant right hand was 182.42 ±37.08 s and 136.56 ±26.00 s after

training, while that of non-trained left hand improved from 175.93 ±36.18 s to 118.45 ±42.75 s without training. The completion time of dominant left hand improved from 167.22 ±35.73 s to 130.03 ±27.33 s, while that of the non-trained right hand improved from 154.08 ±31.79 s to 118.54 ±21.66 s. A paired t-test revealed the improvements in both dominant to non-dominant, and non-dominant to dominant were statistically significant ($p < 0.05$).

CONCLUSION: Our results indicate that the interlimb transfer effect is also present in left-handed individuals, but from both dominant to non-dominant and non-dominant to dominant sides unlike the right-handed individuals.

Oral Presentations

OP-PN08 Nutrition IV

EFFECTS OF KETOGENIC DIET ON MUSCLE HYPERTROPHIC RESPONSE TO RESISTANCE EXERCISE

CERULLO, G., CHARRIER, D., CANATO, M., MORO, T., PAOLI, A.
UNIVERSITY OF PADUA DEPARTMENT OF BIOMEDICAL SCIENCES

INTRODUCTION: The ketogenic diet (KD) is a nutritional approach, commonly recognized for its efficacy in promoting fat loss, characterized by a high fat content, an adequate protein intake, and restricted carbohydrate consumption (<50 grams per day). However, the metabolic adaptations promoted by KD may potentially contrast with the pathways that regulate the hypertrophic response.

Indeed, the KD mimics several effects of caloric restriction by enhancing the activity of key factors involved in fat oxidation and oxidative phosphorylation. Among these factors, AMP-activated protein kinase (AMPK) stimulates mitochondrial activity while concurrently inhibiting the mechanistic target of rapamycin (mTOR), a critical regulator of protein synthesis.

In this regard, the aim of this study is to investigate the impact of the KD on the muscular response to resistance training in trained male subjects.

METHODS: Eight healthy trained male adults (29.9 ± 8.7 years) have been enrolled and randomly divided into a ketogenic diet (KD) or control diet (CD) group. Both diets were similar for energy (35 kcal/kg bw) and protein content (2 g/kg bw). All participants performed the same resistance training (RT) protocol for 4 weeks. Resting metabolic rate, body composition (Dual-energy X-ray absorptiometry), total body water (TBW via bioelectrical impedance analysis), quadriceps cross-sectional area via ultrasound and muscle strength were assessed at baseline and after 4 weeks of RT. In addition, muscle biopsies from the vastus lateralis were sampled at rest, 6 and 24 hours after a single bout of RT performed before and after 4 weeks of intervention. Histological data and phosphorylation of regulatory signaling proteins (i.e., mTOR, 4EBP1, and S6K) are under evaluation.

RESULTS: Preliminary data confirmed that participants in the KD group enhanced fat oxidation compared to the CD group (-12% vs. -6% mean decrease in respiratory ratio). Fat free mass was not significantly affected by the intervention in both groups. However, pronounced fat loss was reported in KD groups (-2,3 kg vs. +0,6 kg). In the KD group, a fluid loss was observed (-3% vs. 0% mean changes in TBW).

CONCLUSION: According to these preliminary results, KD seems to improve body composition without impacting gains in fat-free mass or muscle force. Further analysis of biopsies samples will show the effect of KD on histological parameters and hypertrophic signaling after RT.

EFFECTS OF EXOGENOUS KETOSIS ON MAXIMAL EXERCISE CAPACITY AND OXYGENATION FOLLOWING THREE-DAY HIGH-ALTITUDE RESIDENCE

TOMINEC, D., STALMANS, M., NARANG, B., MILLET, G.P., POFFÉ, C., DEBEVEC, T.
FACULTY OF SPORT, UNIVERSITY OF LJUBLJANA

INTRODUCTION: Altitude-related decrease in ambient pressure results in reduced oxygen availability for mitochondrial respiration. This leads to augmented physiological strain and decreased exercise capacity (1). To counteract this, ventilation, cardiac output, as well as muscle and lung blood perfusion are increased (2). However, even long-term acclimatisation at high altitudes does not fully counteract the negative effects of hypobaric hypoxia (2). Interestingly, we recently showed that elevating blood ketone bodies via oral ketone ester intake can attenuate the decline in blood and muscle oxygenation, while increasing oxygen uptake during submaximal cycling exercise at a simulated altitude of 2500–3000 m (3). In the present work we aimed to investigate whether ketone ester intake can attenuate the drop in blood and muscle oxygenation and subsequently alleviate the reduction of cycling exercise capacity during terrestrial high-altitude sojourn.

METHODS: Thirty-four participants (28 males, 6 females) underwent two experimental trials, one near sea level (295 m; Ljubljana, Slovenia) and one on the 3rd day of a high-altitude sojourn (3375 m; Torino hut, Aosta Valley, Italy). During the high-altitude sojourn, participants received, in randomized order, either a placebo (PLA group, n = 17) or ketone ester (KE group, n = 17) – with the aim to intermittently elevate blood ketone (e.g., D-ß-hydroxybutyrate ([ßHB])) levels to ~2–4 mM. Minute ventilation, oxygen uptake, systemic oxygen saturation and muscle tissue oxygenation, were continuously measured at rest, across submaximal work rates, and at peak exercise during the ramp-wise incremental cycling test (1 W

increment per 3 s) to volitional exhaustion. Independent t-tests with a Bonferroni correction were employed to evaluate differences between groups with significance set a-priori at $p < 0.05$.

RESULTS: KE ingestion resulted in stable ketosis (blood [ßHB] of ~2–4 mM in KE) at altitude, while blood [ßHB] remained low (~0.3 mM) in the PLA group ($p < 0.05$ for KE vs. PLA). No differences between groups were observed for hypoxia-related changes in oxygen uptake, systemic oxygen saturation and muscle tissue oxygenation or concomitant increase in minute ventilation at all relative power outputs. Also, no differences in altitude-related exercise capacity reduction were noted between groups (KE: Δ50 ± 16W vs. PLA: Δ53 ± 20 W, $p = 0.999$).

CONCLUSION: These data suggest that exogenous ketosis induced by ketone ester ingestion does not attenuate high-altitude related drop in blood and muscle oxygenation nor cycling exercise capacity.

EIGHT-HOUR TIME-RESTRICTED EATING WITH EXERCISE IMPROVES METABOLIC HEALTH IN ADULTS WITH CENTRAL OBESITY

ZHENG, C., CHEN, X.K., SUN, F.H., WONG, S.H.S.

THE EDUCATION UNIVERSITY OF HONG KONG

INTRODUCTION: Obesity is associated with several chronic diseases and has become a serious public health concern globally and also in Hong Kong. Time-restricted eating (TRE) is a popular dietary strategy as it only limits eating time without calorie restriction for weight loss. Both TRE and exercise have been examined as useful strategies to treat obesity-induced health problems, but there have been limited studies investigating the combined effect of TRE and exercise. Therefore, this study examined the effect of eight-hour TRE, with or without exercise, on metabolic health in adults with central obesity.

METHODS: This was a 16-week, four-arm randomized controlled trial. A total of 54 participants were randomly assigned to one of the four groups: control group (n=14), TRE group (n=14), exercise group (n=11), and TRE + exercise group (n=15). For the TRE group, participants could eat ad libitum in a self-selected eight-hour eating window with a 16-hour fasting period (allowed to consume water and no-calorie beverages). The exercise group was required to engage in 40 minutes of moderate exercise (55–70% of maximum heart rate) three times per week. Insulin, C-peptide, leptin, adiponectin, and resistin were measured using commercial ELISA kits. Linear mixed models with Bonferroni post-hoc comparisons were applied to examine the intervention effects.

RESULTS: All 54 male participants with central obesity (age = 35.8 ± 6.2 years) completed the 16-week intervention. The eating window was significantly reduced in the TRE and TRE + exercise groups after 16 weeks. All three intervention groups showed reductions in body weight, body mass index (BMI), and waist circumference after the intervention, while only the TRE + exercise group had lower measurements than the control group after the intervention (body weight = 91.3 ± 13.8 vs. 94.7 ± 15.3 kg, BMI = 30.4 ± 4.0 vs. 30.9 ± 4.1 kg/m2, waist circumference = 97.9 ± 9.2 vs. 103.4 ± 9.5 cm). Compared to the baseline, lower levels of glucose were observed in both the TRE (5.3 ± 0.5 mmol/L) and TRE + exercise groups (5.2 ± 0.3 mmol/L). After 16 weeks, reductions in leptin and resistin levels were found in all three intervention groups. However, only the leptin levels in the TRE + exercise group were lower than those in the control group (8.5 ± 4.6 vs. 10.6 ± 4.5 ng/ml) after 16 weeks. Furthermore, the decrease in insulin levels was only observed in the TRE + exercise group (12.8 ± 5.8 vs. 17.9 ± 9.3 mU/L), while no significant change in adiponectin.

CONCLUSION: Although all three interventions showed benefits in weight loss and improved metabolic health-related markers, the combination of TRE and exercise provided additional benefits. These results show that the combination of TRE and exercise may be useful in treating populations with central obesity and improving their metabolic health.

Oral Presentations

OP-AP06 Statistics and Machine Learning

ASSESSING THE CONTRIBUTIONS OF TECHNICAL ERROR AND BIOLOGICAL VARIABILITY TO ERROR OF MEASUREMENT IN RELIABILITY STUDIES

PUEO, B., HOPKINS, W.G., JIMENEZ-OLMEDO, J.M.

UNIVERSITY OF ALICANTE

INTRODUCTION: A neglected issue in reliability studies is the separation of standard (typical) error of measurement into its two components: technical error arising from the measuring device, and biological variability arising from the subjects. Estimation of these components would allow evaluation of the devices performance independent of subject variability. Such estimation is possible when subjects are measured simultaneously with two different or identical devices, followed by analysis with a mixed model (1). We have now developed an alternative analysis implemented with a spreadsheet, which we have validated by simulation. We have also demonstrated its practical application to real data consisting of jump-height measurements.

METHODS: The basis of the spreadsheet is the analysis of the four pairs of change scores between the tests and devices. The standard deviations (SDs) representing technical errors and biological variability were derived with formulae in raw units, percent units (via log-transformation) and standardized units, and their confidence limits were derived with 1800

bootstrap samples (the maximum possible in the latest version of Excel). The spreadsheet analyses were reproduced in a SAS Studio program and compared with a mixed model. The program generated and analyzed 2000 datasets for chosen true (population) values of means and SDs simulating real data. These simulations allowed empirical derivation of factors to correct small-sample biases in the estimates of the SDs and in the coverage of their confidence intervals. For the practical application of the spreadsheet, 31 participants each performed two maximal countermovement jumps, with jump height measured simultaneously using a photoelectric system (Device A) and a jump mat (Device B).

RESULTS: The spreadsheet produced precise estimates and accurate confidence-interval coverage, outperforming the mixed model for sample sizes as low as 10. Analysis of the jump-height data revealed typical errors of 5.6% (90% confidence interval 4.5 to 6.8%) and 7.1% (5.7 to 8.6%) for Devices A and B respectively, which consisted of biological variability of 5.4% (4.1 to 6.8%) combined with technical errors of 1.4% (-2.1 to 2.9%) and 4.5% (3.5 to 5.4%) for Devices A and B respectively. Using standardization with an external SD of 10% to assess magnitudes, the technical error for Device A made negligible contribution to its typical error, while the differences in technical and typical errors between Devices B and A were moderate and likely substantial. There was negligible mean bias in Device B relative to A (-0.6%, -1.6 to 0.6%).

CONCLUSION: The spreadsheet provides accessible trustworthy analysis of reliability data taken simultaneously with two devices. The practical example highlights its relevance in contexts demanding precise measurement.

REFERENCE

1. Pueo et al., Int J Sports Physiol Perform, 2016

Funding: Generalitat Valenciana (grant number CIGE/2022/15).

BIAS ARISING FROM PUBLICATION OF ONLY STATISTICALLY SIGNIFICANT EFFECTS ON ATHLETE ENDURANCE PERFORMANCE: QUANTIFICATION IN META-ANALYSES OF SIMULATED STUDIES

WIESINGER, H.P., HOPKINS, W.G.

PARACELSUS MEDICAL UNIVERSITY, SALZBURG

INTRODUCTION: The magnitude of an effect differs from sample to sample, owing to sampling variation. Larger effects are more likely to be statistically significant and published as important findings. Hence meta-analyzed magnitudes of published effects may suffer from substantial upward publication bias. Here we meta-analyzed simulated studies similar to those in recent meta-analyses of athlete performance to investigate such bias.

METHODS: We simulated effects on endurance time-trial performance in an intervention group by assuming true mean effects of 1.0% (trivial-small) on males and 3.0% (small-moderate) on females, heterogeneity SD (true between-study differences in the mean effect) of 0.0%, 0.5% (trivial-small) and 1.5% (small-moderate), standard errors of measurement of ~3.0% (range 1.5-6.0%), and sample sizes of ~13 (range 10-30). Meta-analyses were performed by excluding 0%, 100%, and 50% of non-significant effects. At least 10 studies were included in each meta-analysis. At least 2000 meta-analyses were performed for each combination of study characteristics, and meta-analyzed effects were averaged to determine bias (difference from true effects). We used a meta-regression mixed model that included a fixed effect for sex, its interaction with the square of the standard error (SE, to adjust for bias), and a random effect for heterogeneity. Mean effects not adjusted and adjusted for bias were those predicted for SE squared equal to its mean and zero, respectively.

RESULTS: The meta-analyses estimated mean effects and heterogeneity without bias when all non-significant effects were included. Complete exclusion of non-significant effects produced the greatest bias in mean effects when heterogeneity was moderate (males, +2.3%; females, +1.2%); adjustment for bias partially corrected the bias for males (to +1.2%) and almost fully corrected the bias for females (to +0.2%). Bias in mean effects was least when heterogeneity was zero (males, +1.5%; females +0.6%), and was almost fully corrected after adjustment (to +0.3% and -0.2%). Heterogeneity itself was underestimated by -0.8% for true moderate heterogeneity and by -0.2% for zero true heterogeneity. When 50% of non-significant effects were excluded, bias was reduced, but the correction for bias was largely ineffective, while heterogeneity was estimated without bias.

CONCLUSION: Publication bias is likely to be small in small meta-analyzed mean effects on athlete endurance performance, and bias will be negligible for large effects. Meta-analysts can improve adjustment for publication bias by using meta-regression to reduce heterogeneity. The problem of publication bias would be obviated if authors submitted, and journal editors accepted, manuscripts irrespective of statistical significance of effects. Meantime, the simulation program, and versions for standardized effects and risk ratios, can be adapted to estimate the bias in mean effects and heterogeneity with any meta-analyses in sport and exercise.

PLAYER UNDER PRESSURE PERFORMANCE ANALYSIS BASED ON TIME-SEQUENTIAL DATA AND GRAPH NEURAL NETWORK

PEI, Y., CHAOYI, G., JIAMING, N., VARUNA, S.

LOUGHBOROUGH UNIVERSITY - LONDON

INTRODUCTION: Sports performance analysis has been developed for decades, and essential metrics like passing rates and tackles have been used to evaluate players, while the context of these metrics is ignored. The key difference between an average player and a star player is how they handle pressure, make correct decisions and keep the same elite performance. Therefore, this study aims to quantify the pressure context for football players and analyse their performance under different pressure levels.

METHODS: Tracking and event datasets with broadcasting videos of 10 different Premier League matches have been used in this research. Tracking data records the x and y location of each player and the ball on the pitch at 25 Hz per second and the event dataset contains the on-ball events including passes, shots and tackles during the match. A Graph Neural Network (GNN) based sequential model is applied to predict whether the possession team is going to lose control of the ball under the opponent's pressure. A higher likelihood of losing control of the ball equals a higher level of pressure, and players' performance under different levels of pressure is then evaluated. Deep learning, GNN-based sequential model, 3D Human Body Estimation and Player Pressure Map (PPM) features were used to leverage the dataset and predict the outcome of football footage.

RESULTS: The purpose of this model is to predict whether the possession team will lose the ball control or not within seconds. The result is compared between various models and features. For the basic GNN model with only a tracking dataset, the prediction accuracy is 55.8%. By adding the 2D PPM features we generated, the accuracy increased to 75.2% and when the PPM features turned into 3D, the accuracy raised to 78.7%. By upgrading the model to a sequential GNN, the prediction accuracy with 3D PPM features reaches 81.2% which is the highest among all the experiments—both PPM features and time-sequential model help to improve the model accuracy massively.

CONCLUSION: The contribution of this pilot work was to quantify the pressure level based on the football context and time-sequential dataset with 3D human body pose. The work is aimed to represent the 3D football context and predict the pressure level of football matches. The pressure metric and context performance analysis are based on the prediction. In summary, PPM features and time-sequential dataset help to improve the model accuracy and lead the metric step forward.

ELEVATING PERFORMANCE: PREDICTING ALTITUDE TRAINING EFFECTS AND IDENTIFYING KEY VARIABLES FOR OPTIMAL ENDURANCE TRAINING

KRANZINGER, C., KRANZINGER, S.1, GLOMSER, G.2

1 SALZBURG RESEARCH FORSCHUNGSGESELLSCHAFT MBH; 2 GAIRRIT

INTRODUCTION: Predicting the individual effects of altitude training is of great interest in endurance sports. Estimating its potential effects results in more efficient training programme design. This study aims to investigate the possibility of predicting altitude training effects in terms of maximum increase in performance adaptation and identify key variables influencing the effectiveness of altitude training through a single performance test comprising two measurements at different altitudes using machine learning models.

METHODS: Data of 50 athletes were analyzed who underwent the same test protocol on a cycle ergometer under two simulated altitude conditions at 400 and three hours later at 1,800 m above sea level, respectively. The altitude was simulated in a mobile altitude chamber. Physical activity was measured with a spiroergometry system from CORTEX (CORTEX Biophysik GmbH, Germany). 21 parameters (covering aspects of eg.: heart rate, respiratory rate, oxygen saturation, fat metabolism) were used for the classification approach. The most important variables were determined by applying a recursive feature elimination algorithm, using a Random Forest and taking into account the out-of-bag error (Diaz-Uriarte & de Andrés, 2005). Three classes were predicted: low, medium, and high effect of altitude training. Various statistical estimation models were tested for the classification: Random Forest, AdaBoost.M1, Support Vector Machine and Naive Bayes. The validation was carried out with a leave-two-subjects-out cross-validation.

RESULTS: The best results were achieved with a Naive Bayes approach. The average classification accuracy across all 1,225 test data sets is 58.8% (sd: 0.34). In addition, an average Cohens kappa of 0.26 (sd: 0.49) is achieved. Examining the most important variables for classification, we find that the altitudes impact is most accurately predicted by the ratio of oxygen saturation during recovery to oxygen saturation during stress at 400 m and the ratio of respiratory rates during recovery to respiratory rates during stress at 1,800 m.

CONCLUSION: Following the framework of Landis and Koch (1977), the results of Cohens kappa show a "fair" classification performance. According to accuracy, the expected increase in performance through altitude training can be predicted for around six out of 10 athletes. The number of test subjects with the label "high" performance improvement through altitude training should be increased, as only four of the 50 athletes have this label, which makes it difficult to classify individuals with a high expected performance improvement through altitude training.

[1] Diaz-Uriarte, R. and Alvarez de Andres, S. arxiv.org, 2005

[2] Landis, J.R. and Koch, G.G. Biometrics, 1977

EXPLAINABLE ARTIFICIAL INTELLIGENCE MODEL FOR IDENTIFYING MARKET VALUE IN PROFESSIONAL SOCCER PLAYERS

ZHANG, S., LI, M.

TSINGHUA UNIVERSITY

INTRODUCTION: The realm of association football transcends the boundaries of sport, evolving into a significant business sector with player transfers being pivotal economic events. Consequently, determining the market value of football players is a critical managerial function. This research introduces an advanced machine learning technique to predict soccer players market values, integrating ensemble models with Shapley Additive Explanations (SHAP) to enhance interpretability.

METHODS: Leveraging data from Sofifa.com and transfermarkt.us recognized for its widespread use among FIFA football manager game fans, the study builds on prior research to perform a comprehensive analysis. The Boruta algorithm,

known for its efficacy in feature selection and implemented via the BorutaShap Python package, was employed to refine the set of player characteristics used in model training. An array of machine learning algorithms was scrutinized to develop an optimal model for appraising player market values including Adaboost, LightGBM, Random Forest, Gradient Boosting Decision Tree (GBDT), CatBoost, and XGBoost.

RESULTS: The initial dataset comprising 29 features was condensed to 22 salient features using the Boruta algorithm. In the quest to find the most accurate predictive model, the GBDT model exhibited exceptional performance. It achieved the highest R-Squared value of 0.889, indicating a strong correlation between the predicted values and actual market values. The subsequent models, CatBoost and LightGBM, displayed slightly lower but comparable R-Squared values. The GBDT models dominance extended to its predictive precision, reflected by the lowest Root Mean Squared Error (RMSE) across the algorithms, suggesting its forecasts were closest to the true player values. The robustness of the GBDT model was further confirmed on a separate test set, where it maintained the highest R-squared value of 0.901 and the lowest RMSE, underscoring its reliability in predicting player market values.

CONCLUSION: The Gradient Boosting Decision Tree (GBDT) model stood out as a superior predictive tool for estimating soccer players market values. The integration of SHAP for model interpretation identified nine crucial player attributes such as short passing, finishing, interceptions, dribbling, standing tackle, sprint speed, acceleration, and reactions that significantly influence market value predictions. These findings are invaluable for football team managers and stakeholders, providing a data-driven basis for transfer negotiations and strategic planning. The application of such advanced predictive analytics can revolutionize the economic aspect of player transfers, offering a more objective and nuanced understanding of player worth in the competitive football market.

Oral Presentations

OP-BM08 Jumping

SQUAT JUMP AND COUNTER-MOVEMENT JUMP CLUSTER ANALYSIS BASED ON SUBORDINATE GROUND REACTION FORCE VARIABLES

ŠARABON, N., KOZINC, Ž., SMAJLA, D.
UNIVERSITY OF PRIMORSKA

INTRODUCTION: Vertical jumps are among most represented sport performance tests. Ground reaction force derived metrics (e.g., force, power, and force impulse) are commonly analysed. Prior research has investigated how characteristics of force-time profiles (e.g., timing of peak force [1], number of force peaks [2]) influence performance. Although a connection between the characteristics of the force-time curve and jump effectiveness is indicated, the challenge of identifying the optimal force-time profile necessitates further investigation. The aim of this paper is to address this knowledge gap by applying clustering approach based on ground reaction force variables of squat jump (SJ) and counter-movement jump (CMJ) force-time signals.

METHODS: High-level athletes (basketball, soccer, tennis, long-distance running, dance, and martial arts; n=310)) participated. Three repetitions of SJ and CMJ were performed on Kistler force plate. K-means clustering method, that aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, was applied to SJ and CMJ parameters. K-means clustering method was used to create 10 clusters, of which the 3 clusters with the highest representation were taken for further processing. Relative distances between cluster centres were calculated for each squat and countermovement jump parameter.

RESULTS: 809 SJs were taken into analysis. Three clusters with highest representation of jumps were: cluster 1 with 375 jumps, cluster 2 with 241 jumps and cluster 3 with 177 jumps. The four SJ parameters with the highest relative distance between cluster centres among the three clusters were: force impulse between maximal force and take off, start interval relative power, force impulse in the 2nd half of push off and start interval velocity.

841 CMJs were taken into analysis. Three clusters with highest representation of jumps were: cluster 1 with 290 jumps, cluster 2 with 277 jumps and cluster 3 with 249 jumps. The four CMJ parameters with the highest relative distance between cluster centres among the three clusters were: force impulse in the 2nd half of push off, push off force impulse, force impulse in the 1st half of push off, positive force impulse.

CONCLUSION: Results of this study demonstrate the grouping of vertical jump actions into force-time curve types that are distinct from one as reflected in more or less standard outcome metrics. This study is an entry step into quality of the SJ and CMJ ground reaction force curves with the ambition to upgrade applied value of this common athletic performance tests.

1. McHugh MP, Hickok M, Cohen JA, Virgile A, Connolly DAJ. Is there a biomechanically efficient vertical ground reaction force profile for countermovement jumps? Transl Sport Med. 2021;4(1):138–46.

2. Peng H Te, Song CY, Chen ZR, Wang IL, Gu CY, Wang LI. Differences between Bimodal and Unimodal Force-time Curves during Countermovement Jump. Int J Sports Med. 2019;40(10):663–9.

SHOULD ECCENTRIC UTILIZATION RATIO BE USED IN ASSESSMENT OF ATHLETES? A REPORT FROM A SERIES OF EXPLORATORY STUDIES

KOZINC, Ž., ŠARABON, N.

UNIVERSITY OF PRIMORSKA, FACULTY OF HEALTH SCIENCES, IZOLA

INTRODUCTION: The eccentric utilization ratio (EUR), defined as the difference between countermovement jump (CMJ) and squat jump (SJ) performance, has been traditionally linked to elastic energy use and stretch-shortening cycle efficiency [1]. However, recent theories suggest higher EUR may also reflect different factors, such as poor concentric rate of force development (RFD) [2], questioning its role as an indicator of athletic performance. The aim of this series of exploratory studies is to contribute to the understating of the mechanisms underlying the variation in the magnitude of the EUR.

METHODS: The paper presents a series of exploratory analyses based on data available from previous confirmatory studies and data from authors' database. In all cases, vertical jumps (CMJ and SJ) were performed on a Kistler force plate (model 9260AA6). Three repetitions of each jump with 1-min rests were performed with hands placed on the hips, and the repetition with best jump height was take for further analysis. Jump heights was calculated using take-off velocity method.

RESULTS: In the largest exploratory study, we compared EUR across 9 different sports (total n = 712), showing little difference between sports characterized by jumping (e.g., volleyball, basketball) and others. In the second analysis (n = 314; runners, basketball and soccer players) inverse correlations emerged between EUR and RFD in SJ ($r = –0.41$; $p < .001$), when the former was calculated based on force parameters. A third analysis (n = 45, volleyball) revealed that CMJ metrics exhibit larger correlation to performance proxies (sprint, agility and approach jump tests) than EUR.

CONCLUSION: The results of the presented exploratory analyses align with the current theory on mechanisms driving variations in EUR [2]. Greater height in CMJ is largely underpinned by the build-up of force and muscle activation during the countermovement. Our analysis suggests that the remaining variation in EUR among individuals may be explained by different factors, and that EUR is not necessarily linked to superior athletic performance. Notably, poor concentric RFD and lower muscle stiffness were suggested to be related to lower SJ performance, and consequently, higher EUR. However, it has to be stressed that further studies are needed to reach firmer conclusions, as our analysis were purely exploratory.

1. McGuigan MR, Doyle TLA, Newton M, Edwards DJ, Nimphius S, Newton RU. Eccentric utilization ratio: Effect of sport and phase of training. J Strength Cond Res. 2006;20(4):992–5.

2. Van Hooren B, Zolotarjova J. The Difference between Countermovement and Squat Jump Performances: A Review of Underlying Mechanisms with Practical Applications. J Strength Cond Res. 2017;31(7):2011–20.

EFFECTS OF AN 8-WEEK JUMP TRAINING ON NEUROMUSCULAR AND CARDIORESPIRATORY FITNESS IN YOUNG HEALTHY NON-EXERCISING ADULTS

BARZYK, P., BIELEKE, M., ASSLÄNDER, L., SCHWENK, M., MORENO, M.M., SCHÜLER, J., GRUBER, M.

UNIVERSITY OF KONSTANZ: UNIVERSITAT KONSTANZ

INTRODUCTION: Physical inactivity has harmful effects on health and is therefore a major public concern. Recently, we were able to show that high-intensity jump training was able to counteract the detrimental effects of 60 days bedrest on muscle and strength losses as well as on declines in aerobic capacity (Kramer et al. 2017). Within the ProPELL (Promoting Physical Exercise in Lab & Life) research project, we now investigated the effects of eight weeks of high-intensity jump training in non-exercising healthy young adults (Bieleke et al., 2022). We hypothesized to find increases in neuromuscular and aerobic capacity in the training group compared to a non-exercising control group.

METHODS: Sixty-four young adults (34 female; mean age: 24.5 years, SD 3.5) were randomly assigned to either an eight-week high-intensity jump training or a control group. The training consisted of three weekly sessions of 15-minute high-intensity jump exercises aimed at improving neuromuscular and cardiovascular function. Pre and Post measurements included jump height and peak power during countermovement jumps, maximum isometric strength (leg extension in an isokinetic device), as well as maximum oxygen uptake (VO2peak) using a cycling spiroergometry protocol. We calculated ANOVAs (group * time) to analyze the data.

RESULTS: Training improved jump height from 36±16 cm to 38±17 cm compared to control (37±16 cm to 37±15 cm; $p<.001$, $d = 0.29$). VO2peak increased in both groups without an interaction effect (training group: 33.3±17.4 to 35.4±16.6 ml/min*kg, control: 30.7±15.6 to 31.8 ± 17.6 ml/min*kg; $p<.001$, $d = 0.9$). No differences were found for the peak power of countermovement jumps and isometric maximal voluntary contraction during leg extension.

CONCLUSION: A 15-minute jump training program three times a week increased jump-specific performance in a group of young healthy non-exercising adults. However, we did not find improvements in neuromuscular and cardiorespiratory fitness in this group. Since we have already shown such effects for jump training as a countermeasure to the detrimental effects of physical inactivity on neuromuscular and cardiorespiratory fitness (Kramer et al., 2017), we conclude that the "load" (intensity and volume) of jump training was not high enough in the present study to increase neuromuscular and cardiorespiratory fitness in healthy young adults.

References:

Bieleke, M., Fischer, U., Gruber, M., Kanning, M., Keim, D., Mier, D. Pruessner, J., Schüler, J. (2022). Promoting Physical Exercise in Lab and Life. Identifier DRKS00029727. https://drks.de/search/en/trial/DRKS00029727

Kramer, A., Gollhofer, A., Armbrecht, G., Felsenberg, D., & Gruber, M. (2017). How to prevent the detrimental effects of two months of bed-rest on muscle, bone and cardiovascular system: an RCT. Scientific reports, 7(1), 13177.

ANGLE-SPECIFIC ANKLE JOINT TORQUE CONTRIBUTING TO THE DIFFERENCE IN COUNTER MOVEMENT JUMP PERFORMANCE

MACHIZUKA, S., JO, I., YOON, J., LEE, H.
YONSEI UNIVERSITY

INTRODUCTION: Counter movement jump (CMJ) is widely used to evaluate lower limb muscle performance. During the CMJ, the ankle plantar flexors are responsible for generating and maintaining concentric force until push-off (1). Considering the force-length relationship, the ankle joint becomes less capable of exerting force as it approaches maximum dorsiflexion. (over 25 degrees) (2). Therefore, the aim of this study is to identify the angle-specific ankle joint torque contributing to the difference in CMJ height between good jumpers (GJ) and bad jumpers (BJ).

METHODS: Fourteen male participants were divided into two groups based on their CMJ height: the GJ group with heights of 50cm or more, and the BJ group with heights of less than 50cm. The participants took part in an experiment consisting of sessions for measuring maximal CMJ height and maximum voluntary contractions (MVC) of isometric ankle torque, which were conducted using a dynamometer at five different angles (-15, 0, 10, 20, 25 degrees). Lower extremity joint kinematic and kinetic data were obtained using the musculoskeletal program (OpenSim4.1). Statistical analysis was conducted using independent t-tests.

RESULTS: Jump height (GJ: 54.0±3.2cm, BJ:45.7±3.6cm), peak GRF (GJ:2.5±0.1, BJ:2.2±0.2), and peak GRF after onset of ankle plantar flexion (GJ:2.6±0.3, BJ:2.2±0.2) were significantly higher in GJ compared to BJ. However, there were no significant differences observed in positive work, negative work, mechanical power, and all joint kinematic and kinetic data. On the other hand, in ankle joint MVC, joint peak torque at -15 degrees (GJ: 1.2±0.1, BJ: 1.0±0.2), 20 degrees (GJ: 2.2±0.4, BJ: 1.8±0.2), and 25 degrees (GJ: 2.0±0.3, BJ: 1.6±0.2) showed significantly higher values in GJ.

CONCLUSION: The difference in ankle joint torque at 20 and 25 degrees between GJ and BJ suggests the importance of exerting and maintaining force during dorsiflexion from the peak of GRF until the peak of GRF following the onset of ankle joint plantar flexion. Therefore, the ankle joints ability to maintain the negative work acquired up to the beginning of the propulsive phase while exerting additional force during push-off at the ankle joint may be a determining factor in jump performance. Especially within this interval, which can be predicted to be situated near the descending limb of the force-length relationship, our results suggest the necessity of ankle joint-specific training closer to the actual angle where the concentric phase begins to enable force exertion near optimal length.

IMPROVEMENT PATTERN OF NEUROMUSCULAR PERFORMANCE IN RELATION TO GROWTH IN ATHLETES AND NON-ATHLETES

PETRIDIS, L., PÁLINKÁS, G., TRÓZNAI, ZS., UTCZÁS K.
HUNGARIAN UNIVERSITY OF SPORT SCIENCE

INTRODUCTION: Substantial increase in neuromuscular performance has been reported around the age at peak height velocity (APHV). This improvement seems to follow a natural pattern, which is similar in both athletic and non-athletic populations. Little is known, however, whether regular and high-level training can further improve neuromuscular performance, beyond the improvement attributed to natural development. The purpose of this study was to compare the developmental pattern of neuromuscular performance in relation to growth between athletes and non-athletes.

METHODS: Data from 684 athletes (mean±sd age: 14.0±1.4 years) and 120 non-athletes (mean±sd age: 13.4±1.5 years) were analyzed. All athletes were engaged in high-level sport-specific training and competition (>8 hours/week) in soccer, handball, or basketball. Non-athletes were not engaged in any regular sport activity outside of their school curriculum. Maximal countermovement jumps were performed on a force platform (HUR labs). Jump height, force, power, and the modified reactive strength index were included in statistical analysis. APHV was used to estimate maturity status. Based on the years from peak height velocity (PHV), we divided the participants into groups of one year interval from -2 years to +2 years around PHV. Descriptive statistics and two-way ANOVA was used for inter-group comparisons.

RESULTS: On average athletes achieved significantly higher jump height compared to non-athletes (mean±sd CMJ: 33.2±5.5 cm vs. 28.3±6.1 cm respectively, $p<0,05$; d=0.88). Improvement rate from the youngest to the oldest PHV group was 38.1% for the athletes and 36.5% for non-athletes. Differences between athletes and non-athletes were of small to moderate effect size (d=0.48-0.62) before APHV and of moderate to large (d=0.62-0.90) effect size after APHV. There was no difference in the in-PHV group (mean±sd CMJ: 32.0±4.9 cm vs. 31.5±6.7 cm respectively, $p>0.05$; d=0.1). Similar results were found for the relative maximal power.

CONCLUSION: A period of accelerated improvement in neuromuscular performance was found ±1 year around the APHV with similar improvement rate in both groups. However, in the most intense improvement period (in-PHV group) the lack of differences suggest that sport-specific training (in the examined sports) does not provide further improvement beyond that attributed to growth. Training stimuli seems to account for additional improvements in neuromuscular performance mainly in the period after the APHV, with athletes achieving increasingly larger performance one and two years after their APHV (around 14 -16 years of chronological age) compared to non-athletes.

Oral Presentations

OP-PN33 Physiology/Mixed Session III

DETERMINANTS OF TIME TO EXHAUSTION DURING HIGH-INTENSITY INTERVAL TRAINING

BOSSI, A.H., HOPKER, J.
EDINBURGH NAPIER UNIVERSITY

INTRODUCTION: The relationship between cycling power output and time to exhaustion (TTE) displays a curvilinear form that can be linearised by employing the logarithm of TTE. This relationship persists even for exhaustive intermittent exercise, wherein high- and low-intensity intervals of fixed power and duration are alternated. While training status, body dimensions, and sex influence the power outputs someone can generate, seemingly comparable cyclists can still manifest considerable inter-individual variability in TTEs. This study explored which factors might contribute to longer TTEs during high-intensity interval training (HIIT).

METHODS: The dataset of Bossi et al. (2023) was reutilised. Sixteen male and two female competitive cyclists (age: 38 ± 11 years, maximal oxygen uptake (VO2max): 54 ± 9 ml·kg-1·min-1) performed an incremental test, two 3-min all-out tests, and two 20-min time trials to establish physiological and performance benchmarks after a familiarisation (visits 1 and 2). Then, in randomised order, participants performed four HIIT sessions to exhaustion at power outputs associated with different intensity prescription methods (visits 3 to 6). HIIT sessions consisted of 4-min work intervals interspersed with 2-min active recoveries. The natural logarithm of TTE in seconds was modelled using linear mixed models, with participant as a random effect, and HIIT power output, age, height, body mass, the maximal scores in the incremental test (VO2max, power output, heart rate, respiratory exchange ratio, respiratory rate, rating of perceived exertion, blood lactate concentration), the power outputs associated with the gas exchange threshold and respiratory compensation point, critical power, work capacity above critical power, time trial mean power output, and estimated vastus lateralis adipose tissue thickness as fixed effects. The best model was selected based on Akaike information criteria. Significance was set at $P \leq 0.05$.

RESULTS: The best model revealed that HIIT power output, VO2max, and maximal respiratory exchange ratio (RERmax) are all determinants of TTE, with the first two emerging as primary factors. Specifically, with an intercept of 11.309 (SE = 3.292), a unit increase in power output reduces the log transformed TTE by 0.032 (SE = 0.003). Conversely, a unit increase in VO2max extends the log transformed TTE by 2.267 (SE = 0.277). A decimal unit increase in RERmax reduces the log transformed TTE by 0.277 (SE = 2.621). The model indicated considerable inter-individual differences, with a SD of 0.460 for the intercept. The SD for the residual variability was estimated as 0.318.

CONCLUSION: Besides the expected effect of the power output target for HIIT, it seems that individuals with higher VO2max, attained with lower RERmax, are more likely to produce longer TTEs. A complex interplay of attributes, possibly involving unexplored factors, complicates the individualisation of HIIT prescription.

REFERENCE:

Bossi et al. (2023) Eur J Appl Physiol 123, 1655–1670

ACUTE EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS) ON EXERCISE TOLERANCE AND THE PHYSIOLOGICAL RESPONSES TO HEAVY- AND SEVERE-INTENSITY EXERCISE

DELL ANNA, S., BERNARDES, A.G., IVANISKI-MELLO, A., LIBERALI, G., MARTINIS, L., CORREALE, L., PEYRÉ-TARTARUGA, L.A., MACHADO, F.A., COSENTINO, G., DE GIORGIO, A., BALDARI, C., BUZZACHERA, C.F.
ECAMPUS UNIVERSITY, ITALY; FEDERAL UNIVERSITY OF RIO GRANDE DO SUL, BRAZIL, UNIVERSITY OF PAVIA, ITALY; STATE UNIVERSITY OF MARINGÁ, BRAZIL, IRCCS MONDINO FOUNDATION, PAVIA.

INTRODUCTION: Transcranial direct current stimulation (tDCS) has emerged as a minimally invasive form of cortical stimulation, with exciting potential for exercise performance. While some studies have confirmed the apparent ergogenicity of tDCS during continuous, large muscle-mass exercise, not all findings are consistent. The variable results between tDCS studies may be attributed, at least in part, to differences in exercise intensity. We, therefore, investigated the effects of acute tDCS on exercise tolerance and the physiological responses to heavy- and severe-intensity exercise

METHODS: Twelve healthy, recreationally active men (mean age ± SD = 25 ± 2 yr, VO2peak 50 ± 8 ml/kg/min) volunteered to participate in this study. All participants were required to report to the laboratory on five separate occasions. On Day 1, they performed a ramp incremental exercise test on an electronically braked cycle ergometer to determine gas exchange threshold (GET), VO2peak, and peak power output (PPO). On Days 2-5, participants received, in a random and crossover order, 20 minutes of brain stimulation of either sham tDCS or anodal tDCS (current intensity: 2 mA) before either heavy- or severe-intensity cycling exercise. Pulmonary exchange and ventilation data, NIRS-derived muscle oxygenation and hemodynamics responses, and surface EMG signals were recorded throughout the exercise bouts. Ratings of perceived exertion (RPE) were also assessed every 2 min in each exercise bout

RESULTS: No significant effects of brain stimulation on exercise tolerance were observed (261 ± 56 sec and 258 ± 59 sec for sham tDCS and anodal tDCS, respectively; $P > 0.05$). Anodal tDCS did not induce significant changes in pulmonary gas exchange and ventilation parameters, NIRS-derived muscle oxygenation and hemodynamics responses, or muscle fibre

conduction velocity during heavy- and severe-intensity exercise compared to sham tDCS (P > 0.05). Similarly, RPE did not significantly differ between the brain stimulation conditions at any time in both exercise intensities (P > 0.05)

CONCLUSION: Our findings indicate that acute brain stimulation with anodal tDCS applied over the primary motor cortex (M1) does not appreciably alter physiological responses to heavy- and severe-intensity exercise or improve exercise tolerance in healthy, recreationally active men. These results support the notion that this simple, minimally invasive neuromodulatory technique may not be effective during continuous, high-intensity, large muscle-mass exercise

NEGATIVE IMPACT OF 14 DAYS OF STEPS REDUCTION ON MUSCLE OXIDATIVE CAPACITY IN YOUNG PARTICIPANTS

MARCIANO, A., NERI, M., CRECCHI, M., SAZZI, C., BROCCA, L., PELLEGRINO, M.A., BOTTINELLI, R., PORCELLI, S.
1 DEPARTMENT OF MOLECULAR MEDICINE, UNIVERSITY OF PAVIA, PAVIA, ITALY

INTRODUCTION: Inactivity negatively affects cardiorespiratory and muscle functions, decreasing exercise tolerance and dramatically increasing disease risks [1]. Previous data showed a time-dependent impairment of muscle oxidative capacity after severe inactivity (bed rest, BR) [2-4]. No changes in mitochondrial function were observed after 7 days of step reduction (SR) [5], a milder inactivity model. Therefore, we investigated the negative impact of 14 days of SR on muscle oxidative capacity estimated by near infrared spectroscopy in young participants. We hypothesized a longer period of SR could negatively affect muscle oxidative function.

METHODS: Thirty (23±3 yr; 68±10 kg; 170±7 cm) participants followed a 14 days SR protocol. Before (T1) and after (T2) inactivity, whole-body oxygen uptake (VO2max) was measured during incremental cycling exercise. Vastus lateralis muscle oxygen uptake recovery rate constant (k) was calculated from tissue oxygen saturation index (TSI) changes during repeated transient occlusions performed immediately after leg-extension exercise. Time of ischemia-reperfusion for the occlusions was manipulated to maintain TSI in non-limiting O2 availability condition. Muscle biopsies were also collected and high resolution respirometry (HRR) was performed.

RESULTS: SR resulted in an 82% reduction of participants' average daily steps. VO2max was significantly reduced after SR (-4.4% from T1; p 0.022). k was significantly lower in T2 (2.1±0.6 min-1) compared to T1 (2.3±0.6; p=0.031). HRR was not different after inactivity (p>0.05).

CONCLUSION: Our data confirm that, after a mild reduction in daily activity for two weeks, whole body maximal oxygen uptake loss is related to limitations in oxygen flow at skeletal muscle level measured in-vivo. The absence of changes in maximally [ADP] stimulated mitochondrial respiration and other respirometric parameters after SR, which confirm previous data after 10 days bed rest interventions [4], raises interests towards other assessments of mitochondrial function, such as sensitivity of mitochondrial respiration to sub-maximal [ADP], and impairments upstream of mitochondria.

[1] Booth et al. Physiol Rev (2017); [2] Dirks et al. J Physiol (2019); [3] Salvadego et al. J Physiol (2018); [4] Zuccarelli et al. J Physiol (2021); [5] Edward et al. J Appl Physiol (2021)

Oral Presentations

OP-MH11 Injury Prevention in female athletes

INJURIES IN WOMEN AND MEN HANDBALL PLAYERS, WHAT DO COACHES NEED TO KNOW? A COMPREHENSIVE ANALYSIS OVER 3 SEASONS AND 154 GAMES

ANDREOTTOLA, G., ONGARO, A., FERREIRA, J., CROGNALE, D.
UNIVERSITY COLLEGE DUBLIN, OLYMPIC HANDBALL IRELAND

INTRODUCTION: Handball is a fast-paced Olympic ball game characterized by both defensive and offensive actions aimed at scoring goals. Performance in handball is influenced by a multitude of factors and it involves a range of actions including throws, passes, jumps, hits, blocks and runs. Athletes may experience muscle injuries such as strains and tears due to the rapid movements and accelerations during the game. Furthermore, collisions with opponents and physical contact can lead to traumas such as bruises, contusions and joint sprains. Handball players are also at risk of upper limb injuries, particularly to the hands and wrists, due to the fastball throws and passes. The aim of this study was to monitor number and details of injuries occurring during official Handball matches to enhance current knowledge, awareness and understanding for coaches and practitioners.

METHODS: A total of 154 matches of women's and men's handball (across 3 seasons - 21/22, 22/23, 23/24) from the national league, national cup and Celtic league of Ireland were analyzed by two independent and experienced sport scientists. A comprehensive report of all injuries, regardless of severity was compiled for the three seasons according to injured body part/region or joint.

RESULTS: The data collection resulted in a total of 58 recorded injuries. Despite logistical constraints, key findings reveal a 40% probability of injury during matches, with knee (22.5%), ankle (19%), face (14%), neck (5%), and the face-neck-head complex (20%) injuries being predominant. 60% of injuries occurred in female players (21/22 14W, 8M; 22/23 19W, 10M; 23/24 5W, 2M)

CONCLUSION: A gender disparity was evident, indicating a potential need for gender-specific physical preparation and awareness by players, coaches, and practitioners. This analysis also highlighted a need for higher accuracy and consistency when reporting handball injuries and ideally including a comparison with other European leagues and competitions.

UNDERSTANDING MUSCLE INJURIES IN ELITE FEMALE FOOTBALL: ARE THEY THE BIGGEST THREAT TO KEEPING PLAYERS PLAYING?

BENNETT, F., MATERNE, O., RAMSDEN, J., GRIFFIN, P., BROWNLEE, T., DRUST, B.

RANGERS FOOTBALL CLUB

INTRODUCTION: Female professional footballers present a high incidence of thigh muscle injuries with a meaningful burden (1). Injuries in elite women's football are scarcely investigated and no study has been conducted in the highest competitive level in Scotland (1,2). The aim of this study was to examine the extent and pattern of non-contact muscle injuries (Nc-Mi), and their respective incidence and burden in a professional female football team playing in Scottish Women's Premier League (SWPL 1).

METHODS: During the 2022-23 season, all injuries that required medical attention (0 day) or led to time-loss were recorded prospectively (as per IOC consensus definitions) by the medical team of the club in 30 unique professional female footballers (mean age: 23 ± 5 years). Nc-MI incidence was calculated as the number of injuries per 1000 playing hours and injury burden as the number of days lost per 1000 hours.

RESULTS: A total of 393 injuries were recorded, 255 (65%) were non-contact lower limb injuries, of which 77% (n=196) were Nc-Mi. This reflects an incidence of 48.3 (95% CI 41.8 to 55.6) injuries per 1000h and a nearly tenfold higher incidence of no time-loss compared with time-loss injuries (43.6; 95% CI 37.4 to 50.5 vs 4.7; 95% CI 2.8 to 7.3). Burden of acute onset injuries was significantly greater than gradual onset (33.3 days vs 16.3 days per 1000h, p<0.0001). Injury incidence (11.9; 5.7-21.8 vs 2.8; 1.3-5.3) and burden (160.3; 134.4-189.7 vs 20.5; 15.9-26.1) were higher for match compared to training (p<0.0001). Hamstring injuries had the highest match injury burden (90.2 days lost per 1000h), the most burdensome muscle injury in training was the quadriceps (14.3 days lost per 1000h).

CONCLUSION: Consideration of time loss injuries only might limit the understanding of potential training load errors on player's musculoskeletal system. The high prevalence and incidence of no-time-loss muscle injuries, particularly of gradual onset indicates the necessity to reflect on them to enhance the understanding of load stimuli response. A greater quadriceps injury burden occurring in training differs from the greater burden of hamstring injuries occurring in matches. Muscle injury risk reduction strategies may therefore be tailored by muscle group on an individual basis, considering the context and type of onset in order to develop an optimal player robustness to lower limb non-contact muscle injuries.

References

1) Amundsen, R., et al. (2023). "#ReadyToPlay: health problems in women's football–a two-season prospective cohort study in the Norwegian premier league." Br J Sports Med.

2) Hallén, A. et al. (2024) 'UEFA Women's Elite Club Injury Study: A prospective study on 1527 injuries over four consecutive seasons 2018/2019 to 2021/2022 reveals thigh muscle injuries to be most common and ACL injuries most burdensome', British Journal of Sports Medicine [Preprint]. doi:10.1136/bjsports-2023-107133.

EXPLORING WORKLOAD-RELATED INJURY RISK FACTORS IN ELITE FEMALE VOLLEYBALL PLAYERS

MASHIMO, S., SAKAGUCHI, M., TAKEGAMI, A., HOGAN, T., YOSHIDA, N.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: Monitoring athletic workloads and athletes' responses is important to minimise injury risk and maximise athletic performance [1]. The relationship between workload and injury has been studied in numerous outdoor sports, such as football and rugby; however, studies on indoor sports, including volleyball, are limited [2]. This study aimed to investigate potential workload-related injury risk factors in elite female volleyball players.

METHODS: From June 2022 to March 2023, 19 Japanese female volleyball players were followed prospectively. Every Sunday, injuries were measured using the Japanese version of the Oslo Sports Trauma Research Center (OSTRC) Questionnaire on Health Problems (OSTRC-H2.JP) [3]. The prevalence of all injuries and substantial injuries were calculated once weekly and presented with 95% confidence interval (CI). Workloads were monitored daily using the session rating of perceived exertion (sRPE) as the internal load and total jump height recorded by VERT 3.0 (Mayfonk Inc., Fort Lauderdale, FL, USA) as the external load. The acute:chronic workload ratio (ACWR) was calculated by dividing acute load (7-day) by chronic load (21-day and 28-day) with a rolling average (RA) and exponentially weighted moving average (EWMA) calculations and coupled and uncoupled approaches. The association between workload and injury was determined by random-effects logistic regression models. Multicollinearity was verified by variance inflation factor (VIF).

RESULTS: The OSTRC-H2.JP average response rate was 85.0% throughout all weeks. The average weekly prevalence of all injuries was 51.4% [95% CI; 47.6–55.2%], of which 13.9% [95% CI; 11.0–16.9%] were considered substantial. The most affected body parts of injuries were the knee (n = 19, 15.8%), hip/groin (n = 12, 10.0%), and thigh (n = 12, 10.0%). After checking for no multicollinearity that VIF ≤ 5, three candidate variables (7:21/internal/coupled/EWMA, 7:21/external/coupled/EWMA, 7:28/external/coupled/EWMA) were included in the random-effects logistic regression model. Adjusted odds ratios (aORs) of workload variables were 0.99 (7:21/internal/coupled/EWMA, 95%CI; 0.33–2.96),

3.84 (7:21/external/coupled/EWMA, 95% CI; 1.21–12.17), and 0.94 (7:28/external/coupled/EWMA, 95% CI; 0.38–2.36), of which "7:21/external/coupled/EWMA" was a significant injury risk factor.

CONCLUSION: In this study, >50% of elite female volleyball players experienced symptoms of injury. Moreover, one in 10 participants presented substantial injuries that affected their sports participation and performance. The external workload was associated with the occurrence of injury; 7:21 ACWR if using a coupled approach and EWMA calculation. Therefore, monitoring external workload is essential to prevent injuries in elite female volleyball players.

1. Soligard et al. (2016) 2. Benson et al. (2020) 3. Mashimo et al. (2021)

THE INFLUENCE OF THE MENSTRUAL CYCLE PHASES ON SINGLE-LEGGED FUNCTIONAL BALANCE AND JUMP TESTS IN FEMALE AMATEUR FOOTBALL PLAYERS

SCINICARELLI, G., WILKE, C.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: The different hormonal levels during the female menstrual cycle phases could negatively influence the athletic performance of female athletes, especially during the first (follicular) than the second (luteal) phase. Consequently, this can increase the susceptibility to lower extremity injuries. The ability of single-leg balance or jumping are fundamental variables in order to succeed in professional and amateur sports. The aim of this study was to observe differences in functional performance tests between the two phases of the menstrual cycle in female football players.

METHODS: Cross-sectional study. 17 female amateur football players (26.82 ± 5.39 years) were tested twice during the follicular (T1) and luteal (T2) phase of the menstrual cycle by using the Y-Balance Test and the Single-leg Jump for Distance Test.

RESULTS: No significant differences in single-leg functional performance between the follicular and luteal phases have been found for both tests ($p > .05$).

CONCLUSION: The different menstrual cycle phases have no influence on functional performance tests in female football players. Therefore, specific preventive training programs focused on balance and jumping skills are recommended during the entire menstrual cycle. Finally, further studies should ensure a more valuable injury prevention approach by the inclusion of motion quality analyses during the menstrual cycle phase.

Oral Presentations

OP-MH15 Exercise and neurological diseases

THE LIVED EXPERIENCES AND SIGNIFICANT CHALLENGES ON LIFESTYLE AND WEIGHT MANAGEMENT FACING PAEDIATRIC PATIENTS WITH DEMYELINATING CONDITIONS

CONSTERDINE, A., CHAPMAN, K., COLLETT, J., DUDA, J.L., DAWES, H.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Demyelinating syndromes (DS) are chronic, relapsing, autoimmune conditions characterised by inflammation and damage to the nerves in the brain and central nervous system). Although DS disorders such as Multiple Sclerosis and Neuromyelitis Optica Spectrum Disorder (NMOSD) are prevalent in the adult population, paediatric onset is rarer and much less studied. These lifelong conditions have severe implications for quality of life, impacting on school performance and social activities, as well as physical, emotional and psychological well-being. Two particularly concerning aspects of these conditions are that they are often accompanied by drastic weight changes and alterations to body composition.

METHODS: 16 young people with DS took part in semi-structured interviews, conducted virtually and audio recorded. Questions related to how the condition has impacted their lifestyle, diet, and physical activity levels. Inductive thematic analysis was employed for data analysis. Rigour and credibility were established through detailed immersion and prolonged engagement of the data, multivocality, member reflections, reflexivity and inter-researcher debriefing.

RESULTS: Six overarching themes were identified: 1) the influence of the diagnosis on the young person, 2) the implication of the treatment, access to services and effects of steroids, 3) the ways in which the young person mediated the effects of their condition through changes to their diet, physical activity/lifestyle and vice versa, 4) the impact of sleep quality on fatigue levels, 5) a change of identity associated with living with a debilitating lifelong condition, and 6) the influence of family.

CONCLUSION: Diagnosis and treatment produced a multitude of intersecting effects on the young people interviewed. Patients fell into three distinct groups, namely some who were very active prior to diagnosis and were highly motivated to strive for activity maintenance post diagnosis. Some patients were not physically active either pre or post diagnosis and struggled to manage their disease course. A third group were moderately active before diagnosis, and then struggled to maintain activity levels or weight after. Some patients in the latter two groups underwent an epiphany leading to a dra-

matic change in their lifestyle and physical activity levels. The data suggested a range of both facilitators and barriers to being physically active with associated behavioural or emotional responses to the diagnosis, treatment and effects of the conditions. Some of these included the effects of family on diet and lifestyle, peer support, motivational disposition, fatigue, stress, fear of physical activity, alienation from their own bodies, fear of exercise exacerbating symptoms, or access to relevant resources or sources of information. Those who maintained or improved their physical activity levels, were able to manage their disease course more adroitly, taking ownership of their condition, with an improvement in well-being.

PHYSICAL ACTIVITY TRAINING PRESERVES EXERCISE TOLERANCE AND SKELETAL MUSCLE OXIDATIVE CAPACITY IN PATIENTS WITH PARKINSON'S DISEASE

NERI, M., GATTI, M., DE ICCO, R., BIGHIANI, F., MARTINIS, L., PISANI, A., CALCULLI, A., COMOLLI, D., FAZIO, C., BOTTINELLI, R., PORCELLI, S.

UNIVERSITY OF PAVIA

INTRODUCTION: Parkinson's disease (PD), the second most common neurodegenerative disease, is characterized by an irreversible loss of dopaminergic neurons in the substantia nigra pars compacta of the basal ganglia, which affects the nervous system, causing motor disturbances (bradykinesia, resting tremor, rigidity, postural instability and gait impairment) [1,2].

Despite it is not clear how alterations in central or peripheral nervous systems controlling skeletal muscle can influence muscle function, PD patients show mitochondrial impairments at skeletal muscle level which can be counteracted by exercise, reducing symptoms and improving patients' quality of life [1,3,4].

The aim of the study was to highlight the beneficial effects of physical activity training on exercise tolerance and skeletal muscle oxidative capacity in PD patients.

METHODS: Eleven trained (PD-TR, age: 58±6 years, disease duration: 8.3±6.4 years) and six sedentary (PD-SED, age: 65±10 years, disease duration: 3.7±2.0 years) PD patients were recruited. The level of physical activity was rated by means of IPAQ-Short. Each subject performed an incremental exercise test on a cycle ergometer up to exhaustion to determine Wpeak and V'O2peak. Vastus lateralis (VL) fractional O2 extraction (DHHbMb), non-invasively evaluated by near-infrared spectroscopy (NIRS), was recorded and expressed as % of a reference value obtained during a transient ischaemia of lower limb [5]. Muscle oxidative capacity (mVO2) of VL was estimated by NIRS from recovery rate constant (k) of TSI changes during brief intermittent arterial occlusions [6].

RESULTS: Wpeak and V'O2peak were higher in PD-TR (232±52 W and 40.1±4.8 ml*kg-1*min-1, respectively) compared to PD-SED (146±36 W and 21.0±1.7 ml*kg-1*min-1, respectively; $p<0.01$). DHHbMb was higher in PD-TR (68.2±17.1 %) compared to PD-SED (32.4±13.5 %; $p<0.01$). k was higher in PD-TR (2.52±0.82 min-1) compared to PD-SED (1.39±0.51 min-1, $p<0.01$). A correlation was found between DHHbMb and k ($r=0.77$; $p<0.001$).

CONCLUSION: The present findings confirm regular physical activity training improves exercise tolerance in PD patients, mainly through an improved muscle oxidative metabolism.

AKNOWLEDGEMENT:

This work was supported by the Italian Ministry of Health "Ricerca Corrente 2022-2024" granted to IRCCS Mondino Foundation.

REFERENCES

[1] Harris et al, J Physiol, 2022

[2] Saiki et al, Sci Rep, 2017

[3] Cardellach et al, Neurology, 1993

[4] Burtscher et al, Int J Mol Sci, 2021

[5] Grassi et al, Med Sci Sports Exerc, 2019

[6] Adami et al, J Appl Physiol, 2018

AEROBIC EXERCISE VS COMBINED COGNITIVE AND AEROBIC EXERCISE IN PEOPLE WITH PARKINSON'S: EFFECTS ON COGNITION AND BIOMARKERS OF NEUROPLASTICITY

FERRUSOLA PASTRANA, A., DAVISON, G., JAVADI, A.H., FULLERTON, C., MEADOWS, S.

EUSES - UDG

INTRODUCTION: Neuropsychological impairments, such as cognitive decline, mild cognitive impairment or dementia, are common in PwP and can impact their daily activities and quality of life. Pharmacological procedures have limited effects to treat those, and research suggests that non-pharmacological interventions, such as exercise or cognitive training, could have the potential to improve cognition. Considering the efficacy of exercise to also promote physical and cognitive improvements, the implementation of the combined modalities could be more beneficial than single-domain training. Aim: to investigate BDNF and pro-BDNF kinetics in PwP during different acute exercise interventions and their relationship with measures of cognitive function, with the overall aim to evaluate if there are added beneficial outcomes from combining physical and cognitive tasks compared to engaging with aerobic exercise only.

METHODS: 6 participants (age 61 ± 12 years; Hoehn and Yahr (H&Y) scale I to II) participated in 4 supervised conditions: a session of acute cycling (A), a second acute cycling session 24 h. after A (B), combined acute session of cycling and cognitive tasks (C) and a resting condition (D). In A, B and C participants completed 30 min of cycling at RPE 14 on a cycle ergometer. Outcome measures included blood and saliva biomarkers (BDNF and pro-BDNF) and measures of cognition (the Stroop test and the Free-Recall test).

RESULTS: Visits B (second) and C (combined) were able to elicit larger improvements in the Stroop test with large (d=0.853) and small to medium (d=0.349) effects, respectively, and up to 30 and 40% improvements, respectively, in immediate long-term memory (LTM) compared to the resting control visit D. Serum and capillary BDNF levels were positively correlated with cognitive performance, whilst platelet-poor plasma BDNF correlations seemed to be headed in the opposite direction.

CONCLUSION: Due to the small sample size of this preliminary study, there was poor sensitivity to detect effects in cognition even though medium to large effect sizes were observed for some comparisons. Therefore, it is not yet fully known to what extent cycling combined with cognitively challenging tasks, compared to cycling alone, improves cognitive function and modulates biomarkers of neuroplasticity in PwP.

ENHANCING TELEHEALTH PROFICIENCY: TRAINING NEEDS OF AUSTRALIAN ALLIED HEALTH PROFESSIONALS IN EXERCISE AND BEHAVIOURAL CHANGE FOR MS THERAPY

MAVROPALIAS, G., BAYNTON, S.L., TEO, S.Y.M., DONKERS, S.J., VAN RENS, F.E.C.A., LEARMONTH, Y.C.

MURDOCH UNIVERSITY

INTRODUCTION: Exercise reduces the severity of multiple sclerosis (MS) symptoms, and may play a crucial role in overall disease management. When people with MS seek exercise guidance, they approach their allied health professionals (AHPs) [1,2]. We investigated the proficiency, knowledge gaps, and training needs and wants of Australian AHPs in telehealth exercise therapy and behavioral change for people with MS. We focused on identifying the educational needs of AHP to optimise professional development training programs.

METHODS: We conducted an online survey engaging 58 AHPs, including 34 physiotherapists, 14 exercise physiologists, and 10 occupational therapists, to assess their current telehealth practices, confidence levels, and training preferences related to exercise and behavioral change for MS. The survey, incorporated multiple-choice, Likert scale, and open-ended questions. Responses were analysed through binary and multinomial logistic regression.

RESULTS: One third of AHPs (33%) displayed a lack of awareness regarding MS exercise guidelines [3], with occupational therapists being the least familiar (60% unfamiliarity). Despite 93% of all AHPs acknowledging the distinction between physical activity and exercise, only 14% could provide accurate and complete definitions. Most AHPs (91%) used physical activity behavioral change strategies, with goal setting being predominant. However, over a quarter (27.6%) of AHPs felt unprepared in promoting exercise to MS clients, with occupational therapists notably the least confident in prescribing and adjusting telehealth exercise programs (90% uncertain). Most AHPs (96.3%) expressed a need for further training, particularly in online self-paced formats, focusing on MS-specific exercise prescription, behavioral change methods, and telehealth delivery techniques.

CONCLUSION: The study underscores a considerable need for specialised, profession-specific training programs among Australian AHPs, especially to augment confidence and competence in telehealth exercise therapy and behavioral change for MS. Such education, ideally delivered through online workshops, will not only address the knowledge gaps but also align with AHPs preferences for self-paced learning. Furthermore, these programs should be developed with a keen understanding of the AHPs current practice environment and healthcare system, ensuring practical applicability and relevance in their daily professional settings. This approach will significantly contribute to the advancement of telehealth practices in MS care, ensuring a higher standard of patient-centered, evidence-based treatment.

References

[1] Learmonth YC, et al. Int J Environ Res Public Health 2021;18:13245.

[2] Learmonth YC, et al. Health Expect 2017;20:574–83.

[3] Kalb R, et al. Mult Scler 2020;26:1459–69.

Oral Presentations

OP-AP29 Thermoregulation II

HEAT ILLNESS COMPLICATED BY HYPONATRAEMIA: IS NON-CLASSIC CONGENITAL ADRENAL HYPERPLASIA AN UNDER-RECOGNISED CAUSE OF EXERTIONAL INCAPACITY?

STACEY, M., HOUSE, C., ROIZ DE SA, D., GRIST, D., BOOT, S., ALLSOPP, A., WOOD, D.R.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: With exercise in the heat, impaired evaporative cooling from hypovolaemia may predispose Exertional Heat Illness (EHI), risking debility and even death. Non-classic congenital adrenal hyperplasia (NCCAH) is caused most

commonly by mutations leading to deficiency in the adrenocortical enzyme 21 hydroxylase (21OHD) and, despite a carrier frequency of 1:25 or more, is one of the most under-recognised autosomal recessive disorders. Typical presenting features of NCCAH arise from adrenal androgen excess, however with sustained stress, parallel defects in gluco- and mineralocorticoid production might be observable. Under sustained heat load, this would have the potential to precipitate EHI from depletional hyponatraemia.

METHODS: United Kingdom military personnel were recruited from three groups referred to a specialist heat illness clinic: those with no history of EHI (controls, n=16), those affected by EHI with no documented hyponatraemia (nEHI, n=16), and cases of EHI complicated by hyponatraemia during deployment from the UK to hot climates (hEHI, n=2). After defining VO2peak, exercising Heat Tolerance Test (HTT) was conducted at 60% relative intensity, in WBGT 27 degrees C. Responses were categorised as pass (heart rate and core temperature plateau) or fail (inability to demonstrate thermal equilibrium at 90 min). Blood was sampled for steroid analysis at rested baseline, post-VO2peak and post-HTT, and with Short SynACTHen Test (STT) to characterise adrenal reserve. On clinical grounds, EHI cases failing HTT were re-tested following a minimum of 12 weeks, and mutations causative of NCCAH, including 21OHD, were sought in hEHI.

RESULTS: HTT was passed at first attempt by 15/16 controls and 11/16 nEHI, with 100% pass rate on re-testing. One hEHI passed HTT first-time and, on genotyping, exhibited carrier status for 21OHD. The other hEHI required two subsequent attempts to pass HTT. Upon re-deployment into climatic heat, he was again thermally intolerant and was referred back for HTT, which he passed, however he was found also to have NCCAH (21OHD homozygote). No participants were shown to have inadequate adrenal reserve in cooler UK conditions, including hEHI with 21OHD mutations. Nevertheless, significant shunting of steroid precursors away from cortisol and aldosterone production was shown in NCCAH, both with HTT and on SST.

CONCLUSION: Genotyping for NCCAH caused by 21OHD and other related enzyme defects may be warranted in athletes and military personnel who develop EHI complicated by hyponatraemia, especially where preceding thermal stress was extreme and sustained. The positive predictive value of HTT for future heat intolerance requires further investigation in this population.

HEAT TRAINING PROTOCOLS: ARE INTERMITTENT OR CONTINUOUS CYCLING PROTOCOLS MORE BENEFICIAL FOR INDUCING A GREATER THERMOREGULATORY RESPONSE IN FEMALES?

KELLY, M., BOWE, S.J.1,2, BARNARD, J.G.1, CONDO, D.1, GUY, J.H.3, SNOW, R.J.1, CARR, A.J.1

1. DEAKIN UNIVERSITY; 2. VICTORIA UNIVERSITY OF WELLINGTON; 3. CENTRAL QUEENSLAND UNIVERSITY

INTRODUCTION: There is evidence that heat acclimation is beneficial in females [1], but it is unclear if intermittent exercise in the heat elicits greater adaptation than work-rate matched continuous exercise. We therefore investigated two different short duration, intermittent work:recovery intervals (compared with continuous exercise) on females' rectal and skin temperatures and heart rate during exercise in the heat.

METHODS: Fourteen recreationally trained females (mean ± SEM: age 29.8 ± 1.7 yr; body mass 68.73 ± 1.51 kg; body surface area 1.80 ± 0.03 m2) completed three 60-min cycling-based sessions in the heat (~39°C, ~40% relative humidity, ~1.40 m.s-1 air speed) with mean external work rate matched between protocols (~239 W.m-2) designed to elicit a mean exercise intensity of ~60%VO2max. The exercise protocols were 1) continuous (CON), 2) 90:90-sec and 3) 30:30-sec work:recovery intervals. Key outcome measures of rectal temperature (Trec), skin temperature (Tskin; °C), and heart rate (HR; beats.min-1) were collected at 30-sec intervals and expressed as mean values over each 3-min block. The change in Trec and Tskin (end-exercise minus resting values) and change in HR (end of last work block minus resting values) were analysed using linear mixed models and Bonferroni post-hoc procedures were used to locate differences where appropriate. Results were considered statistically significant when $p<0.05$.

RESULTS: Change in Trec was higher in 30:30-sec (1.56 ± 0.10°C) compared to CON (1.17 ± 0.11°C; p=0.001), but not between intermittent protocols (p=0.247) or between CON and 90:90-sec (p=0.141). There was no difference (all p>0.265) in Tskin for CON (4.51 ± 0.49°C), 90:90-sec (4.48 ± 0.50°C), or 30:30-sec protocols (5.03 ± 0.48°C). Change in HR at the end of the last work block was higher in 30:30-sec (105 ± 3 beats.min-1) compared to CON (96 ± 3 beats.min-1; p=0.016), but not between intermittent protocols (p=0.686) or between CON and 90:90-sec (p=0.302).

CONCLUSION: Very short duration, intermittent work:recovery intervals elicited a greater change in Trec and HR compared to work rate-matched continuous exercise in the heat in females. It appears longer duration intervals do not demonstrate a beneficial thermoregulatory response in comparison to continuous exercise for females in the heat. This finding indicates that very short duration, intermittent work:recovery intervals may be an exercise mode to consider in female heat acclimation training protocols for team sports, as it elicits a greater thermal stimulus, possibly driving a faster heat adaptive response in females.

1. Kelly et al., Sports Med. (2023).

REAL-TIME THERMOREGULATORY AND BIOMECHANICAL MONITORING TO PREVENT HEAT ILLNESS IN INTERNATIONAL TRIATHLON

JAMES, C.1, MUNIZ-PARDOS, B.2, COMERAS-CHUECA, C.3, GUPPY, F.4, ANGELOUDIS, K.4, COMADRAN DE BARNOLA, E.5, PITSILADIS, A.5, RICO MENESES, M.5, VERDOUKAS, P.5, MILLER, M.5,6, ZELENKOVA, I.2, CASAJUS, J.A.2, PEÑA IGLESIAS, D.2, BANDIERA, D.7, TESSITORE, A.7, PERAZZETTI, A.7, MARTUSCIELLO, F.7, MIGLIORINI, S.8, PITSILADIS, Y.1,5,7

1 DEPARTMENT OF SPORT, PHYSICAL EDUCATION AND HEALTH, HONG KONG BAPTIST UNIVERSITY 2 EXER-GENUD (GROWTH, EXERCISE, NUTRITION AND DEVELOPMENT) RESEARCH GROUP, FIMS COLLABORATING CENTER OF SPORTS MEDICINE, UNIVERSITY OF ZARAGOZA, ZARAGOZA, SPAIN 3 VALORA RESEARCH GROUP, SAN JORGE UNIVERSITY, SARAGOSSA, SPAIN. 4 INSTITUTE OF LIFE AND EARTH SCIENCES, SCHOOL OF ENERGY, GEOSCIENCE, INFRASTRUCTURE AND SOCIETY, HERIOT-WATT UNIVERSITY, EDINBURGH, UK. 5 HUMAN TELEMETRICS, LONDON, UK. 6 WORLD OLYMPIANS ASSOCIATION (WOA), LAUSANNE, SWITZERLAND 7 DEPARTMENT OF MOVEMENT, HUMAN AND HEALTH SCIENCES, UNIVERSITY OF ROME FORO ITALICO 8 MEDICAL COMMITTEE, WORLD TRIATHLON, LAUSANNE, SWITZERLAND

INTRODUCTION: Despite advancements in heat mitigation strategies for athletes, heat related illnesses continue to pose a major risk to athletes' health, particularly in endurance sports. Expert groups and international sporting federations now advocate for athletes' routine monitoring during elite competitions, to ensure their safety. Practical challenges of such initiatives are considerable in sports spanning large distances with multiple exercise modes. Addressing this need, we report on the deployment of wearable technologies for real-time athlete monitoring across multiple World Triathlon events, specifically the 2023 Long-Distance World Triathlon Multisport Championships (LDWTC, Ibiza) and World Triathlon Para Cup (Taranto). The project aims to (i) demonstrate that wearable technologies can help ensure athletes' health and safety (ii) determine the most relevant sensors for use.

METHODS: At the LDWTC, three athletes were monitored. One used a full suite of sensors to measure: core body temperature (TCORE), run kinematics, skin temperature (TSKIN), and heart rate (HR), whilst two were only monitored with TCORE. For run kinematics analyses, the run segment was divided into three equal parts. Environmental conditions were monitored using portable meteorological stations. Data were communicated via a wrist-worn bracelet, transmitting via the cellular network to the cloud. At the Para Cup, seven elite para-triathletes (2 male PTWC [wheelchair users], 1 female [upper limb disability] and 1 male PTS [lower limb disability] and, 2 male and 1 female PTVI [visual impairments]) were monitored for combinations of TCORE, TSKIN, HR and run kinematics.

RESULTS: In Ibiza (ambient temperature 22-25°C), the highest TCORE recorded was 39.52°C (+3.3°C from rest). Across the three segments of the run, the athlete with foot sensors showed gradually shorter stride lengths (1.96 m, 1.72 m, 1.64 m), and increased contact times (233 ms, 251 ms, 259 ms). In Taranto (ambient temperature ~22°C), the highest recorded TCORE was 40.05°C (+2.53°C from rest). Mean core temperature (n=5) was 38.34 ± 0.45°C and mean peak temperature 39.1 ± 0.63°C (+ 1.71± 0.55°C from rest).

CONCLUSION: We implemented a novel multi-sensor monitoring solution during elite triathlon events. High core temperatures at the Para Cup (up to 40.05°C) underscore the need for real-time monitoring. Special attention should be paid to specific populations who are more sensitive to heat illnesses such as athletes with spinal cord injury, for whom real-time monitoring may be even more crucial. A foot-mounted inertial sensor characterised fatigue during the run phase. Further development of integrated multi-sensor approaches, encompassing thermal, cardiovascular, sudomotor, and biomechanical monitoring, combined with multi-location weather data, is needed to accurately predict and prevent heat-related illnesses within elite competition. Future studies in hot environments with a greater sample of athletes should be developed.

THE IMPACT OF NUCLEAR, BIOLOGICAL, AND CHEMICAL PROTECTIVE CLOTHING ON THE PHYSIOLOGICAL RESPONSE OF MILITARY PERSONNEL: METABOLIC EQUIVALENT ANALYSIS AT VARY LOADS AND SPEEDS

CHENG, H.J., FU, S., TSENG, W., LI, Y., SHIH, Y.

UNIVERSITY OF TAIPEI

INTRODUCTION: Members of the Chemical Corps are required to don nuclear, biological, and chemical protective clothing (NBC-PC) along with heavy equipment to execute military operations successfully. Using NBC-PC significantly raises metabolic equivalents (METs), leading to a quicker onset of fatigue and potentially elevating the risk of heat-related injuries (1,2). This study aims to evaluate the physiological response on soldiers wearing NBC-PC during tasks under varying loads and speeds.

METHODS: In this study, 11 soldiers aged 23.7 ± 1.6 were divided into groups: those wearing NBC-PC (NBCG, n=5) and those not (CON, n=6). They underwent walking tests at speeds of 4, 5, 7, and 8 km/h with 20 kg, and 5 and 6 km/h with 30 kg loads. METs were measured using the COSMED K5 wearable metabolic system, and differences between groups were assessed using repeated measures ANOVA.

RESULTS: The results of the study reveal significant differences in METs between the CON and NBCG under various conditions. Specifically, when carrying a 20 kg load at a speed of 5 km/h, the METs were significantly higher in the NBCG (6.56 ± 1.39) compared to the CON (4.09 ± 0.92). This trend continued with a 20 kg load at 7 km/h (NBCG: 11.54 ± 1.8 vs. CON: 7.48 ± 1.05), a 20 kg load at 8 km/h (NBCG: 12.98 ± 1.20 vs. CON: 9.12 ± 1.10), a 30 kg load at 5 km/h (NBCG: 7.80 ± 1.75 vs. CON: 5.19 ± 0.86), and a 30 kg load at 6 km/h (NBCG: 10.28 ± 1.69 vs. CON: 6.81 ± 0.66). These findings indicate that wearing NBC-PC significantly increases the physiological demands on soldiers, as evidenced by the elevated METs across all tested speeds and loads.

CONCLUSION: According to the results of this article, wearing NBC-PC increased the METs of weight-bearing and walking, possibly because the NBC-PC impedes heat dissipation through evaporation and convection, leading to a rise in body temperature and, consequently, an increase in METs. Similar to past research, the METs increased by 2.4% to 20.9% when subjects performed activities in NBC-PC compared to standard uniforms (3). This increase in metabolic load can be attributed to the additional weight of the protective clothing and the broader range of motion required. Adjustments to Wet Bulb Globe Temperature (WBGT) are recommended depending on the gear worn: an increase of 5°F (2.8°C) for a ballistic vest, an additional 10°F (5.6°C) for light work in an NBC suit, and 20°F (11.2°C) for moderate to heavy work. Given these findings, it is crucial to acknowledge that higher walking speeds and ambient temperatures result in greater metabolic loads for military personnel wearing NBC-PC.

References:

1) Young et al., Aviation, Space and Environmental Medicine, 2000

2) Gómez-Oliva et al., Physiol Behav., 2019

3) Dorman and Havenith, Eur J Appl Physiol., 2009

OPTIMAL DURATION OF WHOLE-BODY CRYOSTIMULATION EXPOSURE TO ACHIEVE TARGET SKIN TEMPERATURE: INFLUENCE OF SEX.

JDIDI, H., DE BISSCHOP, C., DUGUÉ, B., DOUZI, W.

UNIVERSITY OF POITIERS, LABORATORY «MOBILITÉ, VIEILLISSEMENT, EXERCICE —UR 20296» FACULTY OF SPORT SCIENCES, 86000 POITIERS, FRANCE.

INTRODUCTION: The efficacy of whole-body cryostimulation (WBC) may be influenced by individual characteristics like body composition or gender. An optimal skin temperature value of 13.6°C, has been proposed as a target temperature to reach an analgesic threshold. The aim of this study was to determine the optimal exposure time required to reach the analgesic threshold and to study the effect of sex on skin temperature changes during and after WBC.

METHODS: Twenty-five healthy participants were assigned into 2 groups (men (n= 15; Body mass index (BMI) = 21.5±1.6 kg.m-2) and women (n=10); BMI = 22 ± 1.8 kg.m-2). In a random order, each participant experienced 4 min of WBC, as well as a control session with no cold exposure. Cold exposure sessions were administered at -50°C with a mean wind speed of 2.3 m/s (WBC chamber, Aurore concept, Noisiel, France). Skin temperature (ST) was measured with a thermal imaging camera (Optrix GmbH, Holzkirchen, Germany) and the mean skin temperature was calculated with the Ramanathan formula. Core body temperature (CBT) was assessed using a telemetric pill (e-Celsius, BodyCap, Caen, France) providing continuous measurement of gastrointestinal temperature. CBT and ST were measured before, during, and after cold exposure.

RESULTS: Considering the mean skin temperature, men reached the threshold of 13.6°C after 4 min exposure, whereas women reached it in 3 min. After 4 min of WBC, a significant difference was noted in all body areas when comparing men and women. Indeed, women exhibited a more considerable decrease in mean skin temperature than men ($p<0.001$). Internal temperature measurement showed that there were no significant changes in CBT during WBC exposure in both men and women ($p>0.05$). Following WBC, a rapid mean skin temperature increase was observed in both groups. However, at 30 min, the mean skin temperature remained significantly lower than at baseline in both groups.

CONCLUSION: Our findings suggest that women needed shorter exposure duration to reach the threshold temperature (13.6 °C). These results highlight that appropriate WBC dosage may differ between sexes. Understanding the impact of this variable on cold exposure outcomes can help to optimize WBC treatments and maximize potential benefits. Furthermore, the non-significant changes in CBT° suggest that, even with the large drop in ST, 4 min of WBC exposure does not appear to interfere with core temperature and present any risk of hypothermia.

Oral Presentations

OP-SH21 Physical activity promotion I

DETERMINANTS OF ENGAGEMENT IN LEISURE-TIME PHYSICAL ACTIVITY AND CLUB SPORT AMONG COLLEGE AND UNIVERSITY STUDENTS

MOTEVALLI, M., DRENOWATZ, C., TANOUS, D.R., WIRNITZER, K.C.

UNIVERSITY OF INNSBRUCK

Determinants of Engagement in Leisure-Time Physical Activity and Club Sport Among College and University Students

INTRODUCTION

Various internal and external indicators, including lifestyle-related, sociodemographic, and environmental factors, have been documented as being linked to physical activity (PA) habits [1-3]. However, there is a lack of data comparing different forms of engagement in PA, sports, and exercise. The present study aimed to investigate potential factors associated with the engagement in leisure-time PA (LPA) and club sports (CS) in a large sample of college/university students.

METHODS

This nation-wide study followed a cross-sectional design and included a final sample of 4,508 students (mean age: 24.9 y; 65.9% females; 66.1% undergraduate students; 18.5% internationals) from 52 colleges and universities across Austria. Participants completed an online survey and provided data on demographics, anthropometric characteristics, and an extensive range of health-related lifestyle factors, including patterns of PA and underlying motivations for PA engagement, as well as details on dietary habits, sleep routines, smoking, and alcohol consumption. Descriptive statistics, chi-square tests, and logistic regression analysis were used to analyze the data.

RESULTS

Across the entire sample, 85.7% of participants reported participating regularly in LPA, and among them, 22.5% were active members of sports clubs. The prevalence of overweight/obesity was 17.8%, while 7.4% students were classified as underweight. Among the 36 potential motives listed in the survey, "Maintaining physical health," "feeling good," and "refreshing the mind" were the most commonly mentioned factors motivating students to engage in LPA and CS. Significant predictors of CS participation included sociodemographic, dietary, and sleep-related clusters, along with individual variables: "residing in rural areas," "being Austrian," "daily consumption of fruits," "daily consumption of >2 liters of fluids," "avoiding smoking," "avoiding alcohol," and "prioritizing sleep as the top health factor" ($p<0.01$). The category of "sleep-related factors" as a cluster and the individual variable "feeling well-rested after sleep" were identified as predictors of LPA participation ($p<0.001$).

DISCUSSION

Although motivational factors for students' involvement in LPA or CS may be similar, participation in each of these two forms is influenced by different internal and external factors. The findings emphasize the importance of considering the type of engagement in PA and sports, and the associated determinants, when designing tailored strategies to foster an active lifestyle, especially among university students and young adults.

REFERENCES

1. Condello G, et al. https://doi.org/10.1186/s12966-017-0510-2

2. Cortis C, et al. https://doi.org/10.1371/journal.pone.0182709

3. Downward P, et al. https://doi.org/10.1080/17461391.

CHARACTERISTICS OF THE EDUCATION AND TRAINING PROCESS FOR THE GROWTH OF CHINESE OLYMPIC CHAMPIONS

HU, H.

NANJING SPORT INSTITUTE

PURPOSE: Years of systematic and deliberate training is the cornerstone of improving athletes sports performance and achieving Olympic success.Education and training are crucial components in the journey to becoming an Olympic champion. METHODS: Using questionnaire, interviews and literature review, this study analyzed the key data for the growth of 175 Olympic champions. Under the overall guidance of the Department of Policies and Regulations of the Chinese General Administration of Sports, and with the help of the sports system of various provinces and cities across the country, a total of 251 questionnaires were issued and 175 valid questionnaires were recovered, with an effective response rate of 69.72%. In terms of specific statistical methods, for most of the quantitative data conforming to the normal distribution, the mean ± SD is used, and the 95% CI is calculated, and the independent sample t test is used for the comparison between these groups; quantitative data for small samples and it does not conform to the normal distribution, the median (interquartile range) is used to indicate, and the non-parametric Mann-Whitney U test is used for comparison between groups. In addition, the one-variable linear regression equation and its fitting line based on least squares verify the linear relationship between the training start age and the training start period. RESULTS: The research found that successful Olympic athletes do not necessarily come from privileged backgrounds or inherit their athletic talents. Centralized class teaching was the main method of education for champions and they have a longer college and postgraduate education compared to the average. The average time it takes to become an Olympic champion is 13.85 years, with the youth training period being the longest and having significant gender and event group differences. The start of training at a young age within a reasonable range leads to success, but premature specialization may not be beneficial. CONCLUSION: The research provides valuable insights for the cultivation of elite athletes.

OPTIMIZING VOLLEYBALL PERFORMANCE: EXPLORING THE INFLUENCE OF SELF-TALK AND PROGRESSIVE MUSCLE RELAXATION ON REACTION TIME IMPROVEMENT

JOHN, J.J.1, SOH, Y.Y.1

TUNKU ABDUL RAHMAN UNIVERSITY OF MANAGEMENT AND TECHNOLOGY

Introduction

This study explores how Self-talk (ST) and Progressive Muscle Relaxation (PMR) impact reaction time in volleyball players. While ST and PMR are known to reduce stress individually, their comparative effects on reaction time are underexplored. By employing these strategies as interventions, this research offers insights into their effectiveness for enhancing athletic performance. Findings provide practical implications for coaches and athletes aiming to optimize reaction time through psychological techniques.

Methods

In this study, 24 experienced male university volleyball players (aged 18-24) with a minimum of 5 years of training were randomly assigned to control (CG) (n=8), Progressive Muscle Relaxation (PMR) (n=8), and Self-talk (n=8) groups. Over 6 weeks, experimental groups received either Self-talk or 15-minute PMR sessions, while controls had no intervention. Reaction time was measured using the SMARTfit Inc (Tract the Target system), and statistical analyses included one-way ANOVA and paired t-tests ($p < 0.05$).

Results

The findings indicated that there was a significant improvement in reaction time in both the PMR group ($p = 0.02$) and ST group ($p = 0.00$) with ST showing the most improvement of 13% (Pre: 0.43±0.05) to Post: 0.38±0.03) compared to PMR with 7.1% (Pre: 0.40±0.006) to Post: 0.4±0.4) and control only 1.7%. There was a significant difference between groups in the post-test, determined by One-way ANOVA, ($F(2,21) = 3.90$, $p = 0.36$). Tukey post hoc revealed that differences were between CG and ST ($p = 0.029$).

Discussion

The discussion underscores the efficacy of both Progressive Muscle Relaxation (PMR) and Self-talk training in enhancing reaction time by mitigating anxiety levels during testing. Notably, the Self-talk group demonstrates superior improvement, potentially attributed to its unique capacity to sharpen focus and concentration by mitigating distracting thoughts. This aligns with Self-talks recognized role in managing sport-related anxiety, countering intrusive thoughts that impede performance. Conversely, PMR operates on the premise that muscle tension, induced by anxiety-provoking thoughts, can be alleviated through relaxation techniques. Despite both approaches yielding positive results, Self-talk emerges as the more potent strategy, suggesting its promise as a cognitive enhancement tool for volleyball players. Harnessing Self-talk techniques could thus offer a promising avenue for enhancing sports performance by enhancing cognitive abilities and alleviating anxiety-related interruptions.

EFFECTS OF DIFFERENT PROTOCOLS OF HIGH INTENSITY INTERVAL TRAINING ON EXECUTIVE FUNCTION OF SEDENTARY YOUNG WOMEN

GUO, L., YUAN, W., LIU, N., LI, W., SHU, C., SHEN, Z., HOU, Z.

DALIAN UNIVERSITY OF TECHNOLOGY

INTRODUCTION: While high intensity interval training (HIIT) has gained increasing popularity as a time-efficient exercise stimulus to promote health and fitness, studies examining its effects on cognition, especially higher-order executive functions, are rather limited [1]. The parameters of a HIIT protocol, including session volume, intensity, and work-to-rest time ratio, have the potential to impact executive function [2]. However, there is still a scarcity of research in this particular domain. Therefore, the aim of the current study is to explore the effects of various HIIT protocol parameters on executive function.

METHODS: Thirteen sedentary women (age: 20.08±1.32 years; BMI: 21.58±2.30 kg/m2) participated in a randomized crossover trial. The trial included three pairs of HIIT protocols that varied in training volume (V), work intensity (I), and work-to-rest time ratio (W/R). The protocol pairs were as follows: A) high volume (HV) for 30 minutes vs. low volume (LV) for 20 minutes, B) high intensity (HI) (over 85% to 95% of maximum heart rate) vs. low intensity (LI) (75% to 85% of maximum heart rate), C) W/R of 1:1 vs. W/R of 1:2. Before and after each condition, the participants completed several cognitive tasks, including the Stroop test (ST), N-back task (NT), and more-odd shifting (MS), to assess their executive function.

RESULTS: Compared to the pretest, significant differences ($p<0.05$) were observed in reaction time (RT) for ST across all the training conditions after acute HIIT training, while greater change in accuracy (AC) only induced by HV ($p<0.05$). For NT, most protocols resulted in a significant decrease in RT ($p<0.05$), except for HV, HI and W/R (1:2) in the 1-back test. Additionally, significant increases in the AC of 2-back test were found for the three groups, excluding HV and W/R (1:2). In MS, there was a significant decrease ($p<0.05$) in RT for subgroups. In addition, in group A, HV had greater effect on the AC of ST (Congruent: $P=0.004$, $\eta2=0.298$; Incongruent: $p<0.001$, $\eta2=0.511$), and HV showed more improvement ($p=0.035$, $\eta2=0.173$) in the RT of MS. In group B, HI demonstrated better result in the RT of MS ($p=0.014$, $\eta2=0.227$).

CONCLUSION: HIIT exercise has been shown to have a positive impact on executive function. However, the specific effects can vary depending on the different protocols used. This studys findings suggest that acute HIIT sessions with higher levels of training volume and/or intensity may be associated with greater improvements in executive function, particularly for sedentary young women. These results highlight the importance of considering the specific parameters of HIIT protocols when designing exercise interventions aimed at enhancing executive function. Further research is needed to better understand the optimal HIIT protocols for maximizing the benefits on executive function in different populations.

References:

1. Jacob et al., Sports Med, 2023.

2. Hsieh et al., J Sports Sci, 2021.

Oral Presentations

OP-SH07 Sociology I

IMPACT OF PHYSICAL EXERCISE ON HEALTHY LIFE EXPECTANCY OF THE ELDERLY IN CHINA

FUBAIHUI, W.
CHINA INSTITUTE OF SPORT SCIENCE

Introduction

The life expectancy of Chinese population is increasing continuously, and whether the proportion of healthy life is increasing simultaneously has become the focus of attention. Healthy life expectancy is an important index to measure life in old age. We aim to estimate the impact of physical exercise on healthy life expectancyof the elderly in China.

Methods

Based on the data from Chinese Longitudinal Healthy Longevity in the 2002-2018, We first calculate the healthy life expectancy of the elderly in China, and then use channels to test the influence of physical exercise on healthy life expectancy of the elderly. We first estimate the regression coefficient of physical exercise on healthy life expectancy, then add channel variables affecting healthy life expectancy and further calculate the contribution of channel variables to healthy life expectancy. Finally, the difference in healthy life expectancy between the elderly with or without exercise habits matched by propensity score.

Results

The influence of physical exercise on the healthy life expectancy of the elderly is always significant. The healthy life expectancy of the elderly with physical exercise habits is 3.45 years longer than that of the elderly without physical exercise habits, and the proportion of healthy life expectancy is also 9.5% higher. The contribution of smoking, drinking, physical exercise, social interaction and medical service accessibility to healthy life expectancy is 1.05%, 1.05%, 3.16%, 2.11% and 1.05%, respectively, and the total contribution is 5.26%.

Discussion

The relationship between physical exercise habits and healthy life expectancy/proportion of the elderly is stable. The healthy life expectancy of the elderly with exercise habits is longer than that of the elderly without exercise habits, and the proportion of healthy life expectancy is significantly higher than that of the elderly without exercise habits. Subdividing the years of exercise habits and further considering the health level in the previous period, the healthy life expectancy of the elderly who do not exercise (especially in the state of not exercising in both periods) is the shortest. The healthy life expectancy of the elderly with short exercise habits and no medical insurance and chronic diseases is at a disadvantage. Health behavior (smoking and drinking), social participation (participation in various activities) and access to timely medical services are channel variables of physical exercise affecting healthy life expectancy. Social participation behaviors such as physical exercise and other activities have a relatively large contribution to healthy life expectancy and its proportion of the elderly. Personal health behavior and medical services have a relatively small impact on it. The healthy life expectancy of rural female elderly and urban male elderly is the shortest among the elderly with exercise habits. This paper further confirms the positive effect of physical exercise

TRUST OR NOT TRUST? EXPLORING THE MATCH-FIXING SCANDALS OF PROFESSIONAL BASEBALL SYSTEM IN TAIWAN

LEE, P.C., HO, C., CHEN, Y., CHENG, T.
NATIONAL TAICHUNG UNIVERSITY OF EDUCATION

Introduction

The apparent development of sports is generally culturally diverse, yet the continuous spread of corruption in sports has evolved to become a global issue, for instance, match-fixing was identified at the beginning of the twenty-first century as a new scourge in sports. In order to understand the advancement of match-fixing within the Taiwanese professional baseball system, through the perspective of trust, this study sought to link and identify those social concepts that have been instrumental in developing professional sport.

Objectives

The present study aims to explore the underlying mechanism of match-fixing by which both individual agendas and organizational interests are served. Insights from organizational sociology differ from economists and legal perspectives but prove convincing to analyze match-fixing.

Materials & Methods

The interviews and literature review were adopted to collect data for analysis and verification. The empirical research was conducted with in-depth interviews, including syndicates, baseball coaches, and former professional baseball players and so on. The interview data is supplemented by analyses of documentary sources such as Taiwanese court transcripts of match-fixing cases, academic articles, and media and press commentaries, etc.

Results & Discussion

The results suggested that trust concepts can be characterized as a form in which social relations configure "support" for various groups of actors. Trust plays a role in match-fixing with the bright and dark sides of trust coexist. The nature of sports can also have an impact on trust. The fact that players have no choice but to trust can be considered the joint effect of identification, obligations, and norms. Players believe that the stakeholders whom they identify as in the same community will not get them in trouble and that their own interests will not be endangered because protective measures are taken to hide illicit agenda.

Conclusions

Using scandals of Taiwan's Chinese Professional Baseball League, trust at the micro and meso levels are examined. These results show that trust and the manipulation of match-fixing were present in the Taiwanese professional baseball system. The actors, their activities, and the intangible resources exchanged in match-fixing can be best understood through the lens of structural, cognitive, and relational trust. However, negative effects of trust are also recognized in match-fixing.

MANUFACTURING EXCELLENCE: THE LABOR PROCESS AND ACTION LOGIC OF CHINESE PROFESSIONAL BASKETBALL PLAYERS

SUN, Z., XIAOFEI, X.

BEIJING SPORT UNIVERSITY

Since the founding of the Peoples Republic of China, the field of competitive sports has achieved remarkable accomplishments that have garnered worldwide attention. Among the most important participants are professional athletes, who serve as both the "backbone of the nation" when representing the country in competitions and as "ascetics" during the rigorous training outside of competitions. Unlike many other laborers, the subject and object of labor in the process of athletes work are highly unified. Competitive sports entail great uncertainty and intense competition, and athletes often bear the honor of their localities or the nation. Through sports and competitions, they undertake significant social functions and responsibilities. Given the unique nature of the labor and identity of Chinese professional athletes, their work sites, labor processes, and labor orders should be areas of focus for sport sociology. Base on the questionnaire survey and deep interviews, this study claims that, "competition and solidarity," a labor form seemingly filled with internal tension, cleverly and efficiently governs the entire labor process of professional basketball players throughout their sporting careers. Its institutional and cultural logic constitute a complete mechanism for "manufacturing excellence" in Chinese competitive sports. This operational logic presents a scene that appears contradictory yet possesses profound internal coherence: in an industry requiring high-intensity physical labor and complex technical labor, managers meticulously control athletes labor production and reproduction time, activity spaces, and physical management to maximize and maintain their competitive abilities throughout their limited sporting careers. Athletes, in turn, express acceptance and support for this management approach, even willingly engaging in the "rushing game" and "consent" dominion logic closely linked to self, collective, and national honor. Based on this logic, the dominant form of labor control is both institutional and cultural, with a series of emotionally charged stimuli associated with honor and spirit actively engaging athletes. The practice of this operational mechanism depends on the internal labor market of the three-tier training network under Chinas nationwide system, as well as the athletes high degree of national identity and pursuit of honor, materializing it into emotional labor. This process is closely related to the ideological functions and cultural characteristics unique to competitive sports. Through the analysis of the labor field and processes of professional basketball players, this research claims that besides the dimensions of internal labor markets and national institutional constraints, the introduction of sports ideology and culture into the analytical framework can reveal another logic of labor processes where professional basketball players not only "manufacturing consent" but also strive to "manufacturing excellence."

10:00 - 11:15

Invited Symposium

IS-MH05 Is there power after disuse? Insights into the effects of sedentarism, bed rest, hospitalization and recovery on muscle mass, muscle function, fatigability, and physical performance in older people

WORSENING OF NEUROMUSCULAR FUNCTION AFTER DISUSE AND BENEFICIAL EFFECTS OF AEROBIC RECONDITIONING IN OLDER PEOPLE

COLOSIO, M.

UNIVERSITY OF PAVIA

Muscle strength and power are essential components for maintaining functional ability in old age, especially in weight-bearing movements such as climbing stairs and rising from a chair. Adequate levels of muscle power are also essential to prevent and counteract deterioration of postural control and thus prevent falls. Disuse can drastically reduce muscle power in the lower extremities, compromising mobility and overall quality of life. Bed rest, which is a recognized experimental model for inducing substantial muscle dysfunction in a matter of weeks, markedly compromises muscle power

generation. This negative impact on neuromuscular function can be exacerbated when disuse is applied to aging muscle. In addition, it is often assumed that disuse may also decrease resistance to muscle fatigue due, at least in part, to disuse-induced changes in muscle energy and blood flow. However, human studies investigating disuse-induced changes in muscle fatigue endurance yield equivocal results, with approximately equal numbers of studies reporting a reduction in fatigue resistance, no change in fatigue resistance, and an increase in fatigue resistance. Finally, resistance and/or endurance training sessions performed after disuse promote recovery of muscle mass and power but may not restore muscle power to pre-disuse values in older individuals. This session will summarize recent data on the impact of disuse on performance fatigability in older adults and how training can mitigate or aid in the recovery of muscle strength and power. In addition, the presentation will explore new findings on the force-velocity-power relationship and performance fatigability obtained from the latest bed rest campaign, in which older adults were forced to stay in bed for 10 days and then trained with endurance exercise for 21 days.

THE IMPACT OF SEDENTARY BEHAVIOR AND BED REST ON PHYSICAL PERFORMANCE AND SIT-TO-STAND MUSCLE POWER IN MIDDLE-AGED AND OLDER PEOPLE

ALCAZAR, J.
UNIVERSITY OF CASTILLA-LA MANCHA

Muscle power is one of the best predictors of physical performance in a wide variety of populations, from young adults to older people. Changes in muscle power with age are well described in the literature, but the factors leading to these changes are poorly understood. Apart from the effect of age per se, lifestyle factors, such as sedentary behavior, may play an important role in the age trajectories of muscle power and physical performance, even independently of physical activity patterns. In this regard, not only the total amount of time spent in sedentary activities, but how this time is distributed throughout the day (e.g. morning vs. evening), or how often it is interrupted, may have a profound effect on muscle power and physical performance among middle-aged and older individuals. Furthermore, understanding the interaction of these patterns with physical activity and exercise training may improve the prescription and recommendation of different doses of physical activity and exercise training for each profile of sedentary behavior. These personalized strategies may prevent or minimize the loss of muscle power and functional capacity observed with aging and could be easily implemented using wearables. Thus, the present lecture will provide new insights into the relationship between different patterns of sedentary behavior, sit-to-stand muscle power and functional capacity in middle-aged people and older people, and the interaction with physical activity and exercise training. In addition, this presentation will share novel findings on the effects of severe sedentary behavior (bed rest) on sit-to-stand muscle power and physical performance in older people, and how these effects are regulated by the inclusion of an exercise-based pre-habilitation program and the implementation of an exercise-based recovery program.

NMES AS A COUNTERMEASURE TO LOSS OF MUSCLE MASS DURING BED REST AND HOSPITALIZATION

SUETTA, C.
RIGSHOSPITALET, UNIVERSITY OF COPENHAGEN

Loss of muscle mass represents a common phenotypic trait associated with bed rest, hospitalization, and critical illness. The repeated cycles of disuse-induced atrophy, followed by incomplete muscle recovery, have been proposed as a significant contributor to the development of sarcopenia, which in turn increases the risk of morbidity, dependency, and mortality. Nevertheless, there is a limited body of research that has endeavored to elucidate the molecular regulators of muscle mass loss in older individuals following bed rest. Consequently, the mechanistic drivers remain unresolved, and aside from resistance exercise, there are currently no effective therapeutic strategies to mitigate muscle wasting and loss of function in hospitalized patients. While Neuromuscular Electrical Stimulation (NMES) may not be as effective as resistance exercise, it could serve as an alternative for patient populations that are critically ill and/or challenging to mobilize. This presentation will explore the influence of age and sex on the effects of enforced bed rest and evaluate NMES as a potential countermeasure.

Invited Symposium

IS-MH03 How to exercise for the health of two generations? – international, evidence-based initiatives for the global promotion of physical activity during pregnancy and postpartum

EVIDENCE-BASED GUIDELINES ARE NOT ENOUGH... - HOW TO OVERCOME BARRIERS TO PHYSICAL ACTIVITY IN PREGNANT AND POSTPARTUM WOMEN?

SANTOS-ROCHA, R.
SPORT SCIENCES SCHOOL OF RIO MAIOR - POLYTECHNIC INSTITUTE OF SANTARÉM

The level of physical activity during pregnancy is a multigenerational public health issue. Updated scientific studies have been supporting the positive multifactorial effects of an active lifestyle with regard to the prevention and treatment of pregnancy-related complications and determined health problems, such as gestational diabetes, gestational hyperten-

sion, obesity, low back pain, urinary incontinence, anxiety or depression, as well as regarding its effectiveness in maintaining fitness and functionality, and in improving postpartum recovery. Practice and clinical guidelines have become an increasingly popular tool for synthesis of evidence-based information to assist practitioners and patients/participants decisions related to start or continue physical activity. These guidelines should be widely used to enhance educational effectiveness and improve health outcomes for pregnant and postpartum women. Several official evidence-based recommendations on physical activity during perinatal period have been issued and updated over the last five years. Yet, these documents lack information on practice regarding the best strategies to promote, implement and ensure adherence to tailored exercise programmes for pregnant and postpartum women. On the other hand, the prevalence of physical inactivity is still high in this population. Certainly, this is largely influenced by the same factors that are responsible for the general trend of inactivity in todays society. However, beliefs passed down from generation to generation still play an important role here, often stronger than arguments supported by scientific knowledge. Further, most women do not receive proper guidance on how to exercise during pregnancy or after childbirth. The aim of this lecture is to present the design and outcomes of an education and research-based initiative: The Active Pregnancy Project. This project focuses on improving women's health and fitness during pregnancy and after childbirth. The four aims of the project are: 1) To implement educational tools for women, exercise and health professionals, based on updated guidelines and evidence on the positive impact of exercise during pregnancy and in postpartum; 2) To build and implement friendly-use and effective virtual tools promoting exercise during pregnancy and in postpartum; 3) To develop and assess the impact of multicomponent exercise programmes delivered in-person and online to improve maternal physical activity, fitness, and health parameters; 4) To assess the impact of exercise and healthy lifestyle on the prevention of common pregnancy and postpartum complaints and diseases. The target audience of this lecture are: researchers interested in analysing the impact of physical activity on the course of pregnancy, childbirth and postpartum period, as well as exercise and health professionals and vocational training providers associated with the promotion of physical activity during pregnancy and postpartum.

HOW DID YOU EXERCISE BEFORE YOU WERE BORN? - THE BIOLOGICAL MECHANISMS IN INFANTS BEHIND THEIR POSITIVE ADAPTATIONS TO MATERNAL EXERCISE

MAY, L.
EAST CAROLINA UNIVERSITY

With the increasing rates of obesity in women of child-bearing age, it is critical to develop strategies to prevent the intergenerational cycle of obesity. Data suggests that maternal exercise positively influences pregnancy outcomes and metabolic health in offspring. However, much is not known about exercise metrics (frequency, intensity, time, type, volume, FITT-V) on placental and thus birth and infant outcomes. To elucidate the biological mechanisms behind positive adaptations to maternal exercise, we assessed FITT-V outcomes on placental, birth, mesenchymal stem cells (MSCs) from umbilical cords at birth, as well as infant health outcomes; women did aerobic, strength, combination (aerobic + strength), or no exercise for 24+ weeks of pregnancy. We hypothesized that increased maternal exercise FITT-V would be associated with improved placenta and birth outcomes, as well as improved infant cellular metabolism and body composition; we also hypothesized that infant fat at the cellular and whole-body level will be less in infants of exercisers compared to non-exercisers. We demonstrated that any maternal exercise mode improves placental health and birth outcomes; importantly, increased FITT-V is associated with improved placenta and birth measures. Further, cell metabolism is improved in infants from exercisers relative to cells of non-exercisers. Maternal exercise also decreased cellular fat and whole-body fat in infants of exercisers compared to infants of non-exercisers. Our data suggests that any maternal exercise mode programs improvements in infants at the cellular and whole-body level. Importantly, FITT-V is positively associated with improved placenta, birth, and infant health. These changes in placenta and offspring increase overall health and thus could decrease the propensity to develop obesity and associated metabolic conditions later in life. This lecture will discuss the outcomes of various experimental randomized controlled trials in pregnancy. Additionally, the details of how measurements can be collected during pregnancy, at birth, and follow-up with mothers and infants will be described. Furthermore, the presenter will also discuss international initiatives related to exercise during pregnancy. The American College of Sports Medicine (ACSM) "Special Interest Group for Pregnancy and Postpartum" from USA will be an example of how to attract various stakeholders to strengthen the potential of undertaken activities. There are many national and international organizations that share similar guidelines for exercise in pregnancy. Additionally, there are many projects related to this topic. Therefore, it is important to have opportunities to discuss and share ideas in order to work synergistically and collaboratively to advance the field of exercise and pregnancy in order to improve maternal and child health. The target audience of this lecture are researchers in the field of physical activity in pregnancy and exercise professionals.

THE NEW ERA OF PRE- AND POSTNATAL EXERCISE (NEPPE) PROJECT – HOW TO REACH OVER 40 COUNTRIES WITH THE EVIDENCE-BASED, ONLINE TRAINING FOR EXERCISE PROFESSIONALS?

SZUMILEWICZ, A.
GDANSK UNIVERSITY OF PHYSICAL EDUCATION AND SPORT

Exercise professionals should be able to plan and implement exercise programmes to facilitate the greatest health benefits for mothers and their children. Unfortunately, studies have shown that most of them present a low level of knowledge about pre- and postnatal physical activity. The lack of appropriate competences will certainly make it difficult to perform their professional tasks. In turn, unavailability of targeted exercise programmes may contribute to physical inactivity during pregnancy and after childbirth. Therefore, in the "The New Era of Pre- and Postnatal Exercise" (NEPPE) project we developed an evidence-based educational programme for exercise professionals. The aim of this lecture is to present how the

NEPPE training was organized and implemented. To strengthen the international context of the project, we used the life-long learning standards 'Exercise in Pregnancy and Postpartum', developed by the European sector organisation EuropeActive (EA). We also used the latest recommendations, scientific and practical achievements in the field of pregnancy and postpartum physical activity. Additionally, a key element was the inclusion of the basic assumptions of the EA 'Online provision of fitness services' qualification. The use of online tools allowed us to increase the area of our educational activities and reach 41 countries from 4 continents (Europe, Asia, Africa and the North America), including the least developed countries. An important result of the NEPPE training is that over 90% of graduates stated that the online mode of training was effective. In the initial theoretical test, they obtained an average of 72% ± 16, in the post-test 86% ± 8 correct answers. The results in the post test were statistically significantly better ($p < 0.000$). In the final assessment, the participants demonstrated also good level of practical skills in planning and implementing exercises for pregnant and postpartum clients. They obtained an average of 83% of the maximum score in preparing exercise programme, and 94% of the maximum score in conducting exercise sessions. We will present recommendations regarding online educational solutions and tools, starting from the recruitment process, through the implementation of classes, verification of learning outcomes, to programme evaluation. They are intended to provide a transparent process of acquiring professional competences, ending with obtaining a certificate that is reliable for various stakeholders. We will also discuss cultural issues that may determine the implementation of exercise programmes for pregnant and postpartum clients in different countries. A completely new, previously untouched topic will be the inclusion of people with disabilities in the area of physical activity in the perinatal period. The target audience of this session are educational institutions, both universities and vocational training providers, exercise professionals and scientists in the field of educational research.

Oral Presentations

OP-AP22 Force Velocity Profiling

THE FORCE-VELOCITY PROFILES OF 20-METER SPRINTS WITH HYDRAULIC RESISTANCE DEVICE: A THEORETICAL BACKGROUND FOR OPTIMAL RESISTANCE LOADS

SAŠEK, M., CVJETICANIN, O., ŠARABON, N.
UNIVERSITY OF PRIMORSKA: UNIVERZA NA PRIMORSKEM

INTRODUCTION: Resisted sprint training improves sprint acceleration performance [1,2], therefore it is commonly used as a training method for enhancing sprint speed [3]. However, the optimal magnitude of external loads for training remains debatable [4,5]. In practice various devices are employed to apply the resistance while sprinting, including sleds, motorised devices, pulley systems, or other friction-based assemblies [6]. Most devices, except from motorised and sleds, do not allow for horizontal force production assessment [7], hindering the adjustment of load towards the most optimal one [8]. Therefore, this study aimed to introduce a novel hydraulic resistance device (HRD), a cost-effective solution that enable precise application of resistance and measurement of performance during sprinting. Because the dynamics of resisted sprints with HRD remains unknown, this study assessed the differences in sprint velocity and force-velocity profiles with low, medium and hight HRD loads.

METHODS: Participants (28) performed three 20-m resisted sprints at low (~15 N), medium (~50 N) and high (~130 N) HRD resistance loads. Magnetic encoders and pressure sensors embedded in the HRD were used to acquire instantaneous sprinting velocity and control the resistance force magnitude, respectively. Maximal sprinting velocity (Vmax) was obtained, and the decrease in sprint velocity (Vdrop) with medium and high HRD load was calculated as a percentage of low load Vmax. Furthermore, the f-v profile variables (F0, V0, Pmax, and Sfv) of resisted sprints were calculated based on the resistance force produced by the HRD and sprint acceleration at particular HRD load. The effect of HRD resistance on Vmax and the f-v profile was tested with one-way ANOVA. To distinguish between low, medium and high HRD loads, Bonferroni post-hoc test was used. The significance level was set at $P<0.05$.

RESULTS: The Vmax under low HRD load ranged from a minimum of 6.07 to a maximum of 8.33 m/s. A significant effect of HRD load on Vmax were observed ($F1.4,38.6 = 947$, $P < 0.001$, partial $\eta 2 = 0.97$). When adding medium and high HRD loads, Vmax decreased for 10.7±3.3% and 32.9±6.5%, respectively ($p < 0.001$). The HRD load had a significant impact on all f-v profile variables. Post-hoc comparisons showed a steeper Sfv at a high load compared to medium and low (-110.0 vs. -87.9 vs. 78.2 N/kg/s/m, respectively), greater F0 at high and medium load compared to low load (9.6 vs. 9.1 vs 8.5 N/kg, respectively), and greater Pmax of low and medium loads compared to high load (16.4 vs. 16.5 vs 14.8 W/kg, respectively).

CONCLUSION: The Vdrop as a consequence of medium and high HRD loads is comparable to previously reported values in the literature [9], therefore, we encourage the utilization of hydraulic resistance for resisted sprint training purposes. Using a medium HRD load when aiming to target high power production during 20-m sprints is recommended, whereas high HRD loads are advised to increase horizontal force production capacity.

THE RATE OF FORCE DEVELOPMENT AS A DETERMINANT OF MAXIMAL THEORETICAL VELOCITY IN THE FORCE-VELOCITY RELATIONSHIP

BOCCIA, G.1,2, BRUSTIO, P.R.1,2, SALVAGGIO, F.3, PINTORE, A.1,2, GROSSIO, L.1, CALCAGNO, E.1, RAINOLDI, A.2,4, SAMOZINO, P.5

1 NEUROMUSCULAR FUNCTION RESEARCH GROUP, SCHOOL OF EXERCISE AND SPORT SCIENCE, UNIVERSITY OF TURIN, ITALY 2 DEPARTMENT OF CLINICAL AND BIOLOGICAL SCIENCES, UNIVERSITY OF TURIN, ITALY 3 DEPARTMENT OF N

INTRODUCTION: Rate of Force development (RFD) calculated at 50 and 100 ms represents the capacity to quickly produce force starting from a relaxed state during isometric contractions. The theoretical maximal velocity obtained from force-velocity (FV) relationship (V0) represents the capacity to produce force at high velocity during dynamic contractions. While these two capacities are intuitively close, their association has not been studied so far. We thus investigated the role of RFD and maximal voluntary force (MVF) on the theoretical maximal velocity (V0) and force (F0) of the knee extensors.

METHODS: Single-leg knee extensors were tested under isometric and dynamic conditions in 44 young adults (15 females). Participants performed two 5-s maximal isometric contractions to calculate MVF and 10 isometric burst-like contractions to compute RFD at 50, 100, and 150 ms and at peak. Then, a set of incremental-load knee extension maximal efforts were performed on a modified knee-extension isoinertial ergometer. Force and velocity were continuously measured and averaged over 80-to-140° knee angles to determine individual hyperbolic FV relationships.

RESULTS: FV relationships were well fitted by hyperbolic regression (r^2 from 0.983 to 0.993). Stepwise linear regression showed that isometric RFDpeak normalized to MVF was the main determinant of V0 ($R2 = 0.157$, $P = 0.006$) while MVF was the main determinant of F0 ($R2 = 0.362$, $P < 0.001$). Correlation analysis showed that RFD at 50ms ($R = 0.418$, $P = 0.003$) and RFD at 100 ms ($R = 0.313$, $P = 0.028$) correlated with V0, while RFD 150 ms correlate with F0 ($R = 0.583$, $P < 0.001$). The curvature of the FV relationship did not correlate with any RFD or MVF indexes.

CONCLUSION: When obtained from averaged values over knee extension, V0 (and not F0) is partially explained by muscle contraction quickness (i.e."explosive" force capacity). So, the capacity to produce force at high velocity partly depends on the capacity to rise quickly the force in the early phase of the contraction, suggesting that some underlying determinants of RFD would also affect V0.

RELATIONSHIPS BETWEEN SURFACE AND UNDERWATER SWIMMING WITH FORCE-VELOCITY PROFILE

GONZALEZ FRUTOS, P., GUIMARD, A., DE LA FUENTE, B., SEGOVIA, C., VEIGA, S.

UNIVERSITY FRANCISCO DE VITORIA

INTRODUCTION: The force-velocity profile (FVP) has shown a relationship with swimming performance (1). However, only 38% of French trainers evaluate strength and speed parameters for some exercises, possibly due to accessibility problems (especially due to price) to modern evaluation devices (2). Recent research has shown a relationship with sprint performance of the Bosco FVP, which is a simplified method that is easy to access and perform (3). Therefore, the objective of the study is to analyze the relationship of Boscos FVP with swimming performance, specifically surface and underwat

METHODS: Seventeen junior swimmers performed both swimming and jumping tests. Swimming test consists of six 25 m maximal sprints from a push start in surface (front-crawl) and underwater (undulatory) conditions with three minutes rest between repetitions and conditions (in random order). Jumping test consists of CMJ and a CMJ50 (CMJ with external loads equivalent to 50% of the swimmers´ bodyweight). The best of three attemps was selected for each jump. FVP50 was calculated using Bosco´s Index (FVP50 = CMJ50/CMJ*100).

RESULTS: Underwater condition showed higher mean 25 m times (16.96 ± 0.74 s vs 14.00 ± 0.86 s; $p < 0.05$) and fatigue index (4.50 ± 2.25 % vs 1.92 ± 0.90 %; $p < 0.05$). Surface swimming mean 25 m times showed very large ($r = - 0.73$, $p < 0.05$) and large ($r = - 0.63$, $p < 0.05$) relationship with CMJ (32.55 ± 5.04 cm) and CMJ50 (16.81 ± 3.12 cm) performance, respectively. Whereas underwater mean 25 m times only showed large ($r = - 0.51$, $p < 0.05$) relationship with CMJ performance. However, Bosco´s FVP50 (51.41 ± 3.64 %) only showed large relationship ($r = -0.58$; $p < 0.05$) with underwater swimming fatigue index.

CONCLUSION: This study highlighted that underwater swimming may require higher explosive strength (CMJ) to improve mean 25 m times, but higher Bosco´s FVP50 (strength profile) to improve fatigue index, as has been observed in field hockey players (3). However, surface swimming may require higher CMJ and CMJ50 to improve mean 25 m times, not finding a relationship with the fatigue index because swimmers in this condition maintained better performance (possibly related to the free breathing).

(1) Raineteau Y, Pla R, Bideau B, Bideau N and Nicolas G (2024) From dry-land to the water: training and testing practices of strength and conditioning coaches in high level French sprint swimmers. Front. Sports Act. Living 5:1338856. doi: 10.3389/fspor.2023.1338856

(2) Chalkiadakis, I.; Arsoniadis, G.G.; Toubekis, A.G. Dry-Land Force–Velocity, Power–Velocity, and Swimming-Specific Force Relation to Single and Repeated Sprint Swimming Performance. J. Funct. Morphol. Kinesiol. 2023, 8, 120. https://doi.org/10.3390/jfmk8030120

(3) González-Frutos, P.; Aguilar-Navarro, M.; Morencos, E.; Mallo, J.; Veiga, S. Relationships between Strength and Step Frequency with Fatigue Index in Repeated Sprint Ability. Int. J. Environ. Res. Public Health 2022, 19, 196. https://doi.org/10.3390/ijerph19010196

The present project was funded within Project PID2021-124392NA-I00 by MCIN/AEI/10.13039/501100011033 / FEDER, UE.

FORCE-VELOCITY RELATIONSHIP IN ROWING AND CONTRIBUTION TO PERFORMANCE.

BUSSENEAU, P.F., DELHAYE, C., MOREL, B., SIMON, F., MORNIEUX, G., BOWEN, M., SAMOZINO, P.
UNIVERSITÉ SAVOIE MONT-BLANC

INTRODUCTION: Rowing performance depends on both capacities to produce high level of power output and to maintain it over time. The contribution of maximal capacities has been studied using force- or load-velocity relationships during squat and bench pull movements with good correlations between maximal power or force at low velocity with rowing performance (1,2). Yet interesting, these maximal capacity indexes have not been assessed during a rowing movement characterized by specific body configurations and coordination. Force-velocity (FV) relationship during rowing has just been explored once using a very specific ergometer (3), which has prevented from routine testing. The aims of this study were thus to test i) the feasibility to determine FV relationship during rowing using an usual rowing ergometer, and ii) the association between FV variables and rowing performance for different rower levels.

METHODS: 59 rowers (from regional to Olympic rowers) performed 3 tests of 8 maximal strokes (with same range of motion) on a rowing ergometer (RowErg, Concept 2) instrumented with of force sensor between the handle and the chain and an incremental encoder on the outside nylock nut. The 3 tests were performed against 3 different resistances: i) maximum and ii) medium flywheel drag, and ii) minimum drag with flywheel covered by a plastic bag. Force, velocity, and power were averaged over each propulsion phase and then used to determine FV relationship from which were computed the theoretical maximal force (F0), velocity (V0), and power output (Pmax). Rowing performance was defined as the mean power over the last 2000m rowing test.

RESULTS: FV relationships were well fitted by linear regression (median r^2=0.981 [0.951-0.996]) with 10.6±2.4 experimental points covered 32.1±6.1% of the curve in the middle of the spectrum. F0, V0 and Pmax values were 1322±258, 3.50±0.33 and 1164±278, respectively. Mean power performance on 2000m rowing (362±90 W) test is strongly positively correlated to Pmax whatever the level (r = 0.61 to 0.90; $p<0.013$). Stepwise regressions analysis showed that both F0 and V0 contributed to explain variance in performance, with different magnitudes regarding the rowers' level (r^2 = 0.28 to 0.80).

CONCLUSION: FV relationships can be accurately determined during a rowing movement using an usual ergometer instrumented by force and velocity sensors. This makes possible routine testing of rowing-specific power and force capacities. Yet highly related to endurance qualities, rowing performance was shown to be highly correlated to maximal power, notably due to high association with force capacities at both low and high velocities. Although the magnitude of these correlations tended to decrease when athlete's level increased, this underlines the importance of neuromuscular qualities in rowing performance.

STATISTICAL PARAMETRIC MAPPING REGRESSION ALLOW TO IDENTIFY THE AREA OF FORCE-VELOCITY-ENDURANCE PROFILE RELATED TO THE SPORT PERFORMANCE IN ELITE ATHLETES.

MOREL, B., BOWEN, M., VONDERSCHER, M., DELHAYE, C., BUSSENEAU, P.F., DI DOMENICO, H., BLERVAQUE, L., MESSONNIER, L., SAMOZINO, P.
UNIVERSITÉ SAVOIE MONT BLANC

INTRODUCTION: A model has recently been proposed to describe the individuals force capacities as a function of movement velocity and exercise duration simultaneously [1]. This force-velocity-endurance (FoVE) profile of an athlete can be assessed during a 3-min all-out test modified to include regular assessments of force-velocity capacities all over the test. Statistical parametric mapping (SPM) can be used to analyse data with multiple dimensions (>1) [2]. It is, for instance, possible to run SPM regression analysis. The aim of this study was therefore to identify the area of the FoVE profile that most correlated with sports performance in elite athletes for 2 disciplines being rowing and ski mountaineering.

METHODS: The same approach was used in two groups of elite athletes from the rowing (n=17, 4 women) and ski mountaineering (n=18, 7 women) national teams. Firstly, the FoVE profiles were assessed using the IFLET test [1] performed on a rowing ergometer for rowers and a cycling ergometer for skiers. To compare the profiles with sport performance, the best performance of the year (i.e. time) over 2000m was considered for rowers and the time at the national vertical race championships was used for skiers. SPM regression was performed to determine the correlation between performance being a scalar and the 3D FoVE profiles. The 5 percentiles most correlated with performance were retained for further analysis.

RESULTS: The goodness of fit of the FoVE profiles were excellent (median r^2 = 0.95). The mean performance over 2000 m was 378 ± 23 s for the rowing group. The mean vertical run time was 22 min 4 s ± 2 min 4 s for the skiers group. SPM regression revealed that the top 5 percentiles of the FoVE profiles were highly correlated and had a low root-mean-square error (RMSE) with sport performance for both sports (r^2 = 0.88 and RMSE = 2.2%; r^2 = 0.83 and RMSE = 5.4% for rowers and skiers, respectively). In addition, the FoVE area most correlated with performance differed between the disciplines. The centroid of the area was for a velocity of 31% of maximum initial velocity and 1.3 Tau in rowing and 50% of maximum initial velocity and 6.3 Tau for ski mountaineering.

CONCLUSION: For the two disciplines tested, and despite a particularly homogeneous population (all were elite athletes in the national team of their sport, including world champions and Olympic champions), a specific area of the FoVE profile correlated very strongly with sport performance. This opens up particularly interesting perspectives for individualised training. Indeed, based on the proposed approach, it is possible to simulate the performance benefits of training that specifically targets force or velocity capacity in the initial or fatigued state, in order to tailor training to optimise performance.

[1] Morel et al. (2023) ECSS.
[2] Pataky et al. (2010) J. Biomech.

Oral Presentations

OP-BM14 Modelling and Simulation

OPTIMIZING THE SKELETAL MUSCLE MODELING IN OPENSIM BASED ON SEMI-PHENOMENOLOGICAL MODEL OF SARCOMERE: A CASE OF BICEPS FEMORIS LONG HEAD

XU, Y., GU, Y.
NINGBO UNIVERSITY

INTRODUCTION: Several biomechanical models for skeletal muscles have seen extensive use. Nonetheless, the model employed in sports biomechanics relied on a non-dynamic equation and was only applicable under quasi-static conditions. This research seeks to develop a skeletal muscle model based on the semi-phenomenological model (SPM) of a sarcomere and employ it in dynamic modeling utilizing the results of kinetic calculations in OpenSim. Subsequently, it aims to validate the precision and dependability of the SPM by comparing joint moment calculations based on the SPM in OpenSim and gravitational resis

METHODS: In this study, the biceps femoris long head was selected as the subject. Kinetic data, sEMG signals, and external joint moments were recorded, collected, computed, and analyzed. The One-dimensional Statistical Parameter Mapping (SPM1D) algorithm was utilized to compare the net knee bending moment and mechanical output calculated in the SPM and OpenSim models through a paired t-test at a significance level of 0.001. The calculated actual knee bending moment served as the reference standard. Correlation analysis was conducted to compare the average joint moments and average mechanical work output calculated by OpenSim tools with the mass of body segments and the sarcomere SPM at each time step.

RESULTS: The SPM significantly decreased the error in joint rotation moment but did not show a significant reduction in the error in the calculation of mechanical work output at each time step. The SPM demonstrated an advantage in calculating instantaneous power, with a negligible difference compared to real instantaneous power output, and improved the accuracy in computing total mechanical work output by reducing the error rate to 43.1%.

CONCLUSION: The results showed that the SPM-based biomechanical algorithm significantly reduced errors in joint rotation moment calculations compared to the traditional Hill-type model in OpenSim, particularly in dynamic contraction conditions. The SPM also exhibited a better transient response, recovering and declining muscle force more quickly. These advantages can be attributed to the SPMs modeling principles, which assume equal time constants for muscle activation and inactivation, resulting in faster muscle force predictions. However, when it comes to the calculation of mechanical work output, both the Hill-type model in OpenSim and the SPM showed no statistically significant difference in error. This aligns with the principles of both models and the studys experimental design. It is worth noting that the complexity of muscle contraction energy output is influenced by factors like action potential frequency, movement type, and muscle activation timing. While the SPM has shown effectiveness in previous experiments, caution should be exercised when applying these results, as the validation data came from insect muscles. In conclusion, the skeletal muscle modeling based on the SPM of sarcomere appears to be a better approach for biomechanical research.

INVESTIGATING THE BIOMECHANICAL IMPLICATIONS OF VARIED PUSH-OFF ANGLES ON METATARSAL AND METATARSOPHALANGEAL JOINTS IN SPEED SKATING

HAICHUN, W., XIAOLAN, Z.
BEIJING SPORT UNIVERSITY

INTRODUCTION: The metatarsal bones, integral components of the metapodial complex, play a critical role in the transmission of stress and serve as a pivotal element in the attenuation of axial loads in speed skating. Conventional biomechanical approaches have demonstrated proficiency in characterizing the impact of technical manoeuvers on foot kinetics; however, they fall short in shedding light on the internal mechanical repercussions instigated by variations in biomechanical parameters. This significantly constrains the advancement of principled analysis aimed at enhancing the technical manoeuvers in speed skating. The objective of this investigation was to develop a sophisticated three-dimensional (3D) finite element model (FEM) of the foot in conjunction with a speed skate to examine the mechanical behaviour of the metatarsal and metatarsophalangeal joints under various loading conditions.

METHODS: A 3D FEM was reconstructed utilizing data from computed tomography and 3D scanning. The models validity was ascertained through the comparison of FEM-predicted outcomes with in vivo measurement data. The FEM was subjected to push-off angles derived from video analysis of an elite skater, with angles set at 42°, 49°, 56°, 63°, and 70°, respectively. Boundary conditions and loading parameters for the FEM stipulated that the distal ends of the tibia and fibula, along with the associated soft tissues, were fixed. The displacement of the ice surface was constrained in all four cardinal directions. The applied forces included a ground reaction force and an Achilles tendon force, quantified at 640N and 480N respectively, while the frictional force between the ice surface and the skate blade was set at a coefficient of 0.003.

RESULTS: The error rates of validation of plantar soft and blade bottom were less than 10%. During the skating propulsion phase, maximal stress is localized at the fifth metatarsal, with the third metatarsal experiencing the least. A decrease in the push-off angle correlates with reduced stress in the first and second metatarsals and increased stress from the third to fifth metatarsals. The most significant stress fluctuations are observed in the first and fifth metatarsals, with changes of 5.229 MPa and 6.379 MPa, respectively. Additionally, the stress at the first and second metatarsophalangeal joints decreases correspondingly, with variations of 0.011 MPa and 0.004 MPa.

CONCLUSION: The alteration in the angle of push-off exerts a discernible influence on the mechanical behaviour of the Metatarsal and Metatarsophalangeal Articulations. These findings offer fresh insights into the biomechanics of skating, potentially guiding the design of sports equipment and the refinement of training programs.

THE ROLE OF METATARSAL BONE DURING THE OLLIE LANDING

YUSEN, W., HAICHUN, W., CHENG, D., YANGYU, G., XIAOLAN, Z.
BEIJING SPORT UNIVERSITY

INTRODUCTION: Ollie has been placed as the focal point since its representativeness of low level stunts among all skateboarding maneuvers. Accompanying by technique advancing, the multi-body dynamics model was used for detecting Ollie's jumping action as well. As previous studies reported that shock attenuation can be realized by changing the shape of longitudinal and transverse arch. However, we don't know whether the metatarsal's (MT) role and trend in skateboarding are consistent with other sport ls. Accordingly, finite element method was used in this study on the purpose of investigating internal movement and shock-absorbing mechanism of MT in the Ollie landing motion.

METHODS: A male skateboarder was recruited. The experimental shoes and skateboard are ES skateboard shoes and 8.0-inch street skateboard. The program was approved by the Ethics Committee of Beijing Sport University (2023143H). We used the CT scanner and the 3D laser scanner to acquire the image. Model extraction and restoration were performed at Mimics 21.0 and Geomagic Studio 2013. The model was verified by comparing the plantar pressure of simulation with the measurement of natural standing condition. The subject performed Ollie movement via the Pedar system to obtain the planter force-time curve (F-T curve). the F-T curve through removing the noise directly, three characteristics were found: the moment of touching the ground (T1), the moment of the peak of the plantar force (T2) and the moment of the trough of the plantar force (T3). Loading the data into the FE model and restore the Ollie landing action.

RESULTS: The result error was approximately 6.98% comparing the measuring outcome and model simulation of peak plantar pressure when subject stood on the skateboard, which were 125kPa and 116.27kPa respectively, and all positioned in the heel. The largest figure of stress peak (1.126MPa) at T1 occurred in MT3. The stress of MT4 at both T2 and T3 were the highest, peaking at 23.211 MPa and 29.161 MPa respectively. The changing trends of peak stress of MTs were the same, namely the tendency of MT1 to MT5 were gradually increasing from T1 to T3 and eventually peaking at T3. During landing, the twisting angles of MT1 and MT2 changed greatly, the medial part of the foot moved downward, and the transverse arch of the foot collapsed. This alteration represented that MTs were withstanding changed impact force at T2 and T3. When cushioning, the sagittal plane of MT2, MT3 and MT4 shifted more. The displacement of medial MT1 was greater than that of lateral MT5, accompanied by midfoot and medial downward displacement and transverse arch collapse.

CONCLUSION: During Ollie landing, the transverse arch of the foot has tendons to collapse, by sinking the medial metatarsal bone to achieve the purpose of delaying the impact. The main load-bearing site is in the middle metatarsal bone(MT2, MT3,MT4), which is subjected to a large vertical axial load. The first and fifth metatarsal bones are mainly auxiliary to prevent lateral migration.

COMBINING POSE ESTIMATION AND INERTIAL MEASUREMENT TRACKING DATA FOR A BIOMECHANICAL SIMULATION OF RIVER WAVE SURFING USING OPTIMAL CONTROL

WEISS, A., MASMOUDI, I., HEINRICH, D., KOELEWIJN, A.
FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG

INTRODUCTION: River wave surfing is gaining traction as a land-based alternative to ocean surfing. However, its complexity and dynamics present challenges in sensor selection for biomechanical analysis, which is valuable for optimizing performance and preventing injuries. We have developed an optimal control-based approach to simulate movements based on inertial measurement units (IMUs), but it did not yet achieve robust results on three-dimensional (3D) motions (1). Human pose estimation, however, can do spatial tracking precisely, but it is limited by occlusions, changing lighting conditions, and capture volume (2). Inspired by (3), we therefore extended our simulation approach by integrating IMU data with pose estimation data. Here, we investigate if this approach can provide insights into kinematics and kinetics of river wave surfing.

METHODS: One participant surfed back and forth in a river wave. He was equipped with ten IMUs, which were aligned to the corresponding body parts via calibration movements (1). Additionally, his movements were recorded from four viewpoints with RGB cameras, synchronized with the IMUs. Nine surf cycles, including a front and a back turn, were identified from the gyroscope data. From the camera recordings, we predicted planar joint angles using RTMPose (4), and from that 3D joint angles through MotionBERT (5). We then created surfing simulations by solving optimal control problems (1, 6) on a 3D musculoskeletal model (1). In this optimal control problem, we tracked the camera-based joint angles and the raw accelerometer and gyroscope data from the IMUs. The interaction between the board and water was adjusted from

skiing simulations (6). We then analyzed the kinematic and kinetic differences in the hip and knee between front and back turns, and between the front and rear stance leg within each surf cycle.

RESULTS: Comparing front and back turns, we found minor differences in peak hip (front: 56.4°, back: 57.2°) and knee (front: 65.8°, back: 64.5°) angles and hip (front: 27.9 Nm, back: 25.5 Nm) and knee (front: 51.4 Nm, back: 44.5 Nm) moments. The joint moments were higher in the rear leg, on average 36.9% higher in the knee (87.6 Nm vs. 64.0 Nm), and 3.5% higher in the hip (32.6 Nm vs. 31.5 Nm). The absolute peak flexion angle was 22.3% higher in the hip of the front leg (58.7° vs. 48.0°), while it was 10.8% higher in the knee (69.8° vs. 62.9°).

CONCLUSION: Our results provide the first biomechanical simulations of river wave surfing. We found that the peak joint angles of the front leg are higher, while the joint moments are on average increased in the rear leg joints. That indicates that strength is more important for the rear leg while flexibility is an important ability for the front leg.

REFERENCES:

1) Nitschke et al., Front. Bioeng. Biotechnol., 2024

2) Zheng et al., ACM Comput. Surv., 2023

3) Pearl et al., J. Biomech., 2023

4) Jiang et al., ArXiv.org, 2023

5) Zhu et al., ArXiv.org, 2022

6) Heinrich et al., Front. Bioeng. Biotechnol., 2022

DON'T LISTEN TO YOUR HEART DURING ANKLE TARGET-MATCHING TASKS

NÉGYESI, J., YUAN, K., NAGATOMI, R., HORTOBÁGYI, T.

HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: Measurement of joint position sense (JPS) is a widely used method to determine the proprioceptive function of a joint. Considering that both emotions and soft tissue compression via compression garments (CGs) can affect heart rate variability (HRV), we hypothesized that emotions evoked by classical music pieces can affect ankle target-matching accuracy differently in the presence vs. absence of a CG.

METHODS: Thirty-five participants were randomly assigned to 4 groups and performed ipsilateral-, and contralateral ankle JPS tasks with and without and above knee CG while listening to pieces of classical music deemed to evoke sad, neutral, or happy emotions. The 4th group received white noise via the headphones. Target-matching errors (absolute, constant, variable JPS), HRV, and EMG activation of 3 muscles were measured, however, the current abstract reports only the JPS and HRV data. Statistical analyses included mixed ANOVAs with planned Bonferroni post-hoc tests. Statistical significance was set at $p < 0.05$.

RESULTS: There were no Group main or interaction effects in absolute and constant error of JPS. In contrast, there was CG • Leg • Group interaction effect ($F_{3,36} = 4.8$, $p = 0.006$, partial eta squared = 0.287) suggesting that emotions evoked by classical music pieces affected variable JPS errors during contralateral target-matching tasks in the absence of CG. Post-hoc analysis revealed that participants listening to happy vs. sad music ($p < 0.001$, $d = 2.09$) or white noise ($p = 0.020$, $d = 1.65$) performed the task with a less constant target-matching strategy. On the other hand, statistical analyses on the HRV data revealed only a Leg main effect ($F_{1,36} = 7.2$, $p = 0.011$, partial eta squared = 0.166) suggesting that participants performed contralateral target matching tasks with larger HRV when matching with their dominant vs. non-dominant ankle joint, regardless of Group.

CONCLUSION: Overall, emotions evoked by auditory input seem to affect the variability of contralateral ankle target-matching accuracy of the dominant leg in the absence of a CG, however, HRV adaptation does not underlie these mechanisms.

Oral Presentations

OP-PN22 Endurance Physiology II

ANAEROBIC CAPACITY ASSESSMENT IN CYCLING: RELATIONSHIPS BETWEEN POWER-DURATION PARAMETERS AND MAXIMAL ACCUMULATED OXYGEN DEFICIT, MAXIMUM BLOOD LACTATE, AND THE FORCE-VELOCITY PROFILE

MORALES-ARTACHO, A., ROUSSEAU, Q., RABITA, G.

INSTITUT NATIONAL DU SPORT, DE LEXPERTISE ET DE LA PERFORMANCE

INTRODUCTION: The hyperbolic relationship between power output and time to exhaustion allows for the estimation of both critical power (CP) and the curvature constant of such a relationship (W'). The latter theoretically represents a fixed amount of work that can be performed above CP, and increasing evidence is highlighting its relevance as a performance determinant in short or intermittent endurance events requiring high anaerobic capacity. However, while previous research has shown relevant links between W' and several muscle physiological and morphological parameters, a holistic exploration of its relationship with common physiological and functional anaerobic capacity measures remains to be

done. Accordingly, this study investigated the relationship between CP and W' with maximal accumulated oxygen deficit (MAOD), maximal post-exercise lactate concentration and the force-velocity profile (Fmax, Vmax, Vopt, Pmax).

METHODS: Eleven healthy trained triathletes (31.2±8.15years, 69.2±5.87kg, 180±5cm, 63.2±3.5ml/kg/min VO2max) performed four separate time-to-exhaustion (TTE) trials. Four different models (2-parameter hyperbolic, 3-parameter hyperbolic, linear, and linear 1/time) were used to compute CP and W. Maximal accumulated oxygen deficit was estimated during a supramaximal TTE trial performed at 100% of peak power output, and blood lactate concentration was assessed 30 minutes post-effort. Fmax, Vmax, Vopt and Pmax were computed from the force-velocity relationship.

RESULTS: Moderate-to-large significant Pearson correlation coefficients were observed among W' linear and 1/Time (16632±4448 and 13810±45 Joules, respectively), MAOD (54.9±11.5 ml/kg), Pmax (1041±183 W), and peak lactate concentration (13.1±3.4 mmol/L; $r > 0.63$, $P < 0.05$). Regardless of the model, no significant correlations were observed between these parameters and CP.

CONCLUSION: The magnitude of W' appears to be linked to the anaerobic capacity of moderately trained cyclists, as estimated from MAOD and post-exercise lactate accumulation measures following a supramaximal TTE effort. In line with previous research, the maximal power capabilities estimated from the force-velocity relationship seem also to be linked to W'. These findings provide useful information when it comes to evaluate anaerobic capacity in cycling. Further investigation will help to gain a deeper understanding of these links and their underlying mechanisms.

RELATIONSHIP BETWEEN VARIOUS PHYSIOLOGICAL DETERMINANTS OF ENDURANCE PERFORMANCE IN ELITE TRIATHLETES

TRISKA, C., ERNST, J., SOUKUP, C., SCHARNER, M., POWOLNY, V., MATHY, A.
LEISTUNGSSPORT AUSTRIA

INTRODUCTION: The apex of the fat oxidation curve (FATmax) as well as maximal fat oxidation rate (MFO) serve as indicators for metabolic health and performance [1]. Among others, peak oxygen uptake (VO2peak) and gross efficiency (GE) also represent key determinants for endurance performance [2]. A relationship of these parameters is debatable and there is a lack of data in elite athletes and therefore, the aim of this work was to assess a potential relationship between parameters of fat oxidation and VO2peak as well as GE in a cohort of elite triathletes.

METHODS: Fourteen male elite triathletes (stature 1.83 ± 0.06 m, body mass 71.2 ± 5.5 kg, incremental peak power output: 5.4 ± 0.2 W/kg) were recruited for this study. Participants performed a graded exercise test on a cycle ergometer (Cyclus2, RBM electronics, Germany) where respiratory gases were measured continuously (MetaMax 3B-R2, Cortex Biophysik GmbH, Leipzig, Germany). The test commenced at 80 W and load was increased by 40 W every 4 min. VO2 and carbon dioxide (VCO2) data were used to calculate fat oxidation according to [3] and the highest measured value for fat oxidation was accepted as FATmax [4]. FATmax was expressed relative to VO2peak. GE was calculated using VO2 and VCO2 data obtained from the last minute of the stage that corresponded to FATmax intensity. Pearson moment correlation was used to assess the strength of any relationship between FATmax (%VO2peak) and VO2max (mL/min/kg), between FATmax (%VO2peak) and GE, and between VO2peak (mL/min/kg) and GE. Standard errors of the estimates were calculated for significant correlations and significance was accepted at $p < 0.050$.

RESULTS: Mean ± SD were 62.4 ± 6.5%, 21.4 ± 1.0%, and 68 ± 5 mL/min/kg for FATmax (%VO2peak), GE, and VO2peak, respectively. Significant correlations were found between FATmax and VO2max ($p = 0.016$; $r = -0.631$, SEE = ±5.2%) and VO2peak and GE ($p = 0.010$; $r = -0.664$; SEE = ±0.8%), but not between FATmax and GE ($p = 0.106$; $r = 0.451$).

CONCLUSION: Present results indicate a strong negative relationship between FATmax intensity and VO2peak, but merely a moderate and non-significant relationship between FATmax intensity and GE. This suggests that a higher aerobic power is associated with a lower relative intensity of maximal fat oxidation, but no association exists between GE and FATmax. Data therefore confirms an inverse relation between VO2peak and the intensity where the highest fat oxidation occurs. This inverse relationship, however, questions the notion of the non-trainability of FATmax. In accordance with previous published work in cyclists a strong negative relationship was found between GE and VO2peak in a cohort of elite triathletes [5].

References:

[1] Jeukendrup & Achten, 2004, Nutrition

[2] Joyner & Coyle, 2008, J Physiol

[3] Jeukendrup & Wallis, 2005, Int J Sports Med

[4] Achten et al., 2002, Med Sci Sport Exer

[5] Lucia et al., 2002, Med Sci Sport Exer

PERFORMANCE AND PHYSIOLOGICAL RESPONSES DURING CONCURRENT MAXIMUM INTENSITY AND THRESHOLD TRAINING SETS SEQUENCE IN SWIMMING

TOUBEKIS, A., NIKITAKIS, I., PARADISIS, G., BOGDANIS, G.
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Combining training sets of various intensities in the same session is a common practise in swimming. Previous studies have examined the effect of set sequence in sessions that combine aerobic-dominated training sets and

sprint intervals [1,2]. However, training sets planned to enhance anaerobic power may also be applied following aerobic training sets and vice versa. The aim of the study was to investigate the effect of the applied sequence of anaerobic power and threshold training sets on performance, metabolic responses and training load.

METHODS: Twelve male swimmers (19±3 years) performed 25 m swimming at maximal effort to evaluate maximal speed. On a subsequent day they completed an incremental intermittent protocol (5x200 m) to calculate the speed corresponding to the lactate threshold (sLT). Based on the preliminary tests, training sets of 8x200 m at sLT separated by 30 s of recovery (set A) and 8x25 m at maximal speed separated by 2 min of recovery (set B) were planned. In two randomized order sessions all swimmers completed the following set sequences: i) set A followed by set B (A-B), ii) set B followed by set A (B-A) with 10 min of passive recovery between sets. Time to complete each repetition was recorded continuously. Blood lactate (BL) was determined at the start, middle and the end of each set. The area under the BL curve was calculated. Blood pH, base excess (BE) and bicarbonate (HCO3) were determined before and after each set. Session-RPE was recorded 30 min after the completion of each session and was used to calculate training load (TL).

RESULTS: Performance in each set separately was not different between sessions regardless of sets sequence ($p>0.05$). Mean BL in set A was higher in B-A session compared to the reverse order (A-B: 3.5±1.6, B-A: 6.8±3.1 mmol/L, $p<0.05$). However, BL in set B was similar between sessions ($p>0.05$). In B-A session, mean BL was higher compared to A-B (BL: A-B: 5.3±3.7, B-A: 6.3±3.6 mmol/L, $p<0.05$). The area under the BL curve was higher in B-A session (A-B: 182.3±79.0, B-A: 284.0±108.3 mmol/L×min, $p<0.05$). pH and BE of the entire A-B session was not different compared to B-A session (pH: A-B: 7.34±0.08, B-A: 7.33±0.08, BE: A-B: -5.4±6.4, B-A: -6.9±6.1 mmol/L, $p>0.05$) while HCO3 was lower in B-A session compared to the reverse sequence (A-B: 20.4±5.2, B-A:19.0±4.9 mmol/L, $p<0.05$). Acid-base parameters in each set separately did not change irrespective to the set sequence ($p>0.05$). TL was higher in B-A session (A-B: 224.3±61.3, B-A: 258.3±44.3 a.u., $p<0.05$).

CONCLUSION: Training sets sequence does not affect performance in each set separately but may influence the entire session metabolic responses. The longer time spent with high metabolic disturbance may cause higher training load induced when anaerobic power training set in preceded.

1. Nikitakis et al., 2023, Sports, 11(12):240.

2. Nikitakis et al., 2023, Int J Sports Physiol Perf, 19(1):53-61.

MAXIMAL OXYGEN UPTAKE, HAEMOGLOBIN MASS AND BLOOD VOLUME RELATIVE TO FAT-FREE MASS IN ELITE ENDURANCE ATHLETES COMPARED WITH UNTRAINED INDIVIDUALS.

HALLÉN, J., LUND-HANSEN, M.

NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Endurance-trained (ET) individuals have higher maximal oxygen uptake (VO2max), blood volume (BV) and haemoglobin mass (Hb-mass) compared with non-endurance-trained (non-ET) individuals and endurance training has been found to increase these variables. Most studies comparing VO2max, BV, and Hb-mass between ET and non-ET individuals, as well as males and females, typically adjust for differences in body mass (BM). However, Hb-mass and BV are strongly associated with fat-free mass (FFM) and VO2max are associated with Hb-mass. Since ET individuals tend to have lower body fat percentages than non-ET individuals, some of the differences in VO2max, Hb-mass and BV are attributed to differences in body composition. This study aimed to investigate the impact of body fat percentage on the difference in BV, Hb-mass and VO2max between ET and non-ET individuals.

METHODS: Forty-seven international and national level endurance athletes (ETA; 33 males; age 24.0±5.0 yrs; VO2max 73 and 65 mL/kg/min for males and females) and 34 controls (CTR; 22 males; age 27.9±4.8yrs; VO2max 54 and 48 mL/kg/min for males and females) were tested for VO2max, Hb-mass (CO-rebreathing), BV and anthropometrics (DXA). The ETA engaged in endurance training 8-12 times a week using running, skiing, and biking throughout the year. The CTR mostly did not train endurance, and those who did, trained less than once a week. Differences between groups were tested with Students t-Test and values are mean±SD.

RESULTS: Fat percentages were 12.9±3.6 and 20.2±7.2 for male ETA and CTR, and 20.3±3.9 and 28.5±6.7 for female ETA and CTR. The differences in VO2max between ETA and CTR were ~35% relative to BM and ~25% relative to FFM, similar for males and females. Importantly, the difference in VO2max between males and females was reduced in ETA from 16% ($p<0.001$) to 5% ($p=0.035$) and in CTR from 13% ($p=0.015$) to 3% (p=ns). Female ETA had 17.0% and male ETA 17.9% higher Hb-mass relative to BM than CTR (females 11.0±1.2 vs 9.4±1.1 g/kg, $p=0.001$; males 13.5±1.1 vs 11.5±1.1 g/kg, $p<0.001$). Relative to FFM, female ETA had 6.3% and male ETA 8.1% higher Hb-mass than CTR (females 13.6±1.1 vs 12.8±1.0 g/kg, $p=0.067$; males 15.2±1.0 vs 14.1±1.0 g/kg, $p<0.001$). The same picture is true for BV with the differences between ETA and CTR reduced by approximately 50% when expressed relative to FFM compared to relative to BM.

CONCLUSION: The difference in fat percentage explains the entire difference in VO2max between non-ET males and females and about 66% of the difference in VO2max between ET males and females. Also, 30% of the difference in VO2max between ET and non-ET individuals is explained by the difference in fat percentage. Similarly, more than 50% of the differences in Hb-mass and BV between ET and non-ET individuals are explained by the differences in fat percentage. Hence, when comparing VO2max and intravascular volumes between groups (i.e. trained vs untrained and males vs females) these variables should be related to FFM rather than BM.

SPEED FLUCTUATION DURING A 10 KM RUN AFFECTS SUBJECTIVE EXERTION AND BLOOD LACTATE LEVELS OF WORLD-CLASS ATHLETES.

TAKII, Y., SUMI, D., MATSUNAGA, R., KO, Y., MARCORA, S., TANIGUCHI, N., SAKAGUCHI, M.
ASICS CORPORATION

INTRODUCTION: In long-distance time trials, a constant pace strategy is considered the fastest [1]. However, elite marathon runners fluctuate their speed during the race [2]. The effects of such speed fluctuations on the physical and mental states of the athletes remain unclear. The purpose of this study was to determine the effect of speed fluctuation during a race-simulated 10 km run on the biomechanics, physiology and psychology of world-class distance runners.

METHODS: Nineteen elite male and female athletes, who have ever been ranked 1-175th in the highest positions of World Athletics Rankings for either road running, marathon, cross-country, or 1500m, participated in this study. They were divided into four groups based on sex and the latest available seasonal best. A circuit course was set up in Plaza de America, Seville, Spain. In the constant (CON) condition, the athletes ran 10 km at a speed set for each group, which was calculated as 90% of the average speed of their seasonal best times within each group. In the fluctuating (FLU) condition, they ran 10 km at speeds fluctuated ±11-12% around the average speed. Blood lactate levels and the height of counter movement jump (CMJ) were evaluated before and after the run and calculated as percentage changes. Heart rate (HR), cadence and step length were measured during the run and averaged during 8-15 of 16 laps. The ratings of perceived exertion (RPE) were measured at the end of laps 4, 8, 12, and 16 using Borg's CR10 scale. The session RPE was obtained right after the 10 km run.

RESULTS: The mean speeds for each group were 5.48±0.03, 5.30±0.07, 4.95±0.06, and 4.62±0.07 m/s in the CON condition and 5.47±0.17, 5.27±0.11, 4.94±0.06, and 4.58±0.04 m/s in the FLU condition. The completion time was 33:21±2:11 and 33:30±2:09 for the CON and FLU conditions, respectively, with the latter being significantly longer ($P < 0.001$). Blood lactate levels showed no significant changes before and after the run under CON conditions but increased significantly under FLU conditions ($P < 0.001$). The post-run blood lactate level was significantly higher in the FLU condition than in the CON condition (FLU: 2.6 ± 1.3 mmol/L, CON: 1.5 ± 0.7 mmol/L, $P < 0.001$). There were no significant differences in percentage change of CMJ (FLU: 104.8 ± 12.2 %, CON: 104.8 ± 11.0 %), HR (FLU: 160.5 ± 10.0 bpm, CON: 162.0 ± 7.1 bpm), cadence (FLU: 182.8 ± 6.9 bpm, CON: 183.4 ± 6.7 bpm) or step length (FLU: 1.65 ± 0.12 m, CON: 1.65 ± 0.12 m) between the two conditions. The RPE score showed no significant changes during the CON condition but increased significantly from lap 4 to 16 in the FLU condition ($P = 0.019$). The session RPE score was significantly higher in the FLU condition than in the CON condition (FLU: 3.4 ± 0.6, CON: 2.9 ± 0.7, $P = 0.002$).

CONCLUSION: Speed fluctuations during a 10 km run do not change the average HR and running mechanics, while increasing world-class athletes subjective exertion and blood lactate levels.

1. Bujan et al. (2000) 2. Mercier et al. (2021)

Oral Presentations

OP-AP23 Sports Technology/Wearables

DYNAMIC RESPONSE OF BLUETOOTH WEARABLE HEART RATE MONITORS DURING INDUCED SHARP CHANGES IN HEART RATE

SABIONI, M., WILLÉN, J., JAKOBSSON, M., DUAL, S.
KTH ROYAL INSTITUTE OF TECHNOLOGY

INTRODUCTION: The quality of RR-intervals (RR) and heart rate (HR) measured by wearable heart rate monitors has been assessed extensively [1-3]; however, most of the validation protocols include only long steady-state acquisition periods, neglecting the dynamic responses and delaying effects of filters applied by manufacturers. While irrelevant in endurance sports, in applications such as high-intensity interval training, those characteristics become important; still, they are largely undocumented. Therefore, this study aims to quantify, evaluate, and compare the dynamic response of RR and HR measurements of commercially available chest-worn wearable monitors during induced sharp changes in HR.

METHODS: A cheap, simple, and highly reproducible strategy was adopted, where a waveform generator was used to create ECG signals simulating the heart activity. RR and HR were recorded using the standard Bluetooth heart rate service for four ECG-based wearable monitors: Garmin HRM-Dual (G), Movesense Active (M), Polar H10 (P), and Wahoo TICKR (W). To simulate sharp changes in HR, four step functions were used (60-120 bpm, 120-60 bpm, 120-180 bpm, and 180-120 bpm), where each test was repeated ten times for each device. Dynamic response was quantified by resampling the signals to 1 Hz and time-aligning to the start of the test. Evaluation and comparison were based on latency, computed as RR latency (time elapsed from the step signal until the sensor RR response) and HR latency (time elapsed from the change in RR until the HR response was within ±3 bpm of the reference).

RESULTS: The RR measurements of all devices responded nearly immediately to changes on the reference signal. RR latency was 1.7±0.2 s (G), 1.6±0.2 s (M), 3.2±0.7 s (P), 2.0±0.5 s (W) (mean±SD) across all step tests. Mean absolute error of RR measurements pre and post step (constant signal) was below 3 ms for all but one device (W: 21 ms). HR response was significantly delayed, and latency was different between devices and step tests. The longest HR latency was observed on

the 120-60 bpm test: 38.9±1.2 s (G), 24.0±0.0 s (M), 23.0±0.3 s (P), 24.3±5.6 s (W). The shortest HR latency was observed on the 120-180 bpm test: 12.6±0.3 s (G), 8.3±0.1 s (M), 4.7±0.7 s (P), 5.2±0.8 s (W).

CONCLUSION: HR measurements were significantly different between the four devices, where all presented some level of latency, indicating that manufacturers implemented different digital filters and thresholds to compute the HR values. Such filtering strategies had great impact on the dynamic response of the sensors, suggesting that those characteristics could be relevant in applications where sharp changes in HR are present. Open documentation of the processing steps is necessary, and future research involving sharp HR changes should be based on RR measurements rather than HR measurements.

1. Schaffarczyk et al. (2022) Sensors

2. Gilgen-Ammann et al. (2019) European Journal of Applied Physiology

3. Rogers et al. (2022) Sensors

QUANTIFYING THE VO2 TO POWER RELATIONSHIP WITH A WEARABLE FOOT-POD POWER MONITOR DURING RUNNING; A CONCEPT EVALUATION

BUCKLEY, J., JONES, S., BUCKLEY, J.P.

KEELE UNIVERSITY

INTRODUCTION: Recent developments in wearable foot-pod technology have provided an equivalent measure of power for runners, similar to what cyclists have enjoyed for many years. A direct measure of power (Watts) during running, as with cycling, thus has the utility for developing a correlation from which to estimate a rate of oxygen uptake (VO2) for a given Watt. The aim of this study was to test the possibility of estimating VO2 from power output during free outdoor running at a self-selected pace, and then deriving a formula to account for changes in this relationship affected by the ground-surface gradient.

METHODS: Fifteen healthy active participants (12 male: 26 ± 6 yrs; 3 female 28 ± 3 yrs) completed three mins of running on each of three different gradients: flat athletics track, 5° uphill and 5° downhill paved foot path. Power output was measured continuously via a shoe-lace attached foot-pod (Stryd Power Monitor, Boulder, Colorado) and similarly for VO2 via a portable wearable pulmonary gas exchange monitor (Cortex MetaMax 3B, Leipzig).

RESULTS: The key results are summarised with four key measures as group means ± SD and analysis of variance statistic (ANOVA):

1. Running power (Watts/kg): Flat = 3.4 ± 0.5; Uphill = 3.9 ± 0.7 (+14.7%Δ vs flat); Downhill = 3.1 ± 0.5 (-8.8%Δ vs flat); ANOVA F=27.9, DF=2 p<0.001

2. Stryd Device equation Estimated VO2 (ml•kg-1•min-1) = 13.16 x Watts/kg: Flat = 46.0 ± 7.4; Uphill = 53.4 ± 9.6 (+16.1 %Δ vs flat); Downhill = 42.3 ± 6.9 (-8.0 %Δ vs flat); ANOVA F=27.7, DF=2 p<0.001

3. Actual VO2 (ml•kg-1•min-1): Flat = 38.7 ± 7.8; Uphill = 40.5 ± 5.6 (+4.7 %Δ vs flat); Downhill = 37.2 ± 6.7 (-3.9 %Δ vs flat); ANOVA F=5.58, DF=2 p=0.015

4. VO2 to Watts Ratio: Flat = 10.0; Uphill = 13.3 (+33 %Δ vs flat); Downhill = 4.3 (-57 %Δ vs flat); ANOVA F = 196.4, DF = 1 p<0.001

Power output and VO2 changed significantly (P<.001) across the three gradients. Compared to flat surface running, the proportional %changes of the respective foot-pod estimated VO2 for running uphill and downhill (+14.7%, -8.8%) remained similar to the respective %change in power output (+16.1, -8.8%). Whereas, the %change in actual VO2 for uphill and downhill running, respectively, were significantly smaller (+4.7%, -3.9%; p<.001). For all three conditions the foot-pod equation for estimating VO2 were significantly lower than actual VO2 (p <.001), and such differences were magnified when expressed as ratio of VO2 to Power.

CONCLUSION: Whilst the Stryd Power foot-pod monitor is able to show reliable and valid changes in running power with changes in both running speed and surface gradient [1], there still remains the need to develop a much more accurate formula for estimating VO2 from power output that accounts for both running speed and surface gradient.

1. Cerezuela, V., et al. Eur J Sport Sci. 2021; 21(3):341-350

NON-INVASIVE MONITORING IN COMPLEX ENVIRONMENTS USING WEARABLE TECHNOLOGY

DECORTE, R., SLEMBROUCK, M., VERSTOCKT, S.

UGENT - IMEC

INTRODUCTION: Transferring laboratory tests and data collection procedures to large-scale field tests presents several challenges due to the inherent differences in controlled laboratory environments versus dynamic field conditions. The extra manual labor required for following up a large-scale study and some logistical concerns such as equipment portability and data collection in remote locations further complicate the transition from lab to field. For a performance and health related study of military recruits, we are developing a continuous monitoring setup using consumer available smartwatches that requires minimal effort from the study operators to obtain the relevant data.

METHODS: We developed an end-to-end pipeline which monitors study participants 24/7 using a Garmin smartwatch. Health parameters measured by multiple Garmin smartwatches are transmitted to a single phone using an operator sync (participants are not required to upload their own data). The proposed solution is tailored towards complex environments

where the applicability must be non-invasive to not disrupt daily activities and has to be decoupled from external servers to ensure confidentiality. As such, study participants of the military recruits can be monitored using a smart watch with GPS capabilities, even during multi-day tactical exercises in the field or during prolonged periods without connectivity. Based on the weekly itinerary, the watch uses different monitoring modes and sampling rates to extend battery life while providing a wide range of (optional) parameters such as heart rate, GPS, movement dynamics, accelerometer, etc. This is linked together with other data sources such as itinerary metadata, test battery results, injuries and more.

RESULTS: The proposed system has been used in an 8-week-long study. During this period, it was used to collect specific GPS based activities (map reading exercises, runs at aerobic and anaerobic thresholds, etc.) and various monitoring parameters (heartrate, steps, sleep quality, stress, etc.). Due to the operator synchronization mechanism, it is easy to deploy such a system in a field test (short or long deployments). The recorded parameters are immediately available when the operator chooses to synchronize the devices. The uploaded data is then automatically linked to the corresponding profile in our central platform and the annotations from other data sources are applied for improved analysis.

CONCLUSION: First results show the feasibility of the proposed approach. However, some remaining issues still need to be resolved in regard to the Garmin Health SDK, which at the moment fails to transfer all the available data from the watch to the phone if a large number of watches are synchronized simultaneously. The valorization potential of the proposed set-up is high as it could also be used in other contexts. E.g. research laboratories that can quickly equip a group of people for their testing without having to manually process all the watches afterwards.

ACCURACY OF A FREE DIVING MASK FOR MEASURING HEART RATE AND OXYGEN SATURATION

ALGOURDIN, P., LAMOLLE, A., OSTRE, B., JOLIFF, Y., LAURIN, J., RAO, G.

UNIVERSITY OF TOULON

INTRODUCTION: Apnea is a sport in which ventilation is stopped in order to push your limits by staying underwater for as long as possible (static or dynamic). With ventilation cut off, the only available source of oxygen is the one present in the blood. Measuring oxygen saturation in the blood (SPO2) is therefore very important for assessing the health of divers and ensuring their safety (1). Freedivers SPO2 can drop to 50% before risking their lives (2, 3). Because of the extreme difficulty of taking measurements under water, very few sensors are suitable for measuring SPO2 combined with heart rate data (HR) (4). In addition, the available ones are often not very easy to use (5,6). In 2023, Oxama company has developed a connected mask that measures HR, SPO2 and indicates the rest time between apneas. This new tool could be a real help for athletes to minimize health risks and increase their performance. It is therefore important to check the accuracy of the mask compared with the gold standard (chest belt and oximeter).

METHODS: 16 participants with no experience in apnea aged between 18 and 25 and with similar skin color (4,7,8) took part in the study. Two experiments were carried out 48 hours apart to avoid fatigue effects. Subjects were fitted with a chest belt (Polar H10) to measure HR, a finger pulse oximeter (Sanokin) to measure SPO2, and the connected face mask (Oxama) also measuring HR and SPO2 (sampling rate 10Hz). The tests were all carried out on a cycling ergometer (Garmin) to limit movement artifacts (4,8,9). The first trial was an incremental test to identify the variations in HR and SPO2 data as a function of intensity. The subject pedals at a power of 50W for 1min30, then the power increases by 20W every 1min30 up to 190W (8 steps). The second test analyzed the variations in HR and SPO2 data under an incremental test with apnea periods. Subjects then repeated the same incremental test as the first step, but with apnea periods of 30s at the end of each stage. The test stopped when the subject could no longer keep the 30s of breath hold or when the 190W limit was achieved. To assess the reliability and accuracy of the HR and SPO2 sensors, the absolute error, Bland Altman diagram and intra-class correlation coefficients were calculated.

RESULTS: As expected the results show that SPO2 falls at the end of apnea periods. This result is consistent with the literature (5). When mask data increases or decreases, those of the reference measurement tools increase or decrease respectively.

CONCLUSION: HR and SPO2 follow the same trend with the mask as with the reference measurement tools, which is very encouraging. The differences in values are probably due to the different locations of the measurements (finger or face). Further testings will be conducted underwater to ensure the mask's reliability in ecological conditions.

[1] Mulder 2023/ [2] Ferretti 2001/ [3] Schagatay 2019/ [4] Hermand 2019/ [5] Kuch 2010/[6] Mulder 2021 / [7] Scherbina 2017/ [8] Zhang 2020/[9] Climstein 2020

VALIDITY OF THE POLAR FITNESS TEST FOR ESTIMATING MAXIMUM OXYGEN CONSUMPTION VERSUS CARDIO PULMONARY EXERCISE TESTING AND ESTIMATIONS BASED ON THE SIX MINUTE WALK TEST

TREFF, G., NEUDORFER, M.1,2, ÖTZLINGER, L.1, KUMAR, D.2, KULNIK, S.T.2, NIEBAUER, J.1,2, SMEDDINCK, J.1, SAREBAN, M.1,2

PARACELSUS MEDICAL UNIVERSITY, SALZBURG. 2: LUDWIG BOLTZMANN INSTITUTE FOR DIGITAL HEALTH AND PREVENTION, SALZBURG.

INTRODUCTION: Maximum oxygen consumption (VO2max) is an accepted surrogate for cardiorespiratory fitness (CRF). A laboratory-based cardiopulmonary exercise test (CPET) represents the standard to determine VO2max. If CPET is not feasible, alternative methods may be justified. The Polar® Fitness Test (PFT) is a heart-rate based test utilizing a sports-wearable, neither requiring physical exercise nor a laboratory to estimate VO2max. This makes the PFT attractive for estimating VO2max in untrained, older people and those with health issues. However, the developer validated the PFT in

healthy 20-60-year olds and there is a lack of studies on the validity of VO2maxPFT in older populations. To this end, we aimed to validate the VO2maxPFT in middle-aged to older people with and without heart rate limiting medication and to compare VO2maxPFT with another clinically established surrogate for CRF, the 6-Minute Walk Test (6MWT) and five 6MWT-based VO2max estimation equations. We also aimed to explore influencing factors on the PFT's accuracy.

METHODS: Thirty-two participants (11 female, age 60 ± 10.2 years, VO2max 33 ± 7.7 mL/min/kg, 11 with regular heart-rate limiting medication) conducted a PFT with photoplethysmographic measurements at the wrist. VO2maxPFT was compared with VO2maxCPET and 6MWT based estimates. We analysed the data using mean absolute percentage error (MAPE), intra-class correlation coefficients (ICC), Bland-Altman plots, Pearson correlation and paired t-tests.

RESULTS: MAPE of VO2maxCPET vs. VO2maxPFT was 17%, ICC was moderate with 0.654 (95% CI [0.402, 0.814]). The upper and lower limits of agreement in the Bland-Altman analysis were 25 mL/min/kg apart. VO2maxPFT and VO2maxCPET were strongly correlated ($r = 0.670$, $p < 0.001$) without significant difference ($p=0.074$).

VO2maxCPET and the distance covered in the 6MWT were strongly correlated ($r = 0.676$, $p < 0.001$). Moreover, two of the five equations estimating VO2max based on the 6MWT (Burr et al. (2011) and Porcari et al. (2021)) indicated stronger correlation with VO2maxCPET ($r = 0.804$ and 0.743, respectively) than VO2maxPFT did.

Exploratory analysis revealed no influence of any of the captured anthropometric, physiological or medication variables on the difference of VO2maxCPET-PFT.

CONCLUSION: The MAPE of VO2maxPFT is 1.7-fold higher than the cut-off of 10% used in similar validation studies. Further, the limits of agreement of the VO2maxPFT are too wide to allow for an individually valid classification into the clinical fitness category proposed by e.g. the American College of Sports Medicine (2013). Hence, the PFT has insufficient validity to substitute CPET-assessments and specific 6MWT derived estimates in the population studied. PFT may be a viable alternative if patients are impaired in their ability to perform a 6MWT.

References

ACSMs Health-Related Physical Fitness Assessment Manual. Lippincott Williams & Wilkins; 2013.

Burr et al. 2011 doi:10.3810/psm.2011.05.1904

Porcari et al. 2021: doi:10.3390/jfmk6

Oral Presentations

OP-MH12 Injury Prevention I

DEVELOPING THE SINGAPORE YOUTH SHOULDER OVERUSE INJURY PREVENTION PROGRAM

LAU, R., MUKHERJEE, S.

NATIONAL INSTITUTE OF EDUCATION

INTRODUCTION: High prevalence rates of shoulder overuse injuries have been documented among overhead youth athletes, suggesting a pressing need for injury prevention efforts. In recent years, there has been increasing discussion regarding the importance of context-specific injury prevention programs, which takes into consideration the implementation context during the development phase, such as end-users' characteristics and equipment available. This vital consideration would improve uptake and compliance following implementation of the program into the real-world. However seemingly no injury prevention program has been developed specifically for the prevention of shoulder overuse injuries among overhead youth athletes in the Asian context. Owing to the popularity of volleyball in Singapore and the biomechanical similarities in the overhead motion across different overhead sports, this study employed the sport of volleyball as a representative of overhead sports in Singapore. The aim of this study was to develop the Singapore Youth Shoulder Overuse Injury Prevention Program (YoSO-IPP) specifically for competitive overhead youth athletes in Singapore.

METHODS: Employing a Delphi technique, a panel comprising of content and context experts was convened to provide feedback on YoSO-IPP, which consists of (1) an exercise program for the overhead youth athletes, (2) an education program regarding overuse injuries for coaches of overhead youth athletes, and (3) an education program regarding overuse injuries for overhead youth athletes. Consensus was set at 75% agreement. A group of youth volleyball athletes were recruited as potential end-uses to specifically assess the feasibility of the exercise program using a feasibility assessment questionnaire.

RESULTS: Eighteen experts comprising of nine content (e.g., sports medicine physicians, a paediatrician, university professor in sports science and medicine, and sports physiotherapists) and nine context experts (e.g., youth volleyball coaches and volleyball teacher-coaches) completed two Delphi rounds with 100% response rate. Consensus was achieved for the exercise program and both education programs. Twelve youth athletes completed the feasibility assessment questionnaire and found the exercises to be feasible in terms of usefulness, practical use, instructions, duration, and ease of execution.

CONCLUSION: Developed specifically for competitive overhead youth athletes in Singapore, YoSO-IPP reached consensus among experts via a Delphi technique. It was also deemed feasible by end-users (i.e., youth athletes) in a feasibility assessment. Comprising of (1) an exercise program for the overhead youth athletes, (2) an education program regarding

overuse injuries for coaches of overhead youth athletes, and (3) an education program regarding overuse injuries for overhead youth athletes, the context-specific YoSO-IPP can be considered as robust, comprehensive, and in a state of readiness for implementation in practice.

DOES GAIT ASYMMETRY INCREASE THE RISK OF INJURY IN RECREATIONAL RUNNERS?

MALISOUX, L., GETTE, P., DELATTRE, N., URHAUSEN, A., THEISEN, D.

LUXEMBOURG INSTITUTE OF HEALTH

INTRODUCTION: Understanding the relationship between asymmetry and injury risk may be relevant for clinicians and researchers as runners at risk could be identified by measuring differences in biomechanical variables from both legs. Then, preventive measures could be introduced to reduce asymmetry, including running technique interventions, when a link to previous injury is deemed clinically plausible. Also, understanding the main determinants explaining the inter-subject variability of asymmetry may help identify runners at risk provided asymmetry indeed relates to injury risk. Therefore, the objectives of this study were to describe the magnitude of asymmetry in spatiotemporal and kinetic variables in 800+ recreational runners, identify the determinants of asymmetry, investigate if asymmetry increases running-related injury risk, and compare spatiotemporal and kinetic variables at baseline between the involved and uninvolved limb in runners having sustained an injury during follow-up.

METHODS: Healthy recreational runners were tested on an instrumented treadmill at their preferred running speed at baseline and then followed up for 6 months. Spatiotemporal and kinetic variables were derived for each lower limb from ground reaction force recordings. The symmetry index was computed for each variable. Correlations and multiple regression analyses were performed to identify potential determinants of asymmetry. Cox regression analyses were used to investigate the association between asymmetry and injury risk. Analyses of variance for repeated measures were used to compare the involved and uninvolved limb in runners having sustained an injury during follow-up.

RESULTS: The analysis includes 836 participants (38,6% females, mean age (SD): 40.3(10.0) years, and body mass index: 24.0(2.9) kg.m-2). 107 participants reported at least one running-related injury. Leg length and fat mass were the most common determinants of asymmetry, but all correlation coefficients were negligible (0.01 to 0.13) and explained variance was very low (multivariable adjusted R2 <0.01 to 0.03). Greater asymmetry for flight time and peak breaking force was associated with lower injury risk (Hazard Ratio [95%CI]: 0.80 [0.64; 0.99] and 0.96 [0.93; 0.98], respectively). No between-limb differences were observed in runners having sustained an injury.

CONCLUSION: This study demonstrated that asymmetry in spatiotemporal and kinetic variables was not associated with higher injury risk in recreational runners. Therefore, the search for bilateral asymmetry in the lower limbs in healthy runners as an approach for primary prevention is not supported by scientific evidence. The study also illustrated the high intra-individual (across variables) and inter-individual variability of asymmetry in biomechanics. Consequently, applying a threshold to determine "acceptable" or "normal" asymmetry levels appears very challenging. Finally, the determinants identified only marginally explained the variability in asymmetry.

JOINT TORQUE AND MUSCLE ACTIVITY DURING ECCENTRIC EXERCISE FOR HIP ADDUCTORS AT VARIED HIP FLEXION ANGLES

MARUŠIC, J., CVJETICANIN, O., ŠARABON, N.

UNIVERSITY OF PRIMORSKA, FACULTY OF HEALTH SCIENCES

INTRODUCTION: Different angles of hip flexion during hip adductor contraction can have a significant effect on strength and electromyographic activity (EMGA) (1). However, this has so far only been verified in isometric conditions. Therefore, the aim of this study was to investigate hip joint torque and EMGA of the adductor longus during eccentric exercises for hip adductors while maintaining three different angles of hip flexion (0°, 45°, or 90°).

METHODS: Sixteen recreationally active participants (mean age: 27 ± 5 years) preformed bilateral eccentric contractions of the hip adductors at slow speed (13°/sec) using a custom-made isokinetic dynamometer, at 0°, 45°, and 90° of hip flexion. EMGA was recorded from the adductor longus muscle using the Trigno Delsys Wireless System (Delsys Inc., Massachusetts, USA).

RESULTS: Peak joint torque was significantly lower during the variation with 90° hip flexion compared to both 0° and 45° variations ($p < 0.001$) while there were no significant differences between the 0° and 45° variations. Adductor longus EMGA did not significantly differ between variations.

CONCLUSION: This study demonstrates that hip flexion angle significantly affects hip joint torque during eccentric hip adduction exercises, with lower torque observed at 90° compared to 0° or 45°. However, adductor longus EMGA remained consistent across all three different hip flexion angles. These findings may contribute to the optimisation of hip adductor strength training, which is one of the most effective measures in the prevention and rehabilitation of hip adductor injuries (the most common type of groin injury in various sports).

1. Delahunt E, Kennelly C, McEntee BL, Coughlan GF, Green BS. The thigh adductor squeeze test: 45° of hip flexion as the optimal test position for eliciting adductor muscle activity and maximum pressure values. Man Ther. 2011;16(5):476–80.

EFFECT OF THE ACTN3 R577X POLYMORPHISM ON THE RISK OF MUSCLE INJURY IN JAPANESE UNIVERSITY ATHLETES

ISHII, T., MIYAMOTO-MIKAMI, E., TAKARAGAWA, M., KOMURA, Y., SUZUKI, K., FUKU, N.

JUNTENDO UNIVERSITY

INTRODUCTION: α-actinin-3 protein is localized to the Z-disc of fast skeletal muscle, where it helps to anchor actin filaments. A common nonsense polymorphism, R577X, in the α-actinin-3 gene (ACTN3) is associated with risk of muscle injury. According to a systematic review, the XX genotype is reported to be at high risk for muscle injury in European athletes [1]. However, no consistent results have been reported in Japanese athletes. One study reported that the RR genotype is at high risk for muscle injury [2], and another study found no association between the ACTN3 genotype and muscle injury [3]. Therefore, we performed a prospective study in a relatively large-scale cohort of Japanese athletes to clarify the effect of the ACTN3 R577X polymorphism on the risk of muscle injury in Japanese athletes.

METHODS: This study included 722 Japanese university athletes (males: n = 487, females: n = 235) from various sports. Muscle injury occurrences were investigated once annually at the end of October using an online questionnaire (study period: November 2017 to October 2022; maximum follow-up period: 4 years). The cause of injury, month of occurrence, and whether the injury was diagnosed by physicians were also assessed. Additionally, the months of exposure to muscle injury occurrences were calculated. The ACTN3 R577X polymorphism (rs1815739) was analyzed using the TaqMan SNP Genotyping Assay. The association of the ACTN3 R577X polymorphism with the incidence of muscle injury was examined under each genetic model (X-additive, dominant, and recessive) using the Cox proportional hazards model adjusted for the main sports.

RESULTS: Genotype frequencies of the ACTN3 polymorphism (RR: n = 157, RX: n = 370, XX: n = 195) were in Hardy–Weinberg equilibrium. There were no significant differences among genotypes in the subject's characteristics, such as follow-up period, sex ratio, age, height, weight, competitive level, and main sport. In all subjects, X allele carriers exhibited a significantly higher incidence of muscle injury than RR genotype carriers (hazard ratio = 1.76, 95% CI = 1.00–3.08, P = 0.049 under the X-dominant model). When analyzed by sex, in male athletes, the X allele was significantly associated with higher incidence of muscle injury (hazard ratio = 2.13, 95% CI = 1.08–4.17, P = 0.028 under the X-additive model), whereas in female athletes, these were no significant associations of the ACTN3 R577X polymorphism with the incidence of muscle injury in any genetic model.

CONCLUSION: Our results indicate that the X allele of the ACTN3 R577X polymorphism is associated with risk of muscle injury in Japanese athletes, regardless of ethnicity.

References:

1. Zouhal, H. et al., J Sport Health Sci, 2023, 12(3): p.359–368.

2. Iwao-Koizumi, K. et al., J Mol Biomark Diagn, 2014, S6.

3. Miyamoto, N. et al., Scand J Med Sci Sports, 2018, 28(3): p.1209–1214.

Oral Presentations

OP-PN23 Physiology/Bone

BONE AND MUSCLE PROPERTIES IN HABITUAL PLANT-BASED DIETERS AND OMNIVORES: AN OMNIPLANT STUDY

PAGE, J., STEBBINGS, G., MURPHY, C., KILDUFF, L., WALDRON, M., HEFFERNAN, S.

SWANSEA UNIVERSITY

INTRODUCTION: Growing interest in plant-based diets has fueled debate surrounding differences in dietary intake that could impact musculoskeletal (MSK) health and performance, such as protein, calcium and vitamin D [1]. Few studies have compared MSK properties of vegetarians (VEGT) and vegans (VEG). Early work, however, suggests muscle size and maximal strength in recreationally active male VEG is comparable to that of OMN [2] but bone mineral density (BMD) is lower and fracture risk greater compared with OMN [3]; although other studies show no differences [4]. This study aimed to compare dietary intake and musculoskeletal properties between habitual OMN, VEGT and VEG across the adult lifespan.

METHODS: One hundred and fifty-one participants were recruited, in a cross-sectional observational design, having followed their chosen dietary pattern consecutively for > two years. Dietary patterns were self-reported and confirmed via food frequency questionnaires and a three-day weighed food diary. OMN (n=63, males=36, females=27, age=32 ±14 years, stature=1.75±0.08m, body mass=78.2±15.5kg), VEGT (n=24, males=4, females=20, age=36±15 years, stature=1.67±0.09m, body mass=67.4±17.7kg) and VEG (n=64, males=28, females=36, age=43±15 years, stature=1.71±0.08m, body mass=71.3±12.6kg) were assessed for body composition, femoral neck (FN) and total hip bone mineral density (BMD) via dual-energy X-ray absorptiometry. Vastus lateralis (VL) muscle thickness, anatomical (ACSA) and physiological cross-sectional area (PCSA), muscle volume and rectus femoris echo intensity (EI) were assessed via B-mode ultrasonography. Analysis of covariance was used (SPSS v29), controlling for age, sex, dietary adherence duration, self-report physical activity and body mass index, as appropriate.

RESULTS: There were no differences between groups for skeletal muscle properties or body composition (P>0.05). Total hip BMD was lower in VEG compared with OMN (VEG=1.09±0.18g/cm2, OMN=1.24±0.18g/cm2; P=0.031), but not VEGT

(1.13±0.14g/cm2, P>0.05) and there were no differences in FN BMD between groups (P>0.05). Both calcium and vitamin D intake were similar between groups (P>0.05); however, protein intake was higher in OMN (1.43±0.69 g/kg) compared with VEG (1.14±0.45 g/kg, P=0.029). Leucine intake was also greater in OMN (5697±3718 mg/d) compared with VEGT (2641±1360 mg/d, P= 0.001) and VEG (2405±1886 mg/d, P<0.001).

CONCLUSION: This study found no differences between groups for muscle properties (thickness, ACSA, PCSA, volume or EI), despite lower intake of protein and important amino acids in the VEG and VEGT. Total hip BMD was lower in VEG compared to OMN, but is unlikely to be clinically relevant, nor were there differences in FN BMD between groups. There does not appear to be any beneficial or detrimental effects of plant-based diets on muscle or bone health.

References

1.Sobiecki et al., 2016,Nutr Res; 2.Page et al., 2021,Eur J Spor Sci; 3.Iguacel et al., 2018, Nutr Rev.; 4.Knurick et al., 2015,Nutrients.

EFFECT OF ECCENTRIC-BASED RESISTANCE EXERCISE ON BONE (RE)MODELLING MARKERS ACROSS THE MENSTRUAL CYCLE AND ORAL CONTRACEPTIVE CYCLE

GUISADO CUADRADO, I., ROMERO-PARRA, N.1,2, PEINADO, A.B.1

1. UNIVERSIDAD POLITÉCNICA DE MADRID; 2. UNIVERSIDAD REY JUAN CARLOS

INTRODUCTION: Exercise guidelines to improve bone strength generally include resistance-based exercises (1). Beyond mechanical stimulus, sex hormones may also have an effect on bone health, as in vitro studies have demonstrated the influence of 17β-oestradiol on osteocyte function (2). Thus, this study investigated the acute effects of eccentric resistance exercise on procollagen type I N-propeptide (P1NP) and carboxy-terminal cross-linking telopeptide of type I collagen (β-CTX-1) concentrations in premenopausal females.

METHODS: Nine eumenorrheic females and ten oral contraceptive (OC) users performed an eccentric-based resistance exercise (10x10 repetitions of back squats with a 4-second eccentric phase) in three of the menstrual cycle (MC) phases [early follicular (EFP), late follicular (LFP) and mid luteal (MLP)] and in the two OC cycle phases [withdrawal (WP) and active pill-taking (APP)], in a randomized testing order. β-CTX-1 and P1NP, 17β-oestradiol and progesterone were assessed pre- and post-exercise. MC and OC cycle phases were confirmed by serum sex hormone analysis.

RESULTS: 17β-oestradiol (pg·ml-1) was lower in EFP (36.635±29.930) compared to LFP (224.807±233.813; p=<0.001) and MLP (161.445±110.082; p<0.001) and higher in the WP (24.857±29.428) compared to APP (12.717±13.357; p=0.004). While progesterone (ng·ml-1) was higher in MLP (8.30±5.23) compared to EFP (0.33±0.33; p<0.001) and LFP (0.21±0.18; p<0.001). In eumenorrheic females, β-CTX-1 (ng·ml-1) was lower in MLP (0.395±0.126) compared to LFP (0.472±0.137; p=0.044). Comparing ovarian hormonal profiles, eumenorrheic females had higher P1NP levels (ng·ml-1) compared to OC users: EFP (62.54±13.13) vs APP (50.69±8,91; p=0.034), LFP (67.32±18.96) vs WP (52.16±10.72; p=0.047), LFP vs APP (p=0.025), MLP (67.51±19.34; p=0.049) vs WP, MLP vs APP (p=0.027). Exercise time effect showed lower β-CTX-1 concentrations post-exercise (MC: 0.376±0.114, p<0.001; OC: 0.340±0.156, p=0.030) compared to pre-exercise (MC: 0.485±0.137; OC: 0.428±0.188) in all participants.

CONCLUSION: Eccentric resistance training decreased β-CTX-1, showing its potential to protect against acute bone resorption. This study underscores the need to understand the characteristics of resistance training for optimal bone health in active females. β-CTX-1 was lower in the MLP compared to LFP of the MC, which may indicate that progesterone can reduce β-CTX-1 without modifying P1NP concentrations. Finally, ovarian hormonal profile influence bone (re)modelling markers, decreasing bone formation in OC users, indicating the need to investigate long-term effects on bone structure and strength.

Funding: Grant DEP2016-75387-P funded by MCIN/AEI/10.13039/501100011033 and by "ERDF A way of making Europe".

References

1. Beck BR, et al. (2017). doi: 10.1016/j.jsams.2016.10.001

2. Klein-Nulend J. et al (2015). doi: 10.1016/j.jbiomech.2014.12.007

ASSESSMENT OF NUTRITIONAL PARAMETERS AND THEIR RELATIONSHIP WITH BONE MINERAL DENSITY OF TRANSGENDER WOMEN VOLLEYBALL ATHLETES UNDERGOING GENDER AFFIRMATION THERAPY: A CROSS-SECTIONAL STUDY

QUARESMA, M., NAKAMOTO, F.P.1, MARQUES, C.G.2, SANTOS, L.M.1, DEGANI-COSTA, L.H.1, NAVARRO, L.S.1, NAVARRO, G.S.1, AGUIAR, V.1, FERREIRA, R.F.S.1, ALVARES, L.A.M.A.1

CENTRO UNIVERSITÁRIO SÃO CAMILO

INTRODUCTION: The impact of low energy availability (LEA) on bone mineral density (BMD) in transgender women athletes (TWA) remains uncertain, and discussions about LEA have garnered attention in recent years. Thus, we aimed to assess and compare nutritional parameters among volleyball players divided into TWA, cisgender women athletes (CWA), and cisgender men athletes (CMA). Additionally, we aimed to examine the association between nutritional parameters and BMD.

METHODS: This is a cross-sectional study. Inclusion criteria involved healthy volleyball players aged 18-39 years; TWA under gender-affirming hormone therapy (GAH) for at least six months. Participants visited the laboratory once. We uti-

lized Dual-energy X-ray absorptiometry to assess body composition (i. e., femur BMD, fat mass and appendicular lean mass (ApLM)). We evaluated blood biomarkers (e.g., vitamin D, calcium, and parathormone [PTH]) in accordance with biochemical kit recommendations. Also, participants completed health and sociodemographic questionnaires along with a 24-hour food recall. Statistical comparisons were conducted using the ANOVA test, and associations were explored through linear regression, considering biological plausibility. Model quality was confirmed using AIC and R2 in regression analysis. Data analysis utilized Jamovi® 2.3.21 version.

RESULTS: Data from a preliminary sample of 22 subjects are presented as mean (SD). The mean duration of GAH was 6.8 years, and the average age of GAH onset was 22 years. The ANOVA test indicated no differences in age (30.4 (2.62), 26.0 (4.24), and 28.9 (4.38) years), body mass index (23.2 (3.52), 23.9 (2.57), and 26.8 (5.01) kg/m2), and fat mass (20.9 (9.53), 19.8 (8.81), and 21.4 (10.1) kg) among TWA, CWA, and CMA, respectively. Energy intake is different among groups ($F(17,2)= 8.28$; $p= 0.003$; $\eta2\rho= 0.493$). For instance, CMA consumed more energy than CWA (Mean Difference [MD]: 1410 kcal; $p= 0.003$) and TWA (MD: 1142 kcal; $p= 0.021$), with no significant differences between CWA and TWA (MD: 268 kcal; $p= 0.764$). However, carbohydrate ($F(17,2)= 1.55$; $p= 0.240$; $\eta2\rho= 0.155$), protein ($F(17,2)= 1.79$; $p= 0.197$; $\eta2\rho= 0.174$), and lipid ($F(17,2)= 2.01$; $p= 0.65$; $\eta2\rho= 0.191$) intake did not differ between groups. Furthermore, serum levels of vitamin D ($F(18,2)= 0.415$; $p= 0.666$; $\eta2\rho= 0.044$), PTH ($F(19,2)= 0.720$; $p= 0.501$; $\eta2\rho= 0.078$), and calcium ($F(19,2)= 2.49$; $p= 0.109$; $\eta2\rho= 0.208$) also did not differ between the groups. Linear regression results (R2: 0.813; $F= 4.34$; $p= 0.036$; sample power: 75%) indicated that, regardless of ApLMI, energy intake, vitamin D levels, calcium, and PTH, TWA was negatively associated with femur BMD ($B= -0.77$; 95% CI: -1.32 to – 0.21; $p= 0.018$). In contrast, CWA showed no associated with femur BMD compared to CMA ($B= -0.31$; 95% CI: -0.86 to 0.23; $p= 0.227$).

CONCLUSION: In conclusion, the energy intake of TWA was lower than CMA, with no differences in macronutrient intake or blood biomarkers. Moreover, TWA was negatively associated with femur BMD.

THE INFLUENCE OF NUTRITION ON THE BONE BIOMARKER RESPONSE TO AN ACUTE BOUT OF EXERCISE: A SYSTEMATIC REVIEW WITH META-ANALYSIS

ESTEVES, G., DUMAS, A., TAKARABE, L., PERFEITO, L., KEANE, K., GUALANO, B., KELLEY, G., BURKE, L., SALE, C., SWINTON, P., DOLAN, E.

FACULTY OF MEDICINE, UNIVERSITY OF SÃO PAULO

INTRODUCTION: Although nutrition and exercise both influence bone metabolism, little is currently known about their interaction. Synthesis of available information has substantial potential to inform nutritional interventions to protect the bone health of exercising individuals, including athletes with high risk of compromised bone health. The purpose of this study was to synthesise available evidence related to the influence of nutrition on the bone biomarker response to acute exercise, using a systematic review and meta-analytic approach.

METHODS: Studies evaluating the influence of nutritional status or intervention on the acute bone biomarker response to a single bout of exercise were included and separated into 4 categories: A) Feeding status and energy availability; B) Macronutrients; C) Micronutrients, and D) Other. Studies conducted on healthy human populations of any age or training status were included. Meta-analysis was conducted when data from at least 5 studies with independent datasets were available, and results are presented as standardized effect sizes and 95% credible intervals (95%CrI). In the case of insufficient data for specific outcomes, results from individual studies were narratively synthesised and standardised mean effect sizes visually represented.

RESULTS: Twenty-three articles were included. Of these, 4 investigated feeding status or energy availability; 7 macronutrients; 8 micronutrients (all calcium) and 6 investigated other approaches, namely, collagen, dairy products or ubiquinol. The largest and most commonly reported effects of a nutritional intervention on the bone biomarker response to exercise were for the bone resorption marker CTX-1. Calcium intake, whether provided via supplements, diet or infusion, reduced exercise-induced increases in CTX-1 (-1.1 [95%CrI: -2.2 to -0.05]). Excluding studies that used calcium infusion reduced the magnitude of this effect (-0.47 [95%CrI: -0.95 to 0.02]). Carbohydrate supplementation appears to support bone during acute exercise, via reducing exercise-induced increases in CTX-1 and potentially increasing the P1NP response. Conversely, a low-carbohydrate/high-fat diet induced the opposite effect. Low energy availability may amplify the CTX-1 response to exercise, but it is unclear whether this is directly attributable to energy availability, or to the lack of specific nutrients, such as carbohydrate.

CONCLUSION: Nutritional intervention can modulate the acute bone biomarker response to exercise, primarily through influencing bone catabolism. In turn, ensuring adequate attention to nutritional factors may be important to protect bone health of exercising individuals, with energy, carbohydrate and calcium availability particularly important factors to consider. Although a wide breadth of data were available, there was substantial heterogeneity in relation to design and intervention characteristics. Direct and indirect replication is required to confirm key findings and to generate better estimates of true effect sizes.

WBV IMPROVES BONE HEALTH IN MOUSE MODELS OF DIFFERENT AGE GROUPS BY MODULATING THE EXPRESSION OF FNDC5, NOX4 AND SIRT1

CARIATI, I., BONANNI, R., ROMAGNOLI, C., DARCANGELO, G., ANNINO, G., TANCREDI, V.
UNIVERSITY OF ROME TOR VERGATA

INTRODUCTION: The aging process compromises bone tissue integrity and predisposes to the onset of diseases, such as osteoporosis, characterized by a progressive impairment of bone microarchitecture associated with increased oxidative stress and altered expression of bone growth regulators. In this context, appropriately designed whole body vibration (WBV) protocols are known to significantly improve bone quality in 4-month-old young mice by increasing the expression of irisin, a myokine with osteoinductive power produced by skeletal muscle in response to exercise. In contrast, little is known about the effects of WBV on bone health in adult and elderly rodents, suggesting that further studies are needed to determine its efficacy in preventing and counteracting age-related bone loss. Based on this evidence, the aim of this study was to investigate skeletal adaptations to WBV in young, adult and old mouse models, assessing any differences in terms of structural, ultrastructural and metabolic changes.

METHODS: 4-, 12- and 24-month-old mice were sacrificed after a three-weekly training with a WBV protocol characterized by three series of mechanical vibrations of 2.30 min, interspersed with a 2.30-min recovery period. Bone tissue samples from the spine were taken from each animal for histological and immunohistochemical analysis, measuring the main morphometric parameters of the bone and investigating the expression of some important markers of bone health, such as fibronectin type III domain-containing protein 5 (FNDC5), NADPH Oxidase 4 (NOX4) and sirtuin 1 (SIRT1). Groups of mice of the same age were maintained under sedentary conditions and sacrificed at the same time as the intervention group mice.

RESULTS: Mice subjected to WBV were characterized by significantly better bone parameters than the corresponding sedentary mice. Particularly, vibratory training promoted an increase in bone volume and trabecular thickness in association with a reduction in trabecular separation, preserving the ultrastructural characteristics of bone tissue. Interestingly, FNDC5 and SIRT1 were more highly expressed in mice exposed to WBV, while a reduction in the levels of NOX4, an indicator of oxidative stress, was found in the bone tissue of all trained groups, with differences according to age group.

CONCLUSION: An appropriate WBV protocol could represent a valid alternative strategy to prevent and counteract bone mass loss in adults and the elderly by reducing oxidative stress and positively regulating myokines with osteoinductive power.

Oral Presentations

OP-MH29 Physical activity promotion II

EVALUATION OF PHYSICAL ACTIVITY, SEDENTARITY AND FITNESS LEVELS IN MEDICAL STUDENTS: AN ALARMING OBSERVATION

MURA, M., METAIS, A., PIALOUX, V., HAUTIER, C., AOUIDAT, M., LOISEL, O., BODET, G., RODE, G., SCHLATTER, S.
LUXEMBOURG INSTITUTE OF HEALTH

Introduction: Medical studies are considered among the most demanding in the world. Students are subjected to constant pressure, with a heavy academic workload. To cope with this workload, many students engage in extensive study sessions while sitting. Academic pressures can also hinder their ability to maintain a balanced lifestyle that integrates physical activity (PA) practice into their daily routines. High levels of sedentary behaviour and low levels of PA can both have a negative impact on their quality of life and health. However, research on medical students remains limited (1-3), and studies utilizing multi-modal assessments of sedentary behaviour, PA, and fitness are necessary to provide a comprehensive overview of the issue.

Method: This study is the first step of a larger project called PROMESS (IRB2023070401) in which 4th and 5th year medical students were recruited for doing a batterie of tests in November 2023 (Faculty of Medicine of Lyon 1, France). The test including a multi-modal assessment of sedentary behaviour, PA, and fitness levels and general anthropometric measurements. Sedentarity behaviours and PA levels were assessed using the GPAQ questionnaire and physical fitness was evaluated with a maximum isometric quadriceps force, a squat jump and a cardiorespiratory endurance test (modified VAMEVAL) (4). VO2max was estimated as 3.5 times VMA.

Results: A total of 61 students were included (47 women; 23 ± 3 yo) ; 24% were overweighed or obese. According to the GPAQ, 73% of them spend more than 8h/day sitting, and 38% did not meet the WHO recommendation of PA (upper threshold 1 200 MET.min/week). The estimated VO2max was of 31 ±2 (women) and 37 ±2 ml/min/kg (men). Only one VO2max was classified as "normal", others were classified as very low (n=5), low (n=22) and weak (n=38) (5). The mean isometric quadriceps force was of 329 ±134 (women) and 391 ±38 N (men). The mean maximal jump height was of 18 ±5 (women) and 26 ±6 cm (men).

Discussion: Medical students spent a considerable time sedentary, and both the PA and physical fitness levels are alarmingly low. Almost 3/4 of them spend more than 8h a day sitting which is known to be a predictor of numerous bad health outcomes independently of PA practice. More than a 1/3 do not meet the WHO recommendation for optimal cardiovascu-

lar health. This alarming observation underscores the urgent need for the implementation of anti-sedentary measures and the promotion of PA in medical education. The following part of the PROMESS project aim to improve medical students fitness levels through individualized support.

(1) Macilwraith and Bennett, Irish Medical Journal, 2018, 111(3), 707

(2) Taylor et al. The Clinical Teacher, 2022, 19(6), e13525

(3) Stephens et al. Military Medicine, 2015, 180, 77-78

(4) Leger and Boucher. Canadian journal of applied sport sciences, 1980, 5, 77-84

(5) Shvartz and Reibold RC. Aviat Space Environ Med, 1990, Jan, 61(1):3-11

SPORTS-MEDICINE FUSION: INNOVATIVE STRATEGIES AND PRACTICES FOR PUBLIC HEALTH PROMOTION IN CHINA

LIU, Y., LU, W.Y.

SHANGHAI UNIVERSITY OF SPORT

【Introduction】

The COVID-19 pandemic has increased public awareness of the importance of physical activity for both physical and mental health,leading to a surge demand for fitness(WHO,2022).China,as a populous nation with a significant population affected by chronic diseases and physical inactivity,has placed a strong emphasis on public health management.The government has prioritized this by implementing policies promoting health through physical activities and endorsing the innovative Sports-Medicine Fusion Model.This model aims to reduce healthcare costs,improve living standards and stimulate sports consumption.This study explores a key question:How can the Chinese government effectively enhance the health status of its 1.4 billion citizens by integrating sports and healthcare resources?

【Methods】

This study combined online/offline and quantitative/qualitative research methods.

Firstly,Python software and the LDA model were utilized for topic identification and sentiment analysis, providing insights into public satisfaction regarding the current healthcare environment.Secondly,supported by the National Social Science Fund,nationwide field research was conducted into three levels:macro(government guidance), meso(sports-medical institution collaboration), micro(community service)

【Results】

Platform data reveals low public satisfaction levels with "fitness guidance organizations"and "physical health assessments".

•Macro level:The central government has launched 2 major national strategies, "Sports Power" and "Healthy China," outlining strategic missions and long-term goals for sports-medicine fusion(Jianhui Dai,2020).Local governments have established 3 coordinating organizations, pilot institutions ,and implementation guidelines.

•Meso level:Sports and medical institutions have explored various practical models , including embedded institutional models, joint operation models, and network radiation models.Successful experiences and constraining factors have been identified.

•Micro level:Customized exercise prescription databases and fitness programs have been developed for diverse demographic groups and disease stages,incorporating elements of Western and Traditional Chinese Medicine, as well as Modern and Traditional Chinese Sports. Digital technology has facilitated data collection,integration,sharing, and utilization, supporting government decision-making, corporate development, and citizen self-health management(Roel Heijlen,2021).

【Discussion】

Sports-Medicine Fusion, as a novel model in Chinas public health management,has established an effective mechanism among the government, institutions, and communities. However,it faces several challenges,including mindset barriers, funding limitations and inadequate infrastructure.Future efforts should prioritize tackling these issues, with a focus on advancing both theoretical research and practical applications.

UPDATED SYSTEMATIC REVIEW AND META-ANALYSIS OF THE EFFECT OF THE NUMBER OF SPRINT REPETITIONS IN A SIT SESSION ON CHANGES IN VO2MAX WITH TRAINING

HUTCHINSON, M., VOLLAARD, N., PAVAL, R., GALLAGHER, I.J.

UNIVERSITY OF STIRLING

INTRODUCTION: The most commonly used sprint interval training (SIT) protocol within research focusing on improving VO2max involves 4-6x30-s repeated "all-out" sprints performed 3 times per week. The finding that reducing the volume of sprint exercise to 2x20-s sprints does not attenuate health improvements [1] led to increased interest in SIT protocols involving fewer / shorter sprints. A previous meta-analysis analysed 34 SIT studies (n=418 participants) and concluded that improvements in VO2max are not attenuated with fewer sprint repetitions [2]. However, the use of magnitude-based inference and the relatively low number of studies using <6 sprint repetitions were limitations of this study, providing a justification for the need for an updated meta-analysis using more robust statistical methods. The aim of this study was to

investigate the effect of the number of sprint repetitions on changes in VO2max in SIT exercise protocols involving untrained participants.

METHODS: The study (PROSPERO ID: CRD42022349104) was carried out in accordance with the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Online databases Web of Science and PubMed were searched up to August 2022 for the independent variable search terms "Wingate", "all-out", "sprint" and "interval training" combined with dependent variable search terms "fitness", "aerobic capacity", "aerobic power", "VO2max", "VO2peak", "oxygen uptake" and "oxygen consumption". Studies included in the previous review [2] were added. A Bayesian meta-analysis was performed to examine the effect of the number of sprints per training session on changes in VO2max with training, along with moderating effects of age, BMI, baseline VO2max, total sprint volume per week, intervention duration in weeks, and work/rest ratio. Means and effect size with high-density intervals (HDIs) were used to describe the results.

RESULTS: A total of 67 studies involving 79 trials (n=1013 participants) were included in the analysis. Overall, SIT interventions were associated with improved VO2max (Mean = 8.7%, 95% HDI: 6.8% to 10.5%). There was no meaningful relationship between the magnitude of the change in VO2max and the number of sprints per session (ES=-0.01, 95% HDI: -0.13 to 0.12). There was a small moderating effect of age (ES=-0.03, 95% HDI: -0.05 to -0.01), but not for other moderators.

CONCLUSION: With increased statistical power and a more robust statistical analysis approach, the present updated meta-analysis confirmed the previous finding that performing a greater number of sprint repetitions in a SIT session does not result in greater improvements in VO2max. Considering the target audience of insufficiently active individuals and the proclaimed benefit of time-efficiency, research into the health benefits of SIT should focus on protocols involving a low number (2-3) of sprints.

ASSOCIATION BETWEEN BODY COMPOSITION AND INTERMITTENT AEROBIC PERFORMANCE IN 10-12-YEAR-OLD BOYS AND GIRLS INVOLVED IN A FOOTBALL TRAINING PROGRAMME

CASTAGNA, C.1,3, PÓVOAS, S.2,3, KRUSTRUP, P.3,4,5, LARSEN, M.3

1) CARLO BO URBINO UNIVERSITY, URBINO, ITALY; 2)CIDESD/UMAIA, MAIA, PORTUGAL; 3) SHSC-SDU, ODENSE, DK; 4) DIAS/SHSC-SDU, ODENSE, DK; 5)UNIVERSITY OF EXETER, UK

INTRODUCTION:

Castagna, C.1,2,3, Póvoas, S.3,4, Krustrup, P.3,5,6, Larsen, M.3

1) Carlo Bo Urbino University, Urbino, IT, 2) Settore Tecnico FIGC, Florence, IT 3) SHSC-SDU, Odense, DK, 4) CIDESD/UMAIA, Maia, PT, 5) DIAS/SHSC-SDU, Odense, DK, 6) University of Exeter, UK

The aim of this study was to analyse the association between body composition and intermittent aerobic performance, in children of both sexes, engaged in a football training programme.

METHODS: One-hundred twenty-seven (age 10.7±0.5 years, body mass 41.2±9.0 kg, stature 149±7 cm) children (70 boys) were tested in the untrained state. Whole-body Dual-energy X-ray Absorptiometry was used to evaluate body composition and intermittent aerobic performance was accessed by an age-adapted aerobic performance field test, the Yo-Yo Intermittent Recovery level 1 Children's test (YYIR1C).

RESULTS: The children covered 618±441m in the YYIR1C showing moderate differences between the sexes ($p<0.05$). YYIR1C performance was moderately-to-trivially negatively associated with Fat Mass and Body Mass, respectively ($p<0.05$). In boys, the associations between Fat Mass, Body Mass and Body Mass Index (BMI) and YYIRC1 were small and negative ($p<0.05$). In girls, YYIR1C performance was small-to-trivially negatively associated with Fat Mass, Body Mass and BMI ($p<0.05$). When accounting for Fat Mass, Body Mass and YYIR1C performance resulted trivially associated in all children. Trivial-to-small associations were found between YYIR1C performance and Body Mass when accounting for Fat Mass and BMI in boys and girls.

CONCLUSION: The results from this study promote the acceptability of the YYIR1C test as tool to evaluate aerobic performance in 10-12-year-old children of both sexes, possessing different body composition in the untrained state.

This work was funded by Nordea Foundation and by Portuguese Funds by FCT – Foundation for Science and Technology under the following project UIDB04045/2020 (https://doi.org/10.54499/UIDB/04045/2020).

BRIDGING DIVIDES: CAN EXERCISE AND SPORT PREVENT FUNCTIONAL IMPAIRMENT IN FORCIBLY DISPLACED POPULATIONS?

KNAPPE, F., FILIPPOU, K., HATZIGEORGIADIS, A., MORRES, I.D., GERBER, M.

UNIVERSITY OF BASEL

INTRODUCTION: According to UNHCRs report (2023), the global incidence of forced displacement has escalated. On average, 36.3 individuals per minute are forced to abandon their homes due to political, economic, and environmental factors. Adapting to a new environment can present significant challenges for affected individuals, including mastering the local language or getting and keeping a job. Social integration requires high functional capabilities, which can be compromised by harsh post-migration living conditions (Schick et al., 2018). In light of these challenges, our objective was to evaluate the effects of exercise and sport on cognitive function and pain alleviation among residents of a refugee camp in Greece and to examine cardiorespiratory fitness as a potential mediator.

METHODS: We conducted a randomized controlled trial. A total of 142 forcibly displaced individuals (52.8% women) were enrolled and assigned to either the intervention group or the wait-list control group. The intervention group participated in co-designed exercise and sport activities for 10 weeks. Co-design was a collaborative approach with service users, staff, and camp management to tailor the intervention and meet individual, cultural, and situational needs. Outcomes included sustained attention, inhibitory control, pain, and cardiorespiratory fitness. The analysis was performed using structural equation modeling.

RESULTS: In the intervention group, 73.5% of participants engaged in exercise and sport activities weekly. There was no evidence for a direct intervention effect on cognitive function or pain (p≥.410). However, compared to the wait-list control group, there was a significant increase in cardiorespiratory fitness in the intervention group at T2, ß=.18, p=.008. Improvement in cardiorespiratory fitness was associated with enhanced reaction times in cognitive tasks, ß=-.23, p=.009, though it had no significant effect on pain scores, ß=.06, p=.500. Sensitivity analysis showed that participation rate was linked to a decrease in pain scores at T2, ß=-.15, p=.037.

CONCLUSION: Initiating exercise and sport within a Greek refugee camp targets a broader population and enhances cardiorespiratory fitness among forcibly displaced individuals. The potential benefits of these activities on cognitive function and pain appear to be related to improved cardiorespiratory fitness and regular participation.

Oral Presentations

OP-SH13 Psychology/Body Image

BIGOREXIA: IDENTIFICATION OF PROTECTIVE AND RISK PSYCHOLOGICAL FACTORS IN YOUNG ADULTHOOD

GIORDANO, F., SALADINO, V., CORTIS, C., CASTELLANI, L., VERRASTRO, V., FUSCO, A.
UNIVERSITÀ DEGLI STUDI DI CASSINO E DEL LAZIO MERIDIONALE

Bigorexia: identification of protective and risk psychological factors in young adulthood

Introduction: Bigorexia was classified as a subtype of body dysmorphic disorder in the Diagnostic and Statistical Manual of mental Disorders 5th ed. The sufferer is obsessed with his/her physical appearance and musculature, and resorts to any strategy to achieve an ideal aesthetic model.

Objectives: The aim is to identify potential protective or risk factors that may determine or influence the development and maintenance of distress related to perceived body image by analyzing how this discomfort relates to and interacts with general psychological distress, general self-efficacy, perceived social support and problematic social media use.

Materials and Methods: The sample consisted of 1067 individuals of both sexes, females (67.9%) aged 18-29 years, mean 23.68, SD 3.92. Statistical analyses included descriptive analysis of the characteristics of the sample, correlational analysis of the main study variables by estimating Pearson correlation coefficients ($p < 0.05$).

Self-report questionnaires:

- Muscle Dysmorphic Disorder Inventory: is a 13-item questionnaire divided into three subscales scored on a five-point Likert scale assessing cognitive, behavioral, and emotional characteristics of Muscle Dysmorphic disorder MD;

- Bergen Social Media Addiction Scale: consists of 6 items rated on five-point Likert scale to assess the eventual misuse of Social Media MS;

- Depression, Anxiety and Stress Scale - DASS21: is a set of three scales rated on a four-point Likert on a four-point Likert scale designed to measure emotional states of depression, anxiety, and stress;

- General Self-Efficacy Scale: consists of 10 items on a four-point Likert scale assessing the general sense of perceived self-efficacy;

- Multidimensional Scale of Perceived Social Support: consists of 12 items on a 7-point Likert scale designed to measure perceived social support from Family, Friends, and a Significant Other.

Results: Data analysis shows a significant positive correlation of MD (mean 2.01, SD .676) with MS (mean 11.13 SD 4.71) p = <.001 r= 401** and with psychological distress (mean 1.28, SD .694) p = <.001 r= 404**, while a negative correlation with social support (5.59, SD 1.06) p = <.001 r= -.327** and general self-efficacy (mean 27.2, SD 5.88) p = <.001 r = -.128**.

Conclusions: Research shows that all variables examined interact significantly with MS-related symptomatology. In particular, our data suggest that the risk of developing MS is associated with greater psychological distress and misuse of MS, while higher levels of perceived self-efficacy and social support appear to act as protective factors.

References

- Tovt, S., & Kajanová, A. (2021). Introduction to bigorexia. Journal of nursing and social sciences related to health and illness, pg, 133-136.

- Griffiths, S., & Murray, S. B. (2018). Muscle dysmorphia: Clinical presentation and treatment strategies.

GENERAL ASPECTS FOCUSED ON PSYCHOLOGICAL AND EATING DISORDERS OF PEOPLE WHO PRACTICE BODYBUILDING; DESCRIPTIVE MONOGRAPHIC REVIEW

LEDEZMA GUTIERREZ, D.G.
UNIVERSIDAD DEL VALLE DE MEXICO Y ESCUELA UNIVERSITARIA REAL MADRID

Abstract: The objective of this work is to describe the relationship between psychological disorders and eating disorders (ED) in bodybuilders. In order to raise this objective, a descriptive monographic review work was carried out, for which certain bibliography was selected and delimited in search of data in order to provide an answer to the uncertainty of the proposed research. The information search strategy was carried out in 2 databases: PubMed and Google Scholar, searching for information in Spanish and English, taking into account the following inclusion and exclusion criteria. Inclusion criteria: articles related to the practice of bodybuilding, articles related to sports psychology, bodybuilding and psychological disorders, articles related to sports supplementation in bodybuilding and articles related to eating disorders. (TCA). Exclusion criteria: athletes under 18 years of age, articles on psychological and nutritional disorders focused on other sports, people who do not do physical exercise. The study sample is made up of 18 articles by different authors. Intake of dietary supplements; Sport nutrition, Psisical activity, Nutritional Science and sport, Dietary supplements, eating disorder in bodybuilding (TCA in bodybuilding), Body image, Body image, Bigorexia in bodybuilding, muscle dysmorphia, behavior in bodybuilders, behavior in bodybuildings.

The results achieved, starting with the analysis of the study carried out by Alonso Andrade, García et al. 2012 and Devrim et al. 2018 it is confirmed that bodybuilders carry out practices that are considered high risk for health and in the psychological aspect with the study carried out by Arbinada and caracuel 2008, it is shown that bodybuilders are more realistic, practical, objective, utilitarian, concrete, organized and disciplined and that the majority of these athletes present vigorexia and body image disorder.

ADOLESCENT FEMALE ATHLETES OF AESTHETIC SPORTS AND THEIR FAMILIES' COMMENSALITY DYNAMICS, CHALLENGES, AND STRATEGIES

JUZWIAK, C., SALAZAR, D.M., PADOVANI, R.C.
UNIVERSIDADE FEDERAL DE SAO PAULO

Introduction: Athletes' food choices and practices are affected by several factors, among which, the eating practices adopted by those with whom they live, which are shared in moments of commensality. Commensality represents the practice of eating together and is one of the main social functions of eating. Thus, the aim of the study was to understand the commensality dynamics in families of adolescent athletes of aesthetic sports from the perspective of the athletes and their guardians.

Methods: Individual face-to-face semi-structured interviews were conducted with 16 female adolescent athletes (seven rhythmic gymnasts and nine figure skaters) and their guardians, totaling 32 interviews, as well as a focus group with each athletes' team. The questions explored families' attitudes and organization regarding mealtime, perceptions of the athletes about their own eating practices, and the role of their families. Analysis was conducted using the thematic content analysis (TCA) and was based on the Family Food Systems model (Travis et al., 2010) and the Dimensions and Roles of Commensality framework (Giacomann, 2016).

Results: The TCA led to three thematic nuclei: a)commensality and family dynamics; b)body norms and eating practices, and c) identities at the table. Families influence athletes diet, but their athletic routines also influence families' eating organization. Athletes and guardians perceive family meals as moments of unity and bonding, although they are hampered by the difficulty in aligning schedules (co-presence) and may represent moments of conflicts. Parental control during mealtimes was an important cause of tension and stress, and the pressure to restrict food reinforced the demands that athletes already experience in their sports environment, and the risk of body image dissatisfaction and disored eating. All guardians pointed out many challenges in being responsible for providing/organizing family meals considering the different preferences and requirements of all family members, while athletes contributed little to the organization of family food.

Discussion: Family commensality and its role on the eating practices of adolescent female athletes is a complex phenomenon. This study provides valuable insights that reinforce the importance of involving the family in nutrition education activities for adolescent athletes. This ensures that they will be able not only to guarantee the nutritional requirements for healthy growth and athletic performance, but also that they can empower young athletes to have a positive perception about their bodies, and to develop a good relationship with food and eating.

References

Travis S, Bisogni C, Razenhofer L. (2010). Appetite, 54:108-17.

Giacoman (2016). Appetite, 107:460-70.

BODY IMAGE IN TEAM SPORTS AND FITNESS ACTIVITIES

FESTINO, E., PAPALE, O., CORTIS, C., FUSCO, A.
UNIVERSITY OF CASSINO AND LAZIO MERIDIONALE

INTRODUCTION: Body image (BI) is a multidimensional construct encompassing how subjects perceive, feel, think and behave in relation to their own bodies. Negative BI is a predictor of health-related issues, including depression, anxiety

and eating disorders. Considering the positive effects of physical activity (PA) and sports on health, this study aims to assess the influence of team sports (TS) and fitness activities (FA) on BI.

METHODS: Sixty-eight adults (age:28.7±10.3yrs) were divided into two groups: TS Group (TSG=34), such as football and volleyball players, and FA Group (FAG=34), such as cross training and weight training participants. To assess the subjective and emotional dimensions of BI, participants completed the BI Dimensional Assessment (BIDA) questionnaire. Using a neutral silhouette-based scale ranging from 1.8 to 5.2, participants indicated their perceived and ideal body shape, as well as the body shape most appreciated by the opposite sex and their peers. Three direct indexes were calculated: Body Dissatisfaction (BD), Sexual Body Dissatisfaction (SxBD), and Comparative Body Dissatisfaction (CBD). Scores ranged from –100% to 100%, with positive values indicating that subjects rated their BI higher than their idealized levels. The Body Dissatisfaction Index (BDI) was calculated as the mean of the absolute values of BD, SxBD and CBD. The BDI ranged from 0 to 100%, with scores >30% considered at risk of BI disorders. To determine differences ($p<0.05$) in BD, SxBD, CBD and BDI between TSG and FAG, unpaired t-tests were conducted.

RESULTS: TSG showed significant ($p<0.05$) lower values for BD (5.7±10.2%), SxBD (-0.2±15%) and BDI (9.6±5.8%) compared to FAG (BD: 13.5±16.8%; SxBD: 11.1±20.6%; BDI: 18.4±11.9%). While for CBD no significant difference ($p>0.05$) was found between groups (TSG: -6.4±11.7%; FAG:-1.5±28.2%).

CONCLUSION: The findings highlight the significant effect of sports participation on body perception. Although neither group exhibited a risk of BI disorders (BDI <30%), highlighting the mental health benefits of PA regardless of its type, TSG reported a better perception of their BI compared to the FAG. BD and SxBD scores were higher in FAG than TSG, suggesting that athletes perceived body shape closely aligns with their ideal and the body shape appreciated by the opposite sex. These results might be attributed to differences in exercise prescription between the two groups. In fact, considering the competitive nature of sports, TSG could have a more rigorous exercise program monitoring than FAG, potentially leading to a physique that aligns with the aesthetic ideal of health and attractiveness. Therefore, controlling and monitoring for exercise frequency, duration, intensity, and type, might be associated with improved BI.

Oral Presentations

OP-SH05 Sport management and law II

VOLUNTEER MOTIVATIONS IN INTERNATIONAL SPORTING EVENTS: THE CASE OF CHENGDU 2021 WORLD UNIVERSITY GAMES

ZHANG, Y., NOH, Y., ZHOU, T., MAO, Y., LIU, S.

UNIVERSITY OF MALAYA

INTRODUCTION: Volunteerism in sports events is a global phenomenon, impacting events from the Olympics to local competitions. Volunteerism in sports has been extensively studied, with a focus on Western contexts, leaving a research gap in non-Western perspectives, particularly in China. This study addresses this gap by translating and validating the Volunteer Motivations Scale for International Sporting Events (VMS-ISE) [1] in the context of the Chengdu 2021 World University Games, offering insights into volunteer motivations in Chinese sports events.

METHODS: Phase I Translation of VMS-ISE: (1) Translated VMS-ISE into Chinese (VMS-ISE-Ch) with four interpreters. (2) Validated content with a panel of experts in sport psychology and volunteer management.

Phase II Adaptation of VMS-ISE-Ch: (1) Evaluated the unified VMS-ISE-Ch through a pilot study with 30 participants. (2) Conducted interviews to identify issues related to translation and cultural adaptation.

Phase III Validation of VMS-ISE-Ch: (1) Examined internal consistency reliability using Cronbach's alpha. (2) Utilized Confirmatory Factor Analysis (CFA) to assess its construct validity. (3) Revised the model based on cultural nuances and Modification Indices in AMOS.

RESULTS: Preliminary analysis involved data cleaning, retaining 416 valid responses. Internal consistency reliability of VMS-ISE-Ch exhibited high reliability (α = 0.83 to 0.90). CFA results initially showed inadequate model fit, prompting the removal of specific items. Revised VMS-ISE-Ch demonstrated acceptable fit indices, confirming robust construct validity.

Discussion:

Comparison with prior studies reveals variations in translated versions, emphasizing the need for cultural specificity. Modifications to the VMS-ISE-Ch model improved overall fit, aligning with cultural expectations. Cultural differences and translation accuracy play pivotal roles in model fit, highlighting the importance of cross-cultural adaptation.

CONCLUSION: The study successfully translated and validated the VMS-ISE-Ch, providing a reliable tool for understanding volunteer motivations in Chinese sports events. Recommendations for future research include exploring relationships between volunteer motivation and outcomes such as satisfaction, loyalty, and continued willingness to volunteer. Expansion of the sample to diverse volunteer groups is suggested for a more comprehensive understanding.

1 Bang, H., & Chelladurai, P. (2009). Development and validation of the volunteer motivations scale for international sporting events (VMS-ISE). International Journal of Sport Management and Marketing, 6(4), 332–350. https://doi.org/10.1504/IJSMM.2009.030064

CHALLENGES AND PATH SELECTIONS FOR MODERNIZATION OF MASS SPORTS GOVERNANCE

WANG, S., CHEN, C.
SHANGHAI UNIVERSITY OF SPORT

Introduction

Mass sports are an indispensable foundation for the development of the sports careers. Breaking through the dilemma of modernizing mass sports governance, enhancing the level of modernization of mass sports governance, and accelerating the modernization of mass sports governance are not only necessary for innovating the governance of mass sports, but also the trend of strengthening the sports governance system and governance capabilities, and more importantly, they are essential for the comprehensive construction of a modern sports powerhouse.

Methods

Mainly using research methods such as literature review, field research, and expert interviews, searched the "CSSCI Journal" on CNKI with the themes of "Sports for all" "Mass sports governance" in resent 10 years (from January 2014 to January 2024), retrieved 262 and 99 papers respectively. Read more than 60 relevant core journal articles, and study more than 10 relevant reports and monographs. The authors went to 10 universities, took part in face-to-face interviews with more than 20 experts in 2023.

Results

Research shows that the modernization of mass sports governance has three positive effects: 1) addressing the issue of unequal public service in national fitness; 2) improving the physical health of the people; 3) meeting the increasing demand for sports in the pursuit of a better life.

The study also found that there are three practical challenges in achieving the modernization of mass sports governance: 1) the development foundation of modern mass sports governance needs to be strengthened; 2) the innovation capability of modern mass sports governance urgently needs to be enhanced; 3) the level of coordination in modern mass sports governance still needs to be improved.

Discussion

Research indicates that the implementation measures for advancing the modernization of mass sports governance need to be addressed from four aspects:1) Strengthening the rule of law construction to provide a legal environment and guarantee for modern governance. Clarify the legal scope of government, market, and sports organizations responsibilities.2) Improving the service system to enhance the quality and level of modern governance. Constructing a stable and reasonable financial investment mechanism and implementing government accountability for public fitness services.3) Reinforcing the integration of ideas to provide momentum and support for modern governance. Implementing "coordinated" governance changes the governance approach of "going it alone".4) Perfecting governance systems to construct a new pattern and new approach for modern governance. Fully leverage the collaborative role of party organizations at all levels, government, sports social organizations, and the public in the modernization of mass sports governance.

INTERNATIONAL SPORTS AFFAIRS TALENT CULTIVATION AND RECOMMENDATION SYSTEM AND ITS DYNAMICS IN CHINA: FROM THE PERSPECTIVE OF INTERCULTURAL TRAINING AND REALISM

TAN, T.C., WU, K.W.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction: An overview of talent cultivation and recommendation practices in China is the purpose of this study, as well as mapping of their human resources within international sports organizations, with an aim to gain a deeper understanding of their political and social implications. The study is based on the theories of intercultural training and realism in international relations, and its results are analyzed both theoretically and practically.

Methods: Our study utilized the content analysis method and a semi-structured interview. Between 2022 and 2024, field research was conducted in Beijing & Shanghai and 18 people with relevant officials, foreign affairs officials, scholars, and experts were interviewed. The preliminary research results have been derived from a collection of policy documents, media reports, and interviews.

Results: The results of the study are presented in three sections: "cultivation system", "recommendation system", and "dynamics." Among the key components of the "Cultivation System" section is the Beijing Sports University model, which emphasizes the cultivation of current students; the "General Administration of Sports model," which emphasizes the development of in-service personnel within the General Administration of Sports system; and the "Tsinghua University model," which emphasizes the development of individuals capable of managing sports events. In this "recommendation system," the following items are summarized: acquiring professional talents from other international organizations; building good relations with the IOC Chairman; and hosting international events to increase opportunities to interact with the IOC and International Federations. There are three major components to "Dynamics," including: meeting the requirements for hosting the Beijing Summer Olympics and Beijing Winter Olympics, strengthening Chinas influence on international sports affairs, and enhancing its influence on Olympic sports organizations rules and referee selection processes.

Discussion: In accordance with the assertion of realism theory, the Chinese government perceived sports competition as a symbol of a global arms race and sought to assert its voice within the global political, diplomatic, and Olympic arenas by increasing its competitive sports strength.

STUDY ON UTILIZATION INDEX AND PRACTICAL INNOVATION OF LARGE-SCALE STADIUMS IN CHINA

FANG, X., CHEN, Y., WANG, X.
ZHEJIANG NORMAL UNIVERSITY

Introduction

We develop a China stadium utilization index (CSUI) that complies with international standards and is appropriate for Chinas unique circumstances by drawing on the Stadium Utilization Index (SUI) and the World Stadium Index (WSI). For the empirical study, data from large-scale stadiums in China is chosen, and the elements that influence the usage index are examined.

Methods

Expert interviews, focus groups, and a review of the literature were used to build a usage index of venues that are appropriate for the national conditions of China. We created the utilization index by taking into account the stadiums use function and two factors: the utilization rate of national fitness (SUI-fitness) and the utilization rate of hosting events (SUI-event). The public data on 266 large-scale stadiums was then collected and experimentally examined from the National Fitness Information Service Platform of China. The association between the relevant variables was examined using independent sample t-tests, and the degree to which the relevant factors predicted the stadium utilization rate was investigated using a linear regression model. We performed statistical analysis using SPSS 25.0.

Results

The study found that the overall utilization index of Chinas stadiums is low. Compared with soccer stadiums such as the World Cup and the Chinese Super League, their utilization rates for tournament activities are relatively low. The distribution of the utilization rate for national fitness is relatively balanced, and most of the stadiums can meet the basic requirements for open services. The analysis of its influencing factors found that venue size, completion time, nature of the operating body, government subsidies, information technology, and other factors are significantly correlated with the utilization rate of the venues, while the influencing factors of SUI-event and SUI-fitness are slightly different. Regression analysis shows that factors such as venue size, completion time, government subsidies, and information technology can predict SUI-fitness.

Discussion

The study draws the following insights: (1) Strictly control the construction scale of stadiums and improve the elastic design and flexible utilization level of stadiums. (2) Take "building venues for games" seriously and focus on the long-term use of newly built stadiums. (3) Pay attention to the upgrading of the software and hardware environment of stadiums and improve the level of intelligence and refinement of the utilization of stadiums. (4) Expand the scope of public sector financial subsidies and improve the level of public welfare opening and utilization of sports venues. (5) Further promote the reform of the right to operate and the public-private partnership system, and improve the design of the relevant supporting systems. (6) Strengthen the popularization and application of CSUI, and provide decision-making references for improving the utilization of sports venues.

MAINTAINING GOVERNMENT DOMINANCE ALBEIT THE PANDEMIC, THE GOVERNANCE OF SPORT LEGACY OF THE 2022 BEIJING OLYMPIC WINTER GAMES IN THE TIME OF COVID-19

HU, X., BAIRNER, A.
TSINGHUA UNIVERSITY

Introduction

The study aims to scrutinises the way in which the governance of the sport legacy of the Beijing Winter Olympics has been changed in the pandemic circumstance. In particular, given the dominance of government in the Chinese society and the significance of cross-sector coalition in governance network, it is sought to not only examine the changes and continuities in the power relations between stakeholders but also reveal how the government has skilfully maintained its dominance in Olympic sport legacy governance in the time of COVID-19.

Methods

A multi-dimensional governance approach, which is recognised as one covering all the different facets that are associated with the notion of 'governance' (Lange et al. 2013, p. 409), is employed in the study in order to examine the institutional, procedural and political aspects of governance (Byun and Leopkey 2020) through analysing qualitative data collected through two rounds of interviews with 26 personnel holding managerial position in Chinese governments, BOCOG 2022, and private organisations related to the Beijing Olympic Winter Games.

Results

The study scrutinises various impact of the COVID-19 on legacy governance through revealing changes in the policy, polity and politics dimension of the governance of two sport legacy goals specified by BOCOG 2022. We also interrogate the relationship between, and the essence of, the changes and continuities in different dimensions of legacy governance.

Discussion

Even though the concept of governance emphasises self-coordinating, inter-organisational coalition or ruling through and by networks, the Chinese government has craftily maintained its dominance in an intangible fashion through a medium, i.e., knowledge, which both influences and is influenced by discourse, which "legitimates social actions and relations

between those who shape the normative conventions and whose life experiences may be shaped by such conventions" (Chatziefstathiou and Henry 2012, p.13). It is thus contended that governance, despite the non-hierarchical characteristics of the concept, is societally restrained by the hierarchical structure of the society in which it operates and functions with a power hierarchy that is controlled by the government even in a less tangible and/or more subtle manner.

Reference

Byun, J. and Leopkey, B., 2020. Exploring Issues within Post-Olympic Games Legacy Governance : The Case of the 2018 PyeongChang Winter Olympic Games. Sustainability, 12 (9) (3585).

Chatziefstathiou, D. and Henry, I.P., 2012. Discourses of Olympism: From the Sorbonne 1894 to London 2012. Houndsmill, Basingstoke, Hampshire ; New York: Palgrave Macmillan.

Lange, P., Driessen, P.P.J., Sauer, A., Bornemann, B., and Burger, P., 2013. Governing Towards Sustainability — Conceptualizing Modes of Governance. Journal of Environmental Policy & Planning, 15 (3), 402–425.

11:30 - 12:45

Plenary Session

PS-PL02 Understanding the challenges and benefits of increasing community sport participation

APPROACHES TOWARDS SOCIO AND CONTEXTUAL UNDERSTANDINGS OF SPORT PARTICIPATION ACROSS GLOBAL CONTEXTS

MISENER, L.

WESTERN UNIVERSITY

Although people manage their own leisure time, we must recognize that states do attempt to influence citizens' leisure activities (Bramham et al., 1993). For instance, governments across Europe promote sport as a worthwhile leisure pastime, as reflected in the 'Sport for All' Charter of the European Council (1975). EU member states and elsewhere across the globe present a similar policy agenda on sport. For example, a critical part of the Canadian Federal Minister of Sport St.Onge's mandate is to increase accessibility to sport programmes, reduce barriers and the achievement of social and economic goals through the intentional use of sport (Trudeau, 2021). Raising levels of sport participation and community engagement in sport, especially among disadvantaged groups such as those with a disability that are less likely to take part in sport, is a particular sport policy across Europe and North America (Hoekman, Breedveld & Scheerder, 2011). This presentation will shed light on differences in sport participation across Europe and provide explanations for these differences, by linking it back to contextual factors. It will challenge the role of government in recent sport participation trends in Europe and internationally and argue that part of the sport participation differences is well beyond the control of sport policy. To conclude it will highlight the added value of governmental involvement in sport for disadvantaged sections of society.

COMMUNITY SPORT FOR PUBLIC HEALTH AND WELLBEING: REACHING, ENGAGING AND RAISING PHYSICAL ACTIVITY LEVELS THROUGH COMPLEX COMMUNITY SPORT PROJECTS

MANSFIELD, L.

BRUNEL UNIVERSITY LONDON

Community sport is being promoted across Europe to raise population levels of physical activity for health and wellbeing. This presentation outlines the methods and findings from the Health and Sport Engagement (HASE) project; a mixed methods outcome, process and economic evaluation of a complex community sport programme. It engaged previously inactive people in sport for 1 x 30 minutes / week. This presentation details the approach and results from participatory focus groups (n=32 x 1 hour) ensuring HASE activities reached, met the needs of, and engaged local inactive people. It explains how a bespoke package of public health training, delivered to sport coaches (n=15) maximised the quality of workforce knowledge in designing and delivering community sport. The findings showed that a total of 550 people engaged in the HASE project. There were large and significant increases in vigorous and moderate physical activity and sport during project design and training. Statistically significant increases over time in happiness were recorded by participants. Quality adjusted life years were slightly higher over time but not statistically significant. Costs of the project varied depending on the character of the inactive population and the delivery requirements. Overall, the HASE project showed that with the right support and provision, barriers to participating in sport can be overcome. Previously inactive people can take part in community sport activity, enjoy doing so, and potentially gain health and wellbeing benefits from participation. The presentation concludes with critical commentary on building and using evidence on community sport for health and wellbeing.

13:45 - 15:00

Invited Symposium

IS-PN05 Neural, muscular and skeletal adaptations to long-term resistance training

NEURAL CHANGES DURING PROLONGED RESISTANCE TRAINING

MAEO, S.
RITSUMEIKAN UNIVERSITY

It has long been believed that neural changes are the main contributors to strength gains after short- and medium-term resistance training (RT). Indeed, there is a compelling body of evidence demonstrating that neural changes, such as increased agonist neural drive (assessed with surface electromyography: sEMG) during maximal voluntary contraction, can explain a majority of the strength gains after ≤12 weeks of RT, with muscular changes (hypertrophy) accounting for only a minor portion of the strength gains (Balshaw et al. 2017; Maeo et al. 2018). However, relatively few early studies with prolonged (6 months) longitudinal RT interventions (Narici et al. 1996; Hakkinen et al. 1998), as well as a recent cross-sectional study (Balshaw et al. 2018), suggest that increases in the agonist neural drive tend to plateau after 2-4 months of RT, whereafter muscle hypertrophy appears to play a greater role in contributing to further increases in strength. Although these findings might suggest neural adaptations to RT are completed within 2-4 months, lack of further change (i.e., plateau) in the agonist neural drive does not exclude continued adaptation of other neural mechanisms. Indeed, there is some evidence that intermuscular coordination continues to adapt with prolonged RT, and likely to contributes to continued strength gains. For example, antagonist coactivation was found to be progressively lower, between untrained controls, medium-term (12 weeks) and long-term (>3 years) resistance trained individuals (Balshaw et al. 2018). Apart from the traditional sEMG measurements, recent studies have utilized more advanced techniques such as high-density surface electromyography (HDsEMG, Casolo et al. 2021) and transcranial magnetic stimulation (TMS, Maeo et al. 2021) when comparing neural characteristics in long-term resistance trained versus untrained controls. To date, there is no clear evidence for differences in agonist neural drive between long-term resistance trained individuals and untrained controls that explain the distinct maximal strength differences between these groups. Nevertheless, recent findings and suggestions from these studies will facilitate future studies using both longitudinal and cross-sectional approaches. Based on the above, this lecture will mainly focus on the potential neural adaptations that may (or may not) contribute to further increases in maximal strength during prolonged RT. In addition, neural strategies during submaximal or rapid contractions that may be associated with improved neuromuscular performance (e.g., improved force steadiness and rapid force production) after long-term RT will be discussed. Finally, methodological considerations for other commonly used techniques (e.g., sEMG normalization to M-max, Skarabot et al. 2021; interpolated twitch technique, Follland & Willliams 2007) and one less explored but likely promising technique (e.g., fMRI) will also be introduced.

MUSCLE AND TENDON ADAPTATIONS WITH PROLONGED RESISTANCE TRAINING

FOLLAND, J.
LOUGHBOROUGH UNIVERSITY

Resistance training (RT) has been suggested to lead to a range of muscular and tendinous tissue adaptations that contribute to changes in function (e.g. strength, power), improved metabolic health and reduced injury risk. Yet the majority of the evidence is from short-term studies that document relatively modest musculotendinous changes, that are likely secondary to neural adaptations in this time frame, and therefore this approach may limit our understanding of the magnitude and importance of musculotendinous adaptations. In contrast prolonged exposure to resistance training may stimulate more pronounced structural changes and provide an opportunity to better understand musculo-tendinous adaptations. This lecture will describe the insights we have gained from the study of long-term RT. Much of what is known about long-term RT has been drawn from cross-sectional studies comparing long-term trained with untrained individuals, due to the limited data from more rigorous longitudinal studies of human participants training for several months or years, and the reasonable insights and weaknesses of this approach will be discussed. Increased whole muscle size, skeletal muscle hypertrophy, is often regarded as the primary adaptation to prolonged resistance training and appears to proceed at an approximately linear rate during the first 6 months of systematic progressive RT (Narici et al., 1996). Thereafter the rate of hypertrophy is assumed to slow even in response to continued training, but with very little quantitative evidence. Evidence suggests that increases in the number of sarcomeres in parallel (due to fibre hypertrophy and/or fibre hyperplasia), rather than sarcomeres in series (due to fibre/fascicle lengthening), may be more important factor for muscle growth (Maden-Wilkinson et al., 2020). Although geometric modelling suggests these adaptations may be related with an increase in the number of sarcomeres in series, having a disproportional effect on the number of sarcomeres in parallel (Jorgenson and Hornberger, 2019). Regional hypertrophy, muscle architecture and the structural changes within fibres will also be discussed. From short-term RT studies the evidence for tendon hypertrophy appears to be equivocal with some observations of region-specific increases in tendon and other reports of no change. Cross-sectional studies of long-term trained vs untrained individuals (Massey et al., 2018) may provide further insight into this debate and inform the capacity of both free tendon and aponeuroses to adapt to RT. Enhanced tendon mechanical properties (e.g. stiffness) may

be a relatively early adaptation as there is evidence for no further changes after the first few months of RT (Massey et al, 2018).

SKELETAL ADAPTATIONS WITH PROLONGED RESISTANCE TRAINING

MARQUES, E.
1 UNIVERSITY OF KALBA, UNITED ARAB EMIRATES (UAE) 2 UNIVERSITY OF MAIA, PORTUGAL

The effect of RT on bone health has received much attention as muscle contractions generated by this type of training activate many molecular mechanisms of mechanosensing and mechanotransduction that are common pathways for muscle and bone. RT has been primarily studied in adults and older adults (with or without comorbidities), but results from prolonged RT are conflicting. Several systematic reviews (with and without meta-analysis) exploring the effect of exercise on bone have been conducted. However, when we select only prolonged RT, only a smaller number of studies are available, and we observe large variations between the individual study findings. The main reason for this outcome can be attributed to the complexity of exercise interventions concerning exercise variables (e.g., exercise intensity, contraction velocity, frequency), training principles (e.g., progression, periodisation), and training conditions (e.g., supervision, devices). Also, the techniques used to quantify bone changes (Dual x-ray absorptiometry (DXA), computed tomography (CT), peripheral quantitative CT, and magnetic resonance imaging (MRI) or bone biomarkers) and the selected locations make the findings even harder to combine and draw firm conclusions. This symposium will present the results of our previous work and others, highlighting what is currently known and where more research is needed.

Invited Symposium

IS-MH06 Respiratory health and effects of inhaled ß2-agonists on performance: Therapy or doping?

OVERVIEW ON BREATHING ISSUES IN ATHLETES

DICKINSON, J.
UNIVERSITY OF KENT

Exercise respiratory symptoms such as tight chest, cough, mucus production and difficulty in breathing are the most common symptoms reported by athletes. The problem for a practitioner supporting an athlete with respiratory symptoms, is that the symptoms are not exclusive to one condition. Excluding cardiovascular disease and fitness status, five respiratory issues are the most common cause of respiratory symptoms. The five issues are asthma/EIB, rhinitis, allergy, breathing pattern disorder (BPD) and exercise induced laryngeal obstruction (EILO). This presentation will discuss how practitioners can systematically assess an athlete to provide a profile of their respiratory function and identify whether they may have any of the five main respiratory issues. The presentation will then discuss an overview of best therapy and management to best support for an athlete to maintain and optimise their respiratory function. An athlete who can optimise the management of their respiratory symptoms is able to maintain respiratory health and compete on a level playing field against athletes who do not have respiratory symptoms. A key focus of the will be on how to differentiate between asthma/EIB, BPD and EILO. In particular, BPD and EILO and are frequently mis-diagnosed as asthma/EIB. An accurate diagnosis is crucial as BPD, EILO will not respond to asthma therapy such as inhaled β2-agonists. A different approach including breathing pattern training, education and anxiety management is required. This approach will highlight to delegates the steps that can be taken to minimise the inappropriate use of asthma therapy, such as inhaled β2-agonists.

EFFECTS AND NEED OF INHALED B2-AGONISTS IN ATHLETES

BOUGAULT, V.
UNIVERSITÉ CÔTE DAZUR

Among the previously cited lower airway disease, exercise-induced bronchoconstriction (EIB) and asthma are the two conditions that may require the use of bronchodilators (e.g. inhaled β2-agonists) and/or inhaled corticosteroids to prevent or reverse bronchoconstriction/asthma crisis in athletes. We will talk here about these medications taken in therapeutic doses. Various bronchodilators, generally short-acting β2-adrenergic agonists (SABA), but also long-acting β2-agonists (LABA) combined with an inhaled corticosteroids are generally prescribed to treat EIB/asthma. They cause a rapid relaxation of airway smooth muscle and act rapidly on respiratory symptoms. SABA, especially Salbutamol, remain the most used drugs to treat asthma or EIB in athletes. An overview of the different β2-agonists used and authorized in the sports world to treat asthma/EIB and their efficacy on respiratory symptoms, lung function, and disease control, when taken alone or in combination with another treatment will be discussed. Their effect on various aspects of performance at therapeutic doses will also be reviewed as well as on the physiopathology of EIB. It is to note that asthma remains a rare but important cause of sudden death in young athletes. Up to now, no evidence of overuse of SABA/LABA has been observed in elite athletes, compared with the general population. However, (1) there is no real gold standard for diagnosing EIB but a range of tests that probably measure different aspects of the effects of exercise on the bronchi; (2) In a great majority of athletes EIB is mild to moderate, sometimes without any symptom. Based on these two points, we will question the neces-

sity of using especially β2-agonists in all athletes diagnosed by a laboratory-based bronchial test. Finally, the talk will end on the on future research needs in the area of EIB management.

THE POTENTIAL OF INHALED B2-AGONISTS TO ENHANCE PERFORMANCE

HOSTRUP, M.

UNIVERSITY OF COPENHAGEN

The widespread use of inhaled β2-agonists among athletes has raised concerns as to their performance-enhancing potential. While systemic use of β2-agonists (such as oral ingestion) is generally perceived as being performance enhancing, inhaled β2-agonists are often claimed not to affect physical performance and 'only make asthmatic athletes able to compete at same level as non-asthmatic athletes'. These claims are often stated without much consideration of dosing or exercise modality. But considering basic β2-agonist pharmacokinetics, for which the inhaled route is a more efficient way to achieve a high systemic exposure than oral ingestion, acknowledging performance-enhancing effects of orally ingested β2-agonists while denying these effects for inhaled administration is contradictory. Furthermore, the claim that inhaled β2-agonists only put asthmatic athletes on par with their peers cannot be based solely on their bronchodilator effect if these drugs also impose extrapulmonary effects that enhance performance beyond their peers. This talk challenges the notion that inhaled β2-agonists are without any relevant effect on athletic performance and raise awareness of their ability to constitute performance-enhancing benefits – mainly at supratherapeutic doses but also at close-to-therapeutic doses.

Oral Presentations

OP-PN10 Nutrition/Ergogenic Aids and other supplements I

THE EFFECTS OF CAFFEINE GUM ON PERFORMANCE DURING THE EXTRA-TIME PERIOD OF SOCCER

FIELD, A., CORR, L., BIRDSEY, L., LANGLEY, C., MARSHALL, B., WOOD, G., HEARRIS, M., MARTINHO, D., CARBURY, C., NAUGHTON, R., FLEMING, F., MOHR, M., KRUSTRUP, P., RUSSELL, M., HARPER, L.

MANCHESTER METROPOLITAN UNIVERSITY

INTRODUCTION: The administration of caffeine from chewing gum is more rapidly absorbed into the blood stream, resulting in a faster onset of effects versus alternative forms of ingestion. Caffeine gum presents a feasible solution during sporting scenarios where time is limited and the ability to maintain performance and cognition is crucial, such as soccer matches that enter the extra-time period. Extra-time is an additional 30-min period of match-play required when matches are tied, and an outright winner is required, for example during the knockout phase of major tournaments and domestic cup competitions, such as the FIFA World Cup. The aim of the study was to assess the effects of caffeine gum on the perceptual-cognitive and physical performance responses during and following extra-time in soccer players.

METHODS: Following institutional ethical approval, twelve male semi-professional soccer players (age: 22 ± 3 years, stature: 1.78 ± 0.06 m, mass: 75 ± 9 kg) with 14 ± 4 years of soccer experience performed 120-min soccer-specific exercise on two separate occasions. In a triple-blind, randomised, crossover design, players chewed a caffeinated (200-mg; caffeine) or control (0-mg; placebo) gum for 5-min following 90-min of soccer-specific exercise. Perceptual-cognitive skills (i.e., passing accuracy, reaction time, composure, adaptability) were assessed using a soccer-specific virtual reality simulator, collected pre- and post-trial. Measures of 15- and 30-m sprint time, reactive-strength index and vertical jump height were obtained at pre-trial, half-time, 90-min and post-trial.

RESULTS: A linear mixed model found that caffeine gum attenuated declines in reaction time (pre: 90.77 ± 0.77 AU to post: 90.65 ± 0.77 AU) by a further 4.15% than placebo (pre: 92.13 ± 0.77 AU to post: 88.19 ± 0.77 AU; $p < 0.01$). Caffeine gum reduced composure by 4.68% (pre: 69.11 ± 0.84 AU to post: 65.87 ± 0.84 AU) versus placebo (pre: 68.84 ± 0.84 AU to post: 68.34 ± 0.84 AU; $p < 0.01$). Time effects were found for reaction time in the placebo condition, and for composure in the caffeine group ($p < 0.01$). Caffeine gum did not influence any other variables ($p > 0.05$).

CONCLUSION: Where caffeine gum is consumed by players prior to extra-time, reaction time increases but composure may be compromised, and sprint and jump performance remain unchanged. Caffeine gum might provide a practical ergogenic solution to cognitive declines during soccer match-play, given the limited time for nutritional interventions in the short 5-min break at 90-min. Improvements in reaction speed are likely to provide advantages concerning anticipation and responding quickly to rapidly evolving scenarios on the pitch. However, maintaining composure and self-control is crucial for highly pressured situations and techniques requiring fine motor skills or refined judgment. Further work could evaluate the co-ingestion of caffeine and substances like L-theanine that modulate the anxiety inducing effects of caffeine.

THE EFFECT OF ACUTE CAFFEINE AND TAURINE CO-INGESTION ON TIME TO EXHAUSTION AND THERMOREGULATORY RESPONSES TO CYCLING IN THE HEAT

AGGETT, J., PEEL, J., TALLENT, J., JEFFRIES, O., WALDRON, M.
SWANSEA

INTRODUCTION: Prolonged exercise in the heat has physiological and metabolic consequences, instigating inexorable rises in core temperature [1], causing exercise to cease early. Isolated caffeine supplementation is often reported to enhance endurance performance, yet has a deleterious effect on thermoregulation and performance in the heat [2]. Conversely, taurine enhances thermoregulatory defences and lowers core temperature, whilst improving endurance performance [3]. Caffeine and taurine are commonly co-ingested before exercise due to their prevalence in sport drinks, but their combined effects on thermoregulation are not known. Therefore, we evaluated the effects of oral caffeine and taurine co-ingestion on time to exhaustion (TTE) and thermoregulatory responses to cycling in the heat at the gas exchange threshold (GET).

METHODS: Ten healthy, non-heat acclimated participants took part in this double-blind crossover study. Participants completed a TTE in the heat (35°C; 40% RH), cycling at a power output associated with the GET, 1 h after ingesting: Caffeine (5mg/kg) and Taurine (50mg/kg) or placebo. Exercising thermo-physiological measures included: breath-by-breath pulmonary gas exchange, core and mean skin temperatures, whole-body sweat rate and heart rate. Heat production and mean skin blood flow were determined using partitional calorimetry. Two-way analyses of variance were used to determine the effect of condition (supplement vs. placebo) and time (10% to 100% epochs) on all thermo-physiological responses. Data are reported as mean±SD.

RESULTS: There were no differences in TTE between conditions ($p=0.608$; placebo = 39.23 ± 14.27 min and supplement = 40.92 ± 17.66 min). Rate of oxygen consumption ($p=0.017$), minute ventilation ($p=0.029$) and heat production ($p=0.019$) were significantly higher following the supplement. There were no differences between conditions for skin ($p=0.539$) and core temperature ($p=0.699$), mean skin blood flow ($p=0.119$), heart rate ($p=0.864$), respiratory exchange ratio ($p=0.546$) and whole-body sweat rate ($p=0.897$).

CONCLUSION: There was no ergogenic effect following pre-exercise co-ingestion of caffeine and taurine in the heat. However, the combined supplement increased oxygen consumption, pulmonary minute ventilation and heat production. Despite these effects, which indicate a thermogenic effect of the supplement, there were no changes in core or skin temperature or sweating between conditions, thus indicating minimal effects on thermoregulation. The combined supplementation might offset the apparent thermogenicity, denoted by the increase in heat production, which can be driven by caffeine supplementation [2]. Therefore, current results are unclear and further work is required to understand how thermal gain was supressed whilst experiencing greater heat production after ingesting mixed ergogenic doses of caffeine and taurine.

References

[1] González-Alonso et al., (1999). J of Phys

[2] Peel et al., (2021). Sports med

[3] Page et al., (2019). EJ of Sport sci

L-MENTHOL ADMINISTRATION PROLONGS TIME TO EXHAUSTION WITH CONCOMITANT SUPPRESSION OF CENTRO-PARIETAL CORTICAL ACTIVITY DURING ENDURANCE CYCLING EXERCISE

TSUTSUMI, Y., ZHANG, W., WANG, Y., ZHAO, J., MOMMA, H., NAGATOMI, R.
TOHOKU UNIVERSITY GRADUATE SCHOOL OF MEDICINE

INTRODUCTION: Breathing discomfort increases during exhaustive endurance exercise and limits the exercise capacity (1). The time to exhaustion (TTE) of endurance running was prolonged by L-menthol administration through mitigation of breathing discomfort (2). This study aims to examine whether the TTE prolongation by L-menthol is due to the improvement in cardiorespiratory function or by modification of brain activity-related discomfort perception (3).

METHODS: Fourteen males (age 39.5±8.8 years, Wpeak 264.7±34.1 w) performed two cycling TTE trials at 85% Wpeak intensity after 20 minutes of warm-up session (WUS) at 60% Wpeak. The participants were randomly assigned to TTE in a crossover design of either water (WA) or L-menthol solution (LM; 0.01% concentration) ingestion with a 7-day interval. The experimental solution (25ml, 30C) was taken three times every 5 minutes during the WUS and once before TTE. Breathing comfort (BC), RPE, and SpO2 were measured 1 minute after each ingestion in the WUS in addition to pre and post warm-up and pre and post TTE. VO2, VCO2, VE, and respiratory rate (RR) were measured during TTE. 64-channel EEG and HR were recorded throughout the sessions. The power spectrum of alpha (8-12Hz) and beta (12-30Hz) bands were measured using Fast Fourier Transform from preprocessed EEG data. The TTE time was analyzed by the Friedman test. All other measurements were compared by a two-way repeated measures ANOVA (condition*time) with Geisser-Greenhouse correction.

RESULTS: TTE in LM was longer than WA (WA: 343.5±192.7, LM: 447.3±311.1, $P<0.05$). No difference was observed in VO2, VCO2, VE, RR and HR during TTE, nor BC, RPE, and SpO2 for pre- and post-TTE. The beta power spectrum in the left centro-parietal area was significantly decreased in LM as compared to WA (condition $P<0.05$, time $P<0.01$) during TTE, however neither the alpha nor beta power during WUS was significantly different. HR, RPE, and SpO2 were the same throughout the WUS. WA decreased BC as exercise progressed during WUS (time $P<0.05$), whereas LM kept the same level.

CONCLUSION: L-menthol administration improved endurance time of exhaustive cycling. An attenuation of left centro-parietal cortical activity was observed under L-menthol condition. Activation of centro-parietal region due to high respiratory flow may have been attenuated by L-menthol. Such attenuation was not observed during warm-up, a moderate-intensity exercise, although L-menthol mitigated discomfort of breathing.

REFERENCES:

1. Kearon et al., Eur Respir J, 1991

2. Tsutsumi et al., Eur J Sports Sci, 2022

3. Von Leupoldt et al., Psychophysiol, 2011

THE EFFECT OF OLEUROPEIN SUPPLEMENTATION ON HUMAN MUSCLE ENERGY METABOLISM AND FATIGUE: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY IN HEALTHY, OLDER MALES

PINCKAERS, P.J.M.1, PETRICK, H.L.1, HORSTMAN, A.2, MORENO-ASSO, A.2, DE MARCHI, U.2, HENDRIKS, F.K.1, KUIN, L.M.1, FUCHS, C.J.1, GRATHWOHL, D.3, VERDIJK, L.B.1, ZORENC, A.H.1, SENDEN, J.M.G.1, MIGLIAVACCA, E.2,3, METAIRON, S.4, POQUET, L.4, MORIN-RIVRON, D.J.S.4, KARAGOUNIS, L.5, HOLLOWAY, G.P.6, FEIGE, J.N.2, VAN LOON, L.J.C.1

1: MAASTRICHT UNIVERSITY, 2: NESTLÉ INSTITUTE OF HEALTH SCIENCES, 3: NESTLÉ CLINICAL RESEARCH UNIT, 4: NESTLÉ FOOD SAFETY AND ANALYTICAL SCIENCES, 5: NESTLÉ HEALTH SCIENCE, TRANSLATIONAL RESEARCH, 6: UNIVERSITY OF GUELPH

INTRODUCTION: The polyphenol oleuropein has been shown to activate the mitochondrial calcium uniporter (MCU), which increases pyruvate dehydrogenase (PDH) activity in a calcium dependent manner. In rodents, this increase in PDH activity following oleuropein supplementation improved mitochondrial function and promoted fatigue resistance. In this study, we examined the effects of acute and chronic oleuropein supplementation on muscle energy metabolism, whole-body substrate metabolism, body composition, leg strength, and fatigue resistance in vivo in healthy, older males.

METHODS: In a randomized, double-blind, placebo-controlled trial, 40 healthy older males (60±5y) received either placebo (PLA, cellulose microcrystalline) or oleuropein (OLE, 100mg provided as 250mg olive leaf extract) supplementation daily for 36 days. On day 1 and day 36 of supplementation, muscle biopsies and blood samples were collected, and indirect calorimetry was performed, prior to and up to 120min following supplement intake. Body composition and upper leg muscle strength and fatigue were measured before and after 29 days of supplementation. Data are expressed as mean ± SD and analyzed using ANCOVA or robust ANCOVA where appropriate.

RESULTS: Acute ingestion of oleuropein on both day 1 and day 36 rapidly increased plasma oleuropein metabolites, which peaked at 60min (P<0.001) post-ingestion. On day 1, there were no changes in muscle PDH activity, mitochondrial respiration, or whole-body substrate metabolism at 120min after acute OLE ingestion. PDH Ser293 phosphorylation in skeletal muscle was higher after OLE vs PLA ingestion (P=0.015), whereas MCU protein content was not altered. After chronic supplementation, the percentage of PDH that was active was ~25% greater in the OLE vs PLA group (49±14% vs 38±10% respectively, P=0.016) with no differences in absolute rates of PDH activity, PDH Ser293 phosphorylation, or MCU protein content between groups. Mitochondrial respiration and mitochondrial protein content were not altered by chronic OLE supplementation. In addition, whole-body substrate metabolism, body composition, leg muscle strength, and fatigue resistance were not influenced by chronic OLE supplementation. Plasma LDL cholesterol was lower after chronic OLE vs PLA supplementation (P=0.043). No differences in other blood metabolic markers (glucose, insulin, lipids, bone turnover markers) were observed between groups.

CONCLUSION: Chronic oleuropein supplementation (100mg/day) increases skeletal muscle PDH activity in healthy, older males. Acute or prolonged oleuropein supplementation does not impact skeletal muscle mitochondrial respiration, muscle strength, muscle fatigue, body composition, or whole-body substrate metabolism.

INFLUENCE OF CAFFEINE ON BIATHLON PERFORMANCE DURING A SIMULATED COMPETITION

ENGEL, H., YILMAZ, C., APPELHANS, D., MATHIEU, J., KOCK, H., STAUNTON, C., KOEHLER, K.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Caffeine has demonstrated consistent benefits in enhancing endurance performance in general and specific improvements in cross-country skiing. However, recent data suggest a negative impact on standing shooting performance at rest. Therefore, the primary aim of the present study was to assess the impact of caffeine on biathlon performance during a simulated competition.

METHODS: Using a randomized, double-blind, cross-over design, national and international level biathletes (n=9, 24 ± 4 yrs, body mass 77.5 ± 4.7 kg, fat % 11 ± 3 %, VO2max 65 ± 3 ml/kg/min) with a habitual caffeine intake of 65 ± 30 mg/day received either caffeine (3mg/kg, CAF) or a placebo (PLC). Biathletes underwent a simulated competition in a laboratory setting, which included 5 laps of 6-min self-paced roller skiing on a motor-driven treadmill, interspersed by 4 shooting bouts (prone, standing, prone, standing) with five shots each. Shots were fired on a 50m indoor shooting range using an electronic target. Breath-by-breath gas exchange and heart rate (HR) were recorded continuously during roller skiing. Blood lactate (bLa) and rating of perceived exertion (RPE) were assessed following each shooting bout. Biathletes also performed precision shooting (20 prone, 20 standing) at rest and following the simulated competition.

RESULTS: Caffeine reduced the average number of hits during standing shooting (7.3 ± 1.6 vs. 8.3 ± 0.8; p = 0.06) but did not affect prone shooting (p = 1.00). Biathletes completed the first two laps significantly faster with CAF (+0.14 ± 0.13 m/s, p = 0.03 and +0.07 ± 0.06 m/s, p = 0.02, respectively), but improvements in overall skiing performance (+0.05 ± 0.7 m/s)

did not reach statistical significance (p = 0.12). Exercise intensity was higher in CAF when compared to PLC (85.6 ± 4.4 vs. 84.3 ± 5.7 %VO2max; p = 0.06) during lap 2. No significant differences in HR and RPE were detected, but bLa was significantly higher from lap 2 to lap 5 in CAF (p < 0.001, respectively). During precision shooting, the number of hits did not differ between CAF and PLC in prone (p = 0.40) or standing (p = 1.00) at rest. In the post-exercise state, CAF tended to improve prone shooting performance (18.7 ± 1.5 vs. 17.8 ± 1.2 hits; p = 0.09). On average athletes reported more severe adverse effects, notably symptoms of nausea and vomiting (p = 0.03), in CAF when compared to PLC. Further, two athletes in CAF had to discontinue the condition due to gastrointestinal issues.

CONCLUSION: Despite a highly individual response, caffeine negatively affected standing shooting performance but tended to improve skiing performance during a simulated biathlon competition. Aside from individual tolerance levels, biathletes should weigh potential costs (impaired shooting performance) and benefits (improved skiing performance) of caffeine on overall biathlon performance, with particular attention to the importance of shooting across various biathlon events.

Oral Presentations

OP-PN34 Muscle damage and heat

COMPARING CONTINUOUS AND INTERMITTENT WHOLE-BODY PASSIVE HEATING: EFFECTS ON THE ACUTE INFLAMMATORY RESPONSE, AUGMENTATION INDEX, BODY TEMPERATURE, AND THERMAL PERCEPTIONS

SU, Y., MARTINKOVA, A., ODONNELL, E., LEICHT, C.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Heat therapy can promote cardiovascular health by lowering cardiovascular disease risk and mortality, potentially by reducing inflammation and altering arterial stiffness. While most research on heat therapy has focused on continuous heat exposure, traditional sauna practice involves alternating between heating and cooling down in 2-3 cycles. This study compares two methods: 60 min of continuous heating (CH) and intermittent heating (IH) consisting of three 20-min sessions with breaks.

METHODS: Healthy young adults (n=21, 25.4±3.3 yrs, body mass index (BMI) 22.0±2.0 kg•m-2) underwent two trials in randomised order: CH exposure (air temperature: 71.8°C, humidity 7.6%) and IH exposure (72.0°C, 6.7%), separated by 15-min breaks (21.9°C, 41.8%). Blood samples to determine IL-6, IL-10 and IL-1ra plasma concentration were collected pre-, post- and 1 h post-intervention; brachial pulse pressure, central pulse pressure, augmentation index (AIx), rectal and skin temperature, basic affect and thermal comfort were assessed throughout the intervention.

RESULTS: Rectal temperature was higher after CH compared with IH (P≤0.01, CH: 38.2±0.3°C, IH: 37.6±0.2°C). Plasma IL-6, IL-10 and IL-1ra concentrations did not differ between conditions (main effects: P≥0.383, interaction effects: P ≥0.057). An increase of IL-6 (P<0.001; pre to post, CH: 0.9±0.8 to 1.5±0.8 pg·ml–1, IH: 1.0±1.0 to 1.5±1.3 pg·ml–1) and IL-1ra was observed (P=0.008; pre to post, CH: 48.8±10.7 to 52.4±11.8 pg·ml–1, IH: 50.7±12.6 to 53.6±15.3 pg·ml–1). Post heat exposure, brachial and central pulse pressures were higher in CH than in IH (P≤0.002). In both conditions, AIx increased following 20 min of heat exposure (P≤0.042) but was lower in CH than IH at 40 and 60 min of heat exposure (P≤0.009). Post heat exposure, the mean skin temperature for CH was lower than for IH (CH: 38.1±1.5°C, IH: 38.7±1.0°C, P<0.001), and thermal discomfort was more pronounced for CH than IH (CH: 2.0±1.3, IH: 1.0±1.1, P=0.003).

CONCLUSION: Despite CH leading to a higher rectal temperature than IH, CH and IH similarly raised the inflammatory markers IL-6 and IL-1ra, whilst the AIx response was blunted in IH following an initial increase. Both the inflammatory response as well as the temporary increase in AIx, indicating increased arterial stiffness, are comparable to the acute exercise response. Importantly, regular exercise can reduce resting inflammatory marker concentrations and improve arterial function and reduce stiffness, lowering AIx over time. It may hence be speculated that these observed acute changes during heat exposure may have long-term benefits of heat therapy, similar to regular exercise. Finally, although IH resulted in a higher mean skin temperature, this protocol was rated as more comfortable. These findings imply that for the inflammatory variables, the overall duration of passive heating might be more critical than a pronounced elevation of core temperature, which should be considered when designing effective heat therapy protocols.

HETEROGENOUS WITH IPSILATERAL REPEATED BOUT EFFECT BETWEEN ELBOW FLEXORS AND KNEE EXTENSORS

TSENG, K.W., TSENG, W., HSIEH, C., FU, S.

UNIVERSITY OF TAIPEI

INTRODUCTION: Unilateral trainings benefits on contralateral muscles have long been established, yet evidence for heterologous muscle cross education remains scarce. This study explored the overflow effect from ipsilateral exercises via two methods: firstly, a maximal eccentric contraction (MaxEC1) on elbow flexors, followed by one (MaxEC2) on same-side knee extensors; secondly, MaxEC1 on knee extensors, then MaxEC2 on elbow flexors. The aim was to investigate cross-educations protective effects, potentially reducing muscle damage and boosting recovery across different muscle groups with sequential eccentric contractions.

METHODS: The study recruited 32 healthy women aged 20–30, divided into four groups: non-dominant upper limb / lower limb (NU/NL), control / non-dominant lower limb (C/NL), non-dominant lower limb / upper limb (NL/NU), and control / non-dominant upper limb (C/NU), each with eight participants. NU/NL group undertook 30 MaxEC1 with non-dominant elbow flexors and 60 MaxEC2 with knee extensors. NL/NU reversed this, with 60 MaxEC1 on knee extensors and 30 MaxEC2 on elbow flexors. C/NU did 30 MaxEC1 on elbow flexors, while C/NL did 60 MaxEC1 on knee extensors. NU/NL and NL/NU conducted their MaxEC2 14 days after MaxEC1. Variables measured included plasma creatine kinase (CK), muscle soreness (DOMS), limb circumference (CIR), joint range of motion (ROM), maximal voluntary isometric contraction (MVC) torque, maximal isokinetic concentric strength (ISOK), acoustic radiation force impulse (ARFI), and joint release angle (JRA), assessed before MaxEC1, after MaxEC2, and daily for five days post-MaxEC2.

RESULTS: NU/NL exhibited quicker recovery in CK, DOMS, ROM, JRA, MVC, ISOK, and ARFI metrics compared to C/NL. Similarly, NL/NU demonstrated faster recovery across all measured variables when compared to C/NU. Notably, significant differences were observed between NU/NL and C/NL in DOMS on Day 2 post-MaxEC2 ($p < .05$), in MVC on Days 0–2 post-MaxEC2 ($p < .05$), in ISOK on Days 0–2 post-MaxEC2 ($p < .05$), in JRA at angles of 45° and 60° on Day 3 post-MaxEC2 ($p < .05$), and in CK on Days 1 and 2 post-MaxEC2 ($p < .05$). Between NL/NU and C/NU, significant differences emerged in ROM on Days 3–5 post-MaxEC2 ($p < .05$), in ARFI on Days 0–2 post-MaxEC2 ($p < .05$), in MVC on Days 0, 1, and 4 post-MaxEC2 ($p < .05$), in ISOK across Days 0–5 post-MaxEC2 ($p < .05$), and in CK on Days 1 and 2 post-MaxEC2 ($p < .05$).

CONCLUSION: The results of this study are similar to those found by Ben in 2018, which demonstrated that unilateral leg press resistance training can enhance both contralateral homologous and heterologous muscles (2). This study suggests that a maximal eccentric contraction on elbow flexors or knee extensors can reduce subsequent muscle damage in the same-side muscle group. These findings can aid coaches, trainers, and therapists in improving rehabilitation and training practices.

Reference:

1. Hyldahl, et al., Exerc Sport Sci Rev., 2017

2. Ben Othman, et al., Appl Physiol Nutr Metab., 2018

TRAINING IN A HOT ENVIRONMENT IMPAIRS THE ANABOLIC RESPONSE TO RESISTANCE TRAINING

PETERSEN, A., CHANDRASIRI, S., STOREY, A., GARNHAM, A., HADIYAN, H., HAMEED, A., NELSON, A.

VICTORIA UNIVERSITY

INTRODUCTION: Whole-body or localised heating can increase the anabolic and strength responses to resistance exercise. However, it is unknown whether concurrent whole-body heating can improve performance or muscle mass adaptations during long-term resistance training. We therefore investigated the effects of whole-body heat stress applied concurrently during resistance training on muscle mass, strength, speed, agility, force and anabolic signalling in males.

METHODS: Eighteen recreationally active males were assigned to HEAT (n = 8, age = 23.3 ± 3.1 years, body mass (BM) = 75.6 ± 14.5 kg, height = 175.6 ± 8.8 cm) or CON (n = 10, age = 21.0 ± 2.7 years, BM = 76.0 ± 11.3 kg, height = 177.2 ± 9.6 cm). Each group undertook 10 weeks of full body resistance training three days per week. CON trained at 23°C, relative humidity 25%, while HEAT trained at 40°C, relative humidity 30%. Strength (1RM leg and bench press), speed (5 and 10 m sprint), agility (T-test), peak force (during squat jump and ballistic push up) and body composition (DXA scan) were assessed at pre-, mid- (week five) and post-intervention. Vastus lateralis muscle biopsies were taken before, 1 h and 48 h after intensity-matched training sessions conducted pre- and post-intervention. Core body temperature and vastus lateralis muscle temperature were measured during the second training session via ingestible telemetric capsule and indwelling thermistor, respectively.

RESULTS: Despite the much higher environmental training temperature for HEAT, peak core body temperature and peak muscle temperature were not significantly different between CON (38.0 ± 0.2°C; 36.0 ± 0.5°C) and HEAT (38.2 ± 0.1°C; 36.8 ± 0.6°C). Leg press 1 RM increased similarly in both CON (50.25 ± 13.99 kg, $p<0.05$) and HEAT (32.75 ± 5.89 kg, $p<0.05$) while bench press 1RM showed no improvement in either group. No improvements were observed in 5 m or 10 m sprint time, agility, or peak force generated during a squat jump or ballistic push up in either group. Total body lean mass and appendicular lean mass increased in CON only by 3.2% and 2.8%, respectively. Upper body lean mass increased and lower body lean mass was unchanged, with no differences between groups. Type I and Type II muscle fibre cross-sectional areas increased in CON only. Myonuclear density increased only in CON, whereas the increase in satellite cell content was not different between HEAT and CON. Markers of the mTOR signalling pathway (total and phospho- Akt, mTOR, p70S6k, 4E-BP1, rpS6) were largely similar between HEAT and CON.

CONCLUSION: These results indicate that, despite no effects on core or muscle temperature, resistance training in a hot environment impaired muscle hypertrophy but had no effect on performance adaptations.

DAILY SHORT-TERM PASSIVE HEAT EXPOSURE FOR EFFECTIVE HEAT ACCLIMATION INDUCTION

BRAZAITIS, M., DAUKSAITE, G., SOLIANIK, R., EIMANTAS, N.

LITHUANIAN SPORTS UNIVERSITY

INTRODUCTION: Heat acclimation (HA) or acclimatization is a process where the body adapts to repeated exposure to heat, resulting in improvements to thermoregulatory mechanisms and heat tolerance (1,2,3). This adaptation leads to

enhanced exercise performance in warm-to-hot conditions. The widely accepted consensus recommends HA sessions lasting at least 60 minutes per day, aiming to increase both body core and skin temperatures while stimulating sweating (1,2,3). However, here we propose that daily activation of nociceptor TRP channels through 5-minute immersion in 45°C water could be the primary mechanism driving HA induction.

METHODS: Ten healthy young adult males and ten females participated in a study where they underwent daily 5-minute whole-body immersions in 45°C water for 14 days. A provoking test for heating tolerance was conducted two weeks before, one day after, and one month after the HA program. Changes in well-established HA parameters such as body temperatures, heart rate, sweating, subjectively perceived stress, and plasma prolactin concentrations in response to provoking heating were measured.

RESULTS: The HA program significantly lowered both resting and post-heating body temperatures ($p < 0.05$), heart rate ($p < 0.05$), subjective warmth perception ($p < 0.05$), and prolactin activity response ($p < 0.05$) in both male and female subjects. These effects remained significant one month after completing the HA program. However, the HA program did not have a significant effect on sweating capacity in either group of subjects ($p > 0.05$).

CONCLUSION: This study, for the first time, demonstrated that undergoing a repeated 14-session head-out hot-water immersion over 14 days induced HA in both sexes. Furthermore, it was observed that the HA effect persisted significantly one month after the HA program. Our study provides strong mechanistic evidence supporting the notion that short-term daily activation of nociceptor TRP channels is crucial for successful HA induction.

References

1. Racinais S et al., Consensus recommendations on training and competing in the heat. Sports Med. 2015.45:925-938.

2. Kelly MK et al., Heat adaptation for females: A systematic review and meta-analysis of physiological adaptations and exercise performance in the heat. Sports Med. 2023 53:1395-1421.

3. Sotiridis A et al., Are five 60-min sessions of isothermic heat acclimation sufficient to elicit beneficial physiological adaptations?

Oral Presentations

OP-BM07 Motor Control

THE ANKLE SENSE OF POSITION ACROSS LIFESPAN

THEODOSIADOU, A., SAHINIS, C., PAPAVASILEIOU, A., FABRE, M., LAPOLE, T., PATIKAS, D.A., AMIRIDIS, I.G., BAUDRY, S.
UNIVERSITÉ LIBRE DE BRUXELLES

INTRODUCTION: Sense of position (SoP), one component of proprioception, is assessed with joint position reproduction (JPR) tests consisting of reproducing a reference joint position with the ipsilateral or contralateral limb. Previous research indicates divergent age effect on SoP, with studies revealing an inverted U-shaped curve in SoP acuity from childhood to senescence, and others reporting no age effect (1,2,3). These divergent results could partially reflect the variety of JPR protocols (ipsi vs. contralateral, amplitude, direction). This study investigated the effect of age on ankle SoP during ipsi (IPSI) and contralateral (CONTR) JPR tests with two amplitudes in dorsiflexion and one in plantarflexion direction.

METHODS: One hundred sixty individuals (3-92 yr) were distributed into 6 groups: Before-Puberty (BP; 3–14 yr), After-Puberty (AP; 14–17 yr), both groups determined based on a maturity test, Young (Y; 20–39 yr), Middle-aged (M; 40–59 yr), Young-Old (YO; 60–75 yrs) and Old-Old (OO; >76 yr) adults. The IPSI test consisted of reproducing a predetermined target ankle position with the same limb, passively presented to the participant for a few seconds (passive-active modality). The CONTR test consisted of reproducing with one limb a target ankle position passively-hold by the contralateral limb (passive-active). Both IPSI and CONTR were performed blind-folded, to a constant dorsiflexion target position (5° dorsiflexion) from 5° (DF10) or 20° (DF25) plantarflexion position (dorsiflexion direction), and to a 10° plantarflexion target position from a 5° (PF15) dorsiflexion position (0°=90° ankle joint; plantarflexion direction). Error was measured as the absolute (absolute error, AE) and the relative (signed error, SE) showling the difference between the target position and the position reproduced by the participant.

RESULTS: In IPSI, no significant difference was observed for AE ($p>0.05$) and SE ($p>0.05$) between groups, regardless of the direction and amplitude. In CONTR, similar results were obtained for AE ($p>0.05$) but SE showed that BP group underestimated the target position compared with Y, YO, OO, and YO and OO overestimated the target position compared with M group for DF25 ($p<0.001$) and DF10 ($p<0.001$). In contrast, PF15 did not revealed any age difference in SE.

CONCLUSION: The lack of age difference in AE suggests that the overall SoP was not influenced by age. However, the differences in SE for dorsiflexion indicates opposite effects between childhood and advancing ages, with children underestimating and older adults over-estimating the target position compared with young and middle-aged adults. This age effect only observed for CONTR suggests that online processing of proprioceptive inputs from the two limbs changes with age, which may rely on inter-hemispheric transmission of the proprioceptive signal.

References

1. Dunn et al. Am J Occup Ther 69, 1-9, 2015

2. Hu et al. Motor Control 27, 596–615, 2023

3. Yang et al. J Sport Health Sci 8, 548–554, 2019

ADJUSTMENT OF MUSCLE SYNERGIES DURING TRANSITIONS TO UNWEIGHTED AND RELOADED RUNNING

FAZZARI, C., MACCHI, R.2, CHAVET, P.1, CASANOVA, R.1, NICOL, C.1

1 AIX-MARSEILLE UNIV, CNRS, MARSEILLE, FRANCE ; 2 INSEP, PARIS, FRANCE

INTRODUCTION: Runners are often confronted with changing external forces. This requires rapid locomotor adjustments, which can be studied using the experimental paradigm of unweighting and reloading. Recently, we found specific adjustments of muscle synergies when running at 60% body weight, compared to 100% body weight (1). In addition to a greater hamstring contribution to the push-off phase, their temporal activations (motor primitives) were wider and more complex. While these adjustments have been described during stable running phases, they need to be specified during the unweighting and reloading transition phases to better understand how locomotor control reorganizes at each running cycle.

METHODS: Thirty-eight men (19±1 yrs) ran sequentially on a lower body positive pressure treadmill at 100, 60 and 100% body weight. The analysis focused on the unweighting and reloading transitions (18±3 and 16±2 running cycles, respectively). Each running cycle was normalized to 200 points (100 points for both stance and flight phases). Muscle synergies were extracted from the EMG signals of 11 right lower limb muscles using non-negative matrix factorisation, and divided into motor modules and motor primitives. Linear mixed models were used to test the adjustments of their Centre of Activity (CoA), Full Width at Half Maximum (FWHM) and Higuchi's Fractal Dimension (HFD) during both transition types, which were each divided into 8 slides of 5% body weight reduction (from S1: [100-95%] to S8: [65-60% body weight]).

RESULTS: The CoA of the push-off motor primitives increased significantly from S4 during the unweighting transition (ES=1.1, p<.001), whereas it decreased significantly from S6 during the reloading transition (ES=0.8, p<.01). Regardless of transition type, the CoA of the late flight primitives decreased from S7 (ES=1.2, p<.05). Regardless of the slide, the CoA of the braking primitives and the FWHM of the push-off primitives were higher during the unweighting transition than during the reloading transition (+33±11%, ES=0.3, p<0.01 and +9±3%, ES=0.4, p<.001, respectively). The HFD of the braking primitives was lower during the unweighting transition than during the reloading transition (-0.8±0.3%, ES=0.3, p<.01).

CONCLUSION: During the unweighting transition, the push-off motor primitives shifted later and the late flight primitives shifted earlier in the running cycle. The latter result is attributed to the gradual increase in the contribution of the hamstring muscles to the push-off phase, previously reported at 60% body weight (1,2). Finally, the stance motor primitives were wider and of lower complexity during the unweighting transition than during the reloading transition. As both are indicators of perturbed locomotion (3), the unweighting transition may require a more robust locomotor control due to the unusual sensory and temporal constraints on the musculoskeletal system.

(1) Fazzari et al., Sci Reports, 2024

(2) Fazzari et al., Front Physiol, 2023

(3) Santuz et al., iScience, 2020

NEUROMOTOR CONTROL OF BACK SQUATS IN THE PRESENCE OF UNILATERAL AND BILATERAL PERTURBATIONS

HAUSER, L., SCHROLL, A., ARAMPATZIS, A.

HUMBOLDT-UNIVERSITÄT ZU BERLIN

INTRODUCTION: Perturbation-based exercise interventions can improve muscle strength and reduce low back pain intensity (1,2). It is suggested that the exposure to perturbations leads to an increase in muscle activation and specific modulations in motor control which improve the ability of the sensorimotor system to cope with perturbations. However, there is a lack of experimental data to support this assumption. Therefore, the current study aimed to investigate the effects of perturbations on muscle activation and modular organization of trunk and leg muscles during a functional exercise.

METHODS: Twenty healthy participants (height 175.96 ± 9.27 cm, body mass 71.89 ± 13.25 kg, age 29.55 ± 7.21 years) performed a series of loaded back squats under four different conditions. The loaded back squats were either unperturbed (NP), perturbed unilateral using unstable ground (UGP) or unstable load (ULP) or perturbed bilateral (BP) combining unstable ground and load. Ground reaction forces, joint kinematics, and the electromyographic (EMG) activity of 14 trunk and leg muscles (bilateral) were recorded. We extracted muscle synergies using non-negative matrix factorization and analyzed the data with statistical parametric mapping and linear mixed models.

RESULTS: Perturbations significantly ($p<0.05$) increased the velocity of the center of pressure (CoP) with concomitant adjustments in ankle-, knee- and hip-joint kinematics. When compared to NP, the EMG activity of most leg muscles was significantly increased ($p<0.05$) in BP and UGP, while most trunk muscles showed an increased EMG activity ($p<0.05$) in BP and ULP. Four fundamental synergies were detected among all conditions. However, we found alterations within the basic activation patterns of the muscle synergies due to the perturbed conditions. In two synergies the full width at half maximum (FWHM) of the temporal components was significantly ($p<0.05$) reduced during the perturbed conditions, while in one synergy the center of activation (CoA) was shifted towards an earlier time point ($p<0.05$).

CONCLUSION: The higher muscle activation and CoP velocity indicate an enhanced demand for the sensorimotor system to perceive sensory signals and to generate appropriate motor commands during the perturbed back squats. The recruitment of the same number of muscle synergies in both perturbed and unperturbed conditions indicate a robust neu-

romotor control during loaded back squats. However, the adjustments in the temporal structure (i.e. changes in FWHM and recruitment time) of the muscle synergies during the perturbed back squats may facilitate the ability of the sensorimotor system to deal with perturbations and may contribute to the reported effectiveness of perturbation-based exercise interventions on the therapy and prevention of low back pain (1,2).

REFERENCES:

(1) Arampatzis et al., Eur J Appl Physiol, 2107

(2) Arampatzis et al., Transl Sports Med, 2020

THE NEUROMUSCULAR RECRUITMENT OF DYNAMIC NEUROMUSCULAR STABILIZATION

TING, Y.L., LI, H., HUNG, W., CHEN, K., WU, Z.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: Dynamic Neuromuscular Stabilization (DNS) is the neuromuscular therapy that can activate the primary motor cortex, sensorimotor cortex, and supplementary motor area of the cerebral cortex by resetting and correcting the balance of body tension and the function of the physiological system. It improves the motor control of strength and endurance and the athletic ability, thereby preventing sports injury and constructing the learning pattern of movements and sports. High-density electromyography (HD-EMG) is a non-invasive method with multiple electrodes to analyze neuromuscular conditions by amplitude map, centroid of gravity (COG), motor unit size (MU), motor unit conduction velocity (CV), and so on. Therefore, we design the present study to investigate the neuromuscular recruitment of the intervention of DNS with HD-EMG.

METHODS: 13 volunteers aged 20 to 30 years old were recruited in the present study. The HD-EMG signals of vastus lateralis obliquus (VLO), vastus medialis obliquus (VMO), semimembranosus (SM), and biceps femoris (BF) were collected prior and post-training through the OTBioLab system while performing plank position on the mat or a Redcord Trainer (sling), respectively. The movement of DNS training protocol was composed of Supine, Side-lying, Side lying with forearm support, Side lying with hand support, Side-lying to quadruped transition, Quadruped, Tripod and High kneeling reverse.

RESULTS: The MU of VMO, VLO, SM and BF increased after the DNS training while performing plank, either on mat or sling. The MU of VMO and VLO were activated more while performing a plank on mat (△VMO: 4, △VLO: 4) than on the sling (△VMO: 3, △VLO: 2). On the contrary, the MU of SM and BF were activated more while performing plank on sling (△SM: 11, △BF: 8) than on mat (△SM: 4, △BF: 3). The COG of VMO, VLO, SM and BF shifted proximally after performing the training task. The COG of VMO shifted proximally especially performing plank on sling. The COG of VLO and BF was scattered that one shifted distally while performing plank on mat and the other shifted proximally, respectively. Rather special that the COG of SM shifted distally while performing plank on mat. The CV of VMO and VLO both increased after performing the training task while performing plank, either on mat (△VMO: 21 m/s, △VLO: 130 m/s) or sling (△VMO: 380 m/s, △VLO: 19 m/s). The CV of SM and BF increased only when performing plank on sling (△SM: 109 m/s, △BF: 656 m/s).

CONCLUSION: Results of the present study indicated that after the intervention of DNS, more MU were activated, the COG were shifted proximally and the CV within motor unit would altered on the lower limb muscles. These findings provide solide evidence that that the neuromuscular recruitment pattern can be altered after training through DNS technique.

Reference:

1) Frank et al., Int J Sports Phys Ther., 2013

2) Kim et al., Technol Health Care., 2018

3) Farina et al., J Electromyogr Kinesiol., 2008

SPORTS-SPECIFIC FACILITATION OF UPPER-LIMB CORTICOSPINAL EXCITABILITY DURING MOTOR IMAGERY OF VARIOUS SPORTS SKILLS

YAMASAKI, D., KANEKO, N., KATO, T., MASHIKI, Y., NAKAZAWA, K.
THE UNIVERSITY OF TOKYO

INTRODUCTION: Motor imagery (MI) is the mental simulation of a movement without any physical output. MI has been applied to sports training because MI induces neural activities similar to those during actual motor execution. However, many studies of MI have focused on basic movements such as single-joint movements or gait, and there are limited findings about neural mechanisms during MI of sports skills. Knowledge of neural mechanisms during MI of sports skills is needed to establish efficient imagery training. Therefore, we aim to examine the effects of various sports skill's MI on corticospinal excitability of the upper limb muscles.

METHODS: Twelve healthy males participated in this study. Electromyographic activity was recorded from the flexor carpi radialis (FCR), extensor carpi radialis (ECR), first dorsal interosseous (FDI), and abductor pollicis brevis (APB) muscles of the dominant hand. Transcranial magnetic stimulation (TMS) was applied over the primary motor cortex of the contralateral side of the dominant hand, and motor evoked potentials (MEPs) induced by TMS were used for assessing corticospinal excitability. MEPs were recorded under the following conditions: a) rest condition and b) MI condition. In the MI condition, subjects performed 5 imagery tasks: 1) baseball pitching (baseball-MI), 2) tennis serving (tennis-MI), 3) volleyball serving (volleyball-MI), 4) basketball free-throw (basketball-MI), and 5) soccer shooting (soccer-MI). All tasks except basketball-MI

were imagined as full strength. We compared MEP amplitudes between the rest condition and MI condition (normalized by MEP amplitudes of the rest condition).

RESULTS: The MEP amplitudes of APB were significantly increased in the baseball-MI ($p<0.05$) compared with those in the rest condition. The MEP amplitudes of FCR were significantly increased in the tennis-MI and volleyball-MI ($p<0.05$) compared with those in the rest conditions. However, there was no significant increase of MEP amplitudes of any muscles in the basketball- and soccer-MI.

CONCLUSION: Significant facilitation in corticospinal excitability of APB occurred only in the baseball-MI, not in all other MI conditions. These results would be related to the fine motor skills in the hand muscles for baseball pitching. Although fine motor skills are involved in basketball free-throw, corticospinal excitability in the basketball-MI did not increase. This difference may be due to the intensity in the upper limb muscles for performing the imagined movement. Corticospinal excitability in FCR was significantly facilitated in the tennis-MI and volleyball-MI, which use forearm muscles as a prime mover. Furthermore, there were no significant changes in corticospinal excitability in the soccer-MI, which mainly involves the lower limbs. The observed differences in the corticospinal excitability of upper-limb muscles during MI of various sports skills would be considered to reflect the motion characteristics of each sport skill.

Oral Presentations

OP-BM16 Running I

CORRELATION BETWEEN ISOKINETIC LOWER-LIMB JOINT STRENGTH AND JOINT STIFFNESS IN RECREATIONAL RUNNERS

ZHANG, Q., CHEN, S.Q., LI, F., MA, H.F.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Stiffness, originally derived from "Hooks Law," is defined as the ratio between the external force and the deformation displacement applied to a spring system, reflecting the systems elastic performance and its ability to accumulate elastic potential energy. In running, higher lower-limb stiffness is beneficial for the storage and release of elastic energy, thus improving running economy. Knee and ankle joint stiffness are considered determining factors of lower-limb stiffness. Meanwhile, during the ground contact phase of running, the muscles around the knee and ankle joints contract synergistically to produce force and regulate the joint stiffness. Therefore, joint muscle strength may play an important role in regulating joint stiffness. This study aims to explore the correlation between isokinetic knee and ankle joint strength and knee and ankle joint stiffness in recreational runners.

METHODS: Thirty-four male runners were recruited to measure knee and ankle joint stiffness at running speeds of 10 and 12 km·h-1 by the Vicon 3D motion capture system and the Kistler 3D force platforms mounted below the treadmill belt. The isokinetic strength test and training system was used to measure isokinetic knee and ankle joint concentric and eccentric peak torque (PT) at the velocities of 60 and 180°·s-1. Pearson correlations, with the Benjamini–Hochberg correction procedure, were used to analyze the correlation between isokinetic knee joint PT and knee joint stiffness, and the correlation between isokinetic ankle joint PT and ankle joint stiffness.

RESULTS: For knee joint, the knee flexor eccentric PT at 60°/s ($P<0.001$, $r=0.614$; $P<0.001$, $r=0.592$) and 180°/s ($P<0.001$, $r=0.582$; $P<0.01$, $r=0.558$) was highly positively correlated with knee stiffness at 10 and 12 km·h-1. The knee flexor concentric PT at 60°·s-1 ($P<0.05$, $r=0.417$; $P<0.05$, $r=0.404$) and 180°·s-1 ($P<0.05$, $r=0.440$; $P<0.05$, $r=0.396$) was moderately positively correlated with knee stiffness at 10 and 12 km·h-1. For ankle joint, the ankle dorsiflexor eccentric PT at 60°·s-1 ($P<0.05$, $r=0.460$; $P<0.05$, $r=0.523$) was positively correlated with ankle joint stiffness at 10 and 12 km·h-1.

CONCLUSION: knee and ankle stiffness during running may be associated with greater knee flexor and ankle dorsiflexor strength, which would inform muscle strength modulation of lower-limb joint stiffness to improve running performance.

EVALUATING THE EFFECTIVENESS OF SPORTS BRAS DURING RUNNING THROUGH DISCRETE AND CONTINUOUS MEASURES OF BREAST KINEMATICS

RENWICK, N., WHITE, J., JONES, B., WAKEFIELD-SCURR, J.

UNIVERSITY OF PORTSMOUTH

INTRODUCTION: Breast biomechanics research is largely focused on reporting discrete measures of nipple displacement during various activities. Evaluating breast movement continuously across the gait cycle may provide insight into when and for how long across the gait cycle sports bras are effective at reducing breast kinematics which may more closely correlate with changes in perceived breast support and pain. This study aims to compare discrete and continuous breast kinematic variables and to assess their relationship with perceived breast support and pain.

METHODS: Thirty-six females (mode bra size 34D) ran on a treadmill bare-breasted and in a sports bra. Electromagnetic sensors captured nipple motion and calculated it relative to a torso reference system (1); gait cycles were identified from right foot contact. Participants rated perceived breast support and pain (scale 0 to 10). Nipple displacement was reported as range of motion (ROM), peak values and breast movement reduction (2); nipple velocity and acceleration were calculated as first and second derivatives of nipple position and reported as peak values; these discrete values were calculated over ten gait cycles and averaged. Data were checked for normality using Shapiro-Wilk tests; Wilcoxon signed-rank or

paired samples t-test compared between breast support conditions. Time histories for relative nipple position (normalised and non-normalised), velocity and acceleration were averaged across ten gait cycles for each participant and compared between breast support conditions using one-dimensional statistical parametric mapping (SPM) (3). Spearman's rho correlation coefficients assessed the relationship between breast support and pain with kinematic variables.

RESULTS: Nipple displacement, velocity and acceleration were significantly reduced in sports bra running compared to bare-breasted running for all discrete variables except peak lateral displacement (p=0.156). SPM identified multiple points across the gait cycle where the sports bra reduced breast movement; superior-inferior normalised displacement was reduced for the largest duration of the gait cycle (87%). Median score for breast support in the bra condition was 8. Median scores for perceived breast pain were 5 and 0 for bare-breasted and bra running, respectively. The strongest relationship with perceived support was reported for superior-inferior ROM (r=0.857; p=<0.001); strongest relationship with breast pain was reported for anterior-posterior peak negative acceleration (r=0.715; p=<0.001).

CONCLUSION: Discrete measures of breast kinematics have a stronger relationship to perceived breast pain and support compared to continuous measures but continuous measures can identify when during the gait cycle a sports bra is most effective at reducing breast movement.

REFERENCES:

1) Mills et al., J, Biomech, 2016

2) Norris et al., Ergonomics, 2021

3) Pataky, J, Biomech, 2010

THE RELATIONSHIP BETWEEN RUNNING BIOMECHANICS AND RUNNING ECONOMY: A SYSTEMATIC REVIEW AND META-ANALYSIS OF OBSERVATIONAL STUDIES

VAN HOOREN, B., JUKIC, I., COX, M., FRENKEN, K., BAUTISTA, I., MOORE, I.S.

MAASTRICHT UNIVERSITY

INTRODUCTION: Running biomechanics are considered an important determinant of running economy (RE). However, studies examining associations between running biomechanics and RE report inconsistent findings.

The objective of this review is therefore to determine associations between running biomechanics and RE and explore potential causes of inconsistency.

METHODS: Three databases were searched and monitored until April 2023. Observational studies were included if they 1) examined associations between running biomechanics and RE, or 2) compared running biomechanics between groups differing in RE, or 3) compared RE between groups differing in running biomechanics during level, constant-speed, and submaximal running in healthy humans (18-65 years). Risk of bias was assessed using a modified tool for observational studies and considered in the results interpretation using GRADE. Meta-analyses were performed when ≥2 studies reported on the same outcome. Meta-regressions were used to explore heterogeneity with speed, coefficient of variation of height, mass and age as continuous outcomes, and standardization of running shoes, oxygen versus energetic cost, and correction for resting oxygen or energy cost as categorical outcomes.

RESULTS: Fifty-one studies (n=1115 participants) were included. Most spatiotemporal outcomes showed trivial and non-significant associations with RE: contact time r = -0.02 (95% confidence interval [CI], -0.15 to 0.12); flight time r = 0.11 (-0.09 to 0.32); stride time r = 0.01 (-0.8 to 0.50); duty factor r = -0.06 (-0.18 to 0.06); stride length r = 0.12 (-0.15 to 0.38), swing time r = 0.12 (-0.13 to 0.36)). A higher cadence showed a small significant association with a lower oxygen/energy cost (r = -0.20 (-0.35 to -0.05). A smaller vertical displacement and higher vertical and leg stiffness showed significant moderate associations with lower oxygen/energy cost (r = 0.35, = -0.31, = -0.28, respectively). Ankle, knee, and hip angles at initial contact, midstance or toe-off as well as their range of motion, peak vertical ground reaction force, mechanical work variables and electromyographic activation were not significantly associated with RE, although potentially relevant trends were observed for some outcomes.

CONCLUSION: Overall, our findings show that biomechanical variables can explain 4-12% of the variance in running economy when considered in isolation, with this magnitude potentially increasing when combining different variables. Moreover, we also show that some biomechanical variables often considered relevant to RE (e.g., contact time) are not overall associated with RE when assessed at a similar speed for all runners. Nevertheless, optimal performance may require optimization of running biomechanics beyond simply minimizing energy cost, thus suggesting that components not significantly associated with RE may still be relevant from a performance or injury preventative perspective

BIOMECHANICAL CHANGES WITH INCREASED SPEED IN ELITE MIDDLE-DISTANCE RUNNERS

HANLEY, B., COOKE, M., GALLAGHER, L., OH, Y.K., PARELKAR, P., THOMAS, A., TUCKER, C.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Distance runners train at different speeds to enhance their physiological and biomechanical capabilities to ensure that their aerobic and anaerobic energy systems are optimised for the demands of racing. The kinematic, kinetic, spatiotemporal, and global stiffness changes that occur as an athlete increases speed are not well understood in well-trained middle-distance runners. The aim of this study was to analyse the biomechanical responses of middle-distance athletes to increases in treadmill speed.

METHODS: Thirteen male athletes (1.79 ± 0.07 m, 66.7 ± 6.1 kg, 22.3 ± 3.2 y) and two female athletes (stature: 1.69 ± 0.01 m, mass: 55.7 ± 0.4 kg, 30.9 ± 2.6 y) participated. Their mean World Athletics points for personal best performances were 1114 (± 73). Each athlete ran on a Gaitway 3D instrumented treadmill (1000 Hz) during an incremental test at 12, 16, 20 and 24 km/h. Data were collected during the second half of each 1-min stage. Two Fastec T5 high-speed cameras (200 Hz) were placed to the sides of the treadmill to record each side of the body separately, and the starting times were synchronised with the treadmill's data collection period. Ground reaction force (GRF) and spatiotemporal data were measured using the treadmill software; lower limb joint angles were measured using the high-speed videos in SIMI Motion; and global stiffness characteristics were calculated using peak vertical GRF via the methods of Morin et al. (JAB, 2005, 21(2), 167–180).

RESULTS: Both step length and cadence increased at each faster running speed (from 1.24 m and 2.70 Hz at 12 km/h to 2.01 m and 3.32 Hz at 24 km/h). Ground contact time decreased during each stage (0.229, 0.194, 0.168 and 0.147 s, respectively), but flight time only increased until 20 km/h (0.143, 0.160 and 0.163 s), with lower values at 24 km/h (0.155 s). Duty factor decreased during each stage (0.308, 0.274, 0.254 and 0.244, respectively) although leg stiffness was consistent throughout testing (11.4, 11.4, 11.4 and 11.6 N/mm, respectively). Vertical push-off rate increased consistently during each stage (31.6, 41.4, 51.2 and 59.9 BW/s, respectively). The main changes that occurred in joint angles and positions at initial contact were an increase in thigh angle (21, 25, 28 and 29°, respectively), shank angle (3, 5, 7 and 8°, respectively) and hip-ankle horizontal distance (0.18, 0.22, 0.25 and 0.27 m, respectively).

CONCLUSION: It was unsurprising that athletes increased step length and cadence with faster treadmill belt speeds, although the increase in cadence from 20 to 24 km/h was the only one that arose from both shorter contact and flight times. The lack of reliance on increased flight time, and the very small increases in joint angles and positions from 20 to 24 km/h, show that there is an anthropometric limit on achieving faster speeds, which require greater force production during the push-off phase. Athletes should thus note the need for appropriate strength and conditioning within their training regimens.

RELATIONSHIP BETWEEN PHYSIOLOGICAL DURABILITY AND BIOMECHANICAL PARAMETERS DURING A MARATHON.

HUNTER, B., MUNIZ-PUMARES, D.
LONDON METROPOLITAN UNIVERSITY

INTRODUCTION: Marathon performance is underpinned by three physiological pillars: V̇O2max, running economy, and the fractional utilization of V̇O2max (1), usually measured in a "fresh" state with limited fatigue. However, these factors are subject to deterioration during prolonged exercise. The ability to resist this deterioration is termed durability (2). Further to exhibiting inter-individual variability, greater durability has been associated with faster marathon times (3). Biomechanical parameters also alter during prolonged running (4). However, it is unclear whether changes to biomechanical parameters during running are affected by, or affect, durability. Therefore, the aim of this study was to examine whether changes to biomechanical parameters are dependent on durability characteristics. It was hypothesised that runners with lower durability would exhibit larger changes to biomechanical parameters during the marathon.

METHODS: Fifty-seven marathon runners (finish time: 232.4±49.7 mins) were recruited and submitted race data collected using their own footworn accelerometer (Stryd Inc) and heart rate (HR) recording device (e.g., smart watch or HR belt). Biomechanical parameters including stiffness, duty factor, cadence, and running speed, were extracted using a custom MATLAB script and separated into eight 5 km bins. Decoupling, a measure of durability (3), was defined as the ratio between HR and grade-adjusted running speed. The decoupling observed in the last 5 km segment of the race (35–40 km) was used to determine the overall magnitude of the decoupling, expressed relative to the 5–10 km segment, and were grouped into high, moderate, and low decoupling groups. A two-way repeated measures ANOVA was performed to detect differences in biomechanical parameters (segment x group), and a repeated measures ANOVA was used to test for group differences in finishing time and decoupling magnitude.

RESULTS: Significant differences were evident between groups in decoupling magnitude ($p<0.001$), with moderate (1.14±0.04) and high (1.41±0.21) groups exhibiting greater decoupling than low (1.04± 0.05). No significant differences were observed in finishing time (low: 224.0±43.8 mins; moderate: 223.5±51.3 mins; high: 249.7±52.2 mins). Interaction effects were evident in cadence, duty factor, running speed, and stiffness ($p<0.001$). Greater decreases in stiffness, cadence and running speed, but greater increases in duty factor, were evident towards the end of the marathon in the high decoupling group when compared to other groups.

CONCLUSION: Athletes with lower decoupling, i.e., greater durability, appear to preserve "fresh" biomechanical parameters during a marathon better than those with higher decoupling, i.e., lower durability. It is not clear whether lower durability is a cause or consequence of these changes.

1. 10.1113/jphysiol.2007.143834; 2. 10.1007/s40279-021-01459-0; 3. 10.1007/s40279-022-01680-5; 4. 10.1016/j.jbiomech.2016.08.032

Oral Presentations

OP-PN24 Cardiovascular Physiology

THE OXYGEN UPTAKE DYNAMICS CONFORM TO CHANGES IN MUSCLE ACTIVATION AND TOTAL HEMOGLOBIN CONCENTRATION DURING CONSTANT-WORK RATE EXERCISE.

MARINARI, G., MARINARI, G., TRAMA, R., ZAGATTO, A.M., IANNETTA, D., MURIAS, J.M.
UNIVERSITY OF CALGARY

INTRODUCTION: Patterns of muscle activation and near-infrared spectroscopy (NIRS)-derived total hemoglobin concentration ([THC]; a proxy for the dynamics in red blood cell volume), may have an important role for changes in oxygen uptake (VO2) during exercise. However, the interplay between electromyography (EMG)-derived muscle activation and [THC] when taken as a single variable, and its potential association to VO2 during constant-work rate (WR) exercise are yet to be explored. This study investigated the EMG/[THC] ratio and its potential correspondence to the dynamics of VO2 during heavy-intensity exercise.

METHODS: Eleven and nine participants were recruited in part one and part two of the study, respectively. The heavy-intensity domain was identified through the step-ramp-step protocol. Part one: participants randomly performed: i) a 21-min square-wave transition from 20 W to a WR corresponding to 75% of the heavy-intensity domain amplitude (CWR); ii) a ramp (20 W·min-1) to the same constant-WR, which was then sustained for 21 min (r-CWR). The CWR and r-CWR trials were repeated to increase the signal-to-noise ratio. Part two: participants performed a 42-min square-wave transition to the same WR, interrupted by a 20-sec period at 20 W between min 21 and 22 (CWRx2). Pulmonary VO2, as well as the root mean square derived from the EMG signal and [THC] from the vastus lateralis, were measured and expressed as a percent of baseline (0%) to end exercise (100%). The EMG/[THC] ratio was calculated and expressed as a percent of its peak value and its end value. The EMG signal was further decomposed using wavelet transform. Significance was set at $P<0.05$

RESULTS: Part 1: No significant main effect of condition existed for both CWR and r-CWR between the dynamics of VO2 and the dynamics of the EMG/[THC] ratio ($P>0.05$), which was consistent for all the 21 min pairwise comparisons (all $P>0.05$). The EMG signal during the CWR condition decreased across time from min 1 ($P<0.05$), while no differences were observed during the constant-WR portion of the r-CWR condition ($P>0.05$).

No significant main effect of condition for the median power frequency (MPF; Hz) was observed ($P>0.05$), with a significant time effect ($P<0.05$) for the CWR condition where MPF was increasing over time, with stable responses during the r-CWR condition ($P>0.05$).

Part 2: No differences in EMG were observed between min 21 and min 22 (i.e., pre and post the 20-sec interruption at 20 W) for the CWRx2 condition ($P>0.05$).

CONCLUSION: This study indicated that the VO2 dynamics during heavy-intensity exercise at constant-WR conform to the changes in EMG/[THC] ratio. This suggests that changes in muscle activation and peripheral oxygen delivery concurrently adjust to support oxidative phosphorylation over time. Further, although muscle activation decreased over time during the CWR condition, MPF increased, suggesting an overall reduced number of recruited muscle fibers, but with a shift to higher-order muscle fibers.

PROTOCOL TO ASSESS MUSCLE BLOOD FLOW DURING CYCLE ERGOMETER EXERCISE USING DOPPLER ULTRASOUND: DESCRIPTIVE RESPONSES AND ASSOCIATIONS WITH CARDIORESPIRATORY PARAMETERS AND MUSCLE OXYGENATION

RIBEIRO, I., BAPTISTA, M.E., SANTOS, L.P., SANTINI, M.H., IRAHA, A.Y., BARTELS, R., PRADO, D.M.L., GUALANO, B., ROSCHEL, H., PEÇANHA, T.
FACULDADE DE MEDICINA DA UNIVERSIDADE DE SÃO PAULO - FM/USP

INTRODUCTION: The assessment of muscle blood flow during whole-body dynamic exercise can offer valuable information about the mechanisms underlying exercise tolerance and fatigue in different populations. However, costs (e.g., magnetic resonance imaging) and/or invasiveness (e.g., intravenous cannulation/contrast injection) are challenging obstacles to wider application, warranting the development of practical, non-invasive, low-cost alternative methods. Objectives: To test the initial validity of a non-invasive ultrasound-based protocol developed to measure muscle blood flow responses during cycle ergometer exercise.

METHODS: Twelve healthy participants (7 males/5 females; 28.9±1.4 years) attended the laboratory for a progressive square wave test on an upright cycle ergometer. The test consisted of 4-min stages at each of the four following intensity domains: 1) moderate (36±9% of maximal workload [WLmax]); 2) moderate-to-heavy (46±10% WLmax); 3) heavy (67±7% WLmax); 4) maximal (100% WLmax). After each stage, participants stopped pedalling and stayed still for 60s for the assessment of the right common femoral artery blood flow (CFBF) using a Doppler ultrasound (Logiq E, GE Medical System, China). Additionally, quadriceps oxygenation (oxy-, deoxy- and total haemoglobin [HbO2, HHb, THb], and tissue saturation index [TSI]) were assessed via Near-infrared spectroscopy. Cardiorespiratory variables were evaluated using a metabolic cart. Mean CFBF responses at baseline and after each stage were compared using a One-way repeated measures ANOVA. The associations between CFBF and cardiorespiratory and NIRS responses (changes from baseline) were per-

formed using aggregated data from all participants across all exercise stages using repeated measures correlation analysis (rmcorr, Stata v18.0). Strength of the linear association between the variables tested were calculated via the rmcorr coefficient (rrm). Significance was set at P<0.05.

RESULTS: CFBF increased following a "quasi-linear" pattern (baseline=0.26±0.15 L/min; moderate=2.28±1.15 L/min; moderate-to-heavy=2.42±1.39 L/min; heavy=3.93±2.11 L/min; maximal=4.16±2.17; P<0.001). CFBF responses to exercise were strongly and linearly correlated with exercise workload (rrm=0.69, P<0.01) and with HHb (rrm=0.68, P<0.01), VO2 (rrm=0.69, P<0.01) and heart rate (rrm=0.70, P<0.01). Additionally, CFBF responses were moderately or weakly correlated to THb, TSI and oxygen pulse (rrm=0.4-0.59 and P<0.05).

CONCLUSION: The results of this study indicate that the proposed protocol may be a valid approach to investigate lower limb muscle blood flow responses during cycle ergometer exercise. This approach can provide a practical and non-invasive alternative to assess muscle blood flow in an applied context.

ESTIMATING METABOLISM DURING VARYING WORKLOADS OF CHEMICAL CORPS PERSONNEL USING NON-INVASIVE PHYSIOLOGICAL MONITORING

HUANG, H.M., FU, S., TANG, C., YU, J., SHIH, Y.

UNIVERSITY OF TAIPEI

INTRODUCTION: Chemical Corps personnel wear nuclear, biological, and chemical protective clothing (NBC-PC) for mission operations, increasing metabolic rates and fatigue risk (1,2). Monitoring their physical strain non-invasively aids command in strategizing. The purpose of this study is to develop an estimated model to monitor workload.

METHODS: Ten Chemical Corps personnel (male: n = 5, age = 23.6 ± 1.7 years; female: n = 5, age = 24.7 ± 3.9 years) were recruited for a study involving body composition analysis, micro-environment temperature (MT) and humidity (MH), and metabolic equivalents (METs) analysis by using the COSMED K5 wearable metabolic system. They underwent walking tests at 4, 6, and 8 km/h speeds, carrying loads of 0 kg, 10 kg, and 20 kg at ambient conditions 25°c. The statistical method used simple and multiple linear regression analysis to construct the most optimal estimated model with the highest correlation with METs.

RESULTS: Simple regression analysis showed heart rate (HR) reserve ratio (HRRratio: HRactivity–HRresting/HRmax–HRresting) had the highest coefficient of determination for METs (R2 = 0.569, p < 0.001). The estimated model was [METs = 3.82+7.70×HRRratio] . Multiple regression analysis showed the combination of HR, HRRratio, and MH had the highest coefficient of determination for METs (R2 = 0.717, p < 0.001). The estimated model was [METs = -15.479+0.261×HR+17.929×HRRratio–0.045×MH]

CONCLUSION: The combination of multiple physiological parameters HR, HRRratio, and MH showed a high coefficient of determination for METs estimation. The METs increased by 2.4% to 20.9% when subjects performed activities in NBC-PC compared to standard uniforms (3). Aerobic capacity may be impaired at ambient temperature 35-35.5°C (4). Wearing NBC-PC results in an increase of 5.6°C for light work and 11.2°C for moderate to heavy work (5). The environmental temperature has a significant impact on the workload of individuals wearing NBC-PC. Therefore, this estimated model was only applicable at 25°C. Further research is required for extreme high and low temperature environments to develop specific estimated models.

References:

1. Young et al., Aviation, Space and Environmental Medicine, 2000

2. Gómez-Oliva et al., Physiol Behav., 2019

3. Dorman and Havenith, Eur J Appl Physiol., 2009

4. Cuddy, et al., J Therm Biol., 2014

5. McLellan, et al., Compr Physiol., 2013

CEREBRAL BLOOD FLOW AND ARTERIAL TRANSIT TIME RESPONSES TO HOME-BASED EXERCISE TRAINING IN HEALTHY OLDER ADULTS

FERON, J., RAHMAN, F., FOSSTVEIT, S., JOYCE, K., GILANI, A., LOHNE-SEILER, H., BERNSTEN, S., MULLINGER, K., SEGAERT, K., LUCAS, S.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Brain vascular health worsens with age, evident by cerebral blood flow (CBF) reductions and lengthening arterial transit time (ATT) (1). Furthermore, low CBF is associated with accelerated cognitive decline in older adults (2). Exercise training can improve aspects of brain health in older adults, including cognitive function (3) and grey matter volume (4), yet its effects on CBF and ATT remain unclear (5). The aim of this study was to assess the impact of exercise training on CBF and ATT in older adults, and determine whether CBF or ATT are important for cognitive function.

METHODS: This randomised controlled trial involved a 26-week home-based exercise intervention in healthy older adults (n=65, aged 60–81 years). Multi-delay (200, 975, 1425, 1850, 2025, 2150, 2250, and 2300 ms) pseudo-continuous arterial spin labelling (pCASL) MRI was used to estimate global and regional CBF and ATT in grey matter. Cardiorespiratory fitness (VO2peak) was determined with an incremental treadmill test to exhaustion. Mixed design ANOVAs with age and sex as covariates assessed between-group differences and multiple linear regressions with ΔCBF or ΔATT as the dependant

variable assessed associations with changes in cardiorespiratory fitness (model: age, sex, ΔBMI, ΔVO2peak) and cognitive function (model: age, sex, education, Δprocessing speed, Δworking memory, Δattention).

RESULTS: Results showed that cardiorespiratory fitness increased in the exercise group (7.7±10.0 Δ%), but not in the controls. There were no between-group differences in CBF or ATT following the intervention. There was an association between the change in cardiorespiratory fitness and the change in global CBF within the exercise group (β=-0.36 [-0.71, -0.02]), whereby cardiorespiratory fitness gains were associated with declines in CBF. Cognitive function did not significantly change in either group, nor were cognitive function changes associated with changes in CBF or ATT.

CONCLUSION: Exercise is generally considered to be beneficial for brain health in ageing (6), but the present data indicate that changes in resting cerebrovascular haemodynamics may not be the most important contributor. More substantial cerebrovascular changes may be seen with longer or different types (e.g., weight-loss) of interventions.

References

1. Damestani, N. L. et al. NeuroImage. 2023.

2. van Dinther, M. et al. Alzheimer's & Dementia. 2023.

3. Colcombe, S. & Kramer, A. F. Psychol Sci. 2003.

4. Erickson, K. I. et al. Neurobiol Aging. 2014.

5. Kleinloog, J. P. D. et al. J. Int J Sport Nutr Exerc Metab. 2023.

6. Voss, M. W. et al. Journal of Applied Physiology. 2011.

Oral Presentations

OP-MH13 Injury Prevention II

CONCURRENT REPETITIONS OVERESTIMATE HAMSTRING:QUADRICEPS RATIOS AT MORE EXTENDED KNEE JOINT POSITIONS: IMPLICATIONS FOR CLINICAL PRACTICE

NICHOLSON, G., WALKER, J., BROGDEN, C., ALT, T.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Recent research suggests that return-to-play protocols may benefit from the inclusion of angle-specific hamstring:quadriceps (H:Q) ratios to accurately understand muscle balance through the ROM (Lunn et al. 2023). In undertaking angle-specific analyses, most isokinetic knee extension-flexion protocols are conducted using concurrent repetitions (CON) whereby active knee extension is immediately followed by active knee flexion. To reduce the influence of the stretch-shortening cycle and limit axis misalignment, isolated repetitions (ISO) have been recommended (Alt et al. 2014) whereby extension and flexion are completed separately. To inform athlete screening protocols, this study examined the effect of CON and ISO protocols on discrete and angle-specific hamstring:quadriceps ratios.

METHODS: Fifteen healthy males (age: 27 ± 4 years; height: 184 ± 9 cm; body mass: 80 ± 9 kg) performed isokinetic tests of the knee flexors and extensors (60 deg/s) using CON and ISO repetitions while sagittal-plane kinematics were captured (100 Hz) to quantify axis misalignment. Statistical parametric mapping then enabled the effects of protocol type (CON vs. ISO) and axis misalignment (uncorrected vs. corrected data) to be compared.

RESULTS: The use of uncorrected data resulted in an underestimation of discrete conventional (–10.2%, $p < 0.001$) and functional (–9.2%, $p < 0.05$) H:Q ratios with these differences being observed for all angle-specific ratios ($p < 0.001$). The use of concurrent repetitions resulted in a significant overestimation of the H:Q ratio (+7.4%, $p < 0.05$) with the differences being most prevalent at extended knee joint positions. Despite the main effect(s) of protocol type and axis misalignment, no significant interactions were observed.

CONCLUSION: Practitioners should be mindful that the use of concurrent repetitions will result in a significantly higher conventional H:Q ratio which will particularly influence angle-specific ratios in more extended knee joint positions. This may increase the likelihood of "false negative" injury risk categorisation during "time-efficient" protocols involving concurrent repetitions. Whilst the use of corrected knee moment data is preferable, practitioners should be mindful that the use of isolated repetitions and corrected joint moment data does not lead to significant differences in discrete or angle-specific H:Q ratios when compared with uncorrected data obtained from concurrent repetitions.

References

Alt, T. et al., (2014) Isokinetics and Exercise Science, 22, pp.333–342

Lunn, DE, et al., (2023) Journal of Strength & Conditioning Research, 10, pp.1519

RELATIONSHIP BETWEEN GENU VARUM AND SPRINT AND JUMP PERFORMANCE IN ELITE YOUTH SOCCER PLAYERS

HENZE, A.S., WIEDEMANN, P., BIZJAK, D.A., MATITS, L., KIRSTEN, J., SCHULZ, S.V.W.
UNIVERSITY HOSPITAL ULM

INTRODUCTION: Genu varum has been shown to be particularly prevalent in soccer players and to increase over time. Several causes have been suggested for genu varum in soccer, including muscular asymmetry and imbalanced overloading of the growth plates. Studies have also shown that this process already begins in childhood and adolescence. The development and increase of genu varum lead to biomechanical changes, increases the risk of osteoarthritis and causes tension shifts within the ligaments. This exploratory study aims to provide insight into the relationship between genu varum and athletic performance in elite youth soccer players.

METHODS: In this study, 247 healthy male soccer players in the Under-12 to Under-18 squads (age 14.64 ± 2.13 years (mean ± standard deviation); body weight: 56.82 ± 14.42 kg, standing body height: 168.19 ± 13.2 cm, years of playing soccer: 9.07 ± 2.76 years, skeletal muscle mass: 28.53 ±7.94 kg) from two German elite youth academies were investigated in August 2023. Performance tests included the 30m linear sprint, the counter movement jump (CMJ), and the heading jump. The intercondylar distance (ICD) was measured using a digital caliper in cm. A linear regression was performed between the ICD and the performance parameters sprint speed (30m linear sprint) and CMJ or heading jump height. An alpha level of .05 (2-tailed) was considered significant.

RESULTS: The overall mean ICD was 1.92 ± 1.8 cm. Regression analysis revealed significant relationships for sprint speed (beta = -0.46, $p \leq .001$), CMJ jump height (beta = 0.53, $p \leq .001$), and for heading jump height (beta = 0.41, $p \leq .001$). Significant relationships were also found for sprint speed (beta = -0.14, $p \leq .001$), CMJ jump height (beta = 0.18, $p \leq .001$), and for heading jump height (beta = 0.09, $p \leq .04$), when the model was adjusted for the athlete's skeletal muscle mass.

CONCLUSION: Our study provides evidence that genu varum is associated with an increase in sprint and jump performance in elite male youth soccer players. Future research is warranted in female athletes and in other team sports with similar physical demands.

SUB-CONCUSSIVE IMPACTS AND THE MENSTRUAL CYCLE: A STUDY OF ELITE FEMALE FOOTBALLERS

LOWERY, M., RONCA, F., BRUINVELS, G., JONES, C., LOOSEMORE, M., BURGESS, P.
UNIVERSITY COLLEGE LONDON / SPORTS & WELLBEING ANALYTICS

INTRODUCTION: Sub-concussive head impacts, particularly those incurred through sports like football, have been associated with long-term neurological risks. While repetitive sub-concussive head impacts have been extensively studied in male athletes, there is a dearth of research focusing on female athletes, despite evidence suggesting potential differences in susceptibility to sports-related concussion and symptom severity across menstrual cycle phases, particularly in the luteal phase. This study investigates whether menstrual cycle phases, influence head impact kinematics during sub-concussive impacts in elite female footballers.

METHODS: Five naturally menstruating elite female footballers (mean age = 23 ± 4 years; mean stature = 163.5 ± 5.5 cm; mean body mass = 62.4 ± 6.2 kg) participated in a 16-week study. Menstrual cycle phases were tracked using the FitrWoman app alongside urinary ovulation kits. From weeks 4 to 16, participants performed a weekly controlled drill involving ten headers thrown from a 5m distance, with head accelerations measured using custom-fitted PROTECHT instrumented mouthguards. A linear mixed model was used to analyze differences in individual head impact acceleration across 256 separate heading events, with the menstrual cycle phase (menstruation, late follicular, ovulation, luteal, premenstrual) as the fixed effect and player as a random effect.

RESULTS: The analysis revealed an average heading intensity of 17.5 ± 5.4 g (linear acceleration) and 1479 ± 548 rad.s-2 (rotational acceleration). At the group level, no significant differences were observed in peak linear ($P = 0.357$) or rotational accelerations ($P = 0.752$) from headers across menstrual cycle phases. However, at the individual level, two athletes experienced significantly greater head accelerations. One athlete had higher linear and rotational acceleration in the late follicular versus luteal phase ($P = 0.023$ and 0.050, respectively). Another showed increased linear acceleration in the premenstrual phase compared to late follicular ($P = 0.006$), and greater rotational acceleration in menstruation versus late follicular ($P = 0.039$). Descriptively, headers in the luteal phase exposed athletes to the lowest accelerations.

CONCLUSION: Results suggest that hormonal fluctuations may not substantially influence head impact biomechanics among elite female athletes under controlled conditions. Although overall head acceleration may not vary with the menstrual cycle phase on average, individual athletes may still experience hormonal fluctuations that affect their head accelerations. While the findings are intriguing, the small sample size limits the generalizability of the results. Future research with larger cohorts and the inclusion of match-specific heading is warranted.

Oral Presentations

OP-AP24 Football Science I

INFLUENCE OF STRENGTH, BIOFEEDBACK AND COMBINED TRAINING ON JUMPING AND KICKING PERFORMANCE IN SOCCER

BAYRAM, I.1,2, CERRAH, A.O.3, NARCISS, S.1, AUGUSTUS, S.4

1 DRESDEN TECHNICAL UNIVERSITY, DRESDEN, GERMANY; 2 ISTANBUL RUMELI UNIVERSITY, ISTANBUL, TÜRKIYE; 3 ESKISEHIR TECHNICAL UNIVERSITY, ESKISEHIR, TÜRKIYE; 4 KINGSTON UNIVERSITY, KINGSTON, UK

INTRODUCTION: Soccer, a dynamic sport, demands a combination of strength, agility, and high levels of skill. Well-structured kicking ability is a pre-determinant parameter for soccer success (1, 2). This study evaluated the impact of specific training modalities (strength, biofeedback, and combined strength and biofeedback) on jumping and kicking performance in U16 regional-level soccer players. The aim was to identify the efficacy of each training method and explore potential synergies when combined.

METHODS: We recruited 21 soccer players, forming three groups with 7 players in each: Strength Group (SG; age: 15 ± 1.15 yrs, training age: 4.29 ± 1.11 yrs height: 1.63 ± 0.07 m mass: 56.20 ± 5.12 kg)), Biofeedback Group (BG; 14±1.85 yrs, 3.71 ± 0.95 yrs, 1.66 ± 0.10 m 52.46 ± 9.70 kg), and Combined Group (CG; 15 ±1.36 yrs, 4 ± 1.29 yrs, 1.59 ± 0.10 m, 47.36 ± 10.48 kg). The intervention period spanned 8 weeks, during which SG received strength training, BG underwent biofeedback training targeting kicking performance, and CG experienced a combination of both, alongside their regular soccer training. To assess the effectiveness of the interventions, we employed two measures of lower limb explosive power: Squat Jumps (SJ) and Countermovement Jumps (CMJ) measured by jumping mat (Smart Speed; Fusion Sport Pty, Ltd, Brisbane, Queensland, Australia). Additionally, we measured kicking performance by evaluating ball velocity with a radar gun (Jugs Pro, USA) during shooting for both dominant and non-dominant legs. We employed mixed design ANOVA with Bonferroni correction to assess and compare the mean performance scores of the training methods ($p<0.05$).

RESULTS: In the analysis of pre and post-test comparisons, SG demonstrated a significant improvement in jump height compared to the other groups (SJ pre: 0.29 ± 0.05 m post: 0.32 ± 0.06 m; CMJ pre: 0.30 ±0.05 m post: 0.32 ± 0.06 m; $p < 0.05$). This underscores the positive impact of strength training on lower limb explosive power. Interestingly, CG exhibited a noteworthy enhancement in ball velocity of both the dominant and non-dominant leg (Dominant pre: 78.90 ± 9.59 km/h post: 85.29 ± 9.33 km/h Non-dominant pre: 59.33 ± 11.32 km/h post: 63.67 ± 9.41 km/h) compared to both SG and BG ($p < 0.05$). The combination of strength and biofeedback training, integrated with regular soccer training, proved to be a powerful catalyst for improving soccer-specific skills.

CONCLUSION: Strength training was effective for improving lower limb explosive power, evidenced by increased jump performance in the SG. More notably, the CG outperformed the other groups in terms of improving kicking performance. Therefore, the combined approach seemed to synergize the benefits of strength and biofeedback training modalities, resulting in a more comprehensive improvement in soccer-specific skills.

REFERENCES:

1. Augustus et al., J. Sports Sci., 2017

2. Augustus et al., J. Sports Sci., 2021

THREE-, FOUR- AND FIVE-DAY MICROCYCLES IN PROFESSIONAL FOOTBALL

GUALTIERI, A., VICENS-BORDAS, J., RAMPININI, E., FERRARI BRAVO, D., BEATO, M.

JUVENTUS FC

INTRODUCTION: In modern football, elite level teams frequently face periods with congested fixtures. This scenario requires teams to play more than once a week in national and international competitions [1]. Previous research reported a gradual reduction in training volume as match day approached [2], but limited information is currently available about shorter microcycles' training load distribution. Therefore, this study aimed to quantify training and match day (MD) load during three- (3dMC), four- (4dMC) and five-day microcycles (5dMC) in elite adult football and analyse the effect of microcycle length on the training load sustained the day before (MD-1) and after a match (MD+1).

METHODS: This study involved 20 male adult elite football players whose external load was monitored for a whole competitive season, assessing periods with congested fixtures (i.e., three-, four- and five-day microcycles). Training exposure (EXP), total distance covered (TD), high-speed running distance (HSR), sprint distance (SD), individual sprint distance (D>80%), number of accelerations (ACC) and decelerations (DEC) were quantified. The load recorded on MD+1 (sustained by non-starting players), MD-1 and MD was compared between the three congested microcycles.

RESULTS: Microcycles length affected most of the variables of interest: HSR ($F = 9.04$, $p < 0.01$), SD ($F = 13.90$, $p < 0.01$), D>80% ($F = 20.25$, $p < 0.01$), accelerations ($F = 10.12$, $p < 0.01$) and decelerations ($F = 6.01$, $p < 0.01$). Comparisons highlighted that 3dMC and 4dMC had greater daily average HSR and D>80% demands than the 5dMC, while 4dMC and 5dMC produced more ACC than 3dMC ($p < 0.05$).

There was an interaction effect between training day and microcycle type for SD ($F = 5.46$, $p < 0.01$), D>80% ($F = 4.51$, $p < 0.01$), ACC ($F = 2.24$, $p = 0.06$) and DEC ($F = 3.91$, $p < 0.01$). In particular, the microcycle type affected D>80% on MD+1

(higher in 3dMC), and ACC and DEC on MD-1 and MD. 4dMC presented a greater number of ACC on MD-1, compared to 3dMC (-8.5, $p < 0.01$, $d = -0.29$) and on MD compared to 3dMC (-11.6, $p < 0.01$, $d = -0.36$) and 5dMC (-9.3, $p < 0.01$, $d = 0.25$). 4dMC presented the greater number of DEC on MD-1, compared to 3dMC (-7.9, $p < 0.01$, $d = -0.23$) and on MD compared to 3dMC (-16.4, $p < 0.01$, $d = -0.43$) and 5dMC (14.2, $p < 0.01$, $d = 0.33$).

CONCLUSION: During congested fixtures, players external training load is influenced by microcycles length, where coaches seem to prefer technical and tactical drills with a reduced muscular impact during shorter microcycles allowing starting players to recover from the previous match. On the other side, non-starting players can be exposed to high-speed running on MD+1 since they may not have this stimulus on the other training days of the week. Independently of the length of the congested fixture microcycle, daily load does appear to decrease when MD approaches.

References: [1] Julian (2021) [2] Clemente (2019)

PRESCRIBING BALL-DRILLS TO REPLICATE OFFICIAL MATCH LOCOMOTOR DEMAND IN TOP-CLASS WOMEN SOCCER PLAYERS

RIBOLI, A., FRANCINI, L., MURATORE, S., CANDELA, S., BOLDRINI, L., MAZZONI, S.

A.C. MILAN S.P.A.

INTRODUCTION: The management of the area-per-player (ApP, m2·player) helps to modulate the locomotor intensity up to official match demand using ball-drills (1-3). The current study aims to determine the ApP to replicate the official match locomotor demands using ball-drills in top-class women soccer players.

METHODS: Twenty-four Italian Serie A players were monitored during both training and match across the season 2022-2023; only outfield players were included. Small-sided games with goalkeepers (SSGwith, n=62 different formats, n=4342 individual samples), ball possession games (POSSgame, n=16, n=621), technical-tactical drills (TTdrill, n=70, n=2789) and official match (n=32, range 4 to 31; n=420 individual samples) were monitored. Relative (m·min-1) total (TD), high-speed running (HSR, 14.4 to 19.8 km/h-1), very high-speed running (VHSR, 19.8 to 25.2 km/h-1), sprint (>25.2 km/h-1) and acceleration+deceleration (Acc+Dec, 3 m/s2) distance were collected. A linear mixed model analysis was used to calculate the individual relationship between m2·player and m·min-1 for each metric and drill; a correlation analysis was also calculated. The ApP for replicating official match demands was forecasted, as previously proposed (1-3).

RESULTS: The ApP was moderately to very largely correlated ($P<0.001$) with locomotor demands in SSGwith (TD, r=0.401; HSR, r=0.617; VHSR, r=0.734; sprint, r=0.591), POSSgame (TD, r=0.446; HSR, r=0.795; VHSR, r=0.566; sprint, r=0.563) and TTdrill (TD, r=0.573; HSR, r=0.752; VHSR, r=0.697; sprint, r=0.241). For SSGwith, POSSgame and TTdrill, the ApP showed no correlations ($P>0.05$) with Acc+Dec. In POSSgame, the ApP to replicate the match demands was 90±16, 142±32, 257±47, 401±50 and 114±21 m2·player for TD, HSR, VHSR, sprint and Acc+Dec, respectively. In SSGwith, the ApP to replicate the match demands was 151±16, 192±34, 277±47, 384±47 and 170±35 m2·player for TD, HSR, VHSR, sprint and Acc+Dec, respectively. In TTdrill, the ApP to replicate the match demands was 126±16, 177±35, 249±41, 313±56 and 151±18 m2·player for TD, HSR, VHSR and Acc+Dec, respectively. For each drill, moderate to very large (ES: 0.65 to 21.7) differences in the ApP across metrics were observed. Trivial to very large (ES: 0.18 to 10.97) differences in ApP for the same metric across SSGwith, POSSgame and TTdrill were found, with SSGwith that required larger ApP than others.

CONCLUSION: These findings may help coaches and performance scientists to recreate the desired external load outcomes using specific ApP during SSGwith, POSSgame and TTdrill in top-class women's soccer. In SSGwith, POSSgame and TTdrill, to overload HSR similarly to official match demands an ApP of about 140 to 190 m2·player is required and an ApP larger than about 250 for VHSR. To replicate sprint, SSGwith and TTdrill should be prescribed with about 300/350 m2·player, while supplemental sprint exercises seem mandatory if POSSgame is a preferential choice for technical purposes.

MODELLING HEART RATE IN FOOTBALL USING REGRESSION AND PERFORMANCE POTENTIAL MODELS: CALIBRATION COMPLEXITY AND TYPES OF KINEMATIC DATA

SCHNACK, T., BACA, A.

UNIVERSITY OF VIENNA

INTRODUCTION: Heart rate (HR) is an important measure for exercise intensity. While it is increasingly common for football players to wear sensor vests that capture kinematic data (acceleration, angular rate and velocity), these devices do not measure HR. Therefore, the aim of this study is to investigate the use of kinematic data to model a players HR in football. Furthermore, the influence of complexity constraints for model parameter calibration is considered.

METHODS: Data of five male professional football players was collected during the first half of a friendly game in January 2023. Apex Pro Series (STATSports Group Limited, Newry, GBR) and Firstbeat Sports (Firstbeat Technologies Oy, Jyväskylä, FIN) sensors measured kinematics and HR, respectively. The relationship between kinematics and HR was modelled using linear regression and the Performance Potential model (PerPot) [1]. The data of each player was split in half for calibration and prediction. Parameters of the PerPot were calibrated through a differential evolution algorithm. The complexity of this algorithm was constrained by two values: the maximum number of iterations (default 10) and the population size (default 4). PerPot was calibrated four times, with the default complexity constraints scaled by the factors 1, 4, 7 and 10, respectively. An analysis of variance with repeated measures was used to assess the influence of the model type, the type of kinematic data and the complexity factor on the root mean square error (RMSE) of the prediction.

RESULTS: PerPot showed a significantly lower RMSE compared to regression (7.6±3.2 vs. 12.8±2.2 bpm, p<0.05). For PerPot, angular rate showed a significantly lower RMSE than velocity (6.8±3.5 vs. 8.23±2.6 bpm, p<0.05) and the complexity factor 1 performed significantly worse than the factors 4, 7 and 10 (11.0±4 vs 7±2.2/6.3±1.8/6.2±1.9 bpm, p<0.05).

CONCLUSION: While regression only makes the assumption that the modelled relationship is linear, PerPot is based on physiological principles. This might explain the difference in the predictive power of the two models. Velocity is a GPS-derived measure, which might explain its inferiority compared to the inertial-based angular rate. The similarity between complexity factor 4, 7 and 10 suggests that from a certain factor on, higher calibration complexities result in diminishing returns in terms of the accuracy of PerPot. This study proves the feasibility of modelling HR in football, based on kinematic data. However, further research needs to be carried out with more subjects to establish acceptable accuracy limits.

REFERENCES:

[1] Endler, S., Hoffmann, S., Sterzing, B., Simon, P., & Pfeiffer, M. (2017). The PerPot Simulated Anaerobic Threshold—A Comparison to Typical Lactate-based Thresholds. International Journal of Human Movement and Sports Sciences, 5(1), 9–15. https://doi.org/10.13189/saj.2017.050102

Oral Presentations

OP-MH30 Cognitive function and exercise in older adults

EFFECTS OF PROGRESSIVE HOME-BASED ECCENTRIC VERSUS STRETCHING EXERCISE TRAINING ON COGNITIVE FUNCTION AND PHYSICAL FITNESS OF OLDER WOMEN

HUANG, M.J., CHEN, T.C.2, SINGH, F.1, TAAFFE, D.R.1, NOSAKA, K.1

1 EDITH COWAN UNIVERSITY 2 NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Cognitive function of older adults is improved by performing aerobic and/or resistance exercise training [1]. Due to the potentially higher cognitive demand of eccentric exercise [2] and its superior impact on muscle function, physical fitness, insulin sensitivity, and blood lipid profile in comparison to concentric exercise [3], eccentric exercise training may be more effective in improving cognitive function. This study explored whether an 8-week eccentric exercise program would enhance cognitive function more than a stretching exercise program in older adults.

METHODS: Healthy older women (66-75 y) underwent either home-based eccentric exercise (ECC, n=14) or stretching exercise (STRETCH, n=14) twice weekly for 8 weeks. The ECC group performed 7 eccentric exercises (chair squat, chair recline back, wall kiss, heel drop, elbow extension, glute bridge, lower back) with repetitions increasing from 5 to 40, and the STRETCH group performed 12 stretching exercises (approximately 30 min per session for both groups). Stroop test for color naming (STCN) and conflicting color words, symbol digit modalities test (SDMT), digit span test (DST) and two types of the trail making test (TMT-A, TMT-B), and 6 physical fitness tests were undertaken before and after the training period and 4 weeks after the last training session. Fasting blood samples were taken 3 days before the first training session and 4 days after the last training session, and analysed for insulin sensitivity and lipid profile markers, and brain-derived neurotrophic factor (BDNF). Changes in the variables over time were compared between groups by two-way repeated-measures ANOVA.

RESULTS: A significant (p<0.05) interaction effect was found for changes in STCN (F=7.34), DST (F=5.13) and TMT-A (F=3.64), with the ECC group showing improvements (P<0.05) in STCN (4.8%), DST (14.7%) and TMT-A (10.2%) from pre- to post-training. However, these changes in cognitive function returned to baseline 4 weeks later. There were no significant changes in other cognitive function tests for either group. Grip strength and 2-min step test showed greater (p<0.05) improvement for the ECC than STRETCH group, and only the ECC group demonstrated improvement in 30-s chair stand, 3-m timed up and go, and 3-m backwards walk tests post-training. There were no significant changes in blood lipid profile and BDNF, but decreases (P<0.05) in serum glucose concentration and whole-blood glycosylated hemoglobin were observed post-training for the ECC group.

CONCLUSION: These results suggest that the eccentric exercise program was more effective in enhancing some aspects of cognitive and physical function of older adults than stretching exercise; however, the limited training period and exercise frequency may have constrained the magnitude of these effects.

1. Falck et al. Neurobiol Aging, 2019

2. Kan et al. Eur J Apply Physiol, 2019

3. Chen et al. Front Physiol, 2017

CAN LOWER-FUNCTIONING OLDER ADULTS OVERCOME THOSE WITH HIGHER-FUNCTIONING COGNITIVE AND PHYSICAL FUNCTIONS?

RAIMUNDO, A., PEREIRA, C., BRAVO, J., CARVALHO, J., ROSADO, H.

ESCOLA DE SAÚDE E DESENVOLVIMENTO HUMANO, UNIVERSITY OF ÉVORA, COMPREHENSIVE HEALTH RESEARCH CENTRE

INTRODUCTION: Cognitive and physical inter-individual variability at baseline should be taken into account for tailored interventions. In addition, effective interventions are needed to promote the functioning level in community dwellings. The

psychomotor intervention and whole-body vibration (WBV), promoting neurocognitive and sensorimotor stimulation, and physiological changes, respectively, can positively affect cognitive and physical functions. PURPOSE: To analyze the effects of a 12-week interactive cognitive-motor program on cognitive and physical functions according to baseline functioning in community-dwelling older people.

METHODS: Nineteen older adults (74.5±5.2 years old) underwent a combined program (psychomotor intervention + WBV). Cognitive function assessments included the Trail Making Test (Parts A&B) and the d2 Test of Attention to assess processing speed (n) and attention (n), respectively. Physical function assessments included the Timed Up and Go test, Fullerton Advanced Balance scale, and 30-s chair stand test to assess mobility (s), balance (points), and lower-body strength (n), respectively. A composite was computed including the sum of all cognitive and physical function standardized variables. A lower- (LFG) and higher-functioning (HFG) groups were created according to the participants' baseline functioning. The Wilcoxon and Mann-Whitney tests were used.

RESULTS: At post-intervention, within-group improvements were found only within LFG in the composite variable (-11.7±3.4 vs. -9.9±3.9, p=0.021, r=0.54). Between-group differences were also observed at post-intervention (LFG: -9.9±3.9 vs. HFG: -2.22±4.1, p=0.002, r=0.70). The effect size was large within and between groups.

CONCLUSION: Our findings suggested that the combined program was effective, particularly within LFG, by improving cognitive and physical functions. Despite HFG continuing to present better results, the LFG presented a higher learning potential, evidencing that neuroplasticity can be promoted even in older adults with lower functioning.

Funding: This study was granted by the ESACA Project (Grant ALT20-03-0145-FEDER-000007), FCT (SFRH/BD/147398/2019) and under the FCT project UIDP/04923/2020.

PHYSICAL FITNESS AND INCIDENT MILD COGNITIVE IMPAIRMENT: A SYSTEMATIC REVIEW

BERGMANN, M., GEDA, Y.E., WOLL, A., KRELL-ROESCH, J.
KARLSRUHE INSTITUTE OF TECHNOLOGY

INTRODUCTION: Physical fitness is associated with various health outcomes, including but not limited to lower mortality, or decreased risk of cardiovascular disease and dementia. However, to date, little is known about the longitudinal associations between physical fitness and the risk of incident mild cognitive impairment (MCI), the intermediate stage between normal cognitive aging and dementia. Therefore, our aim was to provide an overview of current research on the associations between physical fitness and the risk of incident MCI.

METHODS: We conducted a systematic literature review. We searched PubMed database and considered longitudinal and/ or prospective cohort studies published in English or German that examined the associations between physical fitness such as strength or endurance with incident MCI. Screening was performed independently by two authors using AI-based web tools. Quality of included studies was assessed using the STROBE checklist.

RESULTS: The search yielded 2647 studies, of which 21 were finally included in the review. Most studies were conducted in a population-based setting, and the mean follow-up time for incident MCI was 8.2 years. Common measures of physical fitness were strength (i.e., handgrip strength), endurance (i.e., lap time variability from a 400m walk), variables related to muscle quality and function (i.e., sarcopenia, skeletal muscle mass index, muscle function), speed (i.e., finger tapping), balance, and gait-related variables (i.e., speed, variability). In 15 studies, a higher level of physical fitness was associated with a decreased risk of incident MCI, 4 studies did not show a significant association, and some studies reported mixed findings.

CONCLUSION: Physical fitness is associated with the risk of new onset of MCI in older adults. This highlights the importance of maintaining physical fitness throughout adulthood and/ or preventing a decline in physical fitness in old age to potentially delay the onset of MCI. More research is needed to confirm these observations, and to further untangle the mechanism underlying physical fitness and decreased risk of incident MCI.

CHANGES IN EXECUTIVE FUNCTION AND BRAIN OXYGENATION AMONG OLDER ADULTS FOLLOWING A PHYSICAL EXERCISE TRAINING PROGRAM

AHMADI, S., FAIVRE, P., QUIRION, I., O'BRIEN, M., SÉNÉCHAL, M., DUPUY, O., BÉLANGER, M., MEKARI, S.
UNIVERSITY OF SHERBROOKE: UNIVERSITE DE SHERBROOKE

INTRODUCTION: The aging process is linked with various health challenges, including a decline in cognitive abilities primarily due to decreased cerebrovascular function. This decline is associated with an increased risk of impaired cerebral oxygenation, which is a key factor in cognitive health [1]. Physical activity (PA) is recognized as a protective measure against the age-related deterioration of cerebrovascular function, and studies have shown a positive correlation between higher PA levels and improved cognitive health [2]. Therefore, this study aims to assess the effect of physical training on cognitive performance and to explore how cerebral blood oxygenation changes, contribute to these effects.

METHODS: Thirty-seven cognitively healthy older adults (age: 71.4 ± 6.3, 89% females) participated in a 10-week community-based PA intervention (at least 150 minutes of moderate-vigorous PA per week) study. Cognitive performance using computerized Stroop task (naming, inhibition, switching) was evaluated at baseline and after the intervention. During the Stroop task, a multi-channel fNIRS device (to measure relative changes in concentrations of oxygenated hemoglobin (ΔO2Hb) in the brain) was used.

RESULTS: Stroop task results showed improved reaction time for the naming (p=0.003) and switching (p=0.04) conditions. Total ΔO2Hb was greater post-intervention across all three conditions (all, p<0.001). When examining ΔO2Hb responses by general regions, we observed a significant interaction 'Regions by Time', and the areas demonstrating the greatest increase were generally the left side (all, p<0.01) and ventrolateral aspect (all, p<0.01). Among specific regions, ΔO2Hb was increased during the naming and switching conditions in the Left-Dorsolateral (both, p<0.001), Left-Ventrolateral (both, p<0.01), and Right-Ventrolateral (both, p<0.03).

CONCLUSION: Our results confirm that physical training for an older adult community population improves cognitive and, specifically, executive performance. This improvement is accompanied by greater cerebral oxygenation of the left side and front part of the brain. The findings support the hypothesis that physical exercise is not only beneficial for physical health but also for cognitive health in older adults.

REFERENCES:

1. Burtscher J, Millet GP, Fresa M, Lanzi S, Mazzolai L, Pellegrin M. The link between impaired oxygen supply and cognitive decline in peripheral artery disease. Prog Cardiovasc Dis. Published online December 6, 2023.

2. España-Irla G, Gomes-Osman J, Cattaneo G, et al. Associations Between Cardiorespiratory Fitness, Cardiovascular Risk, and Cognition Are Mediated by Structural Brain Health in Midlife. J Am Heart Assoc. 2021;10(18):e020688.

THE EFFECT OF INTEGRATED RESISTANCE TRAINING WITH COGNITIVE STIMULATION ON PHYSICAL PERFORMANCE AND COGNITIVE FUNCTION OF THE ELDERLY

FU, S., LI, Y., WU, P., YU, C., TSENG, K.

UNIVERSITY OF TAIPEI

INTRODUCTION: This study explores the combined effects of resistance training and cognitive stimulation on older adults physical and cognitive performance, addressing the challenges of low participation due to unfamiliarity, fear, and the unclear benefits of integrating these two strategies. Despite their known individual benefits in delaying disabilities and dementia (1), the integration of cognitive exercises into resistance training lacks conclusive evidence. This research seeks to fill that gap by assessing the impact on older adults across varying cognitive abilities.

METHODS: The study involved thirty older adults residing in the community, who were split into two categories: those with mild cognitive impairment group (MCIG) (n = 16, age = 75.5 ± 5.6) and the partial cognitive decline group (PCDG) (n = 14, age = 72.9 ± 4.6). Both sets of participants engaged in a 12-week program that integrated resistance training with cognitive stimulation activities. Before and after this program, assessments measured body composition, MoCA cognitive functions, short physical performance battery (SPPB), and senior fitness test (SFT).

RESULTS: Following the intervention, MCIG and PCDG exhibited notable enhancements in muscular strength for both upper limbs (MCIG: 16.38 ± 5.50 vs. 19.94 ± 5.59, $p < .05$; PCDG: 17.71 ± 3.73 vs. 21.64 ± 3.39, $p < .05$), and lower limbs (MCIG: 13.75 ± 3.66 vs. 21.81 ± 6.15, $p < .05$; PCDG: 13.43 ± 2.98 vs. 21.36 ± 5.05, $p < .05$), dynamic balance (MCIG: 7.56 ± 1.66 vs. 6.17 ± 1.44, $p < .05$; PCDG: 6.22 ± 1.01 vs. 5.35 ± 0.67, $p < .05$), and cognitive function (MCIG: 23.06 ± 2.41 vs. 26.00 ± 4.55, $p < .05$; PCDG: 26.79 ± 0.80 vs. 29.64 ± 0.63, $p < .05$). Moreover, only MCIG showed significant improvement in SPPB (10.81 ± 1.47 vs. 11.75 ± 0.58, $p < .05$).

CONCLUSION: Post-intervention, both groups exhibited significant enhancements in upper and lower limb strength, dynamic balance, and cognitive function, with the MCIG outperforming the PCDG in the SPPB. These outcomes align with prior studies showing that exercise combined with cognitive training can boost cognitive functions in the elderly (2). Specifically, resistance training appears particularly effective for exercise interventions in community-dwelling older adults (3). This evidence supports integrating resistance training and cognitive stimulation in elderly exercise programs, supporting improved results and long-term health benefits.

Reference:

1. Norouzi et al., Phys Sportsmed., 2019

2. Gavelin et al., Ageing Res. Rev., 2021

3. Landrigan et al., Psychol. Res., 2020

Oral Presentations

OP-SH22 Physical activity promotion III

SCHOOL-BASED ENVIRONMENT AND PHYSICAL ACTIVITY IN ADOLESCENTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

WANG, H., HOU, X., YANG, X., JIA, Y.

BEIJING SPORT UNIVERSITY

Introduction: Adolescents lack of regular physical activity (PA) is a significant concern, with most failing to meet the recommended 60 minutes of moderate-to-vigorous intensity PA per day. The school environment is crucial in shaping their motivation for PA, but there is a lack of consensus on which specific factors effectively promote adolescents PA. This re-

view and meta-analysis aim to evaluate the effectiveness of different school environmental factors in improving adolescents PA levels.

Methods: A comprehensive search of five databases (PubMed, Embase, Web of Science, EBSCO, and Cochrane Library) was conducted from the earliest available records to September 2023. This meta-analysis included eighteen studies with a total of 340,749 participants. When two or more studies explored the same factor, a meta-analysis was performed. The school environmental factors examined encompassed seven school social environmental factors (i.e., school-offered daily physical education (PE), offering intramurals, offering interschool sports, school-based extracurricular PA, school policies, the encouragement of using sport equipment or facilities, and outdoor obstacle course) and six school physical environmental factors (i.e., skating areas, school grass areas, boarding areas, ball activities areas, the number of school PA facilities, and swimming areas).

Results: The result revealed a significant positive correlation between the school environment and adolescents PA levels (OR = 1.11; 95% CI = 1.04 to 1.17). Specifically, the school social environment (OR = 1.24; 95% CI = 1.08 to 1.44) was significantly associated with higher levels of adolescents PA. More specifically, school-offered daily PE (OR = 1.44; 95% CI = 1.17 to 1.77), school-based extracurricular PA (OR = 1.16; 95% CI = 1.05 to 1.28), the encouragement of using sport equipment or facilities (OR = 3.25; 95% CI = 1.87 to 5.64), and outdoor obstacle course (OR = 1.58; 95% CI = 1.25 to 1.98) were significantly correlated with higher levels of adolescents PA, respectively. Additionally, the school physical environment did not show a significant association with adolescents PA (OR = 1.03; 95% CI = 0.99 to 1.08). However, among school physical environmental factors, the number of school PA facilities (OR = 1.05; 95% CI = 1.01 to 1.09) was significantly associated with higher levels of adolescents PA.

Conclusions: This meta-analysis demonstrates that the school environment significantly contributes to increasing adolescents PA levels. Among the various school social environmental factors, school-offered daily PE, school-based extracurricular PA, encouragement of using sport equipment or facilities, and outdoor obstacle courses are found to be particularly beneficial for promoting PA among adolescents, respectively. Regarding the school physical environment, the presence of a greater number of school PA facilities is associated with increased levels of adolescents PA.

THE DIFFERENCE IN ACCESSIBILITY OF URBAN GREEN SPACES CHARACTERIZES THE SPATIAL AND SOCIO-ECONOMIC INEQUALITIES IN THE BENEFITS OF PHYSICAL ACTIVITY PROMOTION FOR RESIDENTS

LIU, Y., DU, Y., ZHENG, R., HOU, Y.

NORTHEAST FORESTRY UNIVERSITY

Introduction

Urban green spaces (UGS), which are frequently utilized outdoor public areas by residents, offer a range of ecological benefits for environmental enhancement, as well as opportunities for physical activity through amenities and natural surroundings. However, the distribution of UGS in cities is characterized by a notable inequality, resulting in pronounced health disparities. Understanding the patterns of unequal UGS distribution is crucial for urban planners to develop effective strategies that promote health equity among residents.

Methods

A physical activity promotion index was developed to assess the effectiveness of UGS components in promoting physical activity. Using this index, UGS were categorized into three groups: low, medium, and high quality. The accessibility of these categories was determined using an enhanced two step floating catchment area (2SFCA) method. Additionally, socioeconomic status (SES) scores were calculated for each plot based on education and income levels. Mann-Whitney U test was then employed to examine disparities in UGS accessibility among residents with varying SES.

Results

Firstly, areas surrounding the western and eastern second ring roads, as well as the northeastern part of the city, exhibited high accessibility to medium to high-quality UGS. In contrast, residents residing in the central and southern old urban areas only had high accessibility to low-quality UGS. Notably, certain locations in the northeastern suburbs lacked any UGS services. Secondly, substantial disparities were observed in the accessibility of the three UGS types between regions with high and low SES ($p<0.001$). This suggests that individuals with low SES face disadvantages in accessing UGS services.

Discussion

The research findings highlight a significant disparity in the accessibility of UGS, indicating a potential inequity in the benefits of promoting physical activity among residents. Firstly, individuals residing in the older urban areas face challenges in accessing UGS with adequate facilities and services. This may be attributed to urban planning practices that prioritize short-term gains and overlook the need for comprehensive internal amenities within UGS. Therefore, future planning efforts should focus on increasing UGS coverage in areas where accessibility is currently limited. Moreover, careful consideration should be given to the inclusion of diverse facilities that enhance the capacity of UGS to promote physical activity and public health. Secondly, individuals from low socioeconomic status backgrounds encounter greater difficulties in accessing UGS, thereby facing heightened public health risks. To address this issue, it is recommended to prioritize the expansion of UGS in low SES areas, ensuring equitable access to UGS-based physical activity promotion services across different SES groups. By doing so, the aim is to narrow the health disparities arising from SES differences.

THE PREVALENCE OF SEDENTARY BEHAVIOR AMONG UNIVERSITY STUDENTS LIVING IN 10 CITIES IN SAUDI ARABIA

ALAHMADI, M.

TAIBAH UNIVERSITY

Background:

A considerable body of research has demonstrated that reducing sitting time benefits health. Therefore, the current study aimed to explore the prevalence of sedentary behavior (SB) and its patterns in a large sample of university students living in 10 cities in Saudi Arabia.

METHODS: This study is an adult (aged between 18-35 years old), multi-city study, including 10 city-regions in Saudi Arabia. A total of 6975 university students (49.1% female) were chosen randomly to participate in a face-to-face interview. The original English version of the sedentary behavior questionnaire (SBQ) was previously translated into Arabic. Then, the validated Arabic version of the SBQ was used to assess SB. The Arabic SBQ included 9 types of SB (watching television, playing computer/video games, sitting while listening to music, sitting and talking on the phone, doing paperwork or office work, sitting and reading, playing a musical instrument, doing arts and crafts, and sitting and driving/riding in a car, bus or train) on weekdays and weekends.

RESULTS: SBQ indicated that the total time of SB was considerably high (478.75±256.60 and 535.86±316.53 (min/day) during weekdays and weekends, respectively). On average, participants spent the most time during the day doing office/paperwork (item number 4) during weekdays (112.47±111.11 min/day) and weekends (122.05±113.49 min/day), followed by sitting time in transportation (item number 9) during weekdays (78.95±83.25 min/day) and weekends (92.84±100.19 min/day). The average total sitting time of the SBQ was 495.09±247.38 (min/day) and 58.4% of the participants reported a high amount of sitting time (≥ 7 hours/day). Independent t-test showed significant differences (P≤0.05) between males and females in all types of SB except with doing office/paperwork (item number 4). The results also showed that male students have a longer daily sitting time (521.73±236.53 min/day) than females (467.38±255.28 min/day). Finally, 64.1% of the males reported a high amount of sitting time (≥ 7 hours/day) compared to females (52.3%).

CONCLUSION: In conclusion, the total mean length of SB in minutes per day for male and female university students was considerably high. About 58% of the population appeared to spend ≥7h/day sedentary. Male university students are likelier to sit longer than female students. Our findings also indicated that SB and physical activity interventions are needed to raise awareness of the importance of adopting an active lifestyle and reducing sitting time.

*Almasoud, K. Aljahani, A. Alzaman, N. Al Nozha, O. Alahmadi, O. Jalloun, R. Alfadhli, E. Alahmadi, J. Zuair, A. Alzahrani, N. Alahmdi, A. Alghamdi, M. Aldayel, A. Aljaloud, S. Alharbi, O. Al-Nuaim, A. Alshqaq, S. Alsaedi, B. Alrashidi, A. Alamri, O. Alshaikh, A. Al-Thumali, F. Alshdokhi, K. Bin Awn, A. Jifri, A. Aljuhani, O. Aljaloud, K. Al-Mudarra, M. Ansari, M. Al-Daghri, N.

GENDER DIFFERENCES AMONG UNIVERSITY STUDENTS WITH MODERATE-TO-VIGOROUS PHYSICAL ACTIVITY LEVEL AND PRE-TEST ANXIETY

WENBIN, D., HANTAO, K., DAN, L., CHENXI, X., YUKUN, S.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Female students tend to be exposed to higher pressure than male students due to physiological and psychological factors. The fierce competition in universities leads to a surge of academic pressure. Simultaneously, this pressure has led to severe test anxiety and a decline in moderate-to-vigorous physical activity (MVPA) levels. The aim of the study is to investigate the gender differences between the level of MVPA and test anxiety.

METHODS: A total of 131 undergraduate students (M = 59, F = 72) completed questionnaires the week before the final exam. MVPA was measured through the International Physical Activity Questionnaire (IPAQ). Test anxiety was evaluated by Sarason's Test Anxiety Scale (TAS).

RESULTS: A linear regression revealed a strong negative relationship between physical activity time and test anxiety both in male ($r = -0.26$, $p = 0.0072$) and female students ($r = -0.34$, $p = 0.042$). The unpaired t test showed there were significant gender differences in MVPA level ($P<0.0001$) and pre-test anxiety ($P<0.0001$). In addition, the proportion of moderate and high anxiety levels (TAS scores >12) among female college students (95.8%) is much higher than that among male college students (76.3%).

CONCLUSION: We found significant gender differences in physical activity level and pre-test anxiety among undergraduate students. Female students showed higher levels of anxiety. These results show a lack of physical activity and severe test anxiety problems in female university students. Additionally, universities should focus on the anxiety problems of female students and encourage female college students to engage in physical activities to reduce test anxiety.

Oral Presentations

OP-SH08 Sociology gender

BODY IMAGE, OVERWEIGHT WOMEN AND FITNESS: A COMPARATIVE STUDY OF SELF-PRESENTATION ON WESTERN AND CHINESE SOCIAL PLATFORMS WITHIN A FEMINIST FRAMEWORK

HUANG, L., BI, X., LI, Q.
BEIJING SPORT UNIVERSITY

INTRODUCTION

From challenging mainstream assumptions about womens physical abilities(Saguy, 2013, 2022), to embracing fitness as a feminist alternative politics(Markula, 2003; Markula & Pringle, 2006), active critical attitudes and self-stylized fitness actions have become hallmarks of overweight women, who are identified as fat activists to resist embodied oppression. In the digital age, young plus size women take their movements to the internet. Functioned as performers, as Goffman(1959) indicates, they express their identities through body images. This study focuses on (1) What types of bodies do overweight women who exercise self-present on digital platforms? (2) What are the differences in the self-presented fitness body images of overweight women in the West and China?

METHODS

To answer the questions, Instagram, an online social media platform and social network service for photograph and video sharing with more than two billion monthly active users(Eldridge,2024), and Xiaohongshu, a popular interactive platform for life sharing in China and highly sought after by young people(Han, 2023), were selected. Using a total of 91 bilingual keywords and a two-level social network snowball sampling method (Browne, 2005; He, Zhang & Su, 2022), 1442(Instagram) and 1497(Xiaohongshu) pieces of posts were crawled. Using content analysis method, after stratified sampling, two coders manually coded 200 posts.

RESULTS

Three fitness body images were found, namely victorious body, confrontational body and diverse body. By losing weight and overcoming underlying diseases associated with obesity, Chinese women(56%) are more likely to show their victorious bodies, while western women(44%) see weight loss as a journey. Compared with the women on the Xiaohongshu who show their struggle against obesity stigma, the women on Instagram are more willing to talk about healthy at every size. By using plog(Xiaohognshu) and text messages(Instagram), women on both platform record the training and diet plans, showing a positive attitude through fitness.

DISCUSSION

Sophistication digital technology has given fitness overweight women the possibility to demonstrate and echo feminism online. victorious body and confrontational body are online feedbacks of the traditional performance of feminism under fat activism; while diverse bodies are the conclusion of feminism from a critical perspective, showing new characteristics of digital citizenship.

RESEARCH ON GENDER EQUALITY IN SPORTS IN CHINA: EXAMINING THE TEN-YEAR EVOLUTION OF HIGH-LEVEL FEMALE RESEARCHERS, COACHES AND ATHLETES

BAI, Z., KIRK, D.
SHAOGUAN UNIVERSITY; UNIVERSITY OF STRATHCLYDE

Introduction

With the advance of the three waves of feminist movements, the discursive space for womens participation in sports has been broadened. China is a representative socialist country where the idea of gender equality has taken root. Sorting out Chinas socialist womens sports participation is of great significance to the development of womens sports in the world. This study examines high-level female sports researchers, coaches, and athletes in China over the past decade, aiming to gain a more comprehensive understanding of the changes in gender equality in Chinese sports and to enrichment of relevant research in the field.

Methods

We sampled journals run by the top five sports universities in China. Papers published in these journals in 2012 and 2023 were analyzed to collect data on the gender of the first author and the number of citations. Additionally, we collected gender data on coaches, athletes and gold medalists of the Chinese team at the 2012 and 2020 Olympic Games. Finally, SPSS25 was employed to statistically analyze the disparities among female sport researchers, coaches, athletes, and award-winning athletes from 2012 to 2023. The determination of citation counts was based on the consideration that highly cited literature constituted roughly 10% of the overall references.

Results

(1) In 2012 and 2023, the percentage of female first authors was 26.8% and 29.8% respectively, while the percentage of authors with high citation rates was 24.5% and 20.2% respectively, but none of them are significantly different. (2) In the 2012 and 2020 Olympics, the representation of female coaches comprised 15.9% and 24.2% respectively. The proportion

of female athletes was 56.8% and 69.1% respectively, an increase of 12.3%. The proportion of women winning gold medals was 53.8% and 65.8% respectively, an increase of 12%.

Discussion

The percentage of female first authors in Chinese sport research is much lower than the 41.6% in previous physical education research and similar to the 24.8% in sport medicine research. The underrepresentation of women, particularly in highly cited works, may be linked to social norms in China favoring male industry leaders and inadequate support for female leaders. The increase in the proportion of female participants and gold medalists is closely related to Chinas hosting of the 2008 Summer Olympics and the upcoming 2022 Winter Olympics in Beijing. These two Olympic Games have effectively promoted gender equality and empowered female athletes. It is evident that Chinese women have made significant advancements in the sports arena over the past decade. However, there is room for further improvement in terms of academic researchers and coaches, as women currently account for less than 30%. This disparity can be diminished by increasing the number of female leaders and implementing policies that favor gender equality.

DOES THE MENSTRUAL CYCLE REALLY AFFECT PARTICIPATION IN PHYSICAL ACTIVITY?

BROWN, N., FORREST, L.J., WILLIAMS, R., PIASECKI, J., BRUINVELS, G.

SWANSEA UNVERSITY

Research has revealed that a higher prevalence of physical inactivity exists amongst girls in almost all countries globally. Persistent low physical activity levels amongst adolescent girls constitutes a global public health concern that has called for immediate evidence-based action. One aspect specific for females that may influence participation is the menstrual cycle. Elite female athletes have reported reducing or missing training because of menstrual-related symptoms, yet little research has explored the influence of the menstrual cycle on participation in physical activity which could have much larger negative impacts on long term health and wellbeing in females. This study aimed to explore adolescent girls experiences of the menstrual cycle in relation to participation in physical education (PE) in school. To address the aim of the study, a qualitative descriptive study was conducted. Nine focus groups with female pupils were completed across six school locations in England and Wales, including primary and secondary schools. A range of elements relating to the menstrual cycle, school and PE were discussed by pupils, this included current PE preferences and personal experiences within 4 identified key themes. The first two days of the period was reported my pupils to most affect taking part in PE, this coincided with the type of physical activity prescribed by the teacher. Running and jumping, gymnastics and swimming were reported to be activities avoided during menstruation either due to discomfort of menstrual cramps or breast soreness, the requirement to insert a menstrual product or the fear of leaking. Whereas lower intensity activities or a choice of activity were requested to help improve participation and create positive life-long habits. Additional aspects such as teacher empathy and PE kit influenced participation. Schools can utilise information from the current study to support participation of girls during PE, providing choice of activity or lesson adjustments to help adolescent girls stay physically active and improve overall health and wellbeing. Providing resources and training to teachers, designed with the pupil voice captured in the present study is required.

ELITE ATHLETES AS PARENTS ON THE SPORT PAGES

HELLBORG, A.M.

MALMO UNIVERSITY

Being an elite athlete requires full commitment. Becoming and being a parent also requires commitment, so combing elite sports and parenthood can be difficult (Palmer & Leberman, 2009). Writings about the athletes, especially male athletes, as parents in the press are not new. However, the past 20 years it is an increased visibility in the press of women also having children in the middle of their sporting career (Dashper, 2018). So, what is the press writing when they write about elite athletes being parents? The aim of this research is to discuss and analyse the portrayal of parenthood among elite athletes in the sport pages.

The sport pages of the biggest morning paper in Sweden; Dagens Nyheter (Daily News) have been analysed. Material from the years 2019 and 2020 have been collected. Any article or notification that mentions elite athletes' children has been included. A discourse analysis has been used to highlight the writing and discuss the discourses that exist surrounding elite athletes and parenthood. The aim is that a discourse analysis will help to understand norms and culture in sport by focusing on the sport pages.

The results are that "pregnant" is a word that is frequently used and easy to understand and clearly indicate that something is changing for the athlete. Having a child also creates a "becoming", the construction of the parent is taking place, and this also causes change in the athlete's life, and career (?).The word "birth" is frequently used. This is a more detailed word, closer to the actual childbirth, and connects the women to (her) nature. This can also be said about the epithet "soccermother", where we may have a different understanding of a "soccermum", than a mother that is an elite athlete, since it is often used to describe mothers to sporting children.

Using the word "pregnant" is an easy way to inform, for example we understand that the woman will be unable to do sport during some part of this process. "Pregnant" is a common word to use to describe this situation. However, to use the word "birth", "giving birth" and other phrases with the word "birth" is not as necessary to describe a woman's situation, it is closer and more personal. An interpretation is that this is a way to connect women to nature and it positions women as biological creatures that are controlled by nature in contrast to controlling the body for elite sports. It is like women have

another biological level that triumphs their sporting ambitions. Women have often been viewed as more defined by nature then men have (de Beauvoir, 1949/2020), and this can be seen here as well.

References

de Beauvoir (1949/2010) The second sex. Vintage Books

Dashper (2018) Smiling assassins, brides-to-be and super mums: the importance of gender and celebrity in media framing of female athletes..., Sport in Society, 21:11, 1739-1757

Palmer & Leberman (2009) Elite athletes as mothers: Managing multiple identities, Sport Management Review, 12:4, 241-254

15:15 - 16:30

Invited Symposium

IS-PN07 The other side of physical activity coin: Exploring consequences of physical inactivity on various physiological systems

PERIPHERAL LIMITATIONS OF OXIDATIVE METABOLISM DURING VARIOUS FORMS OF INACTIVITY IN YOUNG AND ELDERLY: BIOMARKERS OF FUNCTIONAL IMPAIRMENTS

ZUCCARELLI, L.

NATIONAL RESEARCH COUNCIL

Oxidative metabolism represents the main energy source for activities in everyday life. Functional evaluation of oxidative metabolism during exercise provides important information on the physiological responses required by the cardiovascular and respiratory systems to meet the skeletal muscle metabolic demand. Whereas cardiovascular impairments associated with (or responsible for) the decreased peak oxygen uptake (VO2peak) during inactivity have been described, more peripheral impairments have been relatively less investigated. Over the last 15 years, new exciting evidence has been published regarding the impairment of skeletal muscle oxidative metabolism during conditions of drastic physical activity reduction (i.e., bed rest interventions). In this presentation, Dr. Lucrezia Zuccarelli will focus on the localisation of the main site(s) of impairment in oxidative metabolism during exercise following inactivity along the O2 pathway from the ambient air to skeletal muscle mitochondria, with a particular interest in the peripheral level. Biomarkers of impairment related to peripheral vascular and endothelial function, the intramuscular matching between O2 delivery and O2 uptake and mitochondrial function during exercise in young and elderly will be presented. A refinement of available tools and methods aimed at enhancing oxidative metabolism and improving aerobic performance would allow to increase the general quality of life of both healthy people and patients. This concept, besides being of interest from a basic science point of view, may be of interest also for other pathological conditions characterized by relatively short periods of profound inactivity, and it could affect the definition of countermeasures rather than rehabilitative interventions.

IMPACT OF PHYSICAL INACTIVITY ON THE NEUROMUSCULAR SYSTEM: A JOURNEY WITH FEW STEPS BUT MANY TURNS

SARTO, F.

UNIVERSITY OF PADOVA

Periods of disuse lead to rapid and marked decreases in muscle mass and force. Interestingly, the reported loss of muscle function largely exceeds that of muscle size, suggesting an impairment in the intrinsic capacity of muscle force production. Although a clear and exhaustive explanation of this phenomenon is still lacking, there is growing evidence that neuromuscular impairment may be a key player in this scenario. In this presentation, Dr. Fabio Sarto will present published and unpublished data that provide new insights into the muscle morphological, functional, electrophysiological and molecular alterations across different experimental models of physical inactivity. Evidence that will be presented unequivocally shows that even brief periods of disuse induce initial signs of myofibre denervation, impairment of excitation-contraction coupling, neuromuscular junction instability, axonal damage and downregulation of skeletal muscle ion channels genes. Furthermore, it will be discussed how alterations in motor unit properties, such as elevated number of turns (reflecting increased motor unit potential complexity) and decreased motoneuron firing rate, have been identified in different studies leveraging gold-standard electromyographic techniques. The differential adaptations of young and older adults in response to muscle disuse will be discussed. Finally, the reversibility of these neuromuscular changes with subsequent retraining periods based on resistance exercises will also be explored.

THE CONSEQUENCES OF PROLONGED PHYSICAL INACTIVITY ON THE BRAIN

MARUSIC, U.

SCIENCE AND RESEARCH CENTRE KOPER

Brain plasticity, also known as neuroplasticity, highlights the brains remarkable ability to adapt and reconfigure itself in response to different experiences, with physical activity being a well-researched factor in this process. However, neuro-

science has paid comparatively little attention to the consequences of prolonged inactivity on the central nervous system. Research on bed rest studies has shed light on the functional decline observed in both young and older adults following extended periods of physical inactivity, yet the underlying neural mechanisms remain elusive. In this presentation, Dr. Uros Marusic will present the latest findings from studies with 10 and 21 days of bed rest in young and older adults. In these studies, high-density electroencephalography was used to investigate sensorimotor processes. The assessment includes both static measures, such as visual-evoked potentials and motor-related cortical potentials, and dynamic assessments of functional performance before and after bed rest using Mobile Brain/Body Imaging technology, which provides a comprehensive insight into the neural changes associated with prolonged physical inactivity.

Invited Symposium

IS-MH10 Searching for the holy grail: understanding women's soccer for performance and injury prevention

A HOLISTIC APPROACH TO UNDERSTANDING MATCH DEMANDS IN WOMEN'S SOCCER

HARKNESS-ARMSTRONG, A.
THE FOOTBALL ASSOCIATION

Fédération Internationale de Football Association (FIFA) has described womens football as the leading opportunity for growth in football (FIFA, 2021). Indeed, womens football has witnessed substantial growth in participation, investment, and research in recent years as key stakeholders attempt to develop the sport at both grassroots and elite levels (Harkness-Armstrong et al., 2022). An important area of research activity has been understanding the match demands which players experience as this appears important for informing training practice design. Most research to date has focused on senior match-play with only ~10% of studies considering youth players. Data shows that senior players cover 9-11 km per match, with approximately one quarter of total distance covered at high-speed (Scott et al., 2020). The physical demands of the womens game continue to evolve, with teams covering ~30% more distance in the highest speed zone (> 23 km.h-1) in the 2019 FIFA Womens World Cup compared to the 2015 edition (FIFA, 2019). Whilst there is a growing literature base citing the physical match demands of womens soccer, there is a lack of evidence considering a more holistic approach which also evaluates the tactical and technical demands and their interaction with the physical dimension. Running with the ball requires an additional energy cost (Piras et al., 2017) and consequently an integrated approach to match analysis should be considered.

IT'S TIME TO PLAY BUT IT'S THE TIME OF THE MONTH - EXPLORING MENSTRUAL CYCLE, PERFORMANCE AND INJURY RISK

ROSS, J.
UNIVERSITY OF MUNSTER

Over the last few years, research in female football has exponentially increased, primarily, on the physical demands and characteristics of female football. Nevertheless, female specific physiology is often not considered. There are proposed associations between key hormones of the menstrual cycle and physiological function (Constantini et al., 2005). It remains relatively unknown whether the menstrual cycle may affect peak physical performance in football players. Recent studies have investigated the effects of the menstrual cycle in controlled settings. Dos Santos Andrade et al. (2017) found reduced hamstring-to-quadriceps strength ratio during the follicular phase. While, Julian et al. (2017) suggested that intermittent endurance may be influenced during the luteal phase. Football matches are won and lost on the pitch, therefore, understanding potential limitations during competitive matches is of great importance. Recent findings suggest that menstrual cycle phase does not contribute largely to the changes in physical performance, in comparison to the effects of general match variation (Julian et al., under review). Consequently, interventions or other methods of coping with menstrual cycle phase do not seem necessary to maximise competitive physical performance. Taken collectively, this information could help inform scientific practice in the applied setting, whilst also assisting scientific research of the importance of considering female specific physiology.

UNDERSTANDING THE INJURY RISK PUZZLE: BUILDING THE ROBUST FEMALE SOCCER PLAYER

DE STE CROIX, M.
UNIVERSITY OF GLOUCESTERSHIRE

Given the increased relative risk of injury in female players it is important to understand how screening might be able to help in developing appropriate injury risk management and performance related programmes. Given the complex puzzle that underpins injury incidence, risk management strategies need to take into account a range of complex factors in the female soccer player. Machine learning has allowed us to explore this puzzle with greater certainty and provided us with more robust intervention programmes. This talk will focus on work with female soccer players across the age groups looking at identifying risk and exploring the effectiveness of intervention programmes designed to reduce injury risk. Data will be drawn from studies funded by both FIFA and UEFA as well as work funded by the English Football Association. This session will be relevant for anyone working within a multi-disciplinary team with female soccer players, especially those who have a remit for conditioning, and readiness.

Oral Presentations

OP-BM18 Footwear

FOOT BIOMECHANICS IN TRAIL RUNNING: PROOF-OF-CONCEPT FOR A QUALITATIVE FIELD STUDY

MORIO, C., DIVRECHY, G., DURAFFOURG, S.
DECATHLON SPORTSLAB

INTRODUCTION: This study introduces a lab-on-the-field approach to analyze the biomechanics of foot positioning during trail running. To overcome the inherent limitations of traditional laboratory-based assessments while recording high-quality data, we moved traditional lab equipment directly onto the field.

METHODS: We instrumented a 25-meter-long outdoor dirt track with a slope of 21% with a large Kistler force plate and 6 Oqus300 Qualisys cameras. Five recreational trail runners (180.6±1.3cm, 74±9.5kg) wore standard trail running shoes (Evadict MT2 2021) with holes cut in the upper for retroreflective markers. An additional in-shoe Pedar plantar pressure system was used. After a 10-minute warm-up, participants walked (W) and ran (R) up (U) and down (D) the 25m slope until 5 valid trials of each locomotion (WU, WD, RU, RD) were recorded. They were asked to walk and run at a comfortable speed. Weather conditions during the data collection. This implies that the kinematics data quality was poor due to mud that obstructed some foot markers. However, the present experiment gives the possibility to examine the mapping of the local constraint applied to the shoe. First, we determined force distribution applied by the foot to the shoe thanks to instrumented insoles. Then, we modified the plantar pressure intensity thanks to the force plate normal data. Finally, we interpreted the tangential force on the foot by using the relative plantar pressure distribution applied to the mediolateral and anteroposterior axes of the force plate. The axis of the insole relative to the force plate was corrected through available kinetic data of the foot.

RESULTS: Both WD and RD presented impact peaks associated with rearfoot strike patterns whereas WU and RU did not show any impact peak. During WU, the higher constraints were localized under the 1st and 2nd metatarsal bones and the hallux with the local force vectors pointing backward. During RU, the higher constraints were localized under the th 1rst and 2nd metatarsal bones with relatively less pressure under the hallux with the local force vectors pointing backward and slightly laterally. During WD, the majority of the constraints were localized under the rearfoot with the local force vectors pointing forward. During RD, the pressure distribution was similar to WD with additional pressure under the forefoot with forefoot local force vectors pointing forward and medially.

CONCLUSION: Although the kinematic data were not available, the present results are of great interest for grip shoe design. We also proved the feasibility of measuring outdoor in-ground reaction force and plantar pressure in a trail-running-like environment and combined them to get relevant data for shoe design. Thus, the special and simple set-up to secure and embed the force plate into the ground while safely measuring force under all weather conditions might be of interest to other research teams.

THE INFLUENCE OF FOOTWEAR AND RUNNING SURFACE ON FOOT-STRIKE PATTERN AND INTUITIVE RUNNING SPEED: A PILOT STUDY

SIOW, J.W., FITZPATRICK, P., SCHOFIELD, G., FRANCIS, P.
SOUTH EAST TECHNOLOGICAL UNIVERSITY CARLOW

INTRODUCTION: Footwear, surface and running intensity are all known to influence the foot-strike pattern adopted when running (Lieberman et al., 2015). Studies comparing foot-strike patterns in shod and barefoot runners often use a common intensity (Cheung et al., 2017) and or a common surface (Lai et al., 2020). To the best of our knowledge, there has not been a study which observes runner's intuitive running speed and foot-strike pattern at a variety of intensities and on different surfaces whilst shod and barefoot. A study like this, may shed light on how runners self-regulate speed and foot strike at varying intensities and in various footwear-surface conditions. The aim of this study was to measure runner's intuitive running speed and foot-strike pattern when asked to run at a variety of intensities (according to rate of perceived exertion; RPE) on two different surfaces (Firm, track and Soft, grass) whilst shod and barefoot.

METHODS: Five recreationally trained long distance runners (males, n=3; females, n=2; age=50.8±16.4years; height=173.8±4.6m; weight=75.97±12.03kg) were recruited for this pilot study. This study consisted of four sessions with a 1-week wash out period in between. In each session, participants commenced with a 6-minute warm up of light intensity (RPE 11) shod running on the tartan track and were given a 3-minute rest before completing all four footwear-surface conditions. Participants were randomly assigned to one of four conditions in order to limit the order effect. The four conditions were: shod on track, barefoot on track, shod on grass and barefoot on grass. Each condition lasted 3 minutes and a 3-minute rest was given in between each condition. Participants were instructed to pace their running speed corresponding to the given RPE level on the day of visit (Day 1, RPE 11; Day 2, RPE 13; Day 3, RPE 15; Day 4, RPE 17). Distance covered and foot-strike pattern were recorded during each trial. Speed was calculated from distance covered divided by three minutes (Speed = Distance ÷ Time). Differences in foot-strike count were calculated in relative percentages (%). Each participant generated 16 data sets (4 conditions, 4 intensities) meaning data presented comes from 80 data sets in total.

RESULTS: Runners ran furthest whilst shod on the tartan track (RPE 11, 2.89±0.31m/s; RPE 13, 3.41±0.21m/s; RPE 15, 3.58±0.24m/s; RPE 17, 3.77±0.31m/s). There was a higher prevalence of rear-foot strike count (~89%) when shod regard-

less of the surface or running intensity used. There was a tendency toward increased mid-foot strike count when running barefoot (~47%) and this increased further when running barefoot on the track (~61%).

CONCLUSION: This pilot study reports greater variance in the foot-strike pattern adopted by runners when running barefoot. This may be due to greater sensitivity to sensory stimuli as surface and or running intensity changes in the barefoot condition. These findings should be interpreted cognisant of the small sample (n=5) used in this pilot study.

STEPPING INTO THE FUTURE: UNVEILING BIOMECHANICAL INNOVATIONS IN 3D PRINTED FOOTWEAR DESIGN

LU, Z., XIN, L., HAIRONG, C., QIAOLIN, Z., GUSZTÁV, F., ANDRÁS, K., YAODONG, G.
UNIVERSITY OF PANNONIA

INTRODUCTION: The three-dimensional (3D) printing technology, developed over the past 40 years since its invention in the 1980s, has found extensive applications across various manufacturing industries. Its distinctive customization and flexibility hold the potential to overcome traditional design constraints, garnering significant attention in the creation of personalized footwear. Despite lower initial awareness among early industries and consumers, recent research, utilizing advanced techniques, delves into the biomechanical performance of 3D-printed footwear, offering renewed hope. This review explores the progress of 3D printing technology in the footwear manufacturing sector from a biomechanical perspective. The research primarily focuses on the performance of 3D-printed footwear in terms of sports injuries, comfort, and athletic performance. Despite existing limitations, an in-depth exploration of the potential of 3D printing technology in the footwear manufacturing domain is expected to provide new insights and momentum for future development.

METHODS: This systematic review was conducted in accordance with the recommendations outlined in the Joanna Briggs Institute (JBI) Reviewers Manual and the PRISMA 2020 guidelines. A fuzzy literature search was performed on October 4, 2023, using the search terms ("3D print" OR "additive manufacture") AND ("shoe" OR "footwear" OR "insole" OR "midsole" OR "sole") across the Web of Science, PubMed, and Scopus databases. Methodological quality assessment was performed using the quantitative evaluation tool developed by Kmet.

RESULTS: After retrieving 1671 articles, an additional 14 articles were identified through citation analysis. Ultimately, 23 studies were included in the comprehensive review. The primary reason for low-quality scores was the failure to report the use of blinding, randomization, and incomplete control of confounding factors. Overall, the majority of studies observed superior performance of 3D printed products in terms of sports injuries, comfort, and athletic performance. However, a minority of studies suggested that in certain indicators, these products may not surpass traditional counterparts.

CONCLUSION: Despite controversies surrounding midfoot pressure distribution and comfort, 3D printing technology has the capability to manufacture footwear that meets individual needs. This includes reducing pressure and impact, enhancing motion control performance, and improving gait stability. The comfort of 3D printed footwear, particularly those designed based on plantar pressure, has demonstrated positive outcomes in the medium to long term, with potential advantages observed in running and jumping activities. Future research should fully leverage technological advantages, integrating advanced machine learning algorithms and finite element analysis techniques. Addressing deficiencies in research design is imperative, and there is a need to promote hypothesis-driven studies in the field.

EFFECTS OF RUNNING SHOES WITH DIFFERENT LONGITUDE BENDING STIFFNESS AND DIFFERENT POSITIVE ANGLE SLOPES ON RUNNING ECONOMY AND KINEMATICS

WANG, Q.
TSINGHUA UNIVERSITY

INTRODUCTION: Compared to conventional racing shoes, carbon-fiber plated shoes reduce the metabolic cost and improve the running economy (RE) during level running. The inclusion of a carbon-fiber plate in the midsole increases the longitudinal bending stiffness of running shoes. Additionally, increasing the plate's stiffness within an appropriate range can further enhance RE. However, the effect of slope on this difference is unknown. This study investigated the RE and kinematics of three racing shoes with varying stiffness levels across three positive angle slopes to predict the ideal longitudinal stiffness for different inclines.

METHODS: Twelve long-distance runners performed nine 3-min trails (3 shoes £ 3 grades) in three running shoes with different stiffness on three positive angle slopes (8%, 5%, 0%) . The runners maintained a relatively constant speed equivalent to 55% of their individually tested maximum speed under each trail. We measured the gas metabolism and kinematic indexes during the steady state of each trail, and calculated running economy (ml/kg/min) for each model and grade combination.Two-way RM ANOVAs and Post-LSD paired tests were performed.

RESULTS: Running economy, contact time and flight time were affected by slope ($P<0.001$, $P=0.008$, $P=0.024$). Post-hoc procedures determined that oxygen consumption was notably higher at 8% slope compared to both 5% and 0% slopes. The contact time and flight time respectively reduced 27.61ms and 16.02ms at 8% slope versus 0%. And it was found that at 8% slope, low-stiffness running shoes had lower running economy ($P=0.021$), longer contact time ($P=0.039$), and shorter flight time ($P=0.045$) than medium-stiffness running shoes. However, there was no significant difference in the interaction terms between slope and longitude bending stiffness of running shoes in either index ($P>0.05$).

CONCLUSION: Running economy decreases with increasing slope, and is accompanied by a decrease in contact time and flight time. At 8% slope, the running economy of low-stiffness running shoes may be worse than medium-stiffness running shoes. However, across different positive angle slopes, variations in shoes longitude bending stiffness show no

significant difference in running economy and related kinematics. Therefore, its inconclusive to predict the optimal stiffness for different slopes.

Oral Presentations

OP-BM22 Neuromuscular Physiology IV

SPINAL AND SUPRASPINAL MOTOR CONTROL DURING DYNAMIC BALANCE PERTURBATION IN MEN AND WOMEN

PIIRAINEN, J., POHJONEN, H., NEVANPERÄ, S., PIITULAINEN, H., MIKKONEN, R.
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Motor control occurs at spinal and supraspinal levels, which can be assessed using H-reflex and V-wave/TMS techniques, respectively. Sex related differences in motor control are contradictory and have previously been studied mainly at rest or in isometric conditions (e.g. 1, 2). In terms of daily activity, it is important to investigate the possible differences in dynamic conditions. The objective of this study was to determine potential sex differences in spinal and/or supraspinal motor control during dynamic balance perturbation. In addition, the relationship between neural and balance control responses was evaluated.

METHODS: A total of 16 participants (8 male, 8 female) between 30 and 45 years of age, were recruited. The measurement protocol included familiarization on dynamic balance exercises, maximal isometric plantar flexion (MVC) and rate of force development (RFD) measurements, and a dynamic balance perturbation test. For the balance perturbations, eight forward and eight backward perturbations were randomly generated in each set (a total of 9 sets) using a balance perturbation device (3). H-reflex and V-wave responses (normalized with maximal M-wave) were measured from soleus muscle at four different delays (30, 70, 100, 130 ms) from the onset of the perturbation. Additionally, center of pressure (COP) displacement and velocity were measured during the plate movement.

RESULTS: Men exhibited higher values in MVC ($p<0.001$) and RFD ($p<0.001$), whereas women demonstrated higher values in COP displacement ($p<0.001$) and COP velocity ($p=0.002$) during the perturbations. No sex differences were observed in V-wave responses during MVC. A significant correlation was observed between MVC and COP displacement ($r=-0.811$, $n=12$, $p< 0.001$) and between RFD and COP velocity ($r=-0.783$, $n=12$, $p=0.003$). In neural responses, V-wave at 130 ms post-onset, correlated negatively with both COP displacement ($r=-0.678$, $n=12$, $p=0.015$) and COP velocity ($r=-0.657$, $n=12$, $p=0.02$). In addition, 130 ms post-onset V-wave/H-reflex-ratio correlated negatively with COP displacement ($r=-0.685$, $n=12$, $p=0.014$) and COP velocity ($r=-0.608$, $n=12$, $p=0.036$).

CONCLUSION: Men demonstrated enhanced supraspinal (voluntary) control during the perturbation which was correlated with more efficient balance control. This may be more related to different control strategies since no sex differences were observed in V-wave responses during MVC. In addition, no difference was observed in spinal control, and there was also no correlation found between spinal control and balance control. However, we did not control the phase of the menstrual cycle which might affect the women´s neural responses and should be studied in future.

REFERENCES:

1) Hoffman et al., Neuroreport, 2018

2) Mendonca et al., Exp Physiol, 2020

3) Nevanperä et al., Exp Brain Res, 2023

SEX DIFFERENCES IN MOTOR UNIT BEHAVIOR IN YOUNG, MIDDLE-AGED AND OLD ADULTS DURING MODERATE ISOMETRIC CONTRACTIONS

CARBONARO, M., BOCCARDO, M., BRUSCO MÜLLER, C., LAURETANI, F., PORCELLI, S., FRANCHI, M.V., BOTTER, A.
POLITECNICO DI TORINO

INTRODUCTION: Aging is a physiological and morphological process characterized by a progressive loss of muscle mass, strength, and power accompanied by a decline in neuromuscular function [1]. Age-related adaptations affect the muscles structural characteristics and neural control [2, 3]. Regarding neural changes, lower motor unit (MU) discharge rates, and increased variability of MU discharges were previously reported in old with respect to young adults [4]. Furthermore, it was observed that the firing rate of early-recruited MUs increases to a lesser extent in old people during increasing force contractions [4]. It is worth noting that current knowledge on MU firing properties in aging is mainly based on studies performed on male populations [5]. Considering the evidence of sex differences in MU behavior [5] and the aging process [6], differentiating the analysis between the two sexes may provide additional insights to understand age-related adaptations better. In this study, we analyzed sex differences in MU recruitment and firing properties in young, middle-aged, and old adults.

METHODS: Thirty middle-aged (MA) adults (15 females, 59±9 years), twenty-eight old (OLD) adults (12 females, 76±4 years), and ten young (YG) as control group (5 females, 26±2 years) were recruited. High-density electromyographic (HDEMG) signals were recorded from the VL muscle using a grid of 64 channels during isometric ramp contractions from 0 to 30% and 50% of the maximum voluntary contraction (MVC) with slow force increase (2% MVC/s). The MUs obtained from

HDEMG decomposition were grouped according to their recruitment thresholds in steps of 10% MVC (0-10%, 10-20%, etc.). Changes in MU firing properties were compared between age groups and sexes.

RESULTS: An average of 10±3, 8±3, and 9±3 MUs were analyzed for each subject of YG, MA, and OLD groups, respectively. The mean firing rates of all the MUs recruited were significantly lower ($p<0.001$) in OLD (9.3±1.5 pps at 30% MVC and 10.1±1.8 pps at 50% MVC) with respect to YG (10.3±1.6 pps at 30% MVC and 11.4±1.5 pps at 50% MVC), and MA (10.2±1.9 pps at 30% MVC and 11.2±2.3 pps at 50% MVC). When compared to males of the same age group, females showed higher firing rates in YG (+11.7%, $p<0.001$) and MA (+8.9%, $p<0.001$) but not OLD (+2.9%, $p=0.60$). In comparison to YG and MA, the MU firing rates of the OLD group increased to a lesser extent with the force increase. Interestingly, this behavior was significantly more pronounced in the female subgroup (i.e. lower firing rate modulation with force increase).

CONCLUSION: Although preliminary, the observed differences in the firing behavior between sexes and age groups indicate that the trajectory of neuromuscular aging could differentiate between males and females, emphasizing the significance of accounting for sex in aging studies.

References

1. Tieland M. et al. (2018) 2. Narici M. V et al. (2003) 3. Roos M. R. et al. (1997) 4. Watanabe K. et al. (2016) 5. Lulic-Kuryllo T. et al.(2022) 6. Hägg S. et al. (20

EXCITABILITY AND PLASTICITY OF THE MOTOR CORTEX ACROSS THE MENSTRUAL CYCLE

SPILLANE, P., PASTORIO, E., GOODALL, S., HICKS, K.M., ANSDELL, P.

NORTHUMBRIA UNIVERSITY

INTRODUCTION: Concentrations of ovarian hormones fluctuate across the eumenorrheic menstrual cycle, which contribute to modulations in cortical excitability (1) and inhibition (2). Oestrogens have an excitatory effect, whilst progesterone has an inhibitory effect within the motor pathway (3). However, it is unknown how such changes affect nervous system adaptation (neuroplasticity), which has the potential to improve functional capacity in health and disease (4). The aim of this study was to determine the effect of the menstrual cycle on motor cortical excitability and plasticity.

METHODS: Data is presented for four of the seventeen female participants who have completed testing so far (age 25 ± 3 years). Participants reported a regular menstrual cycle (≥21 & ≤35 days) and no hormonal contraceptive use over the previous 6 months. After familiarisation, participants visited the lab in three phases of the menstrual cycle: early follicular (EF), late follicular (LF), and mid luteal (ML). One menstrual cycle was tracked with calendar counting and urine ovulation testing prior to data collection, which was repeated with additional blood samples to confirm hormone concentrations during the tested cycle(s).

During each visit, participants received transcranial magnetic stimulation (TMS) and percutaneous nerve stimulation at baseline to quantify corticospinal excitability (MEP), short-intracortical inhibition (SICI), intracortical facilitation (ICF), and sarcolemmal excitability (Mmax). This was followed by a paired associative stimulation (PAS) protocol of median nerve (300% perceptual threshold) and TMS (120% resting motor threshold [rMT], 25 ms interstimulus interval, 200 pairs at 0.25 Hz) to assess neuroplasticity. Baseline assessments were repeated immediately, 15, and 30 minutes after the PAS protocol.

RESULTS: rMT (50 ± 10, 50 ± 11, 51 ± 10 %MSO) and MEP amplitude (7.8 ± 4.8, 8.7 ± 6.5, 9.1 ± 3.3 %Mmax) remained consistent across phases, for EF, LF and ML, respectively. SICI induced inhibition (46.5 ± 31.0, 46.1 ± 12.5, 54.9 ± 35.8 %unconditioned MEP) and ICF induced facilitation in all phases (172.9 ± 47.86, 178.9 ± 45.8, 158.2 ± 10.5 %unconditioned MEP). PAS elicited an increase in excitability in all phases with a ΔMEP of 164 ± 95, 147 ± 27, 106 ± 42 %baseline. Given the low sample size at present, phase effects were not detected for any variables ($p>0.454$).

CONCLUSION: While caution should be taken interpreting this incomplete sample, baseline measures suggest a possible influence of the menstrual cycle on cortical neurotransmission. PAS elicited neuroplasticity in all phases but was lowest during the ML phase, suggestive of an inhibitory effect of progesterone, which has implications for functional capacity in health and disease.

1) Smith et al., Ann Neurol, 2002

2) Ansdell et al., J Appl Physiol, 2019

3) Piasecki et al., Exerc Sport Sci Rev, 2024

4) Suppa et al, Clin Neurophysiol, 2017

INTERHEMISPHERIC INHIBITION AND REACTION TIME: AGONIST VERSUS ANTAGONIST CO-CONTRACTION EFFECTS IN FDI MUSCLE

TAPSELL, L., LATELLA, C., BLAZEVICH, A.J., TAYLOR, J.L.

EDITH COWAN UNIVERSITY

INTRODUCTION: Interhemispheric inhibition (IHI) is a process in which activity from a muscle's M1 representation reduces activity of the contralateral area. For biceps brachii, IHI was reported as greater during contraction of the contralateral agonist (homologous) muscle than the antagonist (Perez et al., 2014). We postulated that greater IHI may influence preparation for voluntary movement by impeding the premovement build up in motor cortical activation, prolonging reaction

time. This study aimed to determine whether changes in IHI associated with agonist or antagonist contralateral contraction influenced reaction time.

METHODS: Fifteen participants completed two experimental sessions. In both sessions, participants completed reaction time (RT) trials to auditory stimuli by transiently abducting the left index finger against a force transducer either during right index finger abduction (90 trials of contralateral agonist contraction), or during right index finger adduction (90 trials of contralateral antagonist contraction). In session 2, single and paired pulse transcranial magnetic stimulation (TMS) was also applied in the premovement period to elicit motor evoked potentials (MEPs) from left first dorsal interosseous (FDI) to assess short- (SIHI) and long-interval (LIHI) IHI in 60 of the RT trials (10 and 40 ms interstimulus interval, respectively). RTs were calculated from non-TMS trials. IHI was expressed as (1-paired pulse MEP/single pulse MEP) x 100. Linear mixed models were used to compare SIHI, LIHI and RT between right abduction and adduction of session 2.

RESULTS: Right index finger abduction resulted in significantly less SIHI (23.4±42.0%; mean±SD) than adduction (36.9±30.6%, p<0.001), though LIHI was unaffected (p=0.321). RT of left abduction was significantly faster (p<0.001, d=0.31) during right abduction (139 ± 27 ms) than right adduction (148 ± 30 ms).

CONCLUSION: Contrary to previous reports in more proximal muscle (biceps brachii), the FDI experienced stronger IHI during contralateral antagonist muscle contractions than during agonist contractions. The latter, with lower SIHI, displayed faster RTs. This study provides novel evidence that IHI toward a muscle may modulate its RT. It demonstrates a role for IHI in coordinating interlimb movements and informs the development of IHI-targeted interventions in motor rehabilitation.

Perez, M. A., Butler, J. E., & Taylor, J. L. (2014). Modulation of transcallosal inhibition by bilateral activation of agonist and antagonist proximal arm muscles. Journal of Neurophysiology, 111(2), 405–414. https://doi.org/10.1152/jn.00322.2013

LOAD-DEPENDENT CHANGES IN THE LATERAL GASTROCNEMIUS MOTOR UNIT FIRING PROPERTIES IN INDIVIDUALS WITH NON-INSERTIONAL ACHILLES TENDINOPATHY.

CONTRERAS, I., ARVANITIDIS, M., FALLA, D., NEGRO, F., MARTINEZ-VALDES, E.
UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Non-insertional Achilles tendinopathy (NIAT) is a common debilitating tendon disorder characterised by an insidious onset of pain accompanied by swelling, stiffness and thickening in the mid-portion of the Achilles tendon (AT). The aetiology of the NIAT remains debated; however, excessive tendon loading is considered a fundamental causative factor. Recent evidence suggests that the triceps surae muscle may influence the magnitude and distribution of the AT load, stress and strain. Consequently, it has been proposed that asymmetrical load transmission to the AT may play an essential role in the development of this condition. This study investigates the triceps surae motor unit firing parameters in individuals with NIAT compared to controls at low, intermediate, and high force levels.

METHODS: Twenty-five healthy (17 males, 8 females, 28.60 ± 3.92 years) and twenty-six participants with NIAT (14 males, 12 females, 29.04 ± 8.46 years) participated in the study. Motor unit firing parameters of the medial gastrocnemius (MG), lateral gastrocnemius (LG), and soleus (SO) muscles were assessed using high-density surface electromyography (HD-sEMG) during isometric plantarflexion contractions at 10%, 40%, and 70% of the maximal voluntary contraction (MVC). EMG signals were decomposed into individual motor unit spike trains by convolutive blind source separation. Motor unit firing rate parameters were compared using a linear mixed-effect model with fixed effect group (control, NIAT), muscle (MG, LG, and SO), torque (10%, 40%, and 70% MVC), and random effect subjects.

RESULTS: Linear mixed-effect model analysis showed that the DR of the LG increased (P=0.002), and the derecruitment threshold of the LG decreased (P=0.04) in the NIAT group compared to the control group at 70% MVC. Additionally, the cross-correlation coefficient (between the cumulative spike train and torque) of the LG decreased at 10% MVC (P<0.0001) and increased at 70% MVC (P=0.013) in the NIAT group compared to the control group.

CONCLUSION: Our findings demonstrate that individuals with NIAT have load-dependent changes in the LG motor unit firing rate parameters, affecting the contribution of the LG to the net plantarflexion force. These results provide additional evidence of the central role of asymmetrical load transmission on the pathophysiology of NIAT.

Oral Presentations

OP-BM09 Jumping and squatting

NEUROMECHANICAL STRATEGIES FOR LONGER FORWARD JUMPS: A MUSCLE SYNERGY ANALYSIS OF SINGLE LEG HOPS

SAITO, H., YAMANO, A., SUZUKI, N., MATSUSHITA, K., YOKOYAMA, H., JOACHIM, V.C., NAKAZAWA, K.
TOKYO UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Single leg hops (SLH) are a vital measure for evaluating the readiness of athletes to return to sports post-injury. The efficacy of SLH is based on its indication of adequate lower limb movement and stability, which is essential for a variety of sports activities. This study investigated the differences in muscle synergies in trunk and lower limbs during SLH at 30% (SLH30) and 100% (SLH100) of maximum distance to understand the neuromechanical mechanisms underlying the high performance of SLH.

METHODS: Ten healthy males were recruited for the study. During the SLH30 and SLH100 tests, unilateral surface EMG data were collected from 15 muscle groups in the trunk and lower limbs. Non-negative matrix factorization (NMF) was employed to extract the muscle synergies.

RESULTS: The number of muscle synergies observed in SLH100 was significantly higher than in SLH30 ($p = 0.0078$, effect size = 1.28). Median values were 4.0 (3.0 – 5.0) for SLH30 and 5.0 (4.0 – 6.0) for SLH100. The cluster analysis identified four muscle synergies shared between SLH30 and SLH100, with a distinct non-knee related synergy emerging in SLH100.

CONCLUSION: Interventions targeting SLH performance should consider muscles linked to the synergy specific to SLH100, especially in individuals with sports-related injuries. Shared synergies between SLH30 and SLH100 represent a foundational neuromuscular control strategy, while a distinct synergy exclusive to SLH100 plays a role in facilitating longer single-leg hops. The synergy specific to SLH100 represents the neuromechanical output for extended forward jumps. However, the presence of a distinct synergy in SLH100, associated with non-knee muscles, suggests potential limitations of SLH in evaluating knee-specific functions.

THREE-DIMENSIONAL ANALYSIS OF FOOT ARCH DYNAMICS DURING JUMP PERFORMANCE.

KOYAMA, K., YAMAUCHI, J.

TOIN UNIVERSITY OF YOKOHAMA

INTRODUCTION: The human foot arch could have a function to utilize elastic energy from a muscle and tendon complex during bipedal locomotion. During running and jumping, foot arches store and release elastic energy when they compress and reform. This stretch-shortening process increases mechanical energy and improve physical performance. Also, the force generating capacity of the foot increases when the foot arch height decreases due to loading. We suggest that the force amplification mechanism is mechanically regulated by the dynamic function of the foot arch in conjunction with the stretching of a muscle and tendon complex of the foot. These functions of the foot could play an important role in enhancing the initiation of jump performance. Indeed, we showed that toe flexor strength was required for the force reacting on the ground during the jump performance while the foot arch function might help to potentiate energy in a countermovement jump (Yamauchi and Koyama, 2020). However, there have been no studies addressing how the dynamic function of the foot arch affects the muscles that generate force during the ground contact phase in the jump performance. The aim of this study was to use kinetic and kinematic motion analysis to examine how changes in the foot arch with increased vertical force affect the jump performance in drop jumping.

METHODS: Twenty-six subjects performed drop jumping from a box of 45-cm hight under the barefoot condition. Vertical ground reaction force (GRF) was measured on a force plate on a right foot during the contact phase of a drop jump, and GRF valuables were calculated. Three-dimensional position data of retroreflective markers and vertical ground reaction force data were synchronously collected with an eight-camera three-dimensional optical motion capture system and a force plate, respectively. The medial longitudinal arch was represented as three retroreflective markers, which were placed on the skin: the navicular tuberosity, the medial border of the first metatarsal head and the medial tubercle of the calcaneus. The foot arch dynamics was analyzed from these kinematic data, and was quantified as the amount of changes in foot arch height and angle at the landing phase and the take-off phase.

RESULTS: The jump height of the drop jumping was 27.6 ± 5.2 cm. The foot arch height and angle on the landing phase were 1.82 ± 0.28 cm and 18.2 ± 4.4 degrees, and those on the take-off phase were 1.78 ± 0.38 cm and 19.4 ± 4.2 degrees. There was no significant relationship between drop jump heights and foot arch variables on the landing phase; however, a significant relationship between drop jump heights and foot arch variables on the take-off phase.

CONCLUSION: The results of this study suggests that the mechanical contribution of the foot arch dynamics could help to enhancing human jump performance. The foot arch has an ability to integrate and generate force in the take-off phase of human countermovement jumping.

KINEMATIC ALTERATIONS IN SINGLE-LEG HOP FOR DISTANCE JUMPS FOLLOWING A PARTICIPANT-TAILORED FATIGUING PROTOCOL

ALESSANDRO, C., NARDON, M., ZANONI, M., BARTESAGHI, M., ZAZA, A., PERIN, C.

UNIVERSITY OF MILANO-BICOCCA

INTRODUCTION: Neuromuscular fatigue is a physiological phenomenon that reduces muscle force and power, affecting neuromuscular strategies during dynamic movements. Research suggests fatigue-induced motor alterations may cause negative effects on lower limb biomechanics [1]. However, whether these alterations increase the risk of musculoskeletal injury is still debated [2]. Here we investigated whether fatigue caused kinematic alterations that increase the risk of anterior cruciate ligament (ACL) rupture, one of the most common injuries during sport activities.

METHODS: Twenty-three male participants performed at least three repetitions of single-leg hop for distance jumps with both dominant (D) and non-dominant leg (ND), before and after an individualized fatiguing protocol on a cycle ergometer until exhaustion. Cycling power was set 10% above the workload associated to each participant's anaerobic threshold, previously determined by cardiopulmonary exercise testing. Hence the fatiguing protocol was adapted to the fitness level of each participant. Sagittal and frontal joint lower-limb angles before- and after the cycling protocol were compared using two-ways repeated measure ANOVA and Bonferroni-corrected post-hoc tests, evaluating whether fatigue induced motor alterations typically associated with an increased risk of ACL injury [3].

RESULTS: Jump length was reduced for both legs following the exercise (D: Δ=-8.5±2.6, ND: Δ=-7.1±3.1 cm; mean ± standard error; p<.001). Joint kinematics were significantly affected by the fatiguing protocol. Following fatigue, there was a reduction of hip and knee flexion angles during the propulsion phase – corresponding to the peak value in the ground reaction force profile (Hip D: Δ=-3.5±1.6°, p=.043; ND: Δ=-3±1°, p=.006; Knee D: Δ=-3.2±0.7°, p<.001; ND: Δ=-2.3±0.7°, p=.003), at foot contact after jumping (Hip D: Δ=-2.6±1.2°, ND: Δ=-2.9±1°, p<.05 ; Knee D: Δ=-1.6±0.6°, ND: Δ=-1.7±0.7°, p<.001), and – just for the hip joint – during landing (D: Δ=-5.4±1.4°, ND: Δ=-5±1.3°, p<.001). Finally, we found a significant and close-to-significance increase in knee valgus during landing, for the dominant (Δ=-1.9±0.6°, p=.004) and non-dominant leg (Δ=-1.2±0.7°, p=.073) respectively.

CONCLUSION: The reduced knee flexion we observed post-cycling during landing suggests a quadriceps-dominant strategy, typically associated with increased ACL strain [3]. Additionally, the increased knee valgus we observed in the dominant leg at landing is another risk factor for ACL injury [3]. Taken together these results suggest an increased risk of ACL injury after fatigue. Additional analyses on joint moments and muscle activity will be performed to integrate these results.

REFERENCES:

1. Barber-Westin & Noyes. Am J Sports Med. 2017

2. Bourne MN, et al. Sports Med. 2019

3. Hewett TE, et al. N Am J Sports Phys Ther. 2010

DO ANKLE-JOINT PLANTAR FLEXION KINETICS CONTRIBUTE TO GREATER JUMP AND SPRINT PERFORMANCE IN TRACK AND FIELD ATHLETES COMPARED TO RECREATIONALLY ACTIVE INDIVIDUALS?

BARBOUR, D., ALLEN, S.J.1, JOHNSTON, M.2, FOLLAND, J.P.1

1. LOUGHBOROUGH UNIVERSITY, LOUGHBOROUGH, UNITED KINGDOM 2. BRITISH ATHLETICS, LOUGHBOROUGH, UNITED KINGDOM

INTRODUCTION: Sprinting and jumping ability are paramount to performance in many track and field events, with variations widely implemented in training and rehabilitation programs. Knowledge of lower limb neuromechanical function may assist in understanding sprinting and jumping performance as well as informing training, testing, and injury prevention strategies. Although sprint and jump tasks have significant plantar flexor (PF) involvement, whether differences in PF kinetics contribute to performance differences between high performing jump / sprint athletes and untrained controls is unknown (1,2). The current study aimed to compare ankle joint PF kinetics between recreationally active (RA) and high performing sprint / jump athletes (HP) during jumping and sprinting tasks.

METHODS: Twenty-four healthy young adults (RA, n=12; HP, n=12) participated in this study with ethical approval and completed isometric maximal voluntary contractions (iMVC) of the PF followed by counter movement jumps (CMJ), drop jumps (DJ), and twenty-two-meter sprints (SP). Motion data was captured using an eighteen camera, 3-dimensional motion capture system (Vicon Motion Systems Ltd, UK) while ground reaction forces were measured using portable and imbedded force plates (Kistler Instrumental AG, Winterhur, Switzerland). Neuromuscular activity of the triceps-surae (TS) was recorded from four sEMG sensors (Trigno mini sensors, Delsys Europe, Sale, UK) over the TS muscles of each leg. Modelling software (Visual3D, C-motion Inc, Maryland, USA) and inverse dynamics was used to calculate, peak positive power, peak moment and positive work relative to body mass around the ankle joint of both legs during the stance phase of each task.

RESULTS: The HP group achieved significantly higher performance measures in all tasks compared to RA (isometric strength: p = 0.01, + 20.8 %; CMJ jump height: p = 0.03, + 20.0 %; DJ jump height p = 0.01, + 28.1 %; SP speed p = 0.04, + 9.1 %). During the CMJ and SP no between group differences were found for PF peak positive power (CMJ: p = 0.10, SP: p = 0.33), positive work (CMJ: p = 0.23, SP: p = 0.51), or peak moment (CMJ: p = 0.08, SP: p = 0.45). The HP group (1.60 ± 0.27 J/kg) did significantly greater positive work at the ankle during DJ when compared to RA (1.37 ± 0.18 J/kg, p = 0.02) although no differences were found in peak positive power or peak moment.

CONCLUSION: PF kinetics at the ankle joint do not seem to explain superior CMJ or SP performance of high-performing sprint / jump athletes compared to recreationally active individuals and may suggest that hip and knee joint kinetics largely account for the group differences in these tasks. Greater positive work around the ankle in the HP group (vs RA) during the DJ, but not other tasks, may be due to a higher demand on the PF during a DJ with less involvement of knee and hip joints.

1. Schache et al., JExpBio, 2015

2. Sugisaki et al., JSportScienes, 2012

INFLUENCE OF MUSCLE COORDINATION ON RUNNING SPRINT PERFORMANCE IN ELITE ATHLETES

MACCHI, R., HEGYI, A.2,3, GIROUX, C.1, RABITA, G.1, COUTURIER, A.1, HOLLVILLE, E.1, NORDEZ, A.3, LACOURPAILLE, L.3, GUILHEM, G.1

1. FRENCH INSTITUTE OF SPORT ; 2. NANTES UNIVERSITÉ; 3. HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: Maximal sprinting velocity influences performance in many sports. Despite the variety of training methods developed to enhance sprinting, a key question remains: is muscle coordination related to performance gains? To deal with the well-known "degrees of freedom problem" [1], movement coordination is organized into muscle synergies [2],

meaning that there are synergistic neural components of movement. The present study aimed to analyse the relationships between muscle coordination and functional performance during sprinting running.

METHODS: 14 elite athletes in rugby sevens and track and field (10 men and 4 women, age: 27.0±3.4 years, height: 181.8±11.9 cm, mass: 81.3±17.6kg) performed two trials of 40-m maximal sprint acceleration. EMG activity of eight ipsilateral muscles from the hamstring, quadriceps and gluteal muscle groups was recorded. Step length, step frequency, stance and flight times as well as maximal speed (Vmax) were measured with an optoelectronic measurement system. Muscle synergies were extracted from the EMG signals over the entire sprint by non-negative matrix factorization and divided into motor modules (i.e., relative muscle contribution) and motor primitives (i.e., temporal coefficients). Each synergy was characterized by their center of activity (CoA), their width of activity, their complexity within the running cycle (Higuchi's fractal dimension) as well as their irregularity between the running cycles (Hurst exponent). Spearman rank correlations were assessed between the muscle synergies and functional parameters.

RESULTS: Three muscle synergies were extracted (R2 = 0.85±0.05). The first synergy referred to the pre-activation and braking phases with a major contribution of the vastus lateralis and the gluteus muscles. The second synergy corresponded to the early swing phase showing a high contribution of the rectus femoris. The third synergy was in the late swing and early stance with large hamstrings contribution. Step frequency and the CoA of the braking synergy were negatively correlated (ρ = -0.59, $p<0.05$). The width of the early swing synergy and Vmax were negatively correlated (ρ = -0.7, $p<0.05$). The Hurst exponent of the braking phase synergy was negatively correlated to the stance time (ρ = -0.56, $p<0.05$) while those of the early swing was positively correlated to the flight time (ρ = -0.56, $p<0.05$).

CONCLUSION: Muscle coordination during sprinting can be resumed into fundamental muscle synergies. These were correlated to the functional parameters suggesting that muscle coordination could be optimized to gain slightly in performance. Although trends were observed, the hamstring synergy was surprisingly not correlated to sprinting performance. Further analyses should focus on the modulation of muscle synergies as a function of the sprint phase.

REFERENCES:

1. Bernshtein, in: The co-ordination and regulation of movements, 1967

2. Lee, Journal of Motor Behavior, 1984

Oral Presentations

OP-MH33 Exercise and diabetes I

THE EFFECTS OF AEROBIC EXERCISE AND DIET ON GLYCEMIC CONTROL IN PEOPLE WITH TYPE 2 DIABETES MELLITUS: A RANDOMIZED CONTROLLED TRIAL

MONTES DE OCA GARCIA, A., MARÍN-GALINDO, A., SANTOTORIBIO, D., REBOLLO-RAMOS, M., CORRAL-PÉREZ, J., COSTILLA, M., ÁVILA-CABEZA-DE-VACA, L., GONZÁLEZ-MARISCAL, A., CASALS, C., PONCE-GONZÁLEZ, J.G.

UNIVERSITY OF CADIZ

INTRODUCTION: Aerobic exercise has traditionally been the main lifestyle strategy, alongside diet, for the management of obesity and type 2 diabetes mellitus (T2DM). Nonetheless, controversy remains about the best therapeutic tool for glycemic control. So, the aim of this study was to compare the effects of aerobic exercise, diet, and the combination of both on glycemic control in people with T2DM.

METHODS: A total sample of 130 adults (n=64 females; 55.7±7.1 years; Body Mass Index=33.1±5.4 kg/m2) with obesity and T2DM were randomized into six groups: High-Intensity Interval Training (HIIT) (n=22), HIIT+Diet (n=25), Moderate-Intensity Continuous Training (MICT) (n=21), MICT+Diet (n=20), Diet Group (n=21), and Control Group (CG) (n=21). The 12-week training consisted of three sessions per week: HIIT included 10×1 intervals pedaling at 90% of peak power output, and MICT consisted of continuous pedaling at 10% above the first ventilatory threshold for 50 minutes. Diet consisted of an individualized diet with a calorie deficit of 300 kcal. Fasting blood samples were taken and glucose, insulin, and glycosylated hemoglobin (HbA1c%) were analyzed. The homeostatic model assessment for insulin resistance (HOMA-IR) was calculated. Finally, a 3-hour oral glucose tolerance test (OGTT) was performed to determine the area under the glucose curve (AUGC) by the trapezoidal method. To examine the intervention effect, a 3x2x2 mixed ANOVA with Bonferroni's post hoc was used.

RESULTS: No differences were found between groups at the baseline ($p>0.05$). A main effect of time ($F(1,123)=26.37$, $p<0.001$, $\eta p2=0.18$) and a time x diet interaction were observed for HbA1c ($F(1,123)=15.84$, $p<0.001$, $\eta p2=0.11$), with differences between baseline and the end of intervention in the groups with diet ($p<0.001$). Main effects of time ($F(1,123)=11.14$, $p=0.001$, $\eta p2=0.08$) and exercise ($F(2,123)=3.47$, $p=0.034$, $\eta p2=0.05$) were observed for HOMA-IR, with differences between HIIT and CG ($p=0.039$). A main effect of time ($F(1,123)=20.23$, $p<0.001$, $\eta p2=0.14$) and significant interactions of time x diet ($F(1,123)=18.44$, $p<0.001$, $\eta p2=0.13$) and time x exercise ($F(2,123)=4.06$, $p=0.020$, $\eta p2=0.06$) were observed for AUGC, with differences between baseline and the end of intervention in HIIT group ($p<0.001$) and groups with diet ($p<0.001$), and differences between diet and non-diet groups at the end of intervention ($p=0.038$). MICT only showed positive results when combined with diet ($p<0.05$).

CONCLUSION: HIIT and caloric restriction are the best therapeutic tools for the management of glycemic control in patients with T2DM, especially when combined. In fact, it has been suggested that the combination of diet and high-intensity exercise improves pancreatic function and body composition, leading to improved glucose metabolism. Thus, we recommended that trainers and exercise professionals use HIIT and diet as the main strategy for the treatment of T2DM.

Grants: 10.13039/501100011033PID2019-110063RA-I00, PID2020-120034RA-I00, EXP_74977, and LI19/21INC.

POLE WALKING-INDUCED EXOSOMAL MIR-1197: A POTENTIAL REGULATOR FOR INSULIN RESISTANCE IN MAFLD

YANG, Z., QIANGMAN, W., YAN, C., XINYAN, W.

CHINA INSTITUTION OF SPORT SCIENCE

INTRODUCTION: Insulin resistance (IR) significantly contributes to metabolic associated fatty liver disease (MAFLD). Pole walking, a specific form of exercise, not only reduces IR-associated risk factors but also decreases visceral fat, which ameliorates IR. Emerging findings reveal that long-term exercise-derived circulating exosomes protect against IR or metabolic syndrome (MS) via exosomal miRNAs[1]. However, mechanisms underlying these effects, particularly through exosomal changes, are not fully understood.

METHODS: Visceral fat levels were assessed in MAFLD patients utilizing magnetic resonance imaging of proton density fat fraction(MRI-PDFF), comparing individuals enrolled in a 12-week pole walking program with a non-exercising control group. Additionally, plasma exosomes were isolated from both cohorts to investigate the potential impact of pole walking exercise on exosomal profiles.A novel miRNA, miR-1197, was identified using a miRNA microarray. Its expression was analyzed in db/db mice and high-fat diet (HFD) mice livers via quantitative real-time PCR (qRT-PCR). To validate the biological function of miR-1197, we performed loss-of-function and gain-of-function experiments, and the underlying mechanism of miR-1197 in the prevention and treatment of MAFLD was examined with RT-PCR and Western Blot.

RESULTS: MRI-PDFF showed that liver fat levels in the exercise group were significantly reduced. qRT-PCR analysis indicated that miR-1197 was significantly decreased in obese mice, and overexpression of miR-1197 could improve IR; whereas the knockdown of miR-1197 produced the opposite results. Moreover, we determined that miR-1197 could bind to PTEN. In addition, we observed a significant upregulation of miR-1197 expression in the plasma exosomes of athletes. Eventually, we indicated that miR-1197 could play a key role in pole walking-mediated insulin sensitivity through regulating PTEN.

CONCLUSION: Our study highlights exosomal miRNA, exo-miR-1197, as a potential regulator of insulin signaling through PTEN modulation. This miRNA may offer a promising therapeutic target for the development of MAFLD.

1. Hou Z, Qin X, Hu Y, Zhang X, Li G, Wu J, Li J, Sha J, Chen J, Xia J, Wang L, Gao F. Longterm Exercise-Derived Exosomal miR-342-5p: A Novel Exerkine for Cardioprotection. Circ Res. 2019 Apr 26;124(9):1386-1400. doi: 10.1161/CIRCRESAHA.118.314635. PMID: 30879399.

LOW-VOLUME HIIT COMBINED WITH SINGLE-SET RESISTANCE TRAINING OR WHOLE-BODY ELECTROMYOSTIMULATION: DIFFERENTIAL EFFECTS ON CARDIOMETABOLIC HEALTH AND PHYSICAL FITNESS IN METABOLIC SYNDROME PATIENTS

RELJIC, D., HERRMANN, H.J., NEURATH, M.F., ZOPF, Y.

UNIVERSITY HOSPITAL ERLANGEN

INTRODUCTION: Exercise is a cornerstone in metabolic syndrome (MetS) treatment. In recent years, various time-efficient exercise modalities, such as low-volume high-intensity interval training (LOW-HIIT), single-set resistance training (1-RT) or whole-body electromyostimulation (WB-EMS) have gained growing popularity. Research has shown that these low-volume training protocols can induce similar or even superior improvements in different health outcomes compared to more traditional, higher-volume exercise modalities in clinical populations [1-3]. The aim of the present study was to compare the effects of combined low-volume exercise programs, including LOW-HIIT (5x1 min at 80-95% maximal heart rate on cycle ergometers), 1-RT (5 machine-based exercises, 8-12 reps at 70-80% of 1-RM) or WB-EMS (20 min muscle stimulation), on cardiometabolic health and physical fitness in obese MetS patients.

METHODS: Seventy-seven obese MetS patients (53±12 yrs, BMI: 39.1±7.0) were randomized into either LOW-HIIT+1-RT or LOW-HIIT+WB-EMS, each performed 2x weekly for 12 weeks. Total time per session was 35 min in both protocols. Maximal oxygen uptake (VO2max), muscle strength of major muscle groups, overall fitness score (Fit-S), selected cardiometabolic risk markers and the MetS severity Z-score were determined pre- and post-intervention.

RESULTS: Both groups significantly reduced body weight by an average of 2.3% ($p<0.05$). By average, VO2max (1.8 mL/kg/min, $p=0.002$), muscle strength in all major muscle groups (average: 10%, all $p<0.05$) and Fit-S (7.8 units, $p<0.001$) increased more in LOW-HIIT+1-RT compared to LOW-HIIT+WB-EMS. Moreover, average reduction in MetS z-score was significantly greater in LOW-HIIT+1-RT (1.2 units, $p<0.001$) compared to LOW-HIIT-WB-EMS, mainly due to higher average decreases in mean arterial blood pressure (9 mmHg, $p<0.001$).

CONCLUSION: The results of this study indicate that a combined LOW-HIIT plus 1-RT program provides greater improvements in physical fitness and cardiometabolic health than LOW-HIIT plus WB-EMS in obese MetS patients. Given the growing popularity of time-saving training protocols and their increasing application in clinical settings, our results provide important novel findings with practical implications for those involved in designing and implementing exercise programs for obese MetS patients. Due to the clinically relevant differences between both programs, LOW-HIIT should be combined with 1-RT rather than with WB-EMS.

REFERENCES

1) Reljic D et al. Sci Rep, 11: 2836 (2021).

2) Reljic D et al. Nutrients, 13: 1640 (2021).

3) Reljic D et al., JPP, 71 : 89-98(2020).

THE EFFECTS OF POSTPRANDIAL VERSUS FASTED HIT TRAINING IN (PRE-)DIABETIC TYPE 2 PATIENTS: A PRELIMINARY STUDY

CELIE, B.M.I., FAORO, V., CARPENTIER, M., CALDERS, P., LAPAUW, B.

UNIVERSITÉ LIBRE DE BRUXELLES

INTRODUCTION: A large body of evidence exists on the beneficial effects of exercise on type 2 diabetes mellitus (T2DM) aetiology, pathogenesis and its micro- and macrovascular complications. Also, postprandial continuous exercise has been shown to acutely blunt glycaemia in both healthy persons and patients with T2DM. To our knowledge, however, there are no available data about the effects of fasted state exercise in T2DM. Considering this lack of knowledge and because there are no data available on the effects of an acute high intensity exercise bout (HIT) in T2DM patients, the aim of this study was to evaluate the effect of HIT on glucose, insulin and

NEFA concentration in fasted versus postprandial state in patients with pre-diabetes and T2DM.

METHODS: Eleven adult overweight or obese males with prediabetes or T2DM, defined as an HbA1c ≥ 6.0 %, using metformine monotherapy (n=9) or diet/exercise (n=2) were included in this study and were tested three times. First, they performed an incremental exercise test until exhaustion on a cycle ergometer to evaluate maximal oxygen consumption (VO2max). The second and third test (cycling), consisted of 3 minutes warming up at 50W, followed by 20 minutes HIT (ten times: 60 seconds

at 80% of VO2max and 60 seconds at 50 Watt), finishing with 40 minutes recovery (including 3 minutes cooling down). Exercise tests were carried out in fasted or postprandial state (90 minutes after a standard meal (carbohydrates: 56%; fat: 22%; proteins: 22%)). Nutritional status was randomized. Glucose, insulin

and non-esterified fatty acids (NEFA) were measured before and after warming up, after 10, 20 minutes of HIT and 40 minutes recovery in a venous blood sample. Data are expressed as mean (SD). A Repeated measures ANOVA was executed with post hoc Sidak to evaluate interaction effects (time * condition) and time effects. Significance level was set at $P<0,05$.

RESULTS: Patients had a mean age of 42 (5,6) years; a mean BMI of 31,9 (5,11) kg/m2, an HbA1c of 6,6 (0,49) % and a relative maximal oxygen uptake of 21,4 (5,33) ml/kg.min. Glucose and insulin concentration decreased significantly in postprandial state during HIT ($P<0,05$ versus pre-HIT), but remained stable in the fasting state. Resting NEFA concentrations were increased in the fasting versus the postprandial condition ($P<0,05$) and remained stable during HIT ($P<0,05$).

CONCLUSION: Postprandial interval exercise possesses the ability to blunt postprandial glycaemia in patients with prediabetes and T2DM while NEFA concentrations are higher in the fasted state but remain stable during HIT.

Oral Presentations

OP-AP25 Recreational Runners

DIFFERENCES IN ACUTE RESPONSES AND CHRONIC ADAPTATIONS ACCORDING TO THE EXERCISE INTENSITY REFERENCE METHOD IN PREVIOUSLY INACTIVE INDIVIDUALS

MAZZOLARI, R., RODRIGUES, P., HECKSTEDEN, A.

UNIVERSITY OF INNSBRUCK

INTRODUCTION: During prolonged continuous exercise, the relationship between external load (e.g. running speed) and internal load [e.g. heart rate (HR)] shifts [1,2,3]. This means, for example, that at a given (vigorous) running speed, the HR will continuously increase, whereas if the goal of the exercise is to maintain a constant HR, the running speed will decrease over time. The time dependence of the internal/external load relationship could lead to different acute responses and chronic adaptations depending on the exercise intensity reference method. This hypothesis was tested in the present study.

METHODS: Twenty-four previously inactive individuals (8 men, 16 women) were randomized into two groups: One group (SPEED-C) trained at a speed halfway between the first and second lactate thresholds, whereas the other group (HR-C) trained at an HR halfway between the thresholds. Both groups underwent 30 min of continuous endurance exercise 3 times per week for 8 weeks. Maximal oxygen consumption (VO2max) and peak treadmill speed (Vpeak) were determined by an incremental treadmill test followed by a verification test before (PRE) and after (POST) the 8 weeks of training. VO2, HR, speed, and perceived exertion measured with the Borg CR10 were recorded during the first and last treadmill training sessions performed in the lab. After POST, an additional exercise session was performed in the lab with the intensity adjusted to the new training level.

RESULTS: SPEED-C showed higher speed (+1.6 km/h, $p<0.001$), VO2 (+7.0 mL/kg/min, $p<0.001$), HR (+21 bpm, $p<0.001$) and perceived exertion (+1.6 points, $p=0.026$) than HR-C during the first training session. The differences in speed (-0.7

km/h, p=0.018), VO2 (-4.2 mL/kg/min, p=0.004) and HR (-13 bpm, p<0.001) but not perceived exertion (-1.0 point, p=0.092) were reduced after 8 weeks of training. However, statistically significant reductions were no longer observed when the intensity was adjusted to the new training level. VO2max (+1.2 mL/kg/min, p=0.047) and Vpeak (+0.9 km/h, p=0.002) improved more in SPEED-C than in HR-C. Among the other physiological characteristics investigated in this study, speed at the second lactate threshold (+1.2 km/h, p<0.001) and speed halfway between the thresholds (+0.4 km/h, p=0.025) also improved more in SPEED-C than in HR-C, whereas HR at the second lactate threshold improved more in HR-C than in SPEED-C (-9 bpm, p=0.020).

CONCLUSION: The exercise intensity reference method (speed vs HR) affects the acute responses and chronic adaptations in previously inactive individuals. However, training conditioning may mitigate some of these differences.

1. Zuccarelli et al. (2018) 2. Zuccarelli et al. (2021) 3. Baldassarre et al. (2022)

INVESTIGATING ACUTE EXERCISE-INDUCED CHANGES IN EEG RESTING STATE BRAIN NETWORKS WITH SPECIAL REGARDS TO EXERCISE DURATION AND EXERCISE SETTING

BÜCHEL, D., LANG, S., TALSNES, R., LEHMANN, T., SANDBAKK, Ø., BAUMEISTER, J.

PADERBORN UNIVERSITY

INTRODUCTION: Acute bouts of exercise can affect the functional organization of the brain and the neural processes contributing to sports performance. Exercise duration and intensity are accepted as key factors in this interplay through their association with metabolic processes which modulate neural activity [1]. Further, qualitative characteristics of exercise bouts such as the mode [2] or setting (indoors vs. outdoors) [3] also seem to modulate acute changes in brain function due to altered sensorimotor demands. This study aimed to explore the effects of exercise duration and setting on acute changes in electroencephalography (EEG) resting state networks (RSNs).

METHODS: Eleven male recreational runners (29.7±6.9 years, 75.3±4.4 kg, 184.8±5.2 cm) performed a field lactate test to obtain individual aerobic threshold (IAT). Each athlete performed two running protocols at IAT speed (3 x 30 mins) within one week, once in indoors (treadmill, IN) and once outdoors (running track, OUT). EEG RSN data (64 channel) was recorded before exercise, immediately after each block and 15 minutes after exercise cessation. Brain graphs were reconstructed to compute whole-brain small world index (SWI, network efficiency), clustering coefficient (CC, network segregation) and path length (PL, network integration) in the theta, alpha-1, and alpha-2 frequency bands. Blood lactate concentration (Lac), heart rate (HR), and Borg scale (BS) were assessed as physiological markers. A two-way repeated measures ANOVA was performed to explore the effects of exercise duration (PRE, 30, 60, 90, POST) and environment (IN vs OUT) on RSNs and physiological parameters.

RESULTS: ANOVA yielded main effects of exercise duration in the alpha-1 network, indicating increases in SWI ($p < .001$) and CC ($p < .001$) and reductions in PL ($p = .02$) after 90 mins of exercise. Physiological outcomes were also modulated by duration and yielded increased HR and BS after 30, 60 and 90 minutes of exercise ($p < .001$). Main effects of exercise setting were neither observed on EEG nor physiological outcomes.

CONCLUSION: In the present study, exercise duration but not setting affected RSNs. Systematic increases in alpha-1 network efficiency were observed following both indoors and outdoors running and may indicate modulations of alertness following prolonged exercise. The analysis of RSNs after exercise may therefore provide valuable insights into brain-exercise-interactions in variable exercise settings, e.g. indoors and outdoors exercise.

1 Voelcker-Rehage & Niemann (2013). Structural and functional brain changes related to different types of physical activity across the life span. Neurosci Biobehav Rev. 37:2268–95.

2 Büchel et al (2023). The Mode of Endurance Exercise Influences Changes in EEG Resting-State Graphs among High-Level Cross-Country Skiers. Medicine & Science in Sports & Exercise. 55(6).

3 Boere et al (2023). Exercising is good for the brain but exercising outside is potentially better. Sci Rep. 13, 1140.

EXAMINING DETRENDED FLUCTUATION ANALYSIS ALPHA 1 AND ALPHA 2 IN SEDENTARY INDIVIDUALS DURING A 3-MONTH RUNNING EXERCISE PROTOCOL

VALENTE, P.A., OLIVEIRA, P., TEIXEIRA, A., AZEVEDO, N., RAMA, L.

UNIVERSITY OF COIMBRA

INTRODUCTION: Achieving a scientific consensus on defining training zones for exercise practice has proven challenging, both in athletes and sedentary individuals. Currently, methodologies such as lactate threshold and respiratory cycle analysis during maximal or sub-maximal tests serve as standard practices. These techniques come with drawbacks: the need for specific and costly equipment, as well as variations in analysis methods worldwide (Sandercock & Brodie, 2006). It is being recognized the importance of heart rate variability (HRV), as it reflects sympathetic and parasympathetic activity, among other related factors. Certain non-linear models, notably DFA alpha 1 and alpha 2 (DFAa1, DFAa2), have shown promising correlations with the aerobic threshold, making them potential markers for demarcating transitions in exercise intensity (Rogers, Giles, Draper, Hoos, & Gronwald, 2020). This study aims to analyze how HRV, specifically alpha 1, varies in sedentary individuals during and after a 3-month exercise protocol and compare it with athletes.

METHODS: For this study, 30 sedentary male volunteers underwent an exercise protocol, exercising twice per week (30 minutes/session on a treadmill at 50-60% of maximal heart rate) for 12 weeks. During each session, the heart rate of each individual was tracked using a POLAR V600 (POLAR ELECTRO, Finland). Before the start (T0), in the middle (T1), and after the

completion of the program (T2), all participants underwent a maximal oxygen consumption test (VO2max) (starting at 6 km/h with a 1 km/h increment every 2 minutes) using a Quark CPET system (COSMED, Italy) and tetrapolar bioimpedance analysis (InBody 770, Inbody, California). During the first month and a half (M1) and the second month and a half (M2), the HRV data were analyzed using KUBIOS Software (KUBIOS Premium OY, Finland).

RESULTS: The sample was 28 ± 9 years old (age); 175.8 ± 5.5 cm (height), and 81.7 kg (total weight). Before the beginning (T0), the sample had 24 ± 9.4% of body fat and finished the exercise protocol with 23.6 ± 9.6%. The participants lost fat during these three months, as expected. Yet, the average DFAa1 in M1 was 1.13, and the DFAa2 in M2 was 1.14. On the other hand, the DFAa2 in M1 was 0.91, and the DFAa2 in M2 was 0.89.

CONCLUSION: These values do not accord with the values established by the sports community for athletes exercise practice (Rogers, Giles, Draper, Mourot, & Gronwald, 2021). As far as we know, it is recommended that athletes who practice exercise must have the DFAa1 around 0.75 and the DFAa2 around 0.5. Yet, these established values do not consider newcomers or sedentary individuals who practice exercise recreationally. In conclusion, this study suggests rephrasing the pattern values to use DFAa1 and DFAa2 for recreational exercise. These values must be confirmed with a greater sample to be standardized for this type of population.

COMPARING PREDICTED MARATHON TIMES BASED ON A SUBMAXIMAL TREADMILL TEST WITH ACTUAL RACE TIMES IN AN OLDER MULTI-MARATHON COHORT

LUNDY, L., REILLY, R.B., FLEMING, N.

TRINITY COLLEGE DUBLIN

INTRODUCTION: Older (>45 years) multi marathoners (>100 marathon completions) maintain high levels of cardiovascular fitness and achieve high race performance metrics. As part of a larger study at Trinity College Dublin [1], it has been observed that multi marathon athletes maintained relative cardiovascular fitness and performance as they age. However, there is often reluctance among exercise physiologists to bring older subjects to maximal exertion to assess cardiovascular fitness.

This study investigated a comprehensive submaximal treadmill test to quantify objective measures of cardiovascular fitness, provide pacing information and predict marathon times to a cohort of older multi-marathoners. Comparing these predicted times to official marathon times, the value of the submaximal test in such a cohort could be assessed.

METHODS: 14 subjects (mean age 53 years, male=10, female = 4, average no of marathons completed = 132) were recruited from a larger study [1]. All subjects underwent a graded submaximal treadmill test and exhaled gas analysis (CPET) to measure VO2 and blood lactate levels (Pro lactate2 analysis). Calculations of VO2MAX were predicated on VO2 increasing linearly with speed up to HR Max. HR Max was defined using the formula: 208-(0.7x age) [2].

VO2MAX, a recognized marker for cardiovascular fitness was calculated. Blood lactate levels were used to predict marathon finish times from lactate thresholds. Actual marathon performance was verified by publicly available Strava data for events around the time of testing.

Marathon time predictions were based on the speed calculated at the fixed Lactate Threshold of 4mmol/L. This being the speed in km/h that trained athletes could maintain for 60 minutes. This was extrapolated to marathon distance using Riegel's formula. T2 = T1 x (D2/D1) x 1.06 where T1 is the given time, D1 is the given distance, T2 is the predicted time for distance D2 [3].

RESULTS: All athletes tested were in the 75th percentile or above for VO2MAX relative to their gender and age on the Copper Institute scale, with recent marathon times within an average of 2.5% of their predicted marathon finish times.

CONCLUSION: This study demonstrates that a submaximal treadmill test can be employed to aid in setting pacing in older athletes for continued optimal performance. Exercise physiologists can confidently use these metrics from submaximal tests without statistical loss of accuracy.

This study also indicates that multi marathoners maintain very high levels of cardio vascular fitness as they age.

[1] Lundy L et al. "Potential for long-term health damage in Multi-Marathoners – an observational study", European College of Sports Science, ECCS Paris, July 2023

[2] Hirofumi Tanaka et al. "Age-predicted maximal heart rate revisited", J Am Coll Cardio. 2001 Jan;37(1):153-6.

[3] Blythe DA et al "Prediction and Quantification of Individual Athletic Performance of Runners", PLoS One. 2016 Jun 23;11(6)

DIFFERENT SUBMAXIMAL TESTS TO EVALUATE AEROBIC ENDURANCE AMONG OLDER ADULTS: GAIT SPEED AND HEART RATE

HAKONARDOTTIR, T., EINARSSON, I.

REYKJAVIK UNIVERSITY

INTRODUCTION: The benefits of exercise and physical function are well-known for quality of life and health. As longevity increases, paying attention to well-being and health is increasingly important. This study aimed to assess the efficacy of different submaximal tests to evaluate aerobic endurance among older adults.

METHODS: 42 elderly volunteers participated in the study, comprising 25 women (59.5%) and 17 men (40,5%) aged 71,93 years ±4.68 years old (65 to 82 years). The testing protocol had three different submaximal endurance tests: A 6-minute walking test on the floor (6MWT), a 12-minute walking test on a treadmill (12MWT) (n =39), and a self-paced 6-minute

walking test on a treadmill (n = 28). Heart rate (BPM) was monitored with heart rate monitors in tests. All tests started with a two-minute seated rest period, and then the participant stood up to begin the test; after completion, participants got seated again for ten minutes with minimum no talking.

RESULTS: A significant correlation was found between the 6-minute walking distance (6MWD) on the floor and self-paced 6MWD on the treadmill ($r = 0,874$, $p < 0,05$) and between 6MWD on the floor and heart rate (HR) ($r = 0,486$, $p < 0,05$). No significant difference was found for HR between 6MWT on the floor and self-paced 6MWT on the treadmill ($t(24)= 2,904$, $p > 0,05$). However, a significant difference was found in the distance walked in 6MWT on the floor and self-paced 6MWT on the treadmill ($t(27)= -7.944$, $p < 0,05$). A significant difference was also found for HR between 6MWT on the floor and 12MWT on the treadmill ($t(36)=5,997$, $p < 0,05$).

CONCLUSION: The results of this study indicate that older adults are likely to walk significantly shorter distances in 6MWT on the floor compared to a 6-minute treadmill walk with self-paced speed. In addition, the heart rate is expected to be higher and tends to drift more upwards as participants walk further. The findings suggest that decreased gait speed influences submaximal endurance testing performance within older adults with different heart rate responses.

Oral Presentations

OP-AP31 Combat Sports

ANALYZING TACTICS IN OLYMPIC WRESTLING: A MARKOV CHAIN PERSPECTIVE

MOUSSA, I., DRIDER, A., VITEL, V., SCHORTGEN, A., LEROY, P., SAULIERE, G., GOYALLON, T., FRUCHARD, B., VAZEILLES, P., REVERET, L., TOUSSAINT, J.

INSTITUT NATIONAL DU SPORT ET DE LEXPERTISE DE LA PERFORMANCE

INTRODUCTION: In the realm of sports, the notion of tactics has been delineated by various researchers as the strategic maneuvers executed by athletes to adjust to dynamically shifting conditions during matches. The delicate equilibrium of competition between two players is disrupted as soon as one scores a point, inevitably prompting alterations in tactics, playing style, and the psychological disposition of the athletes [1]. Hence, the primary objective of this study was to formulate a tactical framework for wrestling matches aimed at predicting the likelihood of match outcomes based on specific scores, remaining time until the end of the match, and associated variables throughout the bout.

METHODS: To achieve this, data on score, time, weight class, round of competition, and wrestling style were automatically annotated from 5280 bouts sourced from the international wrestling circuit. Subsequently, a multi-state Markov model was computed to ascertain the probabilities of match progression and outcome. Transition intensities were derived using the Nelson-Aalen estimator, while the Aalen-Johansen estimator facilitated the calculation of fight evolution probabilities at each moment.

RESULTS: The developed model provides insights into the dynamics of score transitions during a match and enables the estimation of match outcomes based on current scores. All probabilities of score changes and match outcomes were computed for every feasible score differential and consolidated into a matrix. For instance, considering a 4-point disparity, irrespective of wrestling style, this advantage tends to steer the match towards victory (40%), a tendency that becomes more pronounced if the gap arises late in the match (90% in the final minute).

CONCLUSION: This study presented a Markov chain-based approach to enhance comprehension of the tactical progression of wrestling matches. While the results show promise, there are avenues for several enhancements, many of which necessitate a more detailed dataset. Future endeavors will involve incorporating techniques associated with each scored point as well as the location on the combat surface. The current model is poised to advance towards a semi-Markovian model that is non-uniform over time [2], considering the duration spent in a state and parameterized through a priori testing of various distributions.

[1] R. Rein et D. Memmert, « Big data and tactical analysis in elite soccer: future challenges and opportunities for sports science », Springerplus, vol. 5, no 1, p. 1410, août 2016, doi: 10.1186/s40064-016-3108-2.

[2] A. Asanjarani, B. Liquet, et Y. Nazarathy, « Estimation of semi-Markov multi-state models: a comparison of the sojourn times and transition intensities approaches », The International Journal of Biostatistics, vol. 18, no 1, p. 243-262, mai 2022, doi: 10.1515/ijb-2020-0083.

ALTITUDE TRAINING FOR JUDO: PRACTICES, PERCEPTIONS AND EDUCATION OF JUDO ATHLETES AND PERFORMANCE STAFF

TILL, J., CLOAK, R., LANE, A.M.

UNIVERSITY OF WOLVERHAMPTON

INTRODUCTION: Altitude training is a commonly used strategy to enhance endurance performance. With greater access to altitude centres, a greater number of athletes from a range of different sports have used altitude training. Given the importance of specificity in a training programme, it is important to tailor altitude training to the demands of each sport. Practices to using altitude training amongst combat sports such as judo remain largely unknown. Therefore, the aims of this study were threefold: to explore: 1) the practices to using altitude training in judo athletes, coaches, and practitioners

(hereafter referred to as "performance staff"); 2) the perceptions of judokas and performance staff in relation to the use of altitude training; 3) the educational methods implemented by performance staff and judokas regarding altitude training.

METHODS: 11 judokas and 9 performance staff completed an online questionnaire comprised of 5 sections: (1) informed consent; (2) participant information; (3) altitude practices; (4) education and understanding; (5) altitude perceptions. Closed questions were explored using frequency analysis and a 6-step thematic analysis was completed for open-ended questions.

RESULTS: Judo athletes and performance staff primarily used altitude training to improve performance at sea-level (20%) and competition performance at sea-level (20%). Altitude training to improve competition performance at altitude was rare (60%). Using a normobaric chamber (10%) was the most common way of altitude training, with training conducted at moderate altitudes (2,100-2,600 m) were most frequently reported (15%). With training programmes being for 3-4 weeks (10%). Only 35% of respondents had received (judokas) or delivered (performance staff) education on altitude training. The main provider of education amongst judokas were sport scientists (30%) and the use of journal articles as the primary source of information (35%). Most respondents (55%) reported fitness enhancement (e.g. improved aerobic capacity) as the main benefit of altitude training and lifestyle barriers (e.g. cost) (45%) as the primary drawback. 30% of respondents agree that altitude training benefits judo performance and 25% believe it to be beneficial to improving fitness.

CONCLUSION: Findings demonstrate altitude training is not currently common practice in judo although judokas and performance staff seem to perceive altitude training as beneficial to both fitness development and judo performance. Generally, altitude training is used by judokas and performance staff to improve sea-level performance rather than performance at altitude, which is likely to reflect where competition takes place. Few judokas had received education on altitude training. The present study is being extended to increase sample size to explore the generalizability of findings. Finally, some judokas and performance staff seem to perceive altitude training as beneficial to both fitness development and judo performance.

COMBINING HIGH-INTENSITY INTERVAL CONCENTRIC AND ECCENTRIC CYCLING UNDER NORMOBARIC HYPOXIA TO OPTIMIZE JUDO PERFORMANCE: A CASE STUDY IN A WELL-TRAINED FEMALE ATHLETE

FAVRET, F., KOUASSI, B.Y.L.1, GRANDPERRIN, A.2, HUREAU, T.J.1, BLAESS, J.3, EVRARD, C.3, PISTEA, C.3, ENACHE, I.3, DUFOUR, S.P.1

1UNIVERSITY OF STRASBOURG, 2UNIVERSITY OF AVIGNON, 3UNIVERSITY HOSPITAL OF STRASBOURG, FRANCE

INTRODUCTION: Live Low – Train High (LL-TH) models of hypoxia training have provided equivocal results when hypoxia exposure was limited to high-intensity aerobic training sessions [1-2]. A major issue is the reduction in the mechanical training load required to cope with the hypoxia-induced limitation in maximal aerobic power. Using the specific features of eccentric (ECC) cycling, namely its ability to achieve high mechanical power output despite limited metabolic demand [3], might be a promising strategy to maintain or enhance the mechanical training load in LL-TH interventions. This case study aimed to establish if combining high-intensity interval concentric (CON) and ECC cycling under hypoxia improves physiological determinant of judo performance in a well-trained female judo athlete.

METHODS: A well-trained female judoka (21y, 1.70m, 69kg, national level, last two year weekly training volume: 10-15h) underwent 2 weekly normobaric hypoxic (3,000m) training sessions over a 6-wk period. Each training session required 5 repetitions of 3-min CON cycling at 100% of her hypoxic CON maximal aerobic power (MAP), separated by 3-min of active recovery in ECC cycling at 150% of her hypoxic CON MAP. Pre and post training assessments included body composition (DEXA scan), vastus lateralis thickness (VLT, echography), knee extensor maximal voluntary isometric contraction (MVC), maximal incremental cycling tests in normoxia and hypoxia as well as a repeated cycling sprint ability test (RSA, 10s sprint/20s passive recovery). All cycling tests were performed in CON mode. Data are presented as single individual post vs pre relative changes.

RESULTS: All training sessions (exercise CON power=170W; recovery ECC power=260W) were completed with a hypoxic exposure of 60min/wk. Fat mass decreased after training (-9.5%) whereas fat-free mass and VLT increased (2.5 and 7.2% respectively). In hypoxia, the power output associated to maximal oxygen uptake (pVO2max, +11.1%) as well as with the second (pSV2, +20%) and the first ventilatory thresholds (pSV1, +20%) improved after training. In normoxia, greater values were also observed after training for pVO2max (+13.7%), pSV2 (+12.5%) and pSV1 (+25%). MVC did not change (-1.8%) but absolute CON maximal sprint power improved (8.5%). During the RSA test, the number of sprints performed before exhaustion increased (22%) while the peak power output developed during each sprint improved (12%).

CONCLUSION: These data demonstrate the feasibility of a new LL-TH design combining high-intensity CON and ECC cycling in moderate hypoxia. The results suggest beneficial morphological, cardiorespiratory and neuromuscular adaptations with the potential to improve judo performance in well-trained to elite judo athletes. Chronic studies should further explore this new LL-TH strategy to confirm this case report.

1. Dufour et al. J Appl Physiol. 2006

2. Faiss et al. Brit J Sports Med. 2013

3. Isner-Horobeti et al. Sport Med. 2013

This study was supported by a grant ANR-20-STHP-0002

THE RELATIONSHIP OF TRAINING LOAD AND ACUTE: CHRONIC WORKLOAD RATIO IN PROFESSIONAL KARATE ATHLETES

YU, D.
BEIJING RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: ACWR (acute: chronic workload ratio) was regarded as a valid parameter for predict injury. Calculating the ACWR of RPE (rate of perceive exertion) has been used to monitoring training in sports such as karate. Previous studies investigate the relationship between ACWR and injury risk/injury rate, which shown certain reliability and validity. However, the relationship between ACWR and other load related parameters are unknown. This study aims to investigate the relationship between ACWR and different training session load as well as daily and weekly training load.

METHODS: 11 professional karate athletes (Age 22.7±2.1 years, Height 169.9±8.7 cm, Weight 63.6±10.9 kg, Training History 5.5±2.4 years) participated in this study. The training session includes strength & conditioning (S&C) and technical training. S&C were the same for both kata and kumite, while the technical training program were different. Athletes were required to send their RPE on the phone through a questionnaire collection software within 30 minutes after every session of each training day. Foster modified CR-10 RPE scale was used [1]. RPE of each session is sRPE. Training load (A.U.=Arbitrary Units) is the product of sRPE and training time (hours). Training load of each session was calculated. Weekly training load (the sum of one week's total training load), ACWR (the ratio between the average daily load of the most recent 1 week and the average daily load of the most recent 4 weeks) and average daily training load (Total weekly training load divided by training days per week) were collected. Data of 226 weeks of all athletes were analyzed. Using multiple linear regression to investigate the relationship between ACWR and other parameters, with S&C training load, technical training load, weekly total training load and average daily training load as independent variables and ACWR as dependent variables. Significant difference was set at $P<0.05$.

RESULTS: Descriptive statistical results are expressed as mean±standard deviation, include technical training load (2899.1±1649.1 A.U.), S&C training load (1506.8±666.2 A.U.), average daily training load (885.0±298.3 A.U.), ACWR value (0.98±0.23), and weekly total training load (4405.8±2056.9). The results of multiple linear regression analysis showed that the regression equation was significant ($F=62.956$, $P<0.01$). Among them, technical training load ($b=0.00004$, $\beta=0.287$, $P<0.01$) and average daily training load ($b=0.0003$, $\beta=0.406$, $P<0.01$) significantly positively predicted ACWR value. S&C training load cannot predict ACWR value ($b=0.00001$, $\beta=0.043$, $P=0.453$). These variables explained a total of 45.2% of the variation in ACWR.

CONCLUSION: For karate athletes, technical training load and average daily training load can predict ACWR value, however, the S&C training load have no predictive relationship with ACWR. The value of ACWR is mainly affected by the technical training session and average daily training load.

1. Foster et al. (2001)

DEEP LEARNING FOR TAEKWONDO ACTION RECOGNITION

LIU, Z., LI, K., QIN, X.
BEIJING SPORT UNIVERSITY

INTRODUCTION: Action recognition in Taekwondo teaching and training is an important task, and inertial measurement units (IMUs) have more advantages in collecting data compared to camera-based systems. We proposed different deep learning algorithms to recognize Taekwondo technical actions, and compared the accuracies of deep learning methods with the traditional machine learning methods, the data were collected by three-axis accelerometers. This study can promote the public physical Taekwondo training and teaching, and the action recognition can be applied to boxing and other fields.

METHODS: Firstly, twenty subjects wore three-axis accelerometers on different parts of their bodies, including their left wrist, right wrist, lower back, left ankle, and right ankle. They completed Taekwondo technical movements which including 8 types of hand movements (left punch, right punch, left upper block, right upper block, left middle block, right middle block, left lower block and right lower block) and 8 types of leg movements (left front kick, right front kick, left roundhouse kick, right roundhouse kick, left side kick, right side kick, left back kick and right back kick). Each action was performed every 4 seconds, the action name and abnormal information were also recorded at the same time to facilitate subsequent data preprocessing. The sampling frequency of the accelerometer is 30Hz. Secondly, during the data preprocessing, we removed the abnormal data, merged the time series information of different accelerometers, intercepted 4s clips of the action part, and created a data set. Thirdly, action recognition was performed through different deep learning algorithms, for example Convolutional Neural Network(CNN), Long Short-Term Memory (LSTM), Gate Recurrent Unit (GRU), we also compared the results with traditional machine learning method.

RESULTS: The accuracy of one-dimensional residual CNN is 90.3%, after we abandon the Batch Norm layer and add the Dropout layer, the best accuracy of the final validation set reaches 95.5%. However, the accuracy of GRU is 86.4%, LSTM is 90.3%, and they both have varying degrees of overfitting. Compared with traditional machine learning, for example, the accuracy of support vector machines is 82%, decision trees is 77%, both are worse than using deep learning methods.

CONCLUSION: Deep learning method is a better choice in action recognition, it requires no manual feature extraction and the accuracy is usually higher than machine learning method. According to our experiment with small data set, smaller batch size with Dropout can reach higher accuracy and can effectively reduce overfitting in our task. On the other hand, feature extraction in machine learning is still a challenging question.

Oral Presentations

OP-AP36 Warm-up and PAPE

THE ACUTE EFFECTS OF DIFFERENT STRETCHING PROTOCOLS ON LOWER EXTREMITY NEUROMUSCULAR PERFORMANCE IN PHYSICALLY ACTIVE MALES

AYTAÇ, T., PARLAK, M., ÖZGÖR, N., HAZIR AYTAR, S., ERDOGAN, M.
BASKENT UNIVERSITY

INTRODUCTION: The aim of this study was to investigate the acute effects of static stretching, dynamic stretching, and proprioceptive neuromuscular facilitation (PNF) stretching protocols on lower extremity neuromuscular performance in physically active male university students.

METHODS: 29 male students who volunteered for the study had an average age of 21.1 ± 1.6 years, a height of 177.7 ± 6.3 cm, and a body weight of 80.9 ± 11.1 kg. The experimental procedure consisted of four protocols carried out on different days in a randomized order. CONTROL protocol consisted of a general warm-up of 5 minutes and no stretching, for the other three protocols stretching methods were used accordingly: STATIC, DYNAMIC, and Proprioceptive Neuromuscular Facilitation (PNF) stretching applied after the general warm-up for 5 minutes. The general warm-up protocol was carried out on a bicycle ergometer at a workload corresponding to 50–60% of the maximum heart rate. STATIC, DYNAMIC, and PNF protocols targeted the quadriceps, hamstring, hip abductor, hip adductor, and gastrocnemius muscle groups, and the exercises were randomly applied with equal loading times (30-second unilateral application) for a total of 5 minutes each. The Field Tapping Test (TAP) was used to evaluate the lower extremity neuromuscular performance, and it was conducted at 15 seconds, 2, 4, and 8 minutes after each protocol. The rating of perceived exertion (RPE) and the maximum heart rates (HRmax) reached during the tests were recorded. Variance analysis (ANOVA) of repeated measures was used to analyze the effects of warm-up protocols on lower extremity neuromuscular performance.

RESULTS: While there was no significant difference between the TAP values in STATIC, DYNAMIC, and PNF protocols, the TAP results were significantly worse in the general warm-up protocol at 15 seconds and 2 minutes. When examined alone, the TAP values obtained at 15 seconds after the CONTROL protocol are significantly lower than those obtained at 2 and 4 minutes. Although, no significant difference found between the RPE values in the CONTROL and DYNAMIC protocols, RPE values were significantly lower at 15 seconds, 2 minutes for STATIC and at 15 seconds for PNF. Significant differences were also observed in HRmax values across all protocols, with values at 15 seconds were significantly lower than those at 2, 4, and 8 minutes.

CONCLUSION: In conclusion, after analyzing different protocols, it was found that using stretching methods had a quicker and more significant impact on improving lower extremity neuromuscular performance compared to relying solely on warm-up procedures. From a pragmatic standpoint, refraining from stretching prior to activities aimed at enhancing performance yields limited utility compared to protocols integrating stretching exercises subsequent to general warm-ups. Moreover, the absence of notable physiological strain, as evidenced by HRmax values, underscores the safety of incorporating stretching protocols preceding such activities.

PASSIVE THIGH HEATING INCREASES MUSCLE TEMPERATURE AND PRODUCES RELIABLE TORQUE MEASUREMENT THAT INCREASE DURING MODERATE AND FAST VELOCITY KNEE EXTENSOR CONTRACTIONS.

DENNY, D., GIBSON, O., LOW, D.
BRUNEL UNIVERSITY LONDON

INTRODUCTION: Passive heating of skeletal muscle prior to activities requiring maximal muscle force production is an emerging field of research with a view to eliciting benefits during athletic performance and improve neuromuscular function across health and ageing contexts. Evidence supporting the efficacy of utilising to passive heating to generate local but not systemic hyperthermia for improving neuromuscular function has primarily focused on isometric contractions with methodology specific efficacy reported. This study undertook comprehensive assessment of the efficacy and reliability isokinetic knee extensor torque across a variety of contractile speeds and the systemic physiological responses during incremental local hyperthermia. It was hypothesised that i) performance outcomes and physiological responses would be highly reliable and ii) local hyperthermia would improve knee extensor torque.

METHODS: Twenty young, healthy participants (aged 24 ± 3, BMI 23 ± 3) completed two experimental visits. During each visit one thigh was heated with a custom garment circulating water at 50°C (HEAT) with the contralateral leg as the unheated control (CONT). Intramuscular temperature (Tmu) of the vastus lateralis in the HEAT and CONT limb was taken immediately prior to four repetitions of maximal knee extensions on each leg at 60°/s, 180°/s, and 300°/s on an isokinetic dynamometer. Measurements were made at baseline, +30, +60, +90 min. Three-way ANOVA determined differences in torque and Tmu across timepoints, between HEAT and CONT, and between visits. ICC estimates were calculated using absolute-agreement two-way mixed effects model, with coefficient of variance (CV), standard error or measurement (SEM), and minimum detectable change (MDC) also calculated. Statistical significance was set at $p < 0.05$. Data are reported Mean ± SD.

RESULTS: Tmu increased ($P < .05$) from baseline (31.7 ± 1.7°C) at 30 min in HEAT (36.5 ± 1.6°C) and CONT (34.0 ± 1.5°C), with differences in Tmu between HEAT and CONT here and thereafter ($P < .05$). Peak Tmu in HEAT was 37.4 ± 0.5°C after 90

min. Inter day torque data were found to be highly reliable, as determined by an ICC of >.90, CV ≤10%, with Tmu demonstrating good reliability (ICC of >.75, CV ≤10%) . At baseline, torque at 180°/s was not different (HEAT 132 ± 12 Nm; CONT 128 ± 9 Nm) however HEAT was greater than CONT at 30 min (+9 ± 8 Nm), 60 min (+10 ± 6 Nm) and 90 min (+9 ± 8 Nm), ($p < 0.05$). This was also true for torque at 300°/s (baseline: HEAT 105± 8 Nm; CONT 103 ± 9 Nm greater than CONT at 30 min (+10 ± 7 Nm), 60 min (+8 ± 5 Nm), and 90 min (+7 ± 6 Nm)($p < 0.05$). No between visit differences were observed for any measurement ($p > 0.05$).

CONCLUSION: Increasing muscle temperature by ~5°C increased torque by 9% at moderate and 8% at fast contractile velocities while no significant increases in the slowest contractile velocity were observed. Inter day torque outcomes were highly reliable in HEAT and CONT across all timepoints.

POST-ACTIVATION PERFORMANCE ENHANCEMENT (PAPE) PROTOCOLS DO NOT INCREASE JUMPING PERFORMANCE BEYOND GENERAL WARM-UP EFFECTS: FINDINGS FROM TWO ACUTE RANDOMIZED CROSSOVER TRIALS

RAPPELT, L., WIEDENMANN, T.1, MICKE, F.1,3, HELD, S.1,4, DONATH, L.1

<1> GERMAN SPORT UNIVERSITY COLOGNE, COLOGNE, <2> UNIVERSITY OF WUPPERTAL, WUPPERTAL, GERMANY, <3> BIELEFELD UNIVERSITY, <4> IST UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Post-activation performance enhancement (PAPE) describes the enhancement in voluntary muscular performance 3 to 10 minutes after high-intensity preconditioning contractions (depending on athletes' training status: one or more sets and moderate to heavy intensity) [1,2]. With unreliable occurrence and questionable magnitude [3], PAPE effects could also be interfered by mere warm-up effects, including alterations in muscle temperature, optimal intramuscular fluid distribution, and neural processes [1]. To disentangle local PAPE effects on the muscle from a systemic warm-up effect we conducted two randomized crossover trials (RCT) utilizing time-matched protocols.

METHODS: Both RCT consisted of a familiarization and a one-repetition-maximum (1RM) assessment session, followed by two subsequent intervention sessions in randomized order. In study I, n = 28 participants (11 female, age: 23 ± 3, BMI: 24.2 ± 2.3, Squat-1RM: 109 ± 38 kg) performed either Squat (SQ; 3x3 repetitions at 85%1RM) or local electromyostimulation of the quadriceps muscle (EMS, 85% of individual pain threshold; application of electrodes determined by muscle motor point analysis), and in study II, n = 20 participants (6 female, age: 25 ± 4, BMI: 25.4 ± 4.4; SQ-1RM: 114 ± 33 kg, bench-press-1RM: 74 ± 29 kg) performed either SQ or bench press (BP) (both: 4 repetitions at 80%1RM). During the testing sessions, Counter-Movement-Jump height (CMJ; 3 jumps per time point) as a surrogate for explosive strength was assessed after a general (PRE; 5 min cycling) and muscle-specific warm-up (POST_0), and 3, 7 and 11 minutes (POST_3, POST_7, POST_11, respectively) after the PAPE or control protocol.

RESULTS: In study I, no significant time×condition-interaction effect ($p = 0.48$, $\eta p2 = 0.03$), but a large and significant time effect ($p < 0.001$, $\eta p2 = 0.73$) for CMJ was found. In both EMS and SQ the highest CMJ heights were found at PRE (32.9 ± 6.5 cm & 33.2 ± 7.1 cm, respectively) compared to all other time points (EMS: $d \leq 0.38$ (7.3 ± 5.3%); SQ: $d \leq 0.39$ (8.2 ± 4.6%)). In study II, a significant time×condition-interaction effect was found ($p = 0.04$, $\eta p2 = 0.12$) for CMJ. In both BP and SQ the highest CMJ heights were found at POST_0 (34.7 ± 7.4 cm & 35.7 ± 7.3 cm, respectively) compared to all other time points (BP: $d \leq 0.07$ (1.4 ± 3.7%); SQ: $d \leq 0.24$ (4.5 ± 4.6%)). Post-hoc testing revealed only significant differences in SQ between POST_0 and POST_7 (35.7 ± 7.3 cm vs. 34.0 ± 6.9 cm, $p < 0.01$, $d = 0.24$).

CONCLUSION: The effect of a PAPE protocol does not further improve jumping performance compared to a muscle-specific traditional warm-up. Thus, PAPE protocols may be used as (semi-)specific warm-up strategies prior to tasks requiring explosive strength.

References:

[1] Blazevich, JA, Babault, N., Front Physiol. 2019

[2] Wilson, J. et al., J Strength Cond Res. 2013

[3] Dobbs et al., J Strength Cond Res. 2019

NO PAPE EFFECTS AFTER PLYOMETRIC OR FLYWHEEL CONDITIONING ACTIVITIES IN BRAZILIAN NATIONAL TEAM RUGBY PLAYERS

BOULLOSA, D., PEREIRA, L., MOURA, T., REIS, V., SCHULTZ, F., GUERRIERO, A., FERNÁNDEZ-FERNÁNDEZ, J., LOTURCO, I.

UNIVERSIDAD DE LEÓN

INTRODUCTION: Previous studies have systematically reported post-activation performance enhancement (PAPE) effects in specific team sports capacities after diverse conditioning activities in athletes of different sports. Specifically, recent evidence suggests the effectiveness of both plyometric and eccentric overload exercises for PAPE in team sports athletes. However, no study has verified if these conditioning activities are equally effective when looking for PAPE effects in rugby players.

METHODS: Thirteen male rugby players from the Brazilian National Team performed, in randomized order, drop jumps from a height box of 45 cm (DJ45) and a Flywheel protocol. Before, 5 min and 10 min after both protocols, athletes performed two attempts of countermovement jump (CMJ), 30-m linear sprints, and the Zigzag test (change of direction, COD).

RESULTS: The ANOVA did not reveal any within or between groups differences for any performance outcome (CMJ height, 10-m and 30-m sprinting times, and COD performance time). However, true change calculations revealed individual PAPE effects after one of both conditioning activities at different time points.

CONCLUSION: The current study does not confirm the effectiveness of DJ45 and Flywheel conditioning activities for PAPE in jumping, sprinting and COD performances in elite rugby players as a population. Meanwhile, individual responses should be considered when looking for PAPE responses after specific conditioning activities at different time points.

References

Beato et al., IJSPP (2020).

Boullosa et al., IJSPP (2020).

Zagatto et al., Biol. Sport. (2022).

IS POST-ACTIVATION PERFORMANCE ENHANCEMENT REAL? RELIABILITY OF PAPE EFFECTS IN PROFESSIONAL VOLLEYBALL PLAYERS UNDER COMPLEX TRAINING

MASEL, S., MACIEJCZYK, M.

UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Post-activation performance enhancement (PAPE) is a physiological phenomenon that is observed by an increased power output in an explosive exercise such as sprinting or jumping after applying a specific conditioning activity (CA) [1]. The phenomenon is often applied within complex training (CT) and various loading strategies and PAPE application methods may be implemented and acutely enhance subsequent post-CA performance [2,3] . However, authors tend to focus on introducing different study protocols without retesting the same experimental protocol in separate sessions. Thus, the aim of this study was to establish reliability of baseline to post-CA changes in three manners: 1) interday morning and afternoon reliability; 2) intraday morning and afternoon reliability; 3) intraday set-to-set reliability [4].

METHODS: Twelve professional male volleyball players (age: 22±2 years; volleyball training experience: 10.2±2.3 years, body height: 193.4±7.6, body mass: 84.1±8.1 kg) experienced in resistance training (7±1.6 years) participated in the study. They performed one familiarization session (1RM in a trap bar deadlift and squat jump (SJ) familiarization) and four identical experimental sessions (S1, S2, S3, S4). S1 and S3 were morning sessions and S2 and S4 were afternoon sessions, they were performed at the same time of the day. Sessions were performed twice in two days - S1 and S2 on the same day and S3 and S4 on the same day. During each experimental session participants performed mini complex training session - they performed three sets of a CA (3 repetitions of a trap bar deadlift at 80% 1RM with 15% of accommodating resistance) and 90s after a CA performed SJ with 4 minutes intra-set rest interval. The ANOVA with repeated measures was used to assess significance of the effect of a CA (significance was set at $p<0,05$) and ICC to assess reliability of measurements based on absolute-agreement, 2-way mixed-effects model.

RESULTS: During all trials, baseline to post-CA SJ changes were found to be repeatably insignificant in all sets. Interday morning (S1 and S3) reliability was moderate (ICC=0.67) and afternoon (S2 and S4) was good (0.8). Intraday morning and afternoon reliability was good for S1 and S2 (0.88) and poor for S3 and S4 (0.48). Intraday set-to set reliability was good for S1 (0.87), S2 (0.83), S3 (0.82) and moderate for S4 (0.58).

CONCLUSION: This study provides a novel understanding of the PAPE phenomenon within CT. Results of this study suggest that the practitioners may effectively implement appropriately organized CT as both intraday set-to-set and interday morning and afternoon reliabilities seem to be acceptable. Implementing CT at both times of the day may be beneficial with a small advantage of afternoon sessions. However, introducing two CT sessions within one day is highly questionable as at the moment intraday morning and afternoon reliability is vague.

1. Blazevich & Babault (2019) 2. Bauer et al. (2019) 3. Pagaduan & Pojskic (2020) 4. Koo & Li (2016)

Oral Presentations

OP-MH32 Interactions of obesity and exercise

ASSOCIATION BETWEEN EUTHYROIDISM AND MUSCULAR INDEXES IN ADULTS AFFECTED BY OBESITY

GRECO, F., LISTA, M.1, DI LUIGI, L.1, BRUNETTI, A.2, AVERSA, A.2, SGRÒ, P.1

1 UNIVERSITY OF ROME FORO ITALICO, ITALY; 2 UNIVERSITY OF CATANZARO

INTRODUCTION: Thyroid hormones levels are closely correlated with changes in body mass index and body composition regardless of the presence of thyroid dysfunctions [1, 2]. Instead, little is known regarding the influence of thyroid hormones on muscular fitness components [3]. A preserved skeletal muscle mass and strength within a framework of excess body mass may directly influence thyroid function in individuals affected by obesity [4,5]. However, this association may differ between males and females. Therefore, this study aimed to investigate the association between thyroid hormone levels and muscular indexes in male and female adults affected by obesity.

METHODS: A total of 105 individuals with obesity (65 females, 40 males) in euthyroidism have been recruited. The median age for both groups was 44.0 [28.5] years and the median BMI of 33.5 [8.0] kg/m2. Muscular indexes of interest were grip strength - evaluated on the dominant hand using the handgrip test (HG) and muscle performance – conducted on the lower body with the 10-repetition chair-stand test (CST). Free-triiodothyronine (FT3), free-thyroxine (FT4) and their ratio (FT3/FT4) were evaluated to assess thyroid function.

RESULTS: Pearson correlation analysis showed a positive association between HG and FT3 (r=0.261, p=0.036) and a negative association between FT3/FT4 and CST (r= - 0.266, p=0.032) in females. No correlations in males were found (p> 0.05).

CONCLUSION: Levels of FT3 and FT3/FT4 ratio in euthyroidism state may influence muscular indexes only in females affected by obesity. More research is needed to understand the mechanisms behind this correlation and whether thyroid hormones could be a potential biomarker for muscle-related parameters.

References:

1. Walczak and Sieminska, Int J Environ Res Public Health 2021.

2. Ruiz et al. Eur J Endocrinol. 2022.

3. Greco et al. Int Journal of Sport Medicine. 2023.

4. Zupo et al. Front Endocrinol (Lausanne). 2020.

5. Lee et al. Int J Endocrinol. 2020

EFFECTS OF VARIOUS EXERCISE TYPES ON INFLAMMATORY RESPONSE IN INDIVIDUALS WITH OVERWEIGHT AND OBESITY: A SYSTEMATIC REVIEW AND NETWORK META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

CHEN, C., CHEN, X., ZHAO, Y.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Obesity is associated with a range of clinical disease including hypertension, type Ⅱ diabetes and cardiovascular disease. Obesity is frequently accompanied by a chronic, systematic low-grade inflammatory state marked out by an increase in inflammatory biomarkers, and it has been proposed that these changes may be a link between enlarged adipose tissue mass and increased risk of clinical diseases. Therefore, it is obvious that to investigate how to effectively reduce these inflammatory biomarkers in individuals with overweight and obesity (IOO) is necessary. This systematic review and network meta-analysis (NMA) aimed to investigate the effects of different types of exercise on inflammatory biomarkers while considering potential confounders to explore the effective types of exercise to reduce chronic inflammation in IOO.

METHODS: Five databases (Cochrane, Embase, PubMed, Web of Science and EBSCO) were systematically searched. All randomized controlled trials (RCTs) published in English between January 2000 and August 2023 were included. Studies evaluating the effects of exercise intervention on inflammatory biomarkers in IOO were selected and performed a NMA.

RESULTS: A total of 123 RCTs were included, of which 43 reported on leptin, 50 on adiponectin, 74 on C-reactive protein (CRP), 47 on interleukin-6 (IL-6), 45 on tumor necrosis factor-α (TNF-α) and 17 on interleukin-10 (IL-10). It was observed that different exercise type yield distinct effects on different inflammatory biomarkers. Specifically, aerobic exercise combined with resistance training (COM) and aerobic exercise (AE) proved to be the most effective for improving leptin. AE exhibited the greatest effectiveness in reducing CRP and increasing adiponectin. High-intensity interval training (HIIT) was identified as the most effective exercise modality for ameliorate IL-6, TNF-α and IL-10. Resistance training (RT) had the least effect compared to other exercise types. Subsequent meta-regression and subgroup analyses revealed that high-intensity AE demonstrated a greater effect size compared to moderate-intensity AE. The impact of AE on IL-10 was positively associated with both the training period and the age of participants. Positive correlations were observed between reductions in body fat and the effect sizes of CRP, TNF-α, and IL-10. Gender was associated with the effect size of AE on IL-6 and TNF-α, with females exhibiting greater responses to the interventions than males.

CONCLUSION: The findings from this study highlight the potential of exercise in alleviating the inflammatory status in IOO, while distinct exercise modalities exhibit varied impacts on specific inflammatory biomarkers. A dose-response relationship was observed between the intensity and duration of exercise and the effect size of intervention. Changes in body composition correlated with the effectiveness of the intervention. Our result reveal that COM, AE, and HIIT emerge as viable exercise approaches, whereas RT is not recommended.

EFFECT OF HYPOXIA ON EXERTIONAL DYSPNEA IN OVERWEIGHT WOMEN

TOWNSEND, N., QADDOURA, S., HAMAD, N.

HAMAD BIN KHALIFA UNIVERSITY

INTRODUCTION: Exercise in hypoxia is an emerging therapeutic intervention used in the treatment of cardiometabolic diseases including obesity and type 2 diabetes. However, overweight women are prone to experiencing dyspnea on exercise (DoE), and thus may be susceptible to worsening DoE in hypoxia, since ventilation is typically increased. No studies have examined DoE though, during exercise in hypoxia matched for normoxic relative intensity. Therefore, the aim of this study was to investigate whether DoE is exacerbated during treadmill walking in overweight women, in hypoxia (HYPO) at equivalent relative intensity to normoxia (NORM).

METHODS: Eleven sedentary females participated in this study (mean ± SD; BMI 31.2±3 kg/m2, age 24.8±4.2yr, body mass 79.6±7kg). A treadmill ramp test to determine gas exchange threshold (GET), respiratory compensation point (RCP) and VO2max was conducted in NORM (FiO2 ≈ 20.9%) and HYPO (FiO2 ≈ 14.0%). On separate days, a walking exercise session comprising 3x10 min intervals was conducted in NORM and HYPO at equivalent relative intensity in the heavy domain. Exertional dyspnea was assessed using Dyspnea-12 (D12), rating of perceived breathlessness (RPB), and rating of

perceived unpleasantness (RPU) and the ventilatory responses were examined using exercise flow volume loops. A 2-way ANOVA was used to assess condition by time main effects and interaction. Effect size is reported as partial eta-squared.

RESULTS: During incremental exercise, a progressive increase in all indices of DoE occurred during increasing intensity regardless of condition (all P<0.001; η_p^2>0.85). When relative intensity was matched during the 3x10 min interval sessions, there were no significant differences between conditions for D12, RPB, and RPU scales (all P>0.05; η_(p)^2<0.05). Similarly, no differences between NORM and HYPO were observed for VE, end expiratory lung volume, or inspiratory reserve volume (all P>0.05; η_(p)^2<0.05).

CONCLUSION: Whilst DoE progressively increased during ramp incremental exercise irrespective of condition, there was not an independent effect of hypoxia when matched for relative exercise intensity. These perceptions were mirrored by the ventilatory response to exercise which also was no different between conditions. The results suggest that DoE is not affected by hypoxia independently of the ventilatory response to exercise. Thus, future studies examining the effect of hypoxia on cardiometabolic risk factors should control for DoE by matching relative exercise intensity.

ACCURACY OF A VO2PEAK ESTIMATION AT REST USING SEISMOCARDIOGRAPHY BEFORE AND AFTER A 14-WEEK LIFESTYLE INTERVENTION IN OVERWEIGHT AND OBESE SUBJECTS

HANSEN, M.T., HUSTED, K., MODVIG, J.L., LANGE, K.K., WEINREICH, C.M., TRANBERG, C., RØMER, T., DELA, F., HELGE, J.W.
UNIVERSITY OF COPENHAGEN

INTRODUCTION: Directly measured pulmonary gas exchange rates during graded exercise testing (CPET) until exhaustion using online equipment is the gold standard method for the determination of peak oxygen consumption (VO2peak). This methodology requires time, maximal exercise, and expensive equipment and is therefore not always possible. A non-exercise VO2peak estimation model using seismocardiography (SCG) at rest in combination with known demographic determinants of VO2peak has been developed and validated in healthy subjects. SCG adds an objective measure of cardiac function to the model through the measurement of precordial vibrations using an accelerometer. The aim was to investigate the validity and applicability of the SCG VO2peak method in overweight and obese subjects undergoing a 14-week lifestyle intervention. It was hypothesised that the SCG method would be accurate and able to detect changes in VO2peak.

METHODS: The study was carried out at a privately run grown-up school (Ubberup Hoejskole, UBH) that offers 14-week courses on lifestyle changes where students live at the school and voluntarily participate in daily lectures and activities. Men and women with age and BMI between 18-70 years and 25-50 kg/m2 were tested at baseline (n=68) and after 14 weeks (n=53) at UBH. Testing included the determination of demographic variables, an SCG VO2peak estimation performed at supine rest with the Seismofit® recording device placed on the lower part of the sternum, and a CPET VO2peak on a cycle ergometer until voluntary exhaustion. Parametric statistics and an alfa of 0.05 was applied.

RESULTS: Agreement in VO2peak at baseline (n=68, SCG: 26.8±1.9 ml/min/kg, CPET: 26.4±1.7 ml/min/kg, mean±95% confidence interval) showed a bias of 0.5±1.2 ml/min/kg with 95% limits of agreement (LoA) ranging ±10.1 ml/min/kg (Bland-Altman plot). Furthermore, a Pearson's correlation of r=0.77 (p<0.0001) and a standard error of estimate (SEE) of 5.2 ml/min/kg was found between methods. At follow-up (n=53) weight was reduced by 6.5±1.0 kg (Student parried t-test, p<0.0001). CPET VO2peak was increased by 3.2±0.68 ml/min/kg and 168±58 ml/min and SCG VO2peak by 2.5±0.58 ml/min/kg and 87±56 ml/min (two-way ANOVA repeated measure: intervention p<0.0001, method p=0.939 and interaction p=0.125, relative VO2peak). A Pearson's correlation of r=0.40 (p<0.05) was found between the delta change in relative VO2peak but not for absolute VO2peak r=0.11 (p=0.446).

CONCLUSION: The SCG method is accurate for the estimation of VO2peak in an overweight and obese population and the method is appropriate for detecting group changes in both relative and absolute VO2peak following a 14-week lifestyle intervention. Furthermore, the method can detect individual changes in VO2peak but not independently of weight changes. The latter is a strong finding as prediction models often cannot detect changes over time, however, the applicability is still limited by the relatively large variation in LoA and SEE which is inherent to prediction models.

Oral Presentations

OP-MH31 Physical activity patterns in children

PHYSICAL ACTIVITY HABITS AND SLEEPING HOURS IN PRESCHOOL STUDENTS

HONÓRIO, S., BATISTA, M., SANTOS, J., SERRANO, J., REBELO, M., MARQUES, J., CARRIÇO, J.
POLYTECHNIC UNIVERSITY OF CASTELO BRANCO, SPRINT , PORTUGAL

INTRODUCTION: Adequate sleep is increasingly being recognized as a crucial factor for the health of children and adolescents, as it can influence mental abilities, school performance, behavior, emotional balance, body weight and the risk of falls.

METHODS: The objective of the study was to analyze and relate the levels of physical activity of students with their hours of sleep. To find out the levels of physical activity practiced by the students, a questionnaire was given, in which the students reported the number of times and duration of Physical Education classes at school, as well as the number of times and

duration of other sports activities that students practiced outside the school context. The study had 38 children aged between 7 and 9 years of old (M=8,1±0,86), with 21 boys (53,8%) and 17 girls (43,6%). For sleep analysis, the QHSC (Childrens Sleep Habits Questionnaire) translated and validated for the Portuguese language and culture was used. It is a questionnaire completed by parents, with the aim of assessing sleep patterns in school-aged children. Initially composed of 45 items, 33 of them were grouped into eight subscales that reflect different aspects of sleep. These subscales include resistance on going to bed, sleep initiation, sleep duration, sleep anxiety, night awakenings, parasomnias, sleep breathing disorders, and daytime sleepiness. This 33-item framework has been validated for use as a screening tool for sleep disorders in school-aged children aged 4 to 10 years.

RESULTS: we found that students who practiced physical activity once a week had a sleep index of 49, those who practiced physical activity twice a week had an index of 48, those who practiced physical activity 3 times a week 46.25, those who practiced 4 times a week 45.71, those who practiced 5 times 43 in sleep index.

Regarding the results obtained from the correlation, we found that there are no significant changes, however, they present values between 0.16 and 0.19.

CONCLUSION: In the studies of Rocha (2021) and Valente (2014), the same situation was observed in which students who were more active during the weekdays had better sleep quality.

It was found, according to the results, that the greater the practice and duration of physical activities, the better the sleep index evidenced by the children. It is concluded that there is indeed a beneficial relationship between the practice of physical activity and the sleep pattern that presents lower rates of disturbance in the evaluated preschool children.

PHYSICAL ACTIVITY AND ORGANIZED SPORTS PARTICIPATION IN ICELANDIC ADOLESCENTS FROM AGE 15 TO 17: PREDICTORS OF CHANGE

INGVARSDOTTIR, T.H., ARNARDOTTIR, N., ROGNVALDSDOTTIR, V., STEFANSDOTTIR, R., JOHANNSSON, E.
UNIVERSITY OF ICELAND

INTRODUCTION: Despite its confirmed benefits on physical and mental health, physical activity (PA) decreases markedly during adolescence [1]. Organized sports participation (OSP) is an important contributor to PA during this stage [2]. Studies on changes in objectively measured PA and OSP in late adolescence and what factors predict the change in PA and OSP during those years are lacking. The objectives of the study were (1) to study changes in objectively measured PA and OSP from age 15 to 17; (2) to study if body composition, cardiorespiratory fitness, screen time, or mental health factors at age 15 predict the change in PA or OSP from age 15 to 17; and (3) to determine if there were any sex differences in the change or predictors of change in PA or OSP from age 15 to 17.

METHODS: PA was objectively measured using Actigraph GT3X+ accelerometers for one week at age 15 and again at age 17 (n=144, 91 girls). Results were represented as total activity counts per minute of waking wear time. OSP was measured using a questionnaire and defined as participating in sports with a sports club at least once a week. Changes in PA and OSP were assessed with paired samples t-test and chi-squared test, respectively. Mixed-effect linear regression and logistic regression models were used to examine potential predictors of change in PA and OSP, respectively.

RESULTS: Relative change in PA was -17.6% and -21.6% on weekdays and -6.4% and 1.2% on weekends for girls and boys, respectively. There was no sex difference in PA on weekdays, however, girls had higher levels of PA than boys on weekends at both measurement points. OSP dropped from 58.9% and 77.4% at age 15 to 37.8% and 43.4% at age 17, for girls and boys, respectively. Higher lean mass was associated with an increase in PA between ages 15 and 17 (β=21.3, 95% CI: 7.8-34.8.0, p=0.002), and higher BMI and higher body fat percentage were associated with decreased likelihood of persisting vs. quitting OSP between ages 15 and 17 (BMI: OR=0.83, 95% CI: 0.71-0.98, p=0.027; body fat percentage: OR=0.87, 95% CI: 0.80-0.95, p=0.002).

CONCLUSION: PA decreases considerably between ages 15 and 17, especially during weekdays, and OSP drops substantially for both sexes. Increased lean mass at age 15 may serve as a protective factor against the decline in PA between ages 15 and 17. Those with higher BMI and increased body fat percentage may need more encouragement to persist in OSP during late adolescence.

References:

1. Dumith SC, Gigante DP, Domingues MR, Kohl HW. Physical activity change during adolescence: a systematic review and a pooled analysis. Int J Epidemiol. 2011;40:685-698.

2. Khan KM, Thompson AM, Blair SN, et al. Sport and exercise as contributors to the health of nations. Lancet. 2012;380:59-64.

GENDER DIFFERENCES IN 24-HOUR MOVEMENT BEHAVIORS AND PHYSICAL FITNESS AMONG CHINESE PRESCHOOLERS

JIANG, S., NG, J.Y.Y., HA, A.S.
THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: The 24-hour movement behaviors (24-HMB) framework integrates recommendations for physical activity (PA), sedentary behavior (SB), and sleep, which is thought to impact health and development. However, limited research has focused on gender differences in the full distribution of 24-HMB and its health-related outcomes among preschoolers. This study aimed to assess gender differences in 24-HMB and physical fitness (PF). Additionally, the study sought to examine the association between 24-HMB and indicators of PF in this population.

METHODS: A cross-sectional study was conducted with 119 preschoolers (57 boys; 5.03 ± 0.76 years old). PA (light, moderate-to-vigorous, and total), SB, sleep duration, and screen time were measured using accelerometers and parental reports. PF components (cardiorespiratory fitness, speed-agility, lower-body muscular strength, and balance) were assessed using the PREFIT Battery. To examine the relationships between 24-HMB and PF, multiple linear regression models were employed with PF as the dependent variables and 24-HMB as the independent variables while accounting for age, body weight status (BMI), and gender as control variables. A multivariate analysis of variance was conducted, controlling for age and BMI, to investigate gender differences in 24-HMB and PF.

RESULTS: Positive associations were found between cardiorespiratory fitness (CRF) and moderate-to-vigorous physical activity (MVPA) (β=0.254) and total PA (β=0.202), while a negative association was found between CRF and screen use time (β= -0.198). No significant correlations were observed between movement behaviors and other fitness indicators ($p>0.05$). The results of the multivariate test indicated a significant main effect of gender on both 24-HMB and PF ($F=2.53$, $p<0.001$). Compared to girls, boys showed significantly higher MVPA ($F=3.84$, $p=0.012$), longer sleep duration ($F=4.92$, $p=0.003$), and less screen use time ($F=3.40$, $p=0.021$). However, there are no significant gender differences were found in total PA ($p=0.101$) and SB ($p=0.305$). Furthermore, boys demonstrated significantly better balance ability ($F=11.60$, $p<0.001$), speed ability ($F=10.26$, $p<0.001$), and CRF ($F=4.32$, $p=0.007$) than girls, but no significant difference was observed in lower-body muscular strength ($p=0.214$).

CONCLUSION: The study identified disparities in 24-HMB and PF between girls and boys, with boys demonstrating higher levels of PA, longer sleep duration, lower SB, and superior PF performance. Future research should take into consideration the unequal distribution of 24-HMB and PF between genders. Additionally, targeted PA interventions should be implemented to improve 24-HMB and PF specifically in girls. Furthermore, PA and screen use time appear to be effective and reliable predictors of preschoolers CRF, underscoring the importance of promoting healthy 24-HMB for PF development in young children.

EFFECTIVENESS OF A PARENT-FOCUSED INTERVENTION TARGETING 24-HOUR MOVEMENT BEHAVIOURS IN PRESCHOOL-AGED CHILDREN: A RANDOMISED CONTROLLED TRIAL

FENG, J., HUANG, W.Y., SIT, C.H.P., REILLY, J.J., KHAN, A.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: Interventions focused on individual 24-hour movement behaviours (i.e., physical activity, sedentary behaviour, and sleep) in preschool-aged children have been widely studied. However, integrated interventions targeting all three types of behaviours are poorly understood. A 12-week randomised controlled trial with another 12-week follow-up was conducted to assess the effectiveness of an intervention aimed at improving all three 24-hour movement behaviours.

METHODS: Parent–child dyads were randomly assigned to the integrated approach (targeting all three behaviours), the dyadic approach (targeting physical activity and sedentary behaviour), or the wait-list control group. The intervention included educational materials, workshops, and interactive questionnaires, and reminders. The primary outcomes were the preschoolers' overall 24-hour movement behaviours, which were assessed by the Activity Sleep Index (ASI), composition of movement behaviours, and absolute duration of movement behaviours. Generalised estimating equations were used to evaluate the effectiveness of the intervention.

RESULTS: One hundred and forty-seven preschoolers (4.8 ± 0.9 years, 56.5% boys) and their parents were included in the study. The preschoolers in all groups had a lower ASI at follow-up than at baseline. The preschoolers in the integrated approach group showed a smaller decline in ASI at follow-up than those in the control group (3.41; 95% confidence interval [CI] = 0.07, 6.76). The preschoolers in both intervention groups reported less reduction in physical activity relative to the other behaviours at follow-up, as well as a decrease in screen time post-intervention and at follow-up. No significant differences were found for sleep relative to the other behaviours. Furthermore, the preschoolers in the dyadic approach group reported a smaller increase in sedentary behaviour relative to the other behaviours than the control group (–0.21; 95% CI = –0.37, –0.05) at follow-up.

CONCLUSION: The findings demonstrate the effectiveness of the two intervention approaches in improving physical activity relative to the other two movement behaviours and reducing screen time. This indicates the effectiveness of the integrated approach in promoting overall movement behaviours in preschoolers.

Oral Presentations

OP-SH14 Psychological well-being

DANCE YOUR HEART OUT: LEARNINGS FROM AN INVESTIGATION INTO SAFEGUARDING AND ABUSE PREVENTION IN UK DANCE SETTINGS

TIDMARSH, G., SANCHEZ, E., CUMMING, J.

UNIVERSITY OF BIRMINGHAM, ONE DANCE UK, & UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Dance is a widely celebrated artform and physical activity that provides the opportunity for physical, psychological, and social health at professional and community levels. There are multiple intersections between dance and

sport from its integration into major sporting events such as Olympic opening ceremonies, pedagogical approaches and ensuring physically and psychologically safe environments that promote health and performance. When congruence is lacking between safeguarding and abuse prevention policy and its application into psychologically safe performance environments individuals face exposure to risks that negatively impact their health and wellbeing. This research explored safeguarding and abuse prevention in UK dance environments from organisational and dancer perspectives.

METHODS: A qualitative research design was employed to enable in-depth exploration of psychological safety in dance environments in UK Dance organisations. Following purposive sampling, online semi-structured individual interviews were conducted with organisation leaders (n =9) and mixed sample of dancers (n =17, 18+years, professional and vocational). Data were analysed using reflexive thematic analysis.

RESULTS: Results demonstrate the importance of considering both physical and psychological safety in the context of safeguarding and abuse prevention, with synergies between organisational leader and dancer perspectives. Organisational leaders highlighted there is a disparity between the implementing and understanding of safeguarding and abuse prevention between large and small organisations, and that specific guidance in the dance context was limited. A key priority that they raised was mental health and wellbeing. Dancers felt that teachers and peers played vital roles in creating safe and un-safe dance environments. Key elements of safe dance environments included: emotional support, sense of community, and knowledge of support structures. Conversely, power imbalance, emotional and physical abuse, and demand for perfection were key elements that created an unsafe dance environment.

Discussion: There is a drive for the enhancement of safeguarding and abuse prevention policy that is meaningful and relevant to the UK Dance context across professional, pre-vocational and participatory levels. This research highlights the importance of congruence between available policy, its implementation, and the role of the performance environment in facilitating this to enable promotion of physical activity and wellbeing. Importantly, this also holds significance for considering the development and implementation of meaningful safeguarding and abuse prevention policy across a broad range of physical activity and sports.

EXPLORING ATHLETE BURNOUT: THE INTERPLAY AMONG PSYCHOLOGICAL FACTORS IN ELITE ITALIAN ATHLETES

VALDESALICI, A., GHISI, M., BORELLA, E.
UNIVERSITY OF PADOVA

INTRODUCTION: Athletes are routinely exposed to different stressors that can potentially undermine their well-being and cause negative consequences such as sport performance decrements, burnout, and drop-out. Athlete burnout (AB) is a multidimensional syndrome characterized by physical and emotional exhaustion (PEE), sport devaluation (SD), and reduced sense of accomplishment (RSA). Numerous psychological factors are implicated in AB, nevertheless, the interplay between AB and individual psychological factors and sport-related situational variables remains unexplored. This study aims to investigate AB prevalence and severity in Italian elite athletes and explore the possible different impacts of distress, resilience, motivational orientation, and motivational climate on the three dimensions of AB.

METHODS: A total of 107 elite athletes (Age: M=22.99, SD=4.06; Female: n=60) engaging in individual and team sports like basketball, rugby, volleyball, athletics, and fencing, and competing at regional, national, and international levels were recruited for the present study. Athletes completed a series of online questionnaires investigating resilience (Connor-Davidson Resilience Scale-10, CD-RISC-10), distress (Depression Anxiety Stress Scales-21, DASS-21), motivational orientation and motivational climate (Task and Ego Orientation in Sport Questionnaire, TEOSQ; Perceived Motivational Climate in Sport Questionnaire, PMCSQ), and burnout (Athlete Burnout Questionnaire, ABQ).

RESULTS: According to the regression analyses, no socio-demographic characteristic (i.e., age, gender, years of experience) was implicated in AB. Nevertheless, the investigated psychological and situational variables showed different associations with the three dimensions of AB. Specifically, resilience, distress, motivational orientation, and motivational climate explained 15% of variance in PEE dimension of AB (p=0.011), with distress (b=0.028, p=0.003) and performance-oriented motivational climate (b=0.044, p=0.033) resulting as significant predictors. The same model explained 11% of variance in SD (p=0.056) with ego-oriented motivation (b=-0.261, p=0.007) resulting as the only significant predictor. Again, the model explained 20% of variance in RSA (p<0.001) with distress (b=0.021, p=0.01) and resilience (b=-0.027, p=0.013) resulting as significant predictors.

CONCLUSIONS: Mental health professionals together with coaches and athletes should be aware of the role that various psychological aspects and situational factors can have on the different dimensions of burnout, with the aim of developing and implementing strategies to manage distress, increase resilience and foster a positive sport environment where athletes can express their full athletic potential.

OVERCOMING BARRIERS AND FOSTERING DEVELOPMENT IN HIGH-PERFORMING YOUTH ATHLETES IN ARTISTIC SPORTS: INSIGHTS FROM A MIXED-METHOD INVESTIGATION OF THE ATHLETE-COACH-PARENTS TRIAD

ZHOU, Y., CHENGWEN, F., SHUGE, Z.
HUNAN UNIVERSITY OF TECHNOLOGY

Background: Research on the development environments and social influencers for young athletes is a popular topic in sports psychology. However, a majority of such research had a sole focus on the athlete's perspective whilst lacking in the account for coach and parental perspectives and the discrepancies between the athlete-coach-parents triad. Also, a few sporting domains, such as artistic sports (e.g., rhythmic gymnastics, artistic swimming, and figure skating as listed in the

Olympic Games of artistic sports programs) have yet to receive much attention. As such, we aimed to explore and compare the perceived barriers, difficulties, and challenges in the growth and development of young athletes in artistic sports programs from athletes, coaches, and parental perspectives, utilising a mixed-method approach.

Methods: We recruited 25 athletes, 20 parents and 6 coaches through convenience and snowball sampling. A multi-phase mixed-method investigation was implemented, including an exploratory phase (focus groups), an exploratory-confirmatory phase (1-1 interviews), and a consensus phase (brief Delphi). We employed inductive thematic analysis to understand the focus groups and 1-1 interview data and generated statements reflecting athletes, coaches, and parents' perceived barriers, difficulties, and challenges for the consensus building via the ranked order method.

Results: Thematic analysis revealed several significant barriers, including financial constraints, abuse, eating disorders, and the lack of cultural and social support, alongside difficulties in balancing education with rigorous training schedules, managing injuries, and psychological stress. In addition, long-term challenges related to career sustainability, such as technical skill mastery and the necessity for career planning after competitive sports, were identified, highlighting the need for holistic support for athlete development and well-being. Notably, the Modified Delphi method facilitated a consensus on ranking these factors, emphasising the critical role of multi-level supportive systems and interpersonal complexities that shape the developmental experiences of athletes in artistic sports.

Conclusions: This study contributes novel insights into the developmental experiences of young athletes in artistic sports, emphasising on the essential role of supportive environments and the complexity of their growth and progression within the high-performance context. The findings highlighted the critical role of agreements and discrepancies in the athlete-coach-parents triad regarding the perceived barriers, difficulties, and challenges in developing talented artistic sports athletes. Stakeholders and policymakers in artistic sports should consider multi-level interventions to foster the holistic well-being and career longevity of young athletes, tackling not only training and performance but also financial, psychological, and educational needs.

AGREEING THE OPTIMAL METHODS FOR PROMOTING PSYCHOSOCIAL DEVELOPMENT IN YOUNG FOOTBALLERS WITH HYBRID LEARNING PEDAGOGY

DICKSON, A., MARTINDALE, R., HARTLEY, C., DUGDALE, J.H.
EDINBURGH NAPIER UNIVERSITY

Introduction

Identifying "best practice" of delivering sport psychology is an important aspect for supporting the development of young soccer players. Further, with increasingly technologically astute young people, it is important to understand the pedagogy of embracing hybrid methods to facilitate development using technological platforms to complement in-person developmental opportunities. This research aims to 1) qualitatively investigate methods relevant for the development of psychosocial characteristics in youth soccer, and; 2) understand the current practices, characteristics, and developments required for an effective hybrid platform in youth soccer.

Method

Adopting a two-stage process, an e-Delphi polling method was initially adopted to seek consensus pertaining to the most important methods that can be used by coaches and applied psychology practitioners (n = 20). Subsequently, semi-structured interviews (n = 10) were conducted with individuals responsible for the design, delivery, and oversight of hybrid learning across industries - not solely limited to sport – to understand the principles and practices of successfully supporting ongoing development in young soccer players.

Results

The first stage identified five statements that reflected high agreement through high homogeneity of ratings; 1) taking an empathetic approach to development; 2) collaboration and alignment with all stakeholders; 3) coaches consistently leading by example through holding their own conduct to high standards; 4) encouraging player reflection on experience, and; 5) incorporating game elements to enhance motivation for learning and development. The second study presents several coherent themes outlining the barriers, adaptations, accessibility, and features relevant for adopting hybrid methods to engage effectively with young populations.

Discussion

The results of these studies combine to offer practical guidance to shape the delivery of sport psychology programmes that integrate the use of technological platforms. The use of technology should be cognisant towards assumptions at population level, and be adaptable to satisfy an empathetic approach on an individual level. If utilised correctly, hybrid learning can stimulate reflection and learning between instances of direct contact through the promotion of player reflection. This can be utilised to expand a young soccer player's developmental journey and facilitate collaboration with other stakeholders (e.g., coaches). The principles identified in this paper can shape the future of delivering sport psychology to contemporary young soccer players.

17:00 - 18:15

Invited Symposium

IS-MH02 Are the sex hormones friends or enemies when it comes to muscle gain and strength performance in females

OESTROGEN - EFFECT ON RESISTANCE TRAINING ADAPTATIONS AND STRENGTH PERFORMANCE IN FEMALES

HANSEN, M.

AARHUS UNIVERSITY

This presentation is aiming at showing the evidence on the regulatory role of oestrogen on muscular adaptations to resistance training in young and postmenopausal females. Present evidence on how females sex hormones are influencing strength performance during the menstrual cycle and before/after the menopause will be discussed. An enhanced understanding of the regulatory role of oestrogen on training responsiveness is of relevance when aiming at optimizing specific training and performance guidance of female athletes. Target audience includes but is not limited to physiologist, endocrinologists, physical therapists, researchers, coaches, and others with interest in muscle mass regulation and sex differences.

ORAL CONTRACEPTIVES - EFFECT ON ADAPTATIONS TO RESISTANCE TRAINING IN FEMALES

SEYNNES, O.

NORWEGIAN SCHOOL OF SPORT SCIENCES

This presentation will provide an overview of the influence of oral contraceptives on musculoskeletal adaptations to resistance training in femwomen, using a mixture of existing and new evidence. After a summary of the previous studies on this topic, the findings from a new study mostly centred on 2nd generation of oral contraceptives will be presented. These results were obtained using established and novel methodological approaches to address the long-standing question of the influence of oral contraceptives on contractile and connective tissue. Additionally, original findings regarding the adaptations to eccentric resistance exercise in women using oral contraceptives will be presented for the first time. The presentation may be of interest for sport scientists, coaches, and physiotherapists specialising in adaptations to resistance training and injury prevention in females.

HYPERANDROGENISM AND THE ROLE OF TESTOSTERONE FOR PHYSICAL PERFORMANCE IN ELITE FEMALES

LINDÉN HIRSCHBERG, A.

KAROLINSKA INSTITUTET

There is emerging evidence of the role of testosterone for athletic performance in women. Androgens can be beneficial by increasing muscle mass and strength, stimulating erythropoiesis, and by promoting competitive behavior. Conditions of hyperandrogenism like polycystic ovary syndrome (PCOS) and differences of sex development (DSD) seem to be overrepresented in elite female athletes. 46,XY DSD could cause a greatly increased production of testosterone in the male range, 10-20 times higher than the normal female range. If the individual has normal androgen sensitivity, her muscle mass will develop as in males. Furthermore, a recent double-blind, randomized, placebo-controlled study showed a causal effect of testosterone on athletic performance in young exercising women. Since sports are divided into female and male classification, it could be considered unfair to allow female athletes with endogenous testosterone in the male range to compete against women with normal female androgen levels. This consideration led international organizations to establish eligibility regulations for female athletes with severe hyperandrogenism. However, these regulations are controversial and have been challenged in court. In this presentation, I will give an overview of different conditions of hyperandrogenism reported in female athletes. Furthermore, the scientific evidence and underlying mechanisms for a beneficial effect of testosterone on athletic performance in women will be presented. The background to the development of relevant regulations and where we stand today will also be discussed. The target group is researchers, athletes, coaches and sports organizations who are interested in and want to protect womens sports.

Invited Symposium

IS-PN06 Omega-3 PUFA's and metabolic health

OMEGA-3 AND METABOLIC HEALTH: DOSING CONSIDERATIONS

GALLOWAY, S.
UNIVERSITY OF STIRLING

Omega-3 polyunsaturated fatty acids (n-3 PUFA) are bioactive long-chain fatty acids that have been implicated in human cardiovascular and metabolic health. The most widely studied bioactive n-3 PUFA are eicosapentanoic acid (EPA) and docosahexanoic acid (DHA) which can be synthesised from alpha-linolenic acid (ALA). Common food sources rich in n-3 PUFA include linseed/flaxseed oil, chia seeds, walnuts, rapeseed/canola oil and soyabean oil which are good plant-based sources of ALA, whereas fatty fish such as mackerel, sardines, salmon, trout, and herring are good marine sources of EPA and DHA. Since ALA conversion to EPA and DHA is not particularly efficient in humans the ingestion of foods containing EPA and DHA is recommended. The European Food Safety Authority (EFSA, 2010) set an adequate intake (AI) for EPA and DHA for adults at 250mg/day, typically achieved through ingestion of one portion of fatty fish per week. However, research exploring the incorporation of n-3 PUFA into cell membranes to influence responsiveness to nutritional and/or contractile stimuli, as well studies exploring the role of n-3 PUFA in resolution of inflammation have typically used much higher doses. The dose of omega-3 administered in studies has varied from daily amounts of 4-5g/day over short (4-12 weeks) or long periods (6 months), to extremely high doses (up to 52g/day) over only a few days (3-6 days). This presentation will provide an introduction to n-3 PUFA metabolism and explore the incorporation of these lipids into tissues in human studies, in relation to dose administered and age of participants, with a focus on metabolic outcomes in response to contractile or nutritional stimuli.

OMEGA-3 PUFA INTERACTIONS WITH LIPID AND GLUCOSE METABOLISM

HODSON, L.
UNIVERSITY OF OXFORD

The liver is a key metabolic organ that undertakes a multitude of physiological processes. It serves as an intermediary organ between exogenous (dietary) and endogenous energy supply to extrahepatic organs, with hepatocytes rapidly transitioning back and forth between the metabolic tasks of energy storage and supply. Given its pivotal role in regulating systemic metabolism, perturbations in hepatic metabolism can impact on metabolic disease risk. Hepatic de novo lipogenesis (DNL) has been implicated in the development of fatty liver disease and supplementation with the omega-3 fatty acids (FA) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) has been demonstrated to decrease intrahepatic triacylglycerol (IHTAG) and plasma TAG concentrations. In vitro cellular and animal models have proposed the mechanisms by which this is achieved include down-regulation of lipogenic and up-regulation of β-oxidation pathways via hepatic transcriptions factors. The effects of omega-3 supplementation on markers of glycaemia are inconsistent, which may be due to the dose and duration of omega-3 supplementation, along with the clinical status of the individual studies. This talk will discuss how omega-3 fatty acids may alter synthesis and partitioning of fatty acids within the liver and the effects this may have on lipid and glucose metabolism, and the mechanisms that potentially underpin any alterations.

THE EFFECT OF SEX ON CHANGES IN HUMAN SKELETAL MUSCLE OMEGA-3 FATTY ACID COMPOSITION WITH FISH OIL SUPPLEMENTATION

MCGLORY, C.
QUEENS UNIVERSITY

Omega-3 fatty acids play crucial roles in the formation of membranes, production of anti-inflammatory signalling molecules, and improved cardiovascular health. The two most well-characterised omega-3 fatty acids are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). In addition to the established effects on cardiovascular health there is growing evidence that EPA and DHA positively affect skeletal muscle. Indeed, there are reports that EPA+DHA intake potentiates rates of muscle protein synthesis in response to amino acid infusion, mitigates skeletal muscle disuse-atrophy following single-leg immobilization, and enhances skeletal muscle strength during resistance exercise training. Of particular interest is evidence that the effects of EPA+DHA intake are sex-dependent with females experiencing greater benefit from EPA+DHA supplementation compared to males. Although far from conclusive, these sex-dependent effects of EPA+DHA intake maybe related to differences in how EPA and DHA are metabolized in skeletal muscle. In this presentation, novel data related to changes in the content of skeletal muscle fatty acids in response to EPA+DHA intake in females and males will be shared. Data related to how changes in skeletal muscle fatty acid composition with EPA+DHA intake alter the expression of key genes involved in skeletal muscle metabolism will also be presented. Finally, we will discuss if existing fatty acid therapies used to treat cardiovascular disease can be leveraged to promote skeletal muscle heath and function.

Oral Presentations

OP-BM15 Muscle and tendon function I

UNIQUE HYPERTROPHIC EFFECTS OF SINGLE- VERSUS MULTI-JOINT EXERCISE: A COMPARISON BETWEEN KNEE EXTENSION AND LEG PRESS

KINOSHITA, M., MAEO, S.1, KOBAYASHI, Y.1, EIHARA, Y.1, NISHIZAWA, N.1, OHASHI, C.1, KUSAGAWA, Y.1, SUGIYAMA, T.1, WAKAHARA, T.2, KANEHISA, H.3, ISAKA, T.1

1 RITSUMEIKAN UNIVERSITY, 2 DOSHISHA UNIVERSITY, 3 NATIONAL INSTITUTE OF FITNESS & SPORTS IN KANOYA

INTRODUCTION: Single-joint knee extension (KE) and multi-joint leg press (LP) are commonly used as a resistance training exercise for the quadriceps femoris (QF). However, their comparative effectiveness for QF hypertrophy is unclear. Furthermore, although LP can theoretically train multiple muscles at the same time, it is unknown which muscles are trained/hypertrophied by LP. Therefore, this study aimed to compare the hypertrophic effects of KE and LP on QF and other lower-limb muscles.

METHODS: Seventeen untrained healthy young adults (11 males and 6 females) performed KE with one leg and LP with the other leg at 50-70% of one repetition maximum (1RM) of the corresponding task. Each leg performed 5 sets of 10 repetitions per session (2 s for each of the concentric/eccentric phases), 2 sessions per week for 12 weeks. Before and after the intervention, T1-weighted axial 3-T MR images (field of view: 275×275 mm, slice thickness & gap: 5 mm) were obtained to assess muscle volume of the individual QF and gluteus muscles, as well as the whole QF, hamstrings (HAM), and adductor muscles (ADD). In a follow-up experiment, electromyograms (EMGs) during KE and LP (10 reps at 50% 1RM) were measured in eleven males from the following muscles: rectus femoris (RF), vastus lateralis (VL), vastus medialis (VM), biceps femoris long head (BFL), semitendinosus (ST), and gluteus maximum (G-max). The EMG data were normalized to those obtained during maximal voluntary contraction of each muscle (%EMGmax).

RESULTS: After the intervention, muscle volume of each and the whole QF significantly increased in both conditions ($P \leq 0.002$), except for the RF of the LP ($P = 0.290$). The changes were significantly greater for the KE than LP in the RF (+13.2% vs +1.1%) and whole QF (+7.1% vs +4.9%) ($P \leq 0.005$), but similar in the vasti muscles between KE and LP (VL: +6.4% vs +6.2%, VM: +7.2% vs +6.0%, vastus intermedius: +5.0% vs +4.4%, $P \geq 0.161$). The LP significantly increased muscle volume of the G-max (+13.9%), gluteus medialis (+4.1%), HAM (+3.1%), and ADD (+3.8%) ($P \leq 0.020$), while no such significant changes occurred after KE (+0.2%, -0.2%, +1.5%, and -0.5%, respectively, $P \geq 0.064$). Changes in total muscle volume of analyzed muscles were significantly lower in KE than LP (+2.8 vs +5.9%, $P < 0.001$). The EMG analysis showed that %EMGmax values during KE compared to LP were significantly higher in the RF (38.0% vs 21.7%, $P < 0.001$), similar in the VL (36.9% vs 37.1%) and VM (32.4% vs 35.0%) ($P \geq 0.544$), and lower in the BFL (7.3% vs 13.9%), ST (8.1% vs 18.9%), and G-max (8.8% vs 41.2%) ($P \leq 0.003$).

CONCLUSION: KE is more effective than LP for muscle hypertrophy of the QF, which is attributed to significant and insignificant hypertrophy of the RF after KE and LP, respectively. However, LP can indeed train/hypertrophy multiple lower-limb muscles and therefore can be considered more time-efficient exercise. The unique muscle hypertrophy of both KE and LP can be explained by muscle activity during each exercise.

STRETCHING CAUSES UNIFORM CHANGES IN SARCOMERE LENGTH WITHIN RAT MEDIAL GASTROCNEMIUS MUSCLE

MAAS, H., GEUSEBROEK, G., TIJS, C., VAN DIEËN, J.H.

VRIJE UNIVERSITEIT AMSTERDAM

INTRODUCTION: Muscle stretching is frequently applied in sports practice, but also in the treatment of joint contractures. The goal of stretching is to lengthen the muscle fibers, but the actual distribution of the imposed strain among the different structures is unknown. Previously, differences in length of in-series sarcomeres within muscle fibers of rat and mouse tibialis anterior (TA) muscle have been reported (Moo et al., 2016; Tijs et al., 2015). The aim of the present study is to investigate how muscle-tendon strain is distributed within the muscle belly of medial gastrocnemius (MG) muscle.

METHODS: The hindlimbs of 24 adult male Wistar rats (body mass = 316±5g) were positioned in predefined ankle and knee angles (included angles 55°, 90°, 125°, 160° for both joints) and fixed in a formaldehyde solution. MG muscle was removed and whole muscle fibers were dissected from three regions: proximal, intermediate and distal. Muscle belly and mean sarcomere length were assessed.

RESULTS: Increasing knee angle (i.e. extension) and decreasing ankle angle (i.e. dorsiflexion) caused lengthening of MG muscle belly and mean sarcomere length. Length changes were higher in response to changes in ankle angle than to changes in knee angle, in accordance with joint moment arms (Ettema, 1997). Mean sarcomere length did not differ between regions. Also, changes in sarcomere length in response to muscle-tendon lengthening were not different between regions.

CONCLUSION: These results indicate that muscle-tendon strain caused by ankle and knee joint rotations was distributed homogeneously within the MG muscle belly. The difference with previous results in a different muscle (TA) suggests that the distribution of muscle-tendon strain is muscle specific.

REFERENCES:

Ettema, G.J.C., 1997. Gastrocnemius muscle length in relation to knee and ankle joint angles: verification of a geometric model and some applications. The Anatomical Record 247, 1-8.

Moo, E.K., Fortuna, R., Sibole, S.C., Abusara, Z., Herzog, W., 2016. In vivo Sarcomere Lengths and Sarcomere Elongations Are Not Uniform across an Intact Muscle. Front Physiol 7, 187.

Tijs, C., van Dieen, J.H., Maas, H., 2015. Effects of epimuscular myofascial force transmission on sarcomere length of passive muscles in the rat hindlimb. Physiol Rep 3.

COMPARING PLANTAR FLEXOR MUSCLE ARCHITECTURE IN SPRINT AND DISTANCE RUNNERS USING DTI MRI

BALINT, K., HEGYI, A., PÉTER, A., KÓBOR, I., GU, Y., TIHANYI, J., GYEBNÁR, G.

HUNGARIAN UNIVERSITY OF SPORT SCIENCE

INTRODUCTION: The ability of skeletal muscles to generate force is related to their architectural properties. Plantar flexor muscles are important for running propulsion. In propulsion, sprinters have a shorter time to produce larger forces as compared to distance runners, which may be associated with different muscle architecture in sprinters and distance runners. Although some studies examined plantar flexor architecture in these populations using 2-D ultrasonography, it is likely that more advanced 3-D methods such as diffusion tensor imaging (DTI) allow further insights into architectural differences between these groups.

METHODS: In this study, we recruited 15 sprinters and 15 distance runners. To date, data from 9 sprint runners (IAAF score: 977±109, 5 males) and 13 distance runners (IAAF score: 958±125, 10 males) have been processed. 3-D muscle architecture of the plantar flexor muscles was reconstructed by scanning the right leg using T1 and DTI MRI sequences. Muscle segmentation was performed based on the T1 images to establish muscle boundaries and to generate the 3D mesh of the muscles. DTI tractography was used to reconstruct the architecture of the plantar flexor muscles. Muscle volume, fascicle length, pennation angle, and physiological cross-sectional area were estimated for each of the medial and lateral gastrocnemii as well as for four compartments of the soleus muscle. Because data collection is ongoing, statistical analysis has not yet been performed.

RESULTS: In medial gastrocnemius, muscle volume (268±52 vs. 273±58 cm3), fascicle length (80.41±13.12 vs. 84.51±14.20 mm), pennation angle (26.27±2.33 vs. 25.34±1.45º) and physiological cross-sectional area (36.3±9.3 vs. 35.8±11.3 cm2) were similar between sprint and distance runners. Similarly, no difference between groups were evident in lateral gastrocnemius muscle volume (161±35 vs. 170±31 cm3), fascicle length (72.31±11.85 vs. 73.31±7.79 mm), pennation angle (27.93±3.04 vs. 27.93±3.23º) or physiological cross-sectional area (22.4±5.8 vs. 23±3.6 cm2). The total soleus muscle volume (455±118 vs. 456±82 cm3) and average fascicle length (43.8±4.7 vs. 47.6±5.9 mm), pennation angle (32.7±3.9 vs. 31.7±2º) and the physiological cross-sectional area (104.9±29.5 vs. 100.3±24.4) were also similar between groups.

CONCLUSION: Compared to data on non-trained individuals using DTI MRI(1), gastriconemii fascicles were longer in sprinters and soleus fascicles were shorter in distance runners. Seemingly, there is no obvious difference between sprinters and distance runners in the volume or architecture of plantar flexor muscles. After completing our dataset, further analysis will be performed using statistical shape modeling to test for group effects on regional differences in muscle shape and architecture.

REFERENCES:

1) Bolsterlee et al., J. Biomech, 2019

REGIONAL DIFFERENCES IN FASCICLE AND MUSCLE BEHAVIOUR IN HUMAN VASTUS LATERALIS

TRINCHI, M., BIZET, B., MONTE, A., ZAMPARO, P.

UNIVERSITY OF VERONA

INTRODUCTION: Studies performed in animals and humans (at rest) indicate that skeletal muscle is heterogeneous in its architecture, with regional differences in fibre length, pennation angle and fibre type composition that make up anatomically distinct compartments or regions (Tijs et al., 2021). To our knowledge, no studies investigated, so far, the effects of these regional differences on muscle mechanics. Thus, this study aimed to understand how regional differences in vastus lateralis (VL) muscle architecture influence dynamic muscle shape changes in vivo.

METHODS: Twelve healthy young adults participated in the study. Knee extensor torque was measured using an isokinetic dynamometer; subjects were seated with the back supported and the hip joint flexed at 80°. After a standardised warm-up, they were requested to perform three maximal isokinetic contractions at five different angular speeds (30, 75, 150, 210, 270 °/s) over the entire range of motion. Muscle behaviour in distal and proximal regions of VL was recorded by two ultrasound devices positioned at 1/3 and 2/3 of the femur length, respectively. The maximum torque value during the isokinetic phase (at each angular velocity) was used to obtain the torque-fascicles velocity (T-V) curve for both regions. Fascicle and belly velocity were calculated as the first derivative of the length-time curve during the isokinetic phase of each trial, and the mean value was utilised to reconstruct the fascicle and belly T-V relationship for both muscle regions. Belly gearing was calculated as the ratio between muscle belly and fascicle velocity. Finally, the x-axis intercepts of the T-V curves obtained through fascicle and muscle data were obtained for both regions.

RESULTS: At rest, greater muscle thickness (2.4±0.5 vs 1.9±0.7cm) and pennation angle (13.1±2.7 vs 11.7±2.6°) were observed in the proximal vs distal region, respectively. Maximum fascicle and muscle shortening velocities for the distal and

proximal regions were 66.1±25.1 and 70.4±27.3 cm/s and 41.1±20.4 and 47.5±22.2 cm/s, respectively. Belly gearing at zero loads (intercept of the x-axis) was higher (1.14±0.05 vs 1.06±0.02) in the proximal vs distal region.

CONCLUSION: At any given torque value, we observed differences in fascicle and muscle behaviour between muscle regions: higher muscle and fascicle velocity values were observed in the distal region, and the proximal one exhibited higher values of belly gearing compared to the distal one. These data suggest that the architectural differences within a muscle could affect the behaviour of the active components during contraction. Moreover, the differences in uncoupling behaviour between regions allow the VL to operate with similar Force-Velocity potential across its length.

THE OPTIMIZED VERSION OF THE ISOMETRIC POSTERIOR CHAIN TEST IS SUITABLE TO DETECT HAMSTRING STRENGTH, YET NOT ACUTE FATIGUE.

RASP, D., ZAUSER, M., KERN, J., SCHWIRTZ, A., PATERNOSTER, F.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Hamstring strength (HSS) and fatigue (HF) are associated with Hamstring Injuries (HSI) in multiple sports (1). Testing of HSS plays an essential role in return to sport or the prevention of HSI. Tests have to be fast, valid, reliable, mobile and should not put athletes health at risk. Our newly developed procedure of the 90:20 Isometric Posterior Chain Test (IPCT) (2,3) is compared with gold standard dynamometry to assess whether IPCT can be used to detect HF.

METHODS: We tested HSS of 12 soccer players via optimized IPCT, and isokinetic measurements at 180°/s during the Loughborough Intermittent Shuttle Test (LIST). HSS was assessed pre- and post-match (PreM, PostM) and during half-time (HT) with the mentioned tests. We extracted maximum resultant force (Fres) for the IPCT and concentric and eccentric peak torque (CPT, EPT) and work (CW, EW) for the isokinetic measurements. We compared isokinetic HSS with HSS of IPCT. We also extracted the angle of peak torque (APT) for CPT and EPT.

RESULTS: At PreM, Fres showed good agreement with EPT and EW (r=0.71* and r=0.67*) for the dominant leg (DL). In the non-dominant leg (NDL), Fres significantly correlated with CPT (r=0.64*), EPT (r=0.70*), CW (r=0.78**) and EW (r=0.61*), respectively. No significant correlations were found between Fres and isokinetic parameters for neither leg at HT. A tendency between Fres and EPT (r=0.53), and EW (r=0.57) for the DL could be observed. PostM only showed a significant correlation between Fres and CW (r=0.57*) for the DL. However, there were tendencies between Fres and CPT, EPT and EW (r=0.57 each) in the DL and Fres and EPT (r=0.53) in the NDL. APT of CPT at PreM, HT and PostM were 24.7°±8.3°, 28.3°±11.1° and 25.8°±5.1° for the DL and 26,0°±9.1°, 33,6°±22.3° and 23,1°±10,2° for the NDL. APT of EPT of 37,6°±19,9°, 47,1°±16,6° and 55,7°±21,1° for the DL and 47,5°±14,9°, 44,1°±20,6° and 41,8°±17,2° forNDL were measured for the respective points in time. Despite the differences between APT and the moment of measurement, ANOVA revealed no significance for neither of the comparisons.

CONCLUSION: For the DL, Fres and EPT/EW show good agreement for PreM. Due to fatigue, APT of EPT shifts towards a more flexed knee, why agreement between Fres and isokinetic parameters worsens. APT of CPT remain comparable throughout the LIST; so do correlations of Fres with CPT and CW. NDL shows contradicting results. Although APT of EPT shows the highest value – knee more flexed – the agreement of Fres and isokinetic parameters is best at PreM. APT of EPT shifts towards a more extended knee during LIST, whereas APT of CPT increases at HT but becomes smaller at PostM than at PreM. To conclude, the optimized IPCT is suitable to measure HSS but is not acute HF due to change of APT. The high angular velocity of 180°/s may further contribute to a restricted agreement of isokinetic and isometric parameters.

[1] Ekstrand et al., 2022, Br. J. Sports Med. [2] Matinlauri et al., 2019, PLoS One. [3] Rasp et al., 2024, under review.

Oral Presentations

OP-MH16 Exercise for older adults II

HIIT AT HOME – ENHANCING PHYSICAL FUNCTION AND HEALTH-RELATED QUALITY OF LIFE IN OLDER ADULTS. ANY ASSOCIATIONS?

SEILER, H.L., FOSSTVEIT, S.H., FERON, J., JOYCE, K.E., SEGAERT, K., LUCAS, S.J.E., BERNTSEN, S.

UNIVERSITY OF AGDER N, UNIVERSITY OF BIRMINGHAM UK

INTRODUCTION: High-intensity interval training (HIIT) is a training method that is generally well-tolerated and feasible in older adults1 and has been shown to lead to improvements in physical, mental, and overall health-related quality of life (HRQOL)2, as well as having a favourable effect on physical function (PF)3. In clinical populations, PF and HRQOL are strongly linked4. However, there has been less focus on the relationship between changes in these outcomes in non-clinical older populations. Moreover, the effectiveness of HIIT under free-living conditions as part of public health strategy has not been adequately investigated5. Therefore, the aim of the present study was to investigate the effect of a 6-month homebased HIIT programme in older adults on PF and HRQOL and determine whether there were associations between training-induced changes in these variables.

METHODS: Healthy older adults (n=233, 60-84 yrs, 54% female) from Norway and the UK were randomized to a HIIT group (67.6±5.9yr, mean±SD), or a non-exercising control group (67.0±5.2yr, mean±SD). The training was carried out as a 6-month triweekly HIIT intervention. PF was calculated as a composite Z-score (PF Z-score) based on: Grip strength, 30-

sec-chair-stand, Chair-sit-and-reach, Back scratch, Timed-up-and-go, and One-leg standing. HRQOL was assessed by the Short Form health survey questionnaire (SF-12), with an explicit focus on HRQOL-general, -physical- and mental health.

General linear regression models (GLMs) assessed between-group differences in post-intervention PF Z-score, HRQOL-general, -physical- and mental health, with baseline values, age, sex and country as covariates, and group as a fixed factor. For associations between changes in PF and HRQOL within the HIIT group, GLMs were used, with age, sex, and country as covariates. Alpha level of 5% was chosen for statistical significance, with 95% CI presented.

RESULTS: Significant between-group differences post-intervention were observed for PF Z-score (β=0.26, [0.16;0.36]), HRQOL-general health (β=0.76, [0.29;1.23]), and HRQOL-physical health (β=3.05, [0.34;5.77]), but not for HRQOL-mental health.

No associations were observed between absolute changes in PF Z-score and HRQOL-general health (β=-0.80, [-1.83;0.23]), and PF Z-score and HRQOL-physical health (β =-1.85, [-8.52;4.83]).

CONCLUSION: These findings indicate that a non-clinical older population can improve their physical function through a 6-month home-based HIIT intervention, in addition to making improvements in HRQOL, although no associations were observed between these variables. Nevertheless, the findings highlight the potential role of HIIT as a valuable component of public health strategies for older adults.

REFERENCES:

1.Marriott et al., Sports Medicine – Open, 2021

2.Griffiths et al., Journal of Public Health, 2024

3.Stern et al., Sports Medicine – Open, 2023

4. Sunde et al., European Geriatric Medicine, 2021

5.Gray et al., British Journal of Sports Medicine, 2016

THE IMPACT OF ONLINE VERSUS IN-PERSON EXERCISE CLASSES ON EXERCISE INTENSITY IN OLDER ADULTS

MUGGERIDGE, D., FRASER, M., GORELY, T., CRABTREE, C.

EDINBURGH NAPIER UNIVERSITY

INTRODUCTION: Online exercise classes have been popularised in recent years due to the improvement in internet connectivity and the impact of the COVID-19 pandemic restricting in-person exercise classes. Furthermore, the uptake of in-person exercise referral classes is poor and online exercise classes may offer an effective method of delivering exercise interventions in a cost-effective manner (e.g in remote and rural locations). Despite the potential, little is known about the intensity of exercise achieved between these two exercise delivery modes. Intensity is a key parameter for adaptation to exercise. Interestingly, research shows that older adults undertaking cardiac rehabilitation do not meet the prescribed intensity of 40-70% Heart Rate Reserve (HRR). The aim of this study was to assess the intensity that older adults achieved during online versus in-person exercise classes living in a rural location.

METHODS: Eighteen, low-moderately active older adults (64.6 ± 6.5 years) completed four group exercise sessions delivered by the same exercise instructor (L4 Advanced Personal Trainer). Sessions combined aerobic and resistance exercises, following the same structure, and were completed at the same time of day, at least 5 days a part. Two of the exercise classes were completed online and two were completed in-person. Exercise intensity was monitored via a commercially available wearable device; Polar Verity Sense (Polar Electro OY, Kempele, Finland) and data was synced and shared via the Polar Beat app. HR data was categorised as either low or moderate and vigorous (MVPA) intensity based upon HRR training zones (< 40% HRR = Low Intensity [LOW], 40 – 69% = Moderate Intensity [MOD], >70% HRR = Vigorous intensity [VIG]) and percentage of session spent in each HR zone was compared between conditions.

RESULTS: Adherence to the classes was 96.8% and compliance with the technology was 85.9%. Average HR during the sessions were lower during online vs in-person (online: 100 ± 15 b/min vs. in-person: 108 ± 17 b/min; $p < 0.001$). Time spent in LOW during the online class was significantly greater than the in-person class (online: 64.32 ± vs. in-person: 44.70 ± ; $p < 0.001$). Time spent in MVPA was significantly greater during in-person exercise and this was predominantly driven by an increased time spent in VIG activity but did not reach significance (online: 5.60 ± vs. in-person: 18.92 ± ; $p = 0.113$).

CONCLUSION: Older adults achieve a higher intensity of exercise during in-person rather than online group exercise classes. This might have important implications when evaluating the health and economic impact of online exercise interventions as they may not be as effective as in-person classes due to decreased physiological stimulus. Nevertheless, adherence remains low amongst in-person exercise referral classes and therefore online exercise remains an exciting option for improving adherence, reach and choice amongst our diverse population.

AGILITY TRAINING WITH REACTIVE COMPONENTS FOR OLDER ADULTS – A RANDOMIZED CONTROLLED TRIAL.

LICHTENSTEIN, E., KELLER, M., ROTH, R., LUDYGA, S., DONATH, L., FAUDE, O.

UNIVERSITY OF BASEL

INTRODUCTION: Alternative approaches to fall prevention programs for older adults have been called for. Agility-training, blending functional movements, stop-and-go actions, direction changes, strength, balance and cognitive tasks (Donath et al., 2016), appeared more effective than traditional methods (Lichtenstein et al., 2020). However, long-term applications

lacked considerations of individual progression and reactive decision making (Lichtenstein et al., 2023). Adressing the need for quick, unforeseen reactions in fall-risk situations, we explored training tailored to individual progress with complex reactive elements to enhance neuromuscular and cognitive performance as well as psychosocial health surrogates in healthy older adults.

METHODS: Forty-six healthy older adults (28 females, 69.5±6.8 years, 25.9±3.4 kg/m2) were randomized to a control (CON) or agility training (AT) group. AT, over a period of 16 weeks (2 times/week), involved cognitive, strength, balance, and reactive light system tasks, growing in complexity. Cognitive (Eriksen-flanker, Go/No-Go), neuromuscular (tandem stance, counter movement jump, grip strength, leg dynamometry), and gait tests under single and dual task conditions were used. Psychosocial health surveys (CES-D, WHO-QoL-Bref, ISI, FES-I, PSS) were als employed. Data was analyzed using linear mixed effects models, reporting group*time interactions standardized to baseline standard variation.

RESULTS: Compliance was high (85.2±8.3%) and dropouts low (10.8%). After controlling for age, sex and BMI, analysis revealed, on average, at least small effects in favor of the AT group for Go/No-Go task parameters (0.18 CONCLUSION: In this group of very fit and healthy older adults, agility training seems insufficient to markedly improve neuromuscular parameters but could potentially serve to slightly improve response inhibition and mental health over a 16-week period.

References

Donath et al. (2016). Exercise-based fall prevention in the elderly: what about agility?. Sports medicine, 46, 143-149.

Lichtenstein et al. (2020). Agility-based exercise training compared to traditional strength and balance training in older adults: a pilot randomized trial. PeerJ, 8, e8781.

Lichtenstein et al. (2023). Agility training to integratively promote neuromuscular, cardiorespiratory and cognitive function in healthy older adults: a one-year randomized-controlled trial. European Review of Aging and Physical Activity, 20(1), 21.

EFFECTS OF A 20-WEEK PILATES METHOD EXERCISE PROGRAM FOR IMPROVING TRUNK STRENGTH IN OLDER ADULTS.

GEREMIA, S., VILLAS-BOAS, J., SOUSA, F., CARVALHO, J., PIZARRO, A.

FACULTY OF SPORTS-UNIVERSITY OF PORTO

INTRODUCTION: Balance, functional performance and falls have been associated with trunk muscles strength (1) and some evidence show motor control deficits of the trunk muscles in older adults (2). The Pilates method aims to strengthen the core, and seeks to activate the trunk deep muscles before moving limbs allowing seniors to move safely and effectively, and respond better to external disturbances that may occur (3). Our aim is to explore if a 20-week Pilates intervention, easy to apply, low cost and well accepted by older adults could improve trunk strength.

METHODS: Participants (n=66) with a mean age of 72 (DP=5,26) were allocated into a control (n=24) and an experimental group (n=42). EG were divided into small groups (n=14) and submitted to a 20-week Pilates (Polestar® and Phisicalmind®) exercise program of two 60-minute sessions per week. The method uses slow and controlled movements, emphasizing on the concentric and eccentric phases of the exercise and correct posture, preserving the quality of the movement, and aimed to develop trunk strength and stability (core), spinal mobility, upper and lower limb strength and flexibility, coordination, balance, agility, control, and concentration. The maximum concentric torques of the trunk flexor and extensor muscles for participants with an attendance rate of ≥80% were obtained using an isokinetic dynamometer isokinetic (Biodex Isokinetic Systems 4 Pro-Tm) with a 5 maximal repetition test at 60 degrees per second. GLM were used to analyze differences between groups in time.

RESULTS: After the 20-week intervention EG significantly (p=0.03) increased their peak torque at extension (MD 65.985N.m) and flexion (MD 5,561 N.m; p=0.014) while no significant differences were found for the control group between moments in extension but for flexion (MD -12,414 N.m; p<0.001). A significant time*group effect (p<0.001) for flexion and extension (p=0.007) was also found showing different changes over time between the two groups.

CONCLUSION: A 20-week Pilates exercise program was effective in increasing trunk muscles flexion and extension peak torque suggesting an important contribution to older adult's balance that might translate into a reduction in fall risk.

1-Granacher, U., Gollhofer, A., Hortobágyi, T., Kressig, R. W., & Muehlbauer, T. (2013). The importance of trunk muscle strength for balance, functional performance, and fall prevention in seniors: a systematic review. Sports Med, 43(7), 627-641.

2- Hwang, J. H., Lee, Y. T., Park, D. S., & Kwon, T. K. (2008). Age affects the latency of the erector spinae response to sudden loading. Clin Biomech (Bristol, Avon), 23(1), 23-29.

3- Suh, J. H., Kim, H., Jung, G. P., Ko, J. Y., & Ryu, J. S. (2019). The effect of lumbar stabilization and walking exercises on chronic low back pain: A randomized controlled trial. Medicine (Baltimore), 98(26), e16173.

Acknowledgments: doi:10.54499/UIDB/00617/2020. doi:10.54499/UIDP/00617/2020. SG:2023.02364.BD. AP:doi.org/10.54499/DL57/2016/CP1455/CT0002

Oral Presentations

OP-BM24 Biomechanics/Balance and Posture I

CENTER OF PRESSURE DISPLACEMENT AND MUSCLE CO-CONTRACTIONS FACING UNEXPECTED TRANSLATIONS OF AN ELECTRICALLY DRIVEN SUPPORTING PLATFORM: A CROSS-SECTIONAL STUDY IN HEALTHY YOUNG ADULTS.

MARCOLIN, G., BOZZATO, M., FAGGIAN, S., ZULLO, G., RIZZATO, A., PAOLI, A.
UNIVERSITY OF PADOVA

INTRODUCTION: The translation of the base of support represents a promising paradigm to assess dynamic balance control. Dynamometric platforms allow us to quantify postural adjustment objectively throughout the calculation of the Center of Pressure (CoP) displacements. Muscles are engaged to react to these postural perturbations to regain balance and avoid falling. This study aimed to investigate postural responses to unexpected perturbations of the support base through CoP displacements and lower limb muscle co-contractions.

METHODS: Twenty-two healthy young adults (Females = 11) participated in the study. They were assessed on a force platform screwed over a servo-controlled, electrically driven supporting platform combining the following independent variables: direction (forward (FW) and backward (BW)), displacement (25mm, 50mm, and 100mm), and ramp rate (100 mm/s and 200 mm/s). The subjects underwent two sets of 12 trials, randomly combining the platform settings. The CoP anterior-posterior trajectory within the 2.5s time window after the perturbation occurred was considered to calculate the following parameters: mean velocity (UP), displacement (Area95), first peak (FP), maximal oscillations (ΔCoPMax), and standard deviation (PPV). The surface electromyography of the tibialis anterior, gastrocnemius lateralis, rectus femoris, biceps femoris, rectus abdominis, and erector spinae was recorded within the same time window to calculate the co-contraction index (CCI) of the shank, thigh, and trunk. Two-way ANOVAs were performed for CoP-related parameters and CCI. Bonferroni post hoc analysis was performed where appropriate.

RESULTS: UP and Area95 were influenced by direction ($p<0.05$), displacement ($p<0.01$), and ramp rate ($p<0.01$) with higher values in FW than BW and values that increased with the increment of ramp rate and displacement. Similarly, FP and ΔCoPMax were affected by the direction ($p<0.05$) and negatively influenced by the increments of ramp rate ($p<0.01$) and displacement ($p<0.001$). PPV was not affected by platform direction. Interestingly, lower values of FP and ΔCoPMax occurred in the FW translations. Shank, thigh, and trunk CCI within the 2.5s time window showed no significant trends.

CONCLUSION: UP and Area95 results indicated less efficient postural responses in the FW condition. The greater values of FP and ΔCoPMax in BW could depend on the foot-ankle anatomical complex that allows a greater CoP displacement toward the tiptoes. CCI findings did not account for the CoP behavior and warrant further analysis over a shorter time window after the unexpected translation of the platform occurred.

REFERENCES:

Rizzato et al., Sensors, 2023. doi: 10.3390/s23136203.

Brown et al., Gait Posture, 2001. doi: 10.1016/s0966-6362(01)00131-x.

VISUALLY AND MECHANICALLY INDUCED GAIT PERTURBATION EXERCISE ENHANCES TRIP-RESISTING SKILLS

WEBER, A., HARTMANN, U., WERTH, J., EPRO, G., KAUFMANN, M., KLUGE, A., ELLEGAST, R., KARAMANIDIS, K.
UNIVERSITY OF APPLIED SCIENCE KOBLENZ

INTRODUCTION: Perturbation-based balance training during locomotion has gained interest as an effective way to improve recovery responses and prevent falls in various populations groups1. Next to mechanically induced gait perturbations, exercise in virtual reality (VR) is promising for motor skill learning2. Given that generalisation of adaptations is crucial for effective stability control and fall prevention, this study aimed to assess the transfer of adaptive refinements in balance recovery responses obtained via exercising mechanically or visually induced gait perturbations to unpredictable tripping.

METHODS: Within the framework of a work force project, 110 healthy young and middle-aged (18 to 63yrs) postal and industrial workers (i.e. high-risk group for falls) were randomly assigned either to a control group (n=30; no perturbation exercise) or into two perturbation exercise groups (MEC and VR); and walked on a treadmill. The MEC group (n=40) underwent mechanically induced posterior and medio-lateral gait perturbations via ankle and waist pulls using a pneumatically operated brake-and-release system. The VR group (n=40) was given visually induced gait perturbations through rotations of the virtual environment displayed in VR glasses. Prior and following the treadmill tasks, potential transfer effects were examined during walkway negotiation with sudden electronically triggered tripping elements. Training effects on locomotor adaptations and balance recovery improvements during tripping (transfer task) were assessed by analyzing sagittal plane joint kinematics and the components of the margin of stability (MoS) using statistical parametric mapping over the first two recovery steps. Furthermore, the incidence of near-falls and falls in daily life was monitored two weeks prior to and after the treadmill session using a questionnaire.

RESULTS: Both intervention groups showed a comparable increase in MoS during the transfer task in relation to pre-exercise ($p<0.05$). Furthermore, these groups revealed a lower extrapolated center of mass and lower trunk flexion angle during the compensatory steps during tripping post exercise ($p<0.05$) and reported approximately 25% decrease in near-

fall incidents in daily life. The control group did not show any significant changes in balance recovery responses during the transfer task or change in near-fall incidents over the monitored period.

CONCLUSION: The current study suggests that repeated visual and mechanical perturbations during walking can lead to adaptive refinements in balance recovery responses and transfer of adaptations to other conditions, enhancing trip-resisting skills. The improvements in dynamic stability during tripping were related to more effective postural adjustments in trunk dynamics leading to less anterior center of mass displacement in response to unpredictable perturbations, which may help to mitigate sudden perturbations to gait in daily life.

1McCrum et al., 2022, FrontSportsActLiving

2Delgado & Der Ananian, 2021, GamesHealthJ

RESTORING GAIT STABILITY IN PATIENTS WITH KNEE OSTEOARTHRITIS RELIES ON HIP JOINT MOMENTS

REN, X., LUTTER, C., KEBBACH, M., BRUHN, S., YANG, Q., BADER, R., TISCHER, T.

ZHEJIANG NORMAL UNIVERSITY

INTRODUCTION: The lower limb maintains stability after a gait perturbation by establishing a new base of support and generating joint moments, thus contributing to balance recovery. However, different perturbations may require distinct strategies, especially for patients. This study was to investigate the characteristics of normal gait and the first recovery step following forward trip perturbations (trip_Rec1) and compensatory strategies produced by the lower extremities in patients with knee osteoarthritis (OA).

METHODS: Nine patients with knee OA and 15 age-matched able-bodied healthy older individuals volunteered to participate in this investigation. The measurement sessions were performed on the Gait Real-time Analysis Interactive Lab including normal walking and forward tripping perturbed walking. Lower limb joint angles and joint moments were recorded. An independent samples t-test and one-dimensional statistical mapping were employed for statistical analyses of knee flexion excursions and ankle, knee, hip moments throughout the gait cycle between patients with knee OA and older adults, respectively.

RESULTS: Patients with knee OA demonstrated significantly smaller knee flexion excursion than older adults during normal gait (10.70±5.51 vs 17.92±3.48, P=0.0007), whereas no significant difference was observed in the trip_Rec1. At the hip joint, significant differences in sagittal moment were observed between the two groups, at 41.04-58.24% ($P < 0.001$) in the stance phase and at 71.17-84.74% ($P < 0.001$) in the swing phase in normal gait, as well as at 56.44-62.63% ($P = 0.003$) in the stance phase in trip_Rec1. Significant differences in frontal moment were solely observed between the two groups in normal gait at 32.45-41.3% ($P < 0.001$).

CONCLUSION: Patients with knee OA have an increased potential risk of falls during walking due to inherent pathological characteristics. Moreover, the compensation for the hip abduction moment in the frontal plane may keep the gait pattern of patients with knee OA largely consistent with a normal gait as well as with older adults in terms of the stance phase (%). These findings have clinical implications for the rehabilitation of fall-prone older adults and patients requiring gait stabilization, leading to the relevance of physical therapies such as balance-based gait perturbation training.

COMPARISON OF DYNAMIC SINGLE LEG BALANCE BETWEEN LEG IN ITBS RUNNER: A PRELIMINARY STUDY.

JAIHARN, O., SINSURIN, K.2, KHONGPRASERT, S.1

1CHULALONGKORN UNIVERSITY, 2MAHIDOL UNIVERSITY

INTRODUCTION: Iliotibial band syndrome (ITBS) is one of the most common overuses running-related injury (1). One of the contributing factors to ITBS is indeed irregular kinematics of the hip and knee, particularly between legs (2). Biomechanical studies have revealed that Gluteus medius (Gmed) strength impairment is accountable for an increased risk of knee injuries (3-5) since it responsible for stabilizing the pelvis in the frontal plane and maintaining a stable base of support during activities of the single leg. However, there are only a few reports on balance control in ITBS runners. This study aimed to investigate the balance of the single leg. In addition to determine the relationship between Gmed muscle thickness and dynamic balance control.

METHODS: Eight cases of ITBS leg in female runners (Age 35.38±8.20 years) performed single leg dynamic balance using Biodex and the Y-Balance test. While the contralateral leg acted as a control. Bilateral static ultrasound images of the Gmed were obtained over 3 trials to investigate muscle thickness. Differences between legs were examined using paired t-tests. Pearsons correlations were used to analyze the relationships between muscle thickness and dynamic balance tests.

RESULTS: The ITBS leg showed a smaller thickness of Gmed (0.10±0.29 cm) and demonstrated a higher overall stability index (Firm: 1.34±2.37; Foam: 0.65±11.40) compared to the control leg. There is a moderate negative correlation between the thickness of Gmed and the direction of posterolateral reach ($r = -0.55$, $p=0.026$). Additionally, a high positive correlation was found between anterior reach and posteromedial reach direction ($r = 0.75$, $p = 0.001$).

CONCLUSION: Although there was no significant difference between Gmed thickness and dynamic balance. ITBS leg was likely to diminish single leg stability. Thus, asymmetrical assessments between legs should be taken into account in ITBS runners.

REFERENCES:

(1) Nicolas Kakouris et al., J Sport Health Sci, 2021

(2) Reed Ferber et al., J Orthop Sports Phys Ther, 2010

(3) Christopher M Powers, J Orthop Sports Phys Ther, 2010

(4) Eric Foch et al., Gait Posture, 2015

(5) Karrie L Hamstra-Wright et al., Clin Biomech (Bristol, Avon), 2020

COMPARATIVE ANALYSIS OF POSTURAL STABILITY DURING SINGLE-LEG STANCE IN SUBJECTS WITH AND WITHOUT PATELLOFEMORAL PAIN

ARIN-BAL, G., GUNEY-DENIZ, H.

HACETTEPE UNIVERSITY, FACULTY OF PHYSICAL THERAPY AND REHABILITATION

INTRODUCTION: Patellofemoral pain is a musculoskeletal disorder frequently observed in young athletes and is associated with functional impairments. Subjects with PFP exhibit deficits in postural control measures compared to healthy subjects, and there is a need to evaluate these measures, particularly in different stance tasks such as single-leg stance.

METHODS: A total of 34 legs were evaluated for the study, comprising 12 subjects with PFP (3 male, 9 female; 16 legs with PFP) and 9 healthy subjects (3 male, 6 female; 18 legs). After collecting demographic data such as age and body mass index (BMI) from each subject, pain at rest and during activity was assessed using the visual analog scale (VAS), and the Kujala Patellofemoral Score (KPS) was administered to assess functional status to the subjects with PFP. K-Plates from Kinvent (Kinvent Inc., Montpellier, France) were utilized to evaluate postural stability. Each subject performed a single leg-stance for 50 seconds with three repetitions, and the mean scores were analyzed for the differences. Measures collected included ellipse area in mm2, anteroposterior (AP) and mediolateral (ML) amplitudes in mm, and AP, ML, and center of pressure (CoP) path lengths and velocity measures in mm and mm/s, respectively.

RESULTS: The mean age was 24±4.15 years, and BMI was 21.23±2.47 kg/cm2 in the PFP group, while the mean age was 24.83±3.73 years, and BMI was 22.75±2.85 kg/cm2 in the healthy group. Demographic characteristics of the two groups were similar ($p>0,05$). Mean pain scores were 2.18±1.88 at rest and 4.61±2.22 during activity. The mean KPS score was 79.69±7.81 in subjects with PFP. The AP, ML, and CoP path measures were higher, and ML and CoP velocity measures were lower in PFP group compared to healthy controls ($p<0,05$). There were no differences in ellipse area, AP and ML amplitudes, and AP mean velocity measures between the two groups ($p>0,05$).

CONCLUSION: The study results indicate that subjects with PFP, even their functional status is good, exhibit increased postural stability values compared to healthy controls, providing insights into the postural stability differences between the two groups. Subjects with PFP may be at risk due to altered postural stability during various physical activities and sports (i.e., running). Given that postural control is considered a risk factor for developing lower extremity injuries, deviations in postural stability should be addressed to improve health. Single-leg stance assessment can be considered for evaluating postural stability in clinics to better understand the conditions of the subjects with PFP and provide better rehabilitation approaches in case injury originated from poor postural stability.

Oral Presentations

OP-MH35 Exercise and diabetes II

DEPLOYING EXERCISE AS MEDICINE AND HEALTH COACHING FOR INDIVIDUALS AT RISK OF DIABETES IN SINGAPORE

CHIA, J.S.

SPORT SINGAPORE

INTRODUCTION: In Singapore, over 400,000 Singaporeans live with diabetes with a higher than global average of both prevalence of prediabetes and diabetes. This is of great concern, given that 1 in 4 Singapore residents will have prediabetes, and if preventive measures are not taken, 35% of them will eventually develop diabetes. The progression from prediabetes to diabetes is preventable through appropriate lifestyle management, highlighting the need for effective lifestyle interventions and support. Although many physical activity interventions have shown to be effective in clinical trials, their practical efficacy and sustainability over time is largely dependent on the individuals motivation amongst other factors. A key challenge of engaging individuals at risk is that they are likely to feel well and therefore, not see the need to change their behaviours. In Singapore, Active Health which is a national social movement under Sport Singapore, a statutory board under the Ministry of Culture, Community and Youth, seeks to empower individuals to take ownership of their health and wellness through the evidence-based programming and support from the Active Health Coaches who are Exercise-is-Medicine trained. This study was designed to examine the efficacy of a sport-inspired physical activity intervention coupled with health coaching in individuals at risk of diabetes in Singapore.

METHODS: To achieve this, a six-week Active Health Programme combining sport-inspired exercises, crafting of a health and wellness vision and health coaching support was introduced to 100 individuals aged 18 - 39 years. Participants were randomly allocated into two groups, with the control group receiving only the weekly sport-inspired exercises. All participants attended a 60-min session each week. At the end of the 6 weeks, participants were left to exercise independently and returned on Week 12 for assessment.

RESULTS: Significant differences in anthropometric and health biomarkers were observed in all participants at week 12. This was accompanied by a significant increase in moderate-intensity physical activity days for the intervention group.

CONCLUSION: The findings have direct implications on the efficacy of health coaching and specifically, the usefulness of crafting a health and wellness vision in the use of exercise in combatting Type-2 diabetes. This is important given that many programmes focus only on exercise and this inclusion of elements of health coaching and visioning could be key in improving the health of individuals.

ASSOCIATION BETWEEN LEISURE TIME PHYSICAL ACTIVITY AND INSULIN RESISTANCE IN ADULT: AN ANALYSIS OF THE DOSE-RESPONSE RELATIONSHIP

DENG, W., ROJO TIRADO, M.A., LING, J.Y., SU, R.H., TIAN, H., ZHAO, M.S., LI, D., LI, Y.J., YE, Q.

UNIVERSIDAD POLITÉCNICA DE MADRID

INTRODUCTION: Leisure time physical activity (LTPA) is a modifiable factor in the prevention and treatment of Type 2 Diabetes Mellitus. Recent studies indicated that regular LTPA reduced the risk of insulin resistance, metabolic syndrome, and type 2 diabetes. There are established recommendations of 150–300 min of moderate-to-vigorous physical activity per week according to the World Health Organization and American Diabetes Association [1]. However, the relationships between specific LTPA amount and insulin resistance (IR) are still unclear.

METHODS: Data from the 2007 to 2018 National Health and Nutrition Examination Survey (NHANES), were analyzed (n=10,199, adults aged 48.2± 17.6 [20.0, 80.0], 49.7% male). LTPA was assessed using the Global Physical Activity Questionnaire (GPAQ). The LTPA was classified into four categories: (1) inactive 0 min/week, (2) insufficiently active 1 to 149 min/week, (3) sufficiently active 150 to 299 min/week, and 4) highly active ≥300 min/week [2]. IR was determined by the homeostatic model assessment for IR (HOMA-IR) of ≥2.5 [3,4]. Diabetes was defined by either having a self-reported physician diagnosis or having a fasting plasma glucose level of 126 mg/dL or more or an HbA1c (hemoglobin A1c) level of 6.5% or more [5]. A weighted logistic regression model to investigate the correlations between LTPA and IR was performed. Restricted cubic spline (RCS) analysis was used to examine the dose-response relationship between LTPA and IR. All statistical analyses were survey-weighted and adjusted for covariates (i.e., gender, education level, occupation, income level, marital status, alcohol assumption, smoking, BMI, and chronic diseases). Data cleaning and analysis were performed using the R studio software 4.3.1, and P values <0.05 were considered statistically significant.

RESULTS: Type 2 Diabetes was present in 12.8% of the analyzed individuals: 13.5% of males and 12.2% of females. After adjusting for potential confounders, participants who were highly active (LTPA ≥300 min/week) had significantly lower odds of IR (OR: 0.69, 95% CI: 0.53-0.90, $p < 0.05$) than those in the inactive group (0 min/week). Conversely, no significant difference was found between insufficiently active (1 to 149 min/week; OR: 1.13, 95% CI: 0.85-1.52) or sufficiently active group (150 to 299 min/week; OR: 0.94, 95% CI: 0.73-1.21) with the inactive group. Additionally, RCS regression showed that LTPA was related to IR in a non-linear manner (P for non-linearity = 0.014). Specifically, the risk of insulin resistance decreased as LTPA increased, reaching a plateau for LTPA at approximately 420 min/ week (2.8 times than the recommended 150 min/week).

CONCLUSION: Results from the study highlight the importance of reaching a high level of LTPA (about 420 min/week) for maintaining insulin sensitivity and reducing diabetes risk.

IMPACT OF TYPE 2 DIABETES MELLITUS ON PHYSICAL PERFORMANCE AND LOWER LIMB MUSCLE POWER IN OLDER ADULTS:A COMPARATIVE STUDY

WU, L.1, MAÑAS, A.2,3, GÓMEZ-REDONDO, P.2,3, SÁNCHEZ-MARTÍN, C.2,3, MORENO-MANZANARO, D.2,3, GONZÁLEZ-MARTOS, R.2, ARA, I.2,3, GÓMEZ-RUANO, M.1, GUADALUPE-GRAU, A.2

1-DEPARTMENT OF SOCIAL SCIENCES,PHYSICAL ACTIVITY,SPORT AND LEISURE, UNIVERSIDAD POLITÉCNICA DE MADRID, SPAIN; 2-GENUD TOLEDO RESEARCH GROUP,FACULTY OF SPORTS SCIENCES.UNIVERSIDAD DE CASTILLA-LA MANCHA, SPAIN; 3-CIBER ON FRAILTY AND HEALTHY AGING (CIBERFES), INSTITUTO DE SALUD CARLOS III, SPAIN ; 4-CANCER STEM CELL RESEARCH GROUP, UNIVERSIDAD POLITÉCNICA DE MADRID, SPAIN.

INTRODUCTION: Type 2 diabetes mellitus (T2DM) is significantly increasing in the older population (Sesti et al., 2018). Particularly, T2DM not only disrupts systemic metabolic function but also predisposes individuals to a spectrum of health complications, including neuropathy, cardiovascular disease, and retinopathy, which seriously affect the quality of life and long-term health status of older persons (Ng et al., 2014). In addition, a natural decrease in muscle strength occurs with increasing age, and T2DM patients show a greater decline in muscle strength. Therefore, this study aims to compare the differences in physical performance and lower body muscle power production, mediated by the relationship between force and velocity (F-V), between T2DM patients and their healthy counterparts.

METHODS: A final sample of 15 T2DM (T2D group) participants and 15 non-T2DM healthy older adults (CON group) were recruited and matched based on age (T2D:73 ± 2, CON:72 ± 3), gender (7 males and 8 females in each group) and BMI (T2D:30.2 ± 2.1, CON:30.3 ± 1.9) for this cross-sectional study. Physical function was assessed using the Short Physical Performance Battery (SPPB) (Guralnik et al., 1994), while handgrip strength was measured using a digital hand-held dynamometer (Takei TKK5401, Tokyo, Japan). The F-V relationship was evaluated in the leg press exercise (Selection MED, Technogym, Italy) using a lineal encoder (TForce System, Ergotech, Spain). From the F-V regression equation, several variables were derived, including maximum isometric force or intercept force (F0), maximum unloaded velocity (V0), optimal

force (Fopt), optimal velocity (Vopt), the slope of the F-V relationship (F-V slope), and maximum muscle power (Pmax). To assess the differences by groups, the Student's t-test was run considering a significance level set at P≤ 0.05.

RESULTS: SPPB scores in the T2D group were significantly lower than the CON group (T2D:11.2 ± 0.6, CON:11.7 ± 0.7, P=0.043). There was no significant difference in handgrip strength between groups (T2D:27.4 ± 11.1, CON:32.7 ± 7.8, P>0.05). F0 was significantly higher in CON group (T2D:790.95 ± 161.66, CON:1014.34 ± 286.27, P=0.015) while V0 was relatively higher in T2D group (T2D: 1.02 ± 0.32, CON:0.71 ± 0.16, P=0.003). Significant differences were also found in Fopt (T2D:395.47 ± 80.83, CON:546.74 ± 247.3, P=0.038), Vopt (T2D:0.51 ± 0.16, CON:0.35 ± 0.08, P=0.002) and F-V slope (T2D:-855.94 ± 333.92, CON:-1275.45 ± 383.55, P=0.005) between groups. No differences were found between groups for Pmax (T2D:197.82 ± 57.74, CON:182.52 ± 80.75, P=0.556).

CONCLUSION: Type 2 diabetes negatively influences the level of physical function and several variables related to lower limb muscle power-generating ability in older adults. The evaluation of the F-V profile might help to identify specific neuromuscular deficits, guiding the design of targeted exercise programs to enhance physical performance in this population.

EFFECTS OF REDUCED SEDENTARY TIME ON ADIPOSE TISSUE GLUCOSE UPTAKE IN ADULTS WITH METABOLIC SYNDROME

GARTHWAITE, T., SJOROS, T., LAINE, S., KOIVUMAKI, M., VAHA-YPYA, H., NEUVONEN, J., NORHA, J., HOUTTU, N., LAITINEN, K., KALLIOKOSKI, K., VASANKARI, T., KNUUTI, J., HEINONEN, I.

UNIVERSITY OF TURKU

INTRODUCTION: Sedentary behavior (SB) and physical inactivity are associated with insulin resistance, and regular physical activity (PA) is known to improve whole-body glucose metabolism. It is not clear whether reducing SB and increasing PA can improve tissue-specific insulin sensitivity in adipose tissue. The purpose was to investigate the effects of reducing SB on glucose uptake (GU) in adipose tissue in adults at risk of type 2 diabetes in a 6-month randomized controlled trial.

METHODS: Forty-four sedentary inactive middle-aged adults with metabolic syndrome were randomized into intervention (INT, n=23) and control (CON, n=21) groups. INT aimed to limit SB by 1 h/day and CON was instructed to maintain usual habits. SB and PA were measured with hip-worn accelerometers for six months. Insulin-stimulated GU in visceral (VAT) and abdominal and femoral subcutaneous adipose tissue (SAT) was determined with (18F)FDG-PET imaging and hyperinsulinemic euglycemic clamp. VAT and abdominal SAT masses were determined with MRI.

RESULTS: INT reduced SB by 51 min/day and increased moderate-to-vigorous PA by 22 min/day, with no changes in CON. Both groups increased light-intensity PA by 11 min/day on average. Steps also increased in both groups, but the increase was greater in INT compared to CON (+3200 vs. +1700 steps/day). VAT GU and abdominal SAT GU did not change during the intervention in either group, but femoral SAT GU increased from 6.5 (95 % CI 5.8, 7.3) umol/kg tissue/min at baseline to 7.7 (6.8, 8.7) umol/kg tissue/min at six months, with no difference between groups (time p=0.02, group x time p=0.66). VAT and abdominal SAT mass (kg) also decreased slightly in both groups (time p<0.05). The decrease in SAT mass was greater in INT compared to CON, but the difference was not significant (-0.43 kg vs. -0.02 kg, group x time p=0.07). GU per total abdominal VAT and SAT mass did not change in either group. Among all participants, changes in adipose tissue GU correlated with changes in body composition and circulating lipids (p<0.05).

CONCLUSION: A reduction in daily SB did not have an effect on adipose tissue GU. However, reducing SB and increasing PA might improve adipose tissue GU indirectly through their positive effects on body composition.

Oral Presentations

OP-AP28 Training and Testing/Fatigue

IS THE PERCEPTION OF BARBELL VELOCITY DURING THE BACK SQUAT A STABLE PARAMETER UNDER DIFFERENT FATIGUING CONDITIONS?

DELLO STRITTO, E., ROMAGNOLI, R., QUAGLIAROTTI, C., PIACENTINI, M.F.

UNIVERSITY OF ROME FORO ITALICO

INTRODUCTION: Velocity-based training is an objective method of autoregulation that uses barbell velocity and velocity loss to manage and quantify resistance training (RT) sessions. However, in large team settings, electronic devices are not always available for all athletes. For this reason, the perception of barbell velocity (VP) has recently gained interest, with studies demonstrating that after a period of familiarization1,2, VP improves to practically match real velocity (VR). What is still unexplored is how fatigue affects the accuracy of VP. The aim of the present study was to investigate the effects of mental (MF) and physical fatigue (PF) on VP and perception of velocity loss (VLP).

METHODS: Eleven subjects (23.16±2.12years; RT experience: 4.5±2.31 years) participated in a seven-session experimental protocol. The first four sessions aimed to familiarize subjects with VP and VLP. The last three sessions were performed in a PF, MF or control condition in a randomized order. The accuracy in perceiving concentric velocity before and after the different conditions was assessed during a test with 2 blinded-loads (heavy: ?80%1RM, medium: ? 60%1RM), in the Back Squat exercise. PF was induced by 5 x back squats at 75%1RM until exhaustion, while MF was induced by a 45-minute AX-CPT test. The control session involved watching a 45-minute unemotional documentary. VP, VLP, and physical perfor-

mance assessed by a countermovement jump (CMJ), rate of force development (RFD), and maximum voluntary contraction (MVC) were measured before and after each condition. Data were analysed with a Paired t-test to compare pre- and post-fatigue protocol measurements, the level of significance applied was $p<0.05$.

RESULTS: VP and VLP were unaffected ($p>0.05$) by the fatiguing protocols despite a significant reduction in VR (VRrest:0.67±0.08 m·s-1; VR PF:0.44±0.10 m·s-1; VRMF:0.51±0.13 m·s-1). Performance decreased significantly ($p<0.05$) after PF and MF (CMJ: -19%, -7%; RFDmax: -25%, -9%; RFD0-100ms: -22%, -9%; RFD0-200ms: -19%, -10%; MVC: -20%, -10%) Moreover, VAS reported an increase in perceived MF after AX-CPT but not after the documentary. No differences were seen in the control condition ($p>0.05$).

CONCLUSION: Despite a significant reduction in VR, both fatiguing protocols did not alter VP during back squat. These data confirm previous studies performed with shorter protocols3 confirming that VP is a stable parameter on which practitioners can base their training despite different levels of fatigue. Furthermore, CMJ, RFD, and MVC performance were negatively affected by both conditions. While this it is well-established under PF conditions, further investigation is needed to better understand the effects of MF.

References:

1. Dello Iacono, A., et al., (2023

2. Romagnoli, R., et al., (2022)

3 Romagnoli, R., et al., (2022a)

DURABILITY IS ASSOCIATED WITH HIGHER RESISTANCE TO FATIGUE IN ELITE VS RECREATIONAL CYCLISTS

DEMAY, R., MASSON, L., KERHERVÉ, H.A.

UNIVERSITÉ RENNES 2

INTRODUCTION: In road cycling, the ability to perform maximum intensity efforts after hours of racing, or durability, can make a difference between winning and losing [1]. Specifically, differences between World Class and Continental-level athletes are best observed in the fatigued state [2][3], yet the reasons behind these level-dependent variations remain unclear. The aim of this study was to clarify the effect of prolonged duration exercise with interspersed maximal efforts on performance and fatigability in recreationally-trained and elite cyclists.

METHODS: Twelve recreational (maximal oxygen uptake (VO2max):61.9±7.3 mL/min/kg, Critical Power (CP):298±31W) and six elite-level cyclists (VO2max:75.8±5.4mL/min/kg, CP:378±62W) rode on a cycle ergometer for three hours in the moderate-intensity domain (90% VT1: 221±42 vs 180±22W) interspersed with three exhausting bouts destined to deplete W' (3min all-out test, 3AOT) at 0, 90 and 180 min elapsed. Power and heart rate (HR) were continuously monitored. Blood lactate ([La]), expired gases and ratings of perceived exertion (RPE, 6-20 Borg scale) were recorded every 30 min during moderate intensity bouts. Expired gases were measured during, and lactate concentration measured 30-s after each 3AOT. Knee extensor maximal voluntary contractions (MVC) were measured after warm-up, immediately after each 3AOT, and again 10 minutes post each 3AOT.

RESULTS: Elite cyclists were characterised by higher CP, VO2max, peak power (721±96 vs 591±98 W) and VT1 (244 ±45 vs 199 ±29W) than recreational cyclists. During moderate intensity cycling, there were no significant group or time differences in VO2, [La], RPE and HR. There were also no group differences in CHO consumption (2.3±0.5 vs 2.2±0.4 g/min) despite the higher absolute intensity and energy cost (20±3 vs 17±2 kcal.min-1) in the elite group.

There were significant alterations from 1st to 3rd 3AOT, in total work (elite: 75±9 vs 81±10 kJ ; recreational: 62±9 vs 59±10 kJ) and [La] (elite: 13.4±3.2 vs 8.0±2.9 mmol.L-1 ; recreational: 9.2±3.9 vs 7.6±2.9 mmol.L-1). However, W decreased significantly only in recreational cyclists (10.1±1.4 vs 12.4±9.1 kJ). There were no significant changes in CP or VO2peak during the three 3AOT for both groups.

Knee extensor MVC decreased only in recreational group (122±29 vs 104±32 Nm) with no differences in relative voluntary activation in both groups.

CONCLUSION: The main finding of this study was that recreational athletes displayed higher fatigability than elite cyclists over the duration of the prolonged exercise. In elite athletes, initial force was not different after despite higher total work, higher work performed during each 3AOT, and higher W' expended during each 3AOT. Elite cyclists also had similar CHO but higher FAT contribution to total energy expenditure at moderate intensity.

[1] Mateo-March et al. (2021a) [2] Mateo-March et al. (2021b) [3] Van Erp et al. (2020)

FATIGUE-RELATED VARIATIONS IN BILATERAL DEFICIT AND INTERLIMB ASYMMETRY IN YOUNG GYMNASTS

OZGOR, N., KOSE, M.G., KIN ISLER, A.

BAŞKENT UNIVERSITY

INTRODUCTION: The impact of bilateral deficit (BLD) and interlimb asymmetry (IA) on athletic performance and sports injuries is mostly unknown. It is important to understand the fatigue-related changes in BLD and IA in sports such as gymnastics, where both unilateral and bilateral jumps are involved to minimize the decrement in performance that may occur as a result of fatigue and to prevent injuries. This study aimed to investigate the fatigue-related changes in BLD and IA in young female gymnasts.

METHODS: 35 young female gymnasts (aerobic and artistic) voluntarily participated in thise study. They were divided into two age groups as 9-11 years (n=19) and 12-14 years (n=16) based on their competition level and three groups based on their biological maturity level which was determined by peak height velocity (PHV): pre-PHV (n=15), PHV (n=13), and post-PHV (n=7). Anthropometric measurements were conducted for determination of physical characteristics and calculation of biological maturity. To evaluate BLD and IA, the participants performed unilateral and bilateral countermovement jump (CMJ) tests before and immediately after a fatigue protocol. The fatigue protocol consisted of 10 consecutive CMJs without rest, each preceded by a 20-meter sprint involving a 180° change of direction. The fatigue protocol was terminated either when participants failed to reach 50% of their maximum jump height for three consecutive jumps or when they reported exhaustion. Independent samples t-test was used to analyze the differences in BLD and IA between age groups, while one-way analysis of variance (ANOVA) was utilized to determine the differences among the maturity groups. The effects of fatigue-related changes were examined using mixed-design ANOVA, considering age groups and biological maturity. Scheffes post hoc test was applied in the analysis.

RESULTS: The results indicated that age group and maturity level did not have a significant effect on bilateral BLD ($p>0.05$). However, significant fatigue effect was observed with respect to age group and maturity level ($F1,33=11.699$, $p=0.002$, $n2=0.262$ and $F1,32=5.962$, $p=0.020$, $n2=0.157$, respectively). Furthermore, significant interactions were found between age group and fatigue, as well as maturity level and fatigue ($F1,33=13.705$, $p=0.001$, $n2=0.293$ and $F2,32=6.742$, $p=0.004$, $n2=0.296$, respectively). In terms of IA, neither age group nor maturity level had a statistically significant effect ($p>0.05$); however, fatigue had a significant effect on both variables ($F1,33=10.835$, $p=0.002$, $n2=0.247$ and $F1,32=9.575$, $p=0.004$, $n2=0.230$, respectively). Nevertheless, the interactions between age groups and fatigue, as well as maturity level and fatigue, were not statistically significant for IA ($p>0.05$).

CONCLUSION: This study demonstrated that fatigue influenced BLD and IA in young female gymnasts. Additionally, fatigue-related changes in BLD varied according to age and biological maturity, whereas IA did not exhibit any variations related to age and biological maturity.

GREATER EFFICACY FOR COUNTERMOVEMENT JUMP HEIGHT THAN FLIGHT TIME: CONTRACTION RATIO MEASURE FOR SIGNALLING MATCH-INDUCED NEUROMUSCULAR FATIGUE IN ENGLISH PREMIER LEAGUE ACADEMY FOOTBALL PLAYERS.

SPRINGHAM, M., SINGH, N., STEWART, P., JONES, I., NORTON-SHERWOOD, C., MAY, D., SHARMA, S.T., SALTER, J., STRUDWICK, A., SHAW, J.

ST MARYS UNIVERSITY

INTRODUCTION: Neuromuscular fatigue (NMF) is a natural consequence of football match play that can compromise physical performance potential and increase injury susceptibility (Bittencourt et al, 2016). Measures derived from the countermovement jump (CMJ) relating to performance (i.e., jump height; JH) and movement strategy (i.e., flight time: contraction ratio; FT:CT) are commonly used in practice to monitor the neuromuscular status of players around games. However, there is a paucity of research available to examine their conceptual efficacy (i.e., sensitivity to match play and time-course of restoration thereafter) for this purpose in under 18 English Premier League (EPL) academy football players. Consequently, we examined the sensitivity and time-course of restoration of CMJ JH (flight time; JHFT) and FT:CT measures following U-18 EPL academy football match play.

METHODS: Eighteen players (age = 17.0 ± 0.7; height = 1.82 ± 0.07 m; body mass = 73.5 ± 76 kg) from a single category 1 EPL U-18 academy team participated in this investigation. Players performed a standardised warm up and three maximal CMJs at five time points around 8 competitive league home games: one day before (MD-1), 30 mins pre-match (MD-PRE), 30 mins post-match (MD-POST) and two (MD+2) and three (MD+3) days post-match. Jumps were performed on dual force plates (ForceDecks FD4000, Vald Performance, Brisbane, AU), sampling at 1000 Hz. Force-time curves were analysed using proprietary software (ForceDecks Version 2.0.8000, Vald Performance, Brisbane, AU). A PERMANOVA and post-hoc univariate analyses of variance were used to examine match-induced changes to CMJ measures. Data collection followed institutional ethics committee approval and the obtainment of informed player and parent / guardian consent.

RESULTS: CMJ JHFT reduced between MD-1 and MD-POST ($d = 0.33$, small, $p = .031$), remained compromised at MD+2 ($d = 0.35$, small, $p = .023$) and had returned to MD-1 levels by MD+3. CMJ FT:CT reduced between MD-1 and MD-POST ($d = 0.22$, small, $p = .142$) and had retuned to MD-1 levels by MD+2.

CONCLUSION: The CMJ performance (JHFT) measure was more sensitive to match play than the CMJ movement strategy (FT:CT) measure in U-18 EPL academy football players. CMJ JHFT showed a small, significant reduction between MD-1 and MD+3, whereas FT:CT showed a small, non-significant reduction between MD-1 and MD+2. This contrasts the result of Cormack et al (2008), who reported equivocal match-induced changes to JHFT but substantial reductions to FT:CT over similar time-points around Australian Rules Football (AFL) match play. Our finding is likely explained by the compromising effect of match-induced muscle damage on maximal neuromuscular performance, limiting CMJ performance. Though previous research reports that NMF can manifest as a change to CMJ movement strategy measures independently of changes to JH (Gathercole et al, 2015), our finding supports the use of CMJ JH measures for signalling match induced NMF in U-18 academy football players.

Oral Presentations

OP-AP30 Sports Technology/Monitoring

MARKER-LESS 3D HUMAN POSE ESTIMATION FOR ANALYZING LOWER LIMB MUSCLE FORCE DURING DEEP SQUAT

LEE, Y.H., CHANG, J.2, LEE, D.3, LEE, H.1
DANKOOK UNIVERSITY

INTRODUCTION: Analyzing muscle force during weightlifting is a crucial indicator for injury prevention and performance enhancement, and understanding individual muscle forces can prevent overloading and provide optimal training stimuli [1]. Marker-based methods using optoelectronic motion capture systems (OMS) and inertial measurement units (IMU) are primarily utilized for analyzing muscle loads. However, these methods have limitations such as the requirement for spacious laboratory environments with equipment, as well as time-consuming experimental setups and analysis [2]. Therefore, marker-free 3D human pose estimation (HPE) using deep learning is advantageous for application in actual environments since it requires only one camera.

METHODS: In this study, one healthy male (28years, 173cm, 73kg) performed deep squat for 3 set of 5 repetitions. Marker trajectories during deep squat were obtained through a OMS (Vicon Motion Systems), and simultaneously, a 2D camera was used for marker-less HPE analysis. Jointformer model [3], which was pre-trained on the H3WB dataset [4], has been used to transform 2D camera data into 3D coordinates. Lower limb muscle force (Gluteus maximus, gluteus medialis, rectus femoris, vastus lateralis, vastus intermedius vastus medialis) were calculated and compared using coordinates obtained through OMS and HPE, employing Opensim full-body squat model.

RESULTS: As a result, the muscle force of OMS was observed to be 355N in gluteus maximus, 91N in gluteus medialis, 399N in rectus femoris, 150N in vastus intermedius, 78N in vastus lateralis, 237N in vastus medialis, respectively. In addition, the muscle force of HPE is analyzed after the predicted 3D coordinates, and the root mean squared error (RMSE) between the ground truth coordinates measured by 3D markers (OMS) and the predicted 2D-3D coordinates using the Jointformer showed a slight difference.

CONCLUSION: The proposed method analyzed muscle force using marker-less techniques, enabling immediate provision of safety guidelines and methods for training in the sports field. Moreover, it will serve as a foundation for developing models applicable for real-time analysis using 2D single cameras in future research.

REFERENCES:

1. Kemler E, Noteboom L, Beijsterveldt A. (2022). Injuries sustained during fitness activities in the Netherlands: results of a retrospective study.

2. Van der Kruk, E., & Reijne, M. M. (2018). Accuracy of human motion capture systems for sport applications; state-of-the-art review. Eur J Sport Sci, 18(6), 806-819.

3. Zhu, Y., Samet, N., & Picard, D. (2023). H3wb: Human3. 6m 3d wholebody dataset and benchmark. In Proceedings of the IEEE/CVF International Conference on Computer Vision (pp. 20166-20177).

4. Lutz, S., Blythman, R., Ghosal, K., Moynihan, M., Simms, C., & Smolic, A. (2022, August). Jointformer: Single-frame lifting transformer with error prediction and refinement for 3d human pose estimation. In 2022 26th International Conference on Pattern Recognition (ICPR) (pp. 1156-1163). IEEE.

A CROSS-SECTIONAL STUDY ON HEART RATE VARIABILITY AND SUBJECTIVE RECOVERY TO OPTIMISE PERFORMANCE.

HIGGINS, P., O'DONOVAN, A., HAYES, O., DOHERTY, R., DALY, A., CROGNALE, D.
INSTITUTE FOR SPORT & HEALTH, UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Heart rate variability (HRV) and psychological assessments are used to monitor the athlete's response to training and their subsequent recovery status. However, the relationship between HRV and perceptions is not yet understood. The purpose of this cross-sectional study was to explore the associations between HRV and subjective measures of fatigue, recovery, and psychological state.

METHODS: Twenty-five competitive endurance athletes (20.6 ± 2.06 yrs.) were examined in the morning (08:00 to 12:00) after a training session (>6 Rating of Perceived Exertion, > 60 minutes). Heart rate variability (lnRMSSD, pNN50) was determined through 5-minute electrocardiogram recording. The psychological assessments which indicate perceived recovery status were the Total Quality Recovery scale, Perceived Recovery Status scale, Hooper Index and Total Mood Disturbance Score. Pearson's Correlation Coefficient was used to assess the associations between HRV and each of the four psychological assessments. Mean HRV was compared between athletes, when grouped according to recovery status, via the Total Quality Recovery (≥13 or <13) and Perceived Recovery Status (>5 or <5) scales.

RESULTS: A low positive correlation was found between the Total Quality Recovery score and lnRMSSD (r = 0.435, 95% CI = 0.048 – 0.708). Non-significant correlations were reported for all other relationships. A significant mean difference in lnRMSSD and pNN50 was found between athletes with different recovery states on both the Total Quality Recovery (MD = 0.7, 95% CI= 0.17 – 1.22; MD = 23.33, 95% CI= 4.46 - 42.19) and Perceived Recovery Status (MD=0.71, 95% CI= 0.21-1.22; MD = 23.99, 95% CI= 5.66 - 42.34) scales.

CONCLUSION: Our findings suggest that there is a limited association between HRV and perceived recovery scores in endurance athletes. When grouped by recovery status, athletes exhibit differences in HRV. This study warrants further exploration of the relationship between HRV and subjective perceptions of fatigue.

CRITERION VALIDITY OF A SIX SECOND WATTBIKE TEST TO DETERMINE PEAK POWER

ASPE, R., RITCHE, E., MIDDLETON, L., TAYLOR, B., SWINTON, P.

ROBERT GORDON UNIVERSITY

INTRODUCTION: The 30-second Wingate anaerobic test (WAnT30) is commonly used to assess an individual's capacity to generate power from anaerobic energy systems in a laboratory [1]. Whilst the WAnT30 has been shown to be valid and reliable [2], criticisms and limitations are apparent [3]. The use of modified Wingate anaerobic tests (WAnT) comprising 6-, 10-, or 20-second protocols have been proposed as more effective alternatives to the WAnT30 where peak power (PP) is the measure of interest [1,2,4]. Moreover, anaerobic test accessibility has improved with the development of commercially available Wattbikes that integrate a cycling ergometer with user-friendly software. The primary objective of this study was to assess criterion validity of the Wattbike Pro to measure PP. Comparisons were made between a 6-second test on the Wattbike Pro (PPT6) and the WAnT6 and WAnT30 tests performed on a laboratory ergometer. Where systematic bias was encountered, a second objective of the study was to quantify uncertainty in standard correction equations.

METHODS: Thirty-five participants (males: n=30, 21.3 ± 1.6 yrs, 182.3 ± 8.4 cm, 83.9 ± 12.2 kg; Females: n=5, 23.1 ± 2.2 yrs, 168.5 ± 4.8 cm, 69.1. ± 4.8kg) completed two testing sessions in a randomised order on separate days. One testing session included the WAnT30 and the other included the PPT6 and WAnT6 performed in a random order. A Bayesian framework was used to compare group means and to conduct Bland-Altman analyses to assess criterion validity. Bayes factor (BF) with qualitative interpretation of strength of evidence was used to interpret difference in group means. Stability of correction equations were assessed by quantifying uncertainty in regression parameters and fitted values when regressing WAnT6 and WAnT30 on PPT6.

RESULTS: Comparison of WAnT30 and WAnT6 identified "extreme evidence" for greater PP produced during WAnT6 (Difference0.5 = 33.9 [95%CrI: 10.2 to 57.8 W]; BF>100). Bland-Altman analyses identified similar overestimations for PPT6 relative to both WAnT6 and WAnT30. No heteroscedasticity was observed, but proportional biases with overestimations of ~115 W for those at the 0.25-quantile and ~200 W for those at the 0.75-quantile were found. Substantive uncertainty was identified in regression parameters of correction equations corresponding to plausible changes of up to ~60 to 80 W in fitted values.

CONCLUSION: The findings suggest that where PP is of primary interest the WAnT6 should be performed. Where there is no access to a laboratory ergometer, PPT6 can be an appropriate substitute. However, comparing PPT6 with WAnT values, or attempting to predict WAnT values should be used with caution.

MUSCLE OXIDATIVE CAPACITY IN NATURAL BODYBUILDERS: EVIDENCE FROM NEAR INFRARED SPECTROSCOPY

ROMERO-ARENAS, S., JEREZ-MARTÍNEZ, A., GARCÍA DE FRUTOS, J.M., BORGES-SILVA, F.

UNIVERSIDAD CATÓLICA DE MURCIA

INTRODUCTION: The importance of strength training extends beyond neuromuscular adaptations, encompassing also potential metabolic benefits. However, the relationship between strength training and improvements in skeletal muscle mitochondrial function, crucial for energy efficiency, is less well understood. This study focuses on exploring the oxidative capacity of the vastus lateralis in natural bodybuilders, using near-infrared spectroscopy (NIRS), to understand how strength training affects mitochondrial function.

METHODS: Thirty men participated, divided into natural bodybuilders (n=15; 23.2±3.76 years; 180.3±4.63 cm; 89.5±7.23 kg) and a control group (n=15; 21.6±4.54 years; 177.6±6.25 cm; 82.1±3.31 kg). Following the methodology of Ryan et al. (1), arterial occlusions were applied to assess mitochondrial oxidative capacity, determined by the time constant (TC) from a mono-exponential function derived from the NIRS signal.

RESULTS: A significant difference in TC was found between bodybuilders (24.7±6.27 s) and the control group (37.6±9.35 s), indicating a significantly lower TC in bodybuilders ($p<0.001$).

CONCLUSION: The findings suggest that strength training in natural bodybuilders is associated with an increased mitochondrial oxidative capacity, as evidenced by a reduced TC. This implies that, in addition to neuromuscular adaptations, intensive strength training may promote energy efficiency at the cellular level. These results extend the understanding of the metabolic effects of strength training and underline the importance of including this type of training in sports programmes to optimise mitochondrial function.

1. Ryan et al. J Appl Physiol. 2012;113(2):175-183.

ESTIMATION OF LACTATE THRESHOLD WITH TRANSFER FUNCTION MODELS BASED ON HEART RATE AND POWER

STESSENS, L., MEEUSEN, R., AERTS, J.M.

KU LEUVEN

INTRODUCTION: The lactate threshold (LT) is an important marker in endurance sports used to identify training zones and monitor training progress. The determination of the LT requires expensive equipment, invasive sampling and a visit to a

specialized facility. Therefore, regular monitoring of the LT is inaccessible to a large population of cyclists, even among the elite. Mathematical modelling might form a suitable method for continuous monitoring of performance, especially in combination with commercial sensors and wearable technology. In cycling, the heart rate, power and cadence are already continuously measured and monitored with commercial sensors during training and competition, making them particularly suitable for integration in a modelling technique. This study attempts to explore the estimation of LT with linear time-invariant and linear time-varying models solely based on the heart rate and power.

METHODS: 11 amateur, trained cyclists (6 male, 5 female) participated in this study. They performed an incremental performance test on a Lode Excalibur ergometer in laboratory conditions to determine the maximal oxygen consumption (VO2max), ventilatory thresholds (VT) and LT. The workload increased with 40 watts every 3 minutes. The heart rate was measured with a 12-lead electrocardiogram (ECG). Modelling and analysis was performed with the CAPTAIN toolbox in Matlab R2021b. The LT was estimated using a discrete-time transfer function approach, which was selected due to the low computational effort required and robust qualities. The results were compared with the actual LT2, calculated with the modified Dmax method. Linear time-invariant parameter (TIP) and time-varying parameter (TVP) models were compared.

RESULTS: Calculation of the LT with TIP models was performed with an average error of 11%. For 5 out of 11 participants, the estimated LT was approximated with an error smaller than 10 watts. TVP models performed with an average error of 4%. For 9 out of 11 participants, the LT was estimated with an error smaller than 10 watts. Since the heart rate response is a non-linear signal, a linear TIP model is not able to capture the variability of the signal. By introducing time-varying parameters this non-linearity can be accounted for, even with a linear model.

CONCLUSION: Modelling techniques based on the heart rate and power output approximate the LT with a decent accuracy, with TVP models performing better than TIP models. Our results are interesting to the ECSS community since they propose a more accessible complement to the current gold-standard of testing that might enable regular, day-to-day monitoring of the LT, as well as open up up LT testing to a wider audience. Given the widespread popularity of heart rate, power and cadence sensors in the cycling population this modelling approach could even be applied in the field. Future work needs to focus on verifying the technique over a longitudinal time period and adapting it to field-captured data.

Oral Presentations

OP-AP26 Football Science II

INFLUENCE OF TRAVEL DEMANDS AND MATCH LOAD ON RECOVERY FOLLOWING POST-MATCH TRAVEL IN NATIONAL TEAM FOOTBALLERS.

CLEMENTS, E., EHRMANN, F., CLARK, A., JONES, M., MCCALL, A., DUFFIELD, R.

UNIVERSITY OF TECHNOLOGY SYDNEY

INTRODUCTION: Post-match travel is a concern for national team footballers due to physiological and physical stresses of travel, combined with the need to recover from match-play. The combination of match load [1] and travel requirements [2] are likely to have significant implications for the athlete's fatigue, sleep, soreness and recovery. Additionally, physiological stresses of travel and the imposed time constraints may impair post-match recovery processes of athletes, particularly on return to clubs. This study explored how variations in travel demands and match-loads influence perceptual recovery, fatigue and sleep of footballers following travel after a national team match. Additionally, this study aimed to identify the influence of travel demands and the time between match kick-off and travel departure on match recovery (on Match Day +3).

METHODS: Data was collated from 79 male national team footballers between October 2018 and December 2023. Total distance, high-speed distance, very high-speed distance and counts of accelerations and decelerations were measured using GPS. Post-match travel duration, direction, time zone difference, and the time between match kick off and travel departure was calculated based on travel schedules. Athletes completed a perceptual monitoring questionnaire daily from 1 day pre-match through to 3 days post-arrival from travel. The questionnaire included perceptual ratings of fatigue, soreness, sleep and stress, as well as the perceived recovery status scale [3]. Linear mixed models were built to assess the influence of match load and travel variables on each perceptual scale for the 3 days post arrival. Additional models were built using a standardised post-match timepoint of MD+3 to determine whether travel demands, and the timing of travel had influence over post-match recovery.

RESULTS: Perceived recovery, fatigue, soreness, and sleep were reduced on day 1 post-travel and significantly improved for each day post-arrival ($p<0.001$). Higher match-loads were associated with poorer ratings on recovery, fatigue, soreness, and sleep scales ($p=0.001$-0.032). Athletes also reported poorer fatigue, soreness and recovery when travelling out of national teams to clubs compared to between national team matches ($p<0.001$). Travelling eastward was associated with poorer sleep ($p=0.004$). Longer periods between kick-off and travel departure were associated with poorer sleep on MD+3 ($p=0.003$), but had no influence on any other variable.

CONCLUSION: Perceptual recovery, fatigue, sleep, and soreness following post-match travel were affected by both match load and travel demands. Athletes with greater match loads and those travelling eastward after matches are likely to be in a poorer recovery state on arrival. Additionally, departing later after a match was associated with poorer sleep due to arrival closer to MD+3 but had no impact on other recovery measures.

[1] Rabbani et al. (2019) [2] Clements et al. (2023) [3] Laurent et al. (2011)

THE ENERGETIC CONTRIBUTIONS TO SMALL-SIDED SOCCER GAMES AND THE IMPACT OF INDIVIDUAL AEROBIC PERFORMANCE

OH, S., HARTMANN, U.
KOREA FOOTBALL ASSOCIATION

INTRODUCTION: The previous studies examining the intensity of small-sided soccer games (SSGs) have employed heart rate, lactate and assessed the dominant energy system during SSGs. This could lead to wrong interpretation associated with the energy system during SSGs. It is not possible to evaluate the energetic contributions (EC) without determination of the oxygen uptake (VO2). In addition, the responses of the EC to SSGs could be different according to individual fitness level. Thus, the aim of this study is to assess the EC from three energy systems during SSGs, to further investigate the correlation between EC and individual aerobic performance.

METHODS: One week prior to the experiment for SSGs, twelve U16 elite junior soccer players (16.4 ± 1.1 yrs, 69.9 ± 8.8 kg, 178.0 ± 6.5 cm) executed the incremental running test on treadmill (Saturn® 300/100r, GER) in order to determine the aerobic performance by means of the velocity at a fixed LA of 4 mmol/l [1]. The subjects performed 3 different SSGs, 2 vs. 2 (2SG), 4 vs. 4 (4SG) and 6 vs. 6 (6SG), separated by two or three days. 4SG and 6SG were played 4 min, while 2SG was performed 2 min. The EC was calculated based on the accumulated oxygen uptake above rest (aerobic, [WAER]), fast component of the post-exercise oxygen uptake (anaerobic alactic, [WPCr]), maximum net accumulation of blood lactate (anaerobic lactic, [WBLa]) [2] using portable spirometry (MetaMax 3B, GER) and lactate determination (BIOSEN S_line, GER).

RESULTS: WAER during 2SG (69.2 ± 6.8 %) was significantly lower ($p < 0.01$) than 4SG (84.7 ± 3.0 %) and 6SG (87.4 ± 2.8 %), while WPCr and WBLa during 2SG (22.3 ± 3.5 % and 8.5 ± 5.1 %, respectively) was significantly greater ($p < 0.05$) than 4SG (12.4 ± 2.7 % and 2.9 ± 0.6 %, respectively) and 6SG (10.3 ± 2.9 % and 2.4 ± 1.0 %, respectively). WAER during 4SG was significantly lower ($p < 0.05$) than 6SG, while WPCr during 4SG was significantly greater ($p < 0.05$) than 6SG. The significant positive correlation between %WAER and velocity at 4 mmol/l was found (2SG: r=0.78, p=0.005; 4SG: r=0.66, p=0.019; 6SG: r=0.80, p=0.010)

CONCLUSION: The main finding of this study is that the energy supply for all game formats with different game duration comes almost from the aerobic system with more than 70 - 90 % of total energy supply, irrespective of number of players and game duration. The share of anaerobic energy accounted for less than 15 - 30 % of total energy supply. Particularly, the glycolytic share had very small influence on energy supply with less than 3 - 10 %. In addition, the players with high level of aerobic performance could recruit the more aerobic energy system. In this context, coaches should take into account the EC of SSGs and different responses of EC according to the individual aerobic performance, when using SSGs as a tool for soccer-specific endurance training.

1. Mader et al. (1976) 2. Beneke et al. (2004)

INFLUENCE OF SUBSTITUTION AND DIFFERENT ROLE POSITIONS ON METABOLIC POWER AND HIGH-INTENSITY ACTIONS IN PROFESSIONAL SOCCER PLAYERS

LATERZA, F., SAVOIA, C., BOVENZI, A., D'ONOFRIO, R., POMPA, D., MANZI, V.
PEGASO UNIVERSITY

INTRODUCTION: Knowing the physical demands of the official matches is pivotal in every sport. In team sports, such as soccer, different role positioning, and strategical substitutions could make unclear how different physical capacities decrease over time and impact performance. The main limitations of previous studies were the limited number of athletes and data often referred to only one professional team. High-intensity actions are linked to the crucial moment of the match (1); consequently, focusing on these actions is essential. The present investigation aimed to analyze how different cinematic parameters change over game time and provided helpful information to prescribe more effective training programs.

METHODS: Data from four professional teams competing in the Premier Division championship (Series A) were analyzed. The cinematic variables analyzed were average metabolic power (AP) and variables of high-intensity activities. Specifically, the number of power events per minute (PEm), distance (m) covered at (P>25watt/kg) x min-1 (D25), distance (m) covered at (5.28m/s6.94m/s) x min-1 (VHV) were analyzed as high-intensity assessments. All the data were collected by the validated multicamera video analysis system STATS SportVU during official matches for each team. Players were organized into seven groups based on the duration of their gameplay. Each player was assigned to a specific group according to their time played, categorized as follows: 0-15 min, 15-30 min, 30-45 min, 45-60 min, 60-75 min, 75-90 min, and more than 90 min (overtime was not considered). Additionally, different role-positioning, including forwards and wingers (FW), midfielders (MF), center-backs (CB), and left and right-backs (LR), were also contemplated.

RESULTS: Significant differences ($p < 0.05$) were observed for cinematic variables analyzed among different role positions and within the same role across different gameplay durations. The results highlighted a gradual decrease in MFs' performance over time, as evidenced by higher performance values at shorter gameplay durations. In contrast, center-backs displayed a non-consistent pattern, showing no significant impact from time played. MFs also exhibited higher values of average metabolic power (AV) and power events per minute (PEm) compared to other roles, with medium and large effect sizes. Left and right backs and forwards spent more time at very high velocity (VHV) speeds than other roles, independently from the time played.

CONCLUSION: These findings give helpful information about the physical demands required in an official soccer game, and coaches could use these data to review their training prescriptions. References: 1. Filter A, Olivares-Jabalera J, Dos'Santos T, Madruga M, Lozano J, Molina A, et al. High-intensity Actions in Elite Soccer: Current Status and Future Perspectives. Int J Sports Med. 2023 Jul;44(8):535–44.

THE INFLUENCE OF GAMIFICATION ON MOTIVATION AND CARDIAC VARIABLES IN SOCCER

LENNARTZ, R., STOEVE, M., TALAR, K., KUMARAMPULAKKAL, N., DORSCHKY, E., WITTE, M., ESKOFIER, B.
FRIEDRICH-ALEXANDER-UNIVERSITAT ERLANGEN-NURNBERG

INTRODUCTION: Motivation, a complex construct that influences behavior and is a critical factor in an athlete's success is being extensively researched in sports sciences [1,2]. However, motivation is primarily assessed through motivational questionnaires, which results in a lack of objective, continuous measures during a sports activity. Therefore, this study explores the feasibility of measuring short-term motivation through electrocardiogram (ECG). Gamification elements, aligned with self-determination theory (SDT), fulfilling the three basic needs relatedness, competence, and autonomy were used to influence motivation [3].

METHODS: In this study, 42 healthy soccer players (25 males, 17 females; age: (27,8 ± 7,8) years) performed a soccer drill in a circular space surrounded by a 360° screen. The goal for each player was to score as many goals as possible in two different, randomly ordered, counterbalanced scenarios, each lasting 3 minutes - one incorporating gamification elements aligned with SDT and one without. ECG data (Portabiles, Erlangen, Germany) were recorded during the drill. Post-scenario assessments included responses to the Intrinsic Motivation Inventory (IMI) and Player Experience of Needs Satisfaction (PENS), both on a 7-point Likert scale, along with the Borg scale.

RESULTS: Six and nine participants, respectively, were excluded from the questionnaires and ECG analyses. The results of the questionnaires, perceived exertion (Borg scale), perceived autonomy, competence and relatedness (PENS), and interest/enjoyment (IMI) showed no significant differences between scenarios. Average heart rate (HR) during the basic scenario was (116, 25 ± 21,76) bpm, while in the gamified version, it was (108, 39 ± 19,13) bpm ($p = 0.0322$). HR variability (HRV) revealed significantly higher RMSSD (+23 %, $p = 0.0139$) and SDNN (+17 %, $p = 0.0172$) values in the gamified version compared to the basic scenario.

CONCLUSION: In this work, no effect of the gamification elements on motivation could be measured. Some players reported that they solely paid attention to the task and that they ignored additional elements. Nevertheless, the results showed a lower HR and higher HRV in the gamified scenario compared to the basic one, which indicates lower stress levels [5]. This trend is opposed to previous literature [6]. However, due to the complex and individual character of motivation, future analysis should include a detailed investigation of the physiological responses of individuals as well as a long-term study in the presented set-up.

Acknowledgment: This work was supported by VDI/VDE-IT.

[1] Clancy R et al. Psychol Sport Exerc., 27: 232-242, 2016.

[2] Vallerand R et al. Handbook of sport psychology, 59-83, 2007.

[3] Deci E et al. Scand. J. Educ. Res., 38(1): 3-14, 1994.

[4] Francisco-Aparicio A et al. New trends in interaction, virtual reality and modeling, 113-126, 2013.

[5] Aubert A. et al. Sports Med, 33: 889–919, 2003.

[6] Schlömmer M. et al. Sustainability, 13(12), 6608. 2021.

Oral Presentations

OP-MH36 Training interventions for orthopaedic conditions

RESISTANCE TRAINING IMPROVES DISABILITY AND DEEP NECK FLEXOR ENDURANCE IN PATIENTS WITH CHRONIC NECK PAIN

YANG, X., YAO, Y.J., LU, A.Q., ZHANG, H.L., ZHONG, J.Y., CHEN, J., WANG, D.
SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Chronic neck pain (CNP) has become a prevalent musculoskeletal condition, posing a significant challenge to the global healthcare system. Sedentary lifestyles and prolonged poor posture contribute to the increasing incidence of CNP, particularly among younger population. Patients with CNP often exhibit abnormal motor control of the deep cervical flexors which are also easily fatigued even in relaxed situation. Consequently, CNP affects deep cervical flexors endurance and muscle function capacity. Although previous studies have revealed that resistance training can enhance the cervical muscle strength of patients with CNP, few studies paid attention to the motor control and function of deep cervical flexors. To investigate the effects of resistance training on disability and neck deep flexor endurance in patients with CNP.

METHODS: Twenty-four participants with CNP were randomized into an experimental group (EG: n = 12, 24 ± 1.8 yrs, 172.6 ± 8.3 cm, 68.6 ± 10.8 kg) and a control group (CG: n = 12, 23.8 ± 2.0 yrs, 174.8 ± 7.0 cm, 67.2 ± 13.5 kg). The EG under-

went neck resistance training for continuous 6 weeks. The training program was based on the 4 basic patterns of neck movement: flexion, extension, lateral flexion, and rotation. Each training session began with low-load cranio-cervical flexion to activate the deep neck muscles, and was progressed by adding hand resistance and different colored elastic bands. The CG had no intervention. Both groups were assessed at baseline and after the training: neck pain was assessed by a visual analog scale (VAS); neck function was evaluated using the self-reported neck disability index (NDI); cranio-cervical flexion test (CCFT) was conducted for deep cervical flexor endurance measurement. Two-way repeated-measures ANOVA was utilized to determine the significant changes in the aforementioned variables.

RESULTS: Significant interactions between time and group were noted for VAS ($F = 46.108$, $p < 0.001$, $\eta^2p = 0.667$); NDI score ($F = 27.770$, $p < 0.001$, $\eta^2p = 0.558$); and CCFT score ($F = 115.043$, $p < 0.001$, $\eta^2p = 0.839$). EG showed greater release of CNP compared to the CG.

CONCLUSION: This study found that resistance training performed 3 times a week for 6 consecutive weeks can significantly reduced pain levels and NDI score, enhanced neck function, and improved motor control of the deep neck flexors in patients with CNP.

EFFECTS OF 12 WEEKS GYROKINESIS® TRAINING METHOD ON PAIN SYMPTOMS AND FUNCTIONAL LIMITATIONS IN PATIENTS WITH OSTEOARTHRITIS: A PILOT STUDY

MAURI, C., GRAZIOLI, E., CERULLI, C., PARISI, A.
UNIVERSITÀ DEGLI STUDI DI ROMA FORO ITALICO

INTRODUCTION: Osteoarthritis (OA) is the most common musculoskeletal rheumatic disease. Its disabling condition, characterised mainly by pain and functional limitations, has serious implications on patients' quality of life and health national service [1]. Exercise is the main non-pharmacological treatment to reduce pain, increase patients functional capacity and quality of life, and protocols with a high proprioceptive component seem to be the most effective [2]. Gyrokinesis®, which could be defined as sensorimotor training, is an innovative and relatively new method that due to its proprioceptive component could be effective in reducing OA related symptoms.

METHODS: 20 patients affected by OA were enrolled (mean age 57,5 ± 7) and assigned to an exercise group (EG=10) that underwent a 12-week Gyrokinesis® training protocol, and a control group (CG=10) that followed the standard care. The primary outcome was to analyse the effect of the Gyrokinesis® training protocol on perceived pain, through Brief Pain Inventory Questionnaire. As a secondary outcome, functional parameters (Postural Sway, Step Test, 30" Sit to Stand Test, TUG, Stair Climb, Trunk Rotation, Scratch test, Sit and Reach), body composition and kinesiophobia were analysed too. Subjects were evaluated at baseline (T0) and after the 12-week intervention (T1).

RESULTS: Preliminary results on the EG group showed that after 12 weeks of intervention, perceived pain showed a statistically significant reduction between T0 and T1, from 4 (CI 95% 2.57 - 5.42) to 1.25 (0.24 - 2.27) with p=0.007; functional parameters also showed a statistically significant improvement for the postural sway, Step Test, 30" Sit-To-Stand Test, Tug, Stair Climb, Trunk Rotation, Scratch Test, Sit And Reach (with $p<0.05$). Kinesiophobia also showed a significant reduction after 12 weeks of training (p=0.009).

CONCLUSION: Sensorimotor training with the Gyrokinesis® method could be effective in reducing pain symptoms, functional limitations and kinesiophobia levels in patients with OA. The present is a pilot study, so further studies are needed to understand how this type of training can help the therapeutic treatment of these patients.

HIGH-INTENSITY INTERVAL TRAINING IN INDIVIDUALS WITH RHEUMATIC BACK DISEASE

OLSSON, C., TORELL, A., ANDERSSON, Å., HAGLUND, E.
HALMSTAD UNIVERSITY

INTRODUCTION: Physical exercise is an important treatment for individuals with the rheumatic disease axial spondyloarthritis (axSpA). Studies have found that high intensity interval training (HIIT) has positive effects on symptoms and risk factors without exacerbating disease activity(1). However, compliance tends to decrease over time, and long-term supervised training is costly. More knowledge is needed on how to tailor self-managed exercise programs for habitual exercise and improved health. The aim was to study if 12 wks of self-managed HIIT with digital support improved aerobic capacity, strength, body composition, disease activity, and health status differently compared to self-managed moderate intensity training done as usual in an axSpA control group.

METHODS: Thirty-two individuals (16 women), with medically stable axSpA were recruited and randomized to a HIIT intervention group (HIG) or a control group (CTL). HIG completed 3 training sessions/wk where two had to be HIIT (e.g. 4x4 min) in self-selected activities. HIIT was individually tailored and monitored by a fitness watch and included digital support if needed 1/wk. The CTL also used fitness watches and were instructed to exercise as usual (fulfilled WHO recommendations). Assessments were done at baseline and after 12 wks including blood pressure (BP), aerobic capacity (VO2max), grip strength (kg), body mass (kg) and visceral fat (cm2). Self-reported disease activity (BASDAI), physical function (BASFI) and health status (EQ5D) were also measured. Data are presented as mean ± SD, significance level at $p<0.05$. Statistics included a 2 (group; HIG*CTL) by 2 (time; PRE*POST) repeated measures analysis of variance and when main effects or interactions were significant ($p<0.05$) t-tests were used as post-hoc analyses.

RESULTS: Thirty people (age 46 ± 11 years) completed the training intervention. No differences were present between HIG (n=15) and CTL (n=15) at baseline for the studied variables. After 12 wks, both groups lowered their diastolic BP (HIG from

84 to 77 mmHg, p<0.01; CTL from 84 to 79 mmHg p<0.01). Bodyweight did not change but HIG showed a trend that visceral fat decreased (p=0.08), whereas CTL was unchanged (p=0.85). Moreover, both groups significantly increased their cardiac capacity in absolute VO2max (HIG 0.6±0.2 l/min, p<0.01; CTL 0.2±0.2 l/min, p<0.01) but only HIG increased their relative VO2max (9.0 ± 3.5 ml/kg/min, p<0.01). No change (p>0.05) was found in grip strength, health status, physical function or disease activity.

CONCLUSION: After 12 wks of an ongoing RCT comparing self-managed HIIT with moderate training as usual in individuals with axSpA showed that both groups improved DBP and VO2max. HIIT did not seem to affect disease activity, physical function or health status compared to CTL. This indicates that HIIT is a safe form of exercise and both HIIT and moderate intensity training have a good effect on aerobic capacity in axSpA.

Reference: Sveaas SH, et al. Br J Sports Med, 2020. 54(5):292.

Oral Presentations

OP-MH34 School based exercise interventions

SECONDARY SCHOOL RANDOMIZED CONTROLLED INTERVENTIONS WITH A MINIMUM DUAL APPROACH TO HEALTH AND THE LINKS TO BMI IN PUPILS: A PRISMA STUDY WITHIN THE PROJECT FROM SCIENCE 2 SCHOOL

TANOUS, D.R., RUEDL, G., MOTEVALLI, M., WIRNITZER, K.C.

UNIVERSITY OF INNSBRUCK

INTRODUCTION: Health behavior serves as a momentous domain for managing current crises (physical activity [PA] levels; obesity) preeminent in young people and affecting the global population well in excess [1]. In schools, the current behavioral constraints of pupils during compulsory lessons, such as prolonged sitting time, prevent reaching the lowest level of health protection by neglecting the minimum daily PA recommendation by the WHO. This study aimed to assess PA and/or diet (e.g., dual approach) intervention for pupils in secondary schools during usual school hours concerning body weight management.

METHODS: Following the Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines, a study protocol was published. In parallel, a trial registration was completed on the International Prospective Register for Systematic Reviews (PROSPERO: CRD4202347770). The databases covered included Education Source on EBSCO Host (08.12.2021), PubMed (08.12.2021), and EMBASE (20.12.2021). Only RCTs published in English or German were included, with a fully school-based intervention of PA and/or diet. Pupils aged 10-19 of secondary schools in any country without major nutritional deficiency or unstable health condition were the intended population. Title, abstract, and full-text screening, quality assessment, and data extraction were completed by two reviewers.

RESULTS: A total of 5,945 articles were identified by the Boolean logic search strategy; finally, 23 studies, including 9,441 pupils (4,787 males and 4,654 females; mean age: 13.6), were eligible for analysis. Quality assessment indicated that allocation concealment (n = 17) and blinding (n = 21) were the most likely areas of bias. A dearth of top-quality scientific investigation of healthy dietary intervention as well as the minimum dual approach to health for secondary school pupils and the BMI health outcome were found. A random effects meta-analysis found PA intervention implemented in the secondary level school setting (n = 11) for at least eight weeks duration results in -0.12 units (95%-CI: -0.26 – 0.02) of BMI (kg/m2) compared to active controls. Low statistical heterogeneity was found (I2 = 0%; p = 0.60).

CONCLUSION: The findings of the present investigation revealed a more precise effect measure than previous meta-analyses regarding the sole power of secondary schools on PA intervention and the BMI health improvement possibility for pupils. Future RCTs with a healthy diet are recommended. PA intervention for pupils of secondary schools produces healthier body weight management and control for the current global health crisis [2].

References:

1. Motevalli M, Drenowatz C, Tanous DR, Khan NA, Wirnitzer K. Management of Childhood Obesity –Time to Shift from Generalized to Personalized Intervention Strategies. Nutrients 2021; 13: p.1200.

2. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep 1985; 100: 126–31.

IMPACT OF A SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTION PROGRAM ON PHYSICAL ACTIVITY LEVELS, SLEEP PATTERNS, AEROBIC FITNESS, AND MOTOR COMPETENCE

COSTA, J., VALE, A.2, CORDOVIL, R.3, RODRIGUES, L.4, CARDOSO, V.1, PROENÇA, R.5, COSTA, M.1, NETO, C.3, BRITO, J.1, GUILHERME, J.1,6, SEABRA, A.1

1PORTUGAL FOOTBALL SCHOOL, PORTUGUESE FOOTBALL FEDERATION; 2POLITÉCNICO DO PORTO-ESE,PORTUGAL; 3CIPER, FMH,PORTUGAL; 4ESDL-IPVC,SPRINT,PORTUGAL; 5SCHOOL D. CARLOS I,PORTUGAL; 6CIFID,FADE-UP,PORTUGAL

INTRODUCTION: The lack of physical activity (PA) and increasing time spent in sedentary behaviors during childhood stress the importance of developing low-cost and easy-to-implement school-based interventions, aiming to increase PA in children. The "Super Quinas" project evaluated the effectiveness of an intervention program to improve PA, aerobic fitness, sleep, and motor competence (MC) on children in primary school.

METHODS: This pilot project was conducted in 44 schools across the country (i.e., in Portugal), and involved over 1600 school-age children (6 to 10 years old). It took place between January and March 2023 at several school facilities, during extra-curricular activities and led by physical education teachers. All 1600 children completed the MC assessment (MCA) in the PRE test in the 1st week and the POST test in the 12th week. Additionally, a sub-group of 38 children underwent more specific tests (i.e., PA, sleep, body composition and aerobic fitness) for a detailed analysis of the impact of this intervention project. The experimental group (EG) comprised 8 girls and 11 boys (n =19), while the control group (CG) included 9 girls and 10 boys (n =19), all aged 9–10 years. All children attended the same school. The experimental group enrolled in a 12-week intervention program (one more extra-curricular activity class of 60 min per week compared to the CG). Heart rate (HR), external load and enjoyment level (1, no fun to 5, great fun) were recorded in all classes. PA and sleep were measured by accelerometry, aerobic fitness was measured by Children´s Yo-Yo test (YYIR1C) during 1st week (PRE), 6th week (DUR) and 12th week (POST) intervention. MC in PRE and POST intervention was assessed by the MCA instrument.

RESULTS: Comparing the EG and CG in DUR and POST, the EG spent ~18 min and ~34 min more time in moderate to vigorous PA (MVPA) per day (P<0.001); had ~44 min and ~203 min less sedentary time per day (P<0.001); performed more 44 and 128 m in the Children´s Yo-Yo test compared to CG (P<0.001) and slept more 17 and 114 min per night (P<0.001). In POST motor competence was significantly better (27%) in the EG compared to CG (P<0.001). The %HRmax during the extra-curricular classes ranged between 65-81% (i.e., light to moderate intensities), and the enjoyment between fun and great fun.

CONCLUSION: Our findings indicate that adding one more physical education lesson of 60 min per week (i.e., a total of 120 min of physical education weekly), over three months, resulted in significant improvements in PA levels, sleep patterns, aerobic fitness, and MC in children aged 9–10 years. Thus, this study highlights the role of the school-based programs as important determinants of PA levels in elementary school-children. These data reinforce and justify that priority should be given to the development of national action programs that encourage the adoption of healthier lifestyles and to the creation of structural and environmental conditions favorable to children's health.

DOES THE INTERVENTION OF THE SCHOOL-BASED HEALTH PROMOTION PROGRAMME "JOIN THE HEALTHY BOAT" REACH CHILDREN FROM A HIGH OR LOW SOCIO-ECONOMIC BACKGROUND?

KOBEL, S., WARTHA, O., DREYHAUPT, J.

ULM UNIVERSITY

INTRODUCTION: Worldwide, the prevalence of childhood overweight and obesity increases. Children with low socioeconomic status (SES) are more often affected by overweight and obesity. SES is also associated with health behaviours. In order to avoid health disparities, school-based health promotion programmes such as "Join the Healthy Boat" can help. Intervention outcomes can differ by SES, therefore children's health behaviours were investigated after a one-year intervention in respect of their SES.

METHODS: 1620 children's data (7.1±0.6 years; 50.6% male) was analysed; anthropometric data was taken on-site, other health-related parameters and SES were assessed subjectively. Logistic regression models and GEEs were calculated.

RESULTS: Comparisons by SES show that there were significant differences in children's characteristics and health behaviours. After one year, overweight prevalence increased significantly in low-SES children in the control group (CG; p<0.001) but stayed the same in the intervention group (IG). There were no intervention effects for physical activity or screen media use, but children with high SES in the IG skipped breakfast significantly less often than in the CG (p<0.001). Parental education level and household income were also assessed separately, with similar results.

CONCLUSION: The health-promotion programme "Join the Healthy Boat" has the potential to promote children's health via a school-based intervention and therefore reach all children independent from their background. This study shows vast gaps between several health behaviours of primary school children depending on their SES, favouring those children coming from more privileged families. A longer implementation may show more effects.

FEASIBILITY OF PEER-LED HIGH-INTENSITY INTERVAL TRAINING IN SECONDARY SCHOOLS: THE YOUNG FITNESS LEADERS PROJECT

WESTON, K., BURN, N., GALNA, B., WESTON, M., GORDON, A., BASTERFIELD, L.

UNIVERSITY OF STRATHCLYDE

INTRODUCTION: Despite being an efficacious way of improving aspects of child and adolescent physical and mental health, school-based high-intensity interval training (HIIT) interventions are typically delivered by researchers, which limits scalability. This problem could be solved via a peer-led programme, whereby older school pupils deliver HIIT sessions to younger pupils. So, we aimed to explore the feasibility of delivering a school-based peer-led HIIT intervention in North East England.

METHODS: Using a non-randomised controlled trial design, 44 Year 7 pupils (aged 12.1 ± 0.3 years [mean ± SD]) were recruited from one secondary school, with 21 pupils (8 girls) assigned to a peer-led 8-week HIIT intervention and 23 Year 7 pupils (17 girls) to the control condition. Five Year 12/13 pupils (aged 17.3 ± 0.4 years) were recruited as peer-leaders and received in-person and virtual training on the delivery of school-based HIIT using boxing and whole-body exercises. These pupils then delivered HIIT sessions twice weekly during morning tutor time (0830-0845 hours). Sessions initially were 4 x 45 s maximal effort bouts, interspersed with 60 s rest. Each fortnight, bout length increased by 5 seconds. Primary outcomes were recruitment, retention, and intervention attendance. Intervention fidelity was examined via heart rate

monitoring with 85% of age-predicted maximal heart rate the criterion for high-intensity exercise. Secondary outcome measure was the post-intervention change in 20m shuttle-run test (20m SRT) performance. Intervention fidelity was examined via mixed linear modelling and the intervention effect on 20m SRT via analysis of covariance.

RESULTS: Recruitment was 72% (21/29 eligible pupils) for intervention participants, 74% (23/31) for controls, and 30% (5/12) for peer-leaders. All peer-leaders and control participants completed the study; in the intervention group two boys dropped out. Intervention attendance (expressed as percentage of available intervention sessions [n=16] was 73%. Mean intervention heart rate was 76.3 (95% Confidence Interval 73.2, 79.3) % of age-predicted maximal heart rate with a within- and between-participant variability of 5.9 (4.0, 8.5) % points and 9.8 (9.2, 10.0) % points, respectively. The proportion of intervention repetitions (n=508) meeting our high-intensity criterion was 26 (22, 30) % (bout 1: 19 [13, 27]) %, bout 2: 22 [16, 30] %, bout 3: 27 [21, 36] %, bout 4: 35 [27, 43] %). The intervention effect (intervention minus control) was imprecise (2; -2, +7 shuttles, p = 0.323, d = 0.16; -0.16, 0.47).

CONCLUSION: Peer-led HIIT may represent a scalable and feasible school-based exercise model from a recruitment, retention and attendance perspective. However, the intensity of the HIIT sessions was often below our high-intensity criterion, suggesting intervention delivery and fidelity could be improved. This could be addressed by providing more training and support to the peer-leaders before and during the intervention period.

THE EFFECT OF ACTIVE LEARNING ON ACADEMIC PERFORMANCE IN A PRIMARY SCHOOL SETTING - THE HEALTH-ORIENTED PEDAGOGICAL PROJECT (HOPP)

MAMEN, A., FREDRIKSEN, P.M.
KRISTIANIA UNIVERSITY COLLEGE

Introduction

Active Learning (AL) is an educational strategy designed to integrate physical activity (PA) into the learning process within schools, aiming to address concerns that segregating PA from academic instruction could diminish time for educational activities and potentially impact learning outcomes negatively.

Methods

The Health Oriented Pedagogical Project (HOPP), conducted in Horten, Norway, serves as a case study for examining the effects of school-based PA interventions. This project involved 1545 pupils aged 6 to 11 from seven elementary schools, with two control schools (752 pupils) serving as a benchmark for comparison. Initiated in 2015, HOPP was a 6-year longitudinal study focusing on public health, cardio-metabolic risk factors, and, importantly, academic performance. The Norwegian Directorate for Education and Trainings annual compulsory tests, assessing reading, numeracy, and English skills, provided a measure for evaluating the interventions impact.

Results

Results from these tests for 5th graders, spanning from 2015 to 2019, indicated significant performance improvements in English language acquisition, calculus, and reading proficiency among pupils from the intervention schools compared to those in control schools. These findings suggest that integrating PA into the curriculum not only supports physical health but also enhances crucial academic skills.

Discussion

The HOPP projects positive outcomes in areas such as language skills, mathematical reasoning, and reading comprehension underscore the effectiveness of long-term AL programs. These improvements highlight the potential for PA to facilitate better concentration and information retention, thereby enhancing overall academic performance. The studys results advocate for the integration of AL within educational curricula to boost both academic outcomes and physical health, emphasising the importance of long-term interventions and teacher involvement in the development and implementation of such programs. This approach is suggested as a viable method to achieve sustainable integration into school curriculums, with the ultimate goal of enhancing student outcomes across multiple domains.

18:30 - 19:30

Conventional Print Poster Presentations

CP-SH05 Mentoring and Coaching

WHAT ARE THE FACTORS THAT LEAD TO EXCESSIVE PUNISHMENT BEHAVIOR OF SCHOOL SPORTS CLUB COACHES?

SHIMIZU, Y., MIYAZAKI, M.
INTERNATIONAL CHRISTIAN UNIVERSITY, J.F. OBERLIN UNIVERSITY

Introduction

Sports-based club activities are popular in Japanese junior high and high schools, and it is reported that traditional authoritarian coaching still remains in some clubs and is traumatizing young students. The Japanese Ministry of Education

and Sports recently started to offer training seminars for sports coaches as a means to eradicate abusive behavior during sports club activities. The purpose of this study was to identify factors that lead to coaches' punishment behaviour including excessive reprimand and corporal punishment, which were to be used in our following study to develop a psychological measurement scale of abusive behaviour of school sports club coaches.

Methods

The subjects were 50 junior high and high school teachers in Japan who were also coaches in school sports clubs (male: 32, female: 18, mean age 41.5). From October to December 2023, they were asked to describe three circumstances in their sports coaching in free-style writing: 1) when they lost their temper, 2) when they became emotional towards athletes, and 3) when they could not control their anger. Those questions were presented with some examples of descriptions (e.g., "An athlete's attitudes were disrespectful," "I was overwhelmed with the workload," "I had been irritated") and it was made clear that similar answers to the different circumstances were acceptable. To classify their response, text-mining analysis and co-occurrence network analysis were conducted.

Results

The results of the collected text data analyses found five categorized groups of factors: 1) Athletes' attitudes towards training and games (low motivation, lack of tenacity, and lack of passion), 2) Errors in athletes performance (simple errors, careless errors, and miscommunication among athletes), 3) Violation of club rules (arriving late or leaving early, not cleaning or tidying up after training, disrespectful behaviour among club members), 4) Lack of courtesy towards coaches (disrespectful attitudes towards coaches, lack of politeness and respectable wording, unclear greetings and replies), 5) Reluctance in training (neglecting basic repetitive training, neglecting independent training, lack of concentration during training).

Discussion

The results indicate that school sports club coaches think several student behaviours are triggers to their losing temper and anger control and becoming emotional. It must be true that there are numerous irritating moments with a group of adolescents; however, it should be noted that comparatively few of them recognized that their working conditions and psychological state might have had negative effects on their emotional control. Besides school sports club circumstances that are likely to have negative impact on coaches' emotional control, coaches' reflection on their own psychological state, or lack of it, will need to be examined in developing a psychological model to address excessive punishment behavior of sports coaches.

COACHING STYLES OF SOFT TENNIS COACHES AT INTRAMURAL SPORTS CLUBS IN JAPANESE JUNIOR HIGH SCHOOLS

KOMINE, S., TAKEDA, T., KAWANISHI, M.
GRADUATE SCHOOL OF HOKUSHO UNIVERSITY

Introduction

There are approximately 300,000 competitive junior high school students playing soft tennis in intramural sports clubs (ISCs) at schools in Japan. In Japan, the transition of ISCs from school to community will begin in 2023, and the "Comprehensive Guidelines for School Club Activities and new Community Sports Club Activities" call for the construction of a new sports environment that meets the divers sports preferences and needs of junior high school students through the coordination of ISCs and community club activities (Sports Agency et al,2022). A coaching style that changes the balance between "instructional behavior" and "developmental behavior" according to the level of the players is recommended for coaching the youth generation (Zushi, 2017). Therefore, it is important to examine the challenges of coaching styles that approach the current ISCs instructors from a comprehensive perspective, including their interests, values, attitudes, and opinions about coaching, in order to secure and train appropriate instructors for future regional transitions.

Purpose

The purpose of this study was to clarify the relationship between the coaching styles of ISCs instructors of junior high school soft tennis in Japan and their job status in ISCs.

Methods

A web-based survey was conducted on 14,725 junior high school soft tennis club instructors nationwide over a one-month period beginning in July 2023. The number of respondents was 1,162 (7.9% of response rate). The coaching style was measured using a 5-point Likert-type scale ranging from "important" to "not important for 30 items.

Results

The highest mean values of the coaching style items were related to coaching ideals, such as "developing leadership skills as a sports coach", while the lowest mean values were related to athletic ability, such as developing mental strength that can be demonstrated in a game. Next, an exploratory factor analysis using the main factor method and varimax rotation was conducted to clarify the factor structure. As a result, five factors were extracted and named as factor 1 "Leadership ideal ", factor 2 "Educational effect", factor 3 "Integrity", factor 4 "Lifelong sports", and factor 5 " Competitive ability". To verify the relationship between each status, we conducted at-test of the scores of each factor between "school faculty advisor" and "outside instructors". The results showed that the mean scores of factors 1, factor 3, factor 4, and factor 5 were significantly higher for the outside instructors than for the school faculty advisors ($P<.001$).

Conclusion

In coaching ISCs, school faculty advisors tended to emphasize "educational effects," while outside instructors were more likely to emphasize "leadership ideal", "integrity", "lifelong sports" and "athletic ability.

References

Japan Sports Agency, Agency for Cultural Affairs, Government of Japan (2022) Comprehensive guidelines for school club activities and new regional club activities.

Zushi K (2017) Coaching model and the content of general coaching studies that should be conducted in physical education colleges, Journal of Coaching Studies, Vol. 30, Extra Issue: 137-140.

RESEARCH ON THE TRAINING OF CHINESE MENS COMPETITIVE BASKETBALL RESERVE TALENTS IN NEW ERA

LEI, Y.

HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Introduction

Chinas competitive sports reserve talents have experienced transformation from the "nation-wide system" to the "combination of sports and education", and then to the "integration of sports and education" model. This research is to discuss the social influencing factors of the shortage of reserve talents for mens competitive basketball in China as well as constructing the training model of Chinese mens competitive basketball.

Methods

29 basketball coaches and sports journalist took part in semi-structured face-to-face interviews and conducting focus group interviews with 80 parents of competitive basketball reserve talents, 60 middle school and college basketball reserve talents. These samples are well representative of respondents from 6 provinces with different levels of economic and social development, high-level coaches who practice basketball at least 10 years, high-level basketball journalists and parents who support their childrens participation in basketball training. Using three-level decoding method and combines with "generic analysis" to analyze data. Trustworthiness was ensured through several processes (i.e. Credibility-triangulation method, prolonged engagement; Transferability-collecting the opinions in regions with different levels of economic and social development; Reliability-thick description; Confirmability-reflexivity.)

Results

The shortage of reserve talents in Chinese men's competitive is affected by three factors: the body culture tradition of Chinese civilization; the difficulty of achieving class mobility for high-level reserve talents; parents with different working professions have different reasons for supporting their children in basketball training.

Discussion

The new Chinese mens competitive basketball reserve talent training model includes:

1.The training path based on school.

(1) Give full play to the fundamental role of physical education in primary and secondary schools in talent cultivation.

(2)The reform plan to integrate sports and education in primary and secondary schools,including:coach hiring,talent selection model,training model.

(3)The reform plan of training college competitive basketball reserve talents,including:integration sports colleges and professional/provincial youth teams,university establishes high-level competitive basketball team independently .

2.The training path based on competition.

(1) Competition is a lever for the development of competitive sports.

(2) Exploring the feasibility of implementing "league competition system" at the university level.

(3) Using the media rationally to enhance the communication and influence of competitions in various systems and academic stages.

3.The training path supported by the market.

(1) Integrating schools and enterprises.

(2) Integrating schools and sports venues.

4.The training path supplemented by society.

(1) Integrating schools and basketball association.

(2) Integrating schools and families.

LIFE SKILLS COACHING FOR COLLEGE SOCCER CLUBS

TOKAIRIN, T., TOKAIRIN, Y.

JOSAI UNIVERSITY

Background

Japanese university soccer has a long tradition, and today the level of the sport is increasing dramatically. Every year many universities produce a significant number of players who go on to play professionally and for the Japanese national team. University soccer is not only a competitive sport, but as part of an educational institution it is also required to con-

tribute to society and to help students grow as individuals. University soccer clubs conduct a range of activities both on and off the pitch, and are considered effective for both athletic and educational development.

Objective

The purpose of this study is to elucidate the effects of university soccer clubs off-the-pitch activities on their players life skills and performance.

Methods

Subjects in this study were student players in the Kanto University Soccer League during three seasons (2021: n=96, 2022: n=97, 2023: n=86) (age range 18-23). Off-the-pitch programs throughout the year included soccer events for boys and girls, and outdoor activities. We conducted correlation analysis based on the subscales of the Life Skills Scale for Athletes (Shimamoto et al., 2013).

Results

In the 2021 season, correlations were found in the "goal setting skills" and "best effort" ($r=0.554$, $p<0.001$) life skills, and additionally in the 2022 season ($r=0.513$, $p<0.001$) in "thinking ability" ($r=0.555$, $p<0.001$). The same was true for the 2023 season (in order: $r=0.564$, $p<0.001$: $r=0.525$, $p<0.001$). The team was promoted to the Kanto University Second Division League in the 2021 season, demoted in the 2022 season, and promoted again in the 2023 season.

Discussion

In the 2022 and 2023 seasons, the correlation between "thinking ability" and "goal setting" increased. Implementing a student-centered program led to improvement in students ability to think, plan, and execute independently. Due to the competitive nature of soccer, improvement of these abilities is thought to be related to performance improvement.

References

Shimamoto , K., Tokairin , Y., Murakami , K., Ishi , M. (2013)Appraisal of Required Life Skills for Athletes : A Scale Development on College Student Sport Psychology Research. 40(1):13-30.

"WE NEED TO STRESS THEM": A CASE STUDY ON AN ELITE FOOTBALL ACADEMY'S USE OF COMPETITION TO ENHANCE AND CATALYSE THE DEVELOPMENT OF FOOTBALLING TALENT

ELDER, K., ENGLISH, C., PITKETHLY, A., FOUNTAIN, H., MARTINDALE, R.

THE UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Professional football is recognised by many as a 'results driven business' where competition outcomes are significant and can have a momentous effect on the lives of vast number of people groups. With the increased research in academy football and the development of footballing excellence, it is surprising that still very little is understood about the use of competition within academy programmes and how this reoccurring experience is used to shape and promote the development of footballing ability.

Methodology:

Six academy coaches and the academy director from an Elite tier Scottish football academy took part in semi-structured, face-to-face interviews at the end of an academy season. Data was subject to inductive, reflexive thematic analysis which ensured trustworthiness of data by utilising processes such as member checking, data triangulation and critical review within the research team.

Findings:

The competition uses, intentions and objectives of the football academy were analysed and found to fit into one of three categories: 1) playing to learn, 2) learning to win, and 3) playing to win. Findings also highlighted the academy's 'stress, stretch and support' approach to developing talent within competition, and how this approach was operationalised across each stage of the academy.

Discussion:

Competition was used in a variety of ways within the football academy to promote the development of the academy players' footballing ability. Within the early years of academy football, competition was entirely focused on the development of football specific abilities and understanding with no attention given to the outcome of each competition experience. As players progressed through the academy age groups, a focus on achieving positive competition outcomes was introduced which contributed to the development of an ego-orientated motivational climate within the group and between peers. The academy sought to use competition as a method of assessing the future, first team suitability of academy players. Academy coaches were encouraged to systematically manipulate competition stressors and experiences to stress and stretch the players to observe which players could cope with the need to win in specific games. Competition success and individual statistics were outlined to players as key metrics on which contract offers would be based, thus further ingraining a peer-created, ego-orientated motivational climate within the academy age groups.

EXPLORING BIRTH ADVANTAGES IN ITALIAN SWIMMING. HOW CULTURAL AND CONTEXTUAL FEATURES OF THE ENVIRONMENT SHAPE MALE YOUTH ITALIAN SWIMMERS DEVELOPMENTAL EXPERIENCES AND PROGRESSION WITHIN THE MODEL

MORGANTI, G., VITARELLI, M., STRASSOLDO DI VILLANOVA, F., RUSCELLO, B., PADUA, E.
UNIVERSITÀ SAN RAFFAELE - ROMA

Introduction

The Standard Model of Talent Development (SMTD) is a common deterministic talent pathway adopted by sports systems. Athletes' progression through the SMTD is related to acquiring early abilities and achieving early results. The SMTD causes the specialization of the selected few and the de-selection of the many unable to fit in with the requirements of the organizations and leads to several reported selection biases [1]. Youth performance outcomes are dependent on contextual factors, which eventually lead to birth advantages (relative age effects (RAEs) and birthplace effects). This study aimed to investigate birth advantages' influences on the Italian swimming talent pathway. We hypothesized that (a) value-directedness towards competition and working hard promoted in Italian swimming, reflected in early specialization practices and early success promotion, would cause the presence of RAEs; and (b) regional disparities that characterize Italy, would define swimmers' developmental experiences and their skill-acquisition processes.

Methods

We explored the birth quarter (BQ) and place of early development (PED) of male Italian youth swimmers (age groups: 15-year, n=341, 17-year, n=380), competing at the annual Winter Italian National Youth Championship. To explore whether birth advantages influence national-level youth swimmers' participation, the observed BQs and PEDs distribution of the 15-year age group were compared to the expected values (i.e., census statistics). Moreover, to investigate how birth advantages influence swimmers' ability to maintain their national status, the observed BQs and PEDs distributions of the 17-year age group were compared to the expected values (i.e., 15-year age group).

Results

Results revealed skewed BQs ($P<0.0001$) and PEDs ($P<0.0001$) distributions in the 15-year age group. BQ1s and swimmers developing in Central Italy were more likely to compete at National level (odds ratios (ORs), BQ1 vs. BQ4: 2.82; Centre vs. South: 2.60). The 17-year age group's BQs ($P=0.008$) and PEDs ($P=0.04$) distributions were skewed compared to the 15-year age group. BQ3s, BQ4s, and swimmers developing in North and Central Italy recorded the highest ORs of maintaining their national status (1.56, 1.43, 2.42, 1.25 respectively).

Conclusions

Findings revealed talent appears as a relational phenomenon based on contextual factors that indirectly define swimmers' performance outcomes. Value-directedness towards competition causes the overrepresentation of BQ1s, who are favored at the beginning of the developmental stage, but who contrary to expectations are less likely to retain their national status. Indeed, value-directedness towards working hard (i.e., resilience) may favor the few BQ3s and BQ4s to further develop. Moreover, findings showed that Italian regional disparities undermine South Italian youth swimmers' access to facilities, thus limiting their sport-specific skill progression.

Bibliography

1) Bailey & Collins, 2013.

PARADOXICAL LEADERSHIP, ATHLETE WELL-BEING, AND SPORT PERFORMANCE: THE MEDIATING ROLE OF THE COACH-ATHLETE RELATIONSHIP

HU, B., FLETCHER, D.1, JOWETT, S.1, ARNOLD, R.2
1LOUGHBOROUGH UNIVERSITY, 2UNIVERSITY OF BATH

Sports coaches are operating in complex and fast-changing environments where the one-size-fits-all approach may not be appropriate. Research from diverse fields suggests that contradictory yet interrelated behaviours are desired, known as paradoxical leadership. Despite circumstantial evidence of paradoxical leadership in sport, surprisingly, systematic investigation is limited. Therefore, this study is conducted to investigate the influence of paradoxical leadership on athlete well-being and perceived performance and the mediating role of the coach-athlete relationship.

Methods

This cross-sectional study involved self-reported psychometric questionnaires with 279 athletes (male = 150, female = 129) who engaged in diverse sports (e.g., basketball, football, volleyball, athletics, shooting, gymnastics, swimming, badminton, and karate). Respondents in the 18-21 age group accounted for 70.61% of the total respondents (n = 197). The questionnaire assessed six variables: paradoxical leader behaviour, eudaimonic well-being, perceived performance, and 3Cs (i.e., commitment, closeness, and complementary) of the coach-athlete relationship. Items measuring paradoxical leader behaviour were aggregated, with higher ratings indicating that coaches had a greater ability for paradoxical behaviours. Using SPSS 29 to examine the direct and indirect effects, as well as the statistical significance.

Results

Paradoxical leadership predicted eudaimonic well-being ($\beta = .38$, $p < .001$), perceived performance ($\beta = .38$, $p < .001$), commitment ($\beta = .42$, $p < .001$), closeness ($\beta = .55$, $p < .001$), and complementary ($\beta = .47$, $p < .001$). Commitment, closeness, and complementary mediated the direct effect of paradoxical leadership on eudaimonic well-being with the effect

size of .08 (95% CI [.03, .14]), .12 (95% CI [.06, .20]), and .10 (95% CI [.04, .17]), respectively; the 3Cs mediated the direct effect of paradoxical leadership on perceived performance, with the effect size of .14 (commitment), .22 (closeness), and .22 (complementary), and 95% CIs were [.00, .31], [.02, .46], and [.07, .41], respectively.

Discussion

The study proposed a paradoxical approach to performance enhancement. Theoretically, the study extended the literature on coaches' leadership, offering a paradoxical perspective to examine sports leaders' behaviour. In practical terms, coaches were suggested to recognise the positive effects of the paradoxical approach and refine their behaviours flexibly according to the circumstance in which they find themselves to improve athlete well-being, perceived performance, and the coach-athlete relationship. The dyadic relationship functioned as a mediator in paradoxical coaching, encouraging coaches to develop a quality interpersonal interaction between themselves and athletes. Overall, the study found the facilitative role of paradoxical leadership for athlete performance and highlighted the importance of the coach-athlete relationship in paradoxical coaching.

PERCEIVED IMPORTANCE AND SELF-EVALUATIONS OF FEMALE-SPECIFIC KNOWLEDGE: CURRENT INSIGHTS INTO COACHING OF FEMALE ATHLETES

TORSTVEIT, M.K., AUSLAND, Å., AUGUSTSSON, S.R., IVARSSON, A., KJÆR, J.B., LAXDAL, A.G., LINNÉR, S., MELIN, A.K., RADOVAN, F., SOLSTAD, B.E.

UNIVERSITY OF AGDER

Introduction

In contemporary sports coaching, a prevailing perspective centres around knowledge and methodologies largely derived from male athletes, often generalized to coaching of female athletes. However, this approach fails to consider biological, psychological, and social factors inherent to coaching female athletes. Thus, the main purpose of this study was to investigate associations between coaches' perceived importance of female-specific coaching topics and their self-evaluations of knowledge regarding the same topics. It was also of interest to examine the need of a coach education program (CEP) for improved coaching of female athletes.

Methods

A web-based survey was administered to coaches of female athletes in Norway, encompassing inquiries into perceived importance and self-evaluations of knowledge of female-specific topics, such as puberty, hormonal influences, and communication. The need of a CEP for improved coaching of female athletes were rated on a scale from 1 (low) to 7 (high). A total of 650 coaches (n=260 females) in ten different sports responded to the survey. The average age was 44 years (SD=16.1) with an average coaching experience of 11.3 years (SD=7.8). Repeated Measure ANOVA using SPSS software was used to analyse the data.

Results

Statistically significant disparities between ratings of perceived importance and coaches' self-evaluations of knowledge across all variables (ps < .001, Cohen's d ranged between .73-.92), were found. Coaches consistently rated the importance of female-specific coaching topics higher than their perceived competence in addressing them with no significant interaction effects based on sex (ps > .05, n2 ranged between .000-.002) or completed coach education (ps > .05, n2 ranged between .000-.002). Additionally, higher perceived availability of knowledge was positively associated with smaller differences between ratings of perceived importance and coaches' self-evaluations of all variables (ps <.001, n2 ranged between .009-.019). Lastly, the results showed a median score of 6 in terms of need of a CEP for improved coaching of female athletes.

Discussion

These findings underscore a gap between coaches' perceived importance and their self-evaluations of knowledge regarding female-specific coaching topics, thereby signalling the need for enhanced availability of knowledge and CEPs focusing on female-specific topics. The absence of interaction effects based on sex or completed coach education might indicate that both male and female coaches, despite having completed previous CEPs, need more in-depth knowledge about coaching female athletes. Further, the association between knowledge availability and the reduced disparity between ratings of perceived importance and coaches' self-evaluations of knowledge highlights the importance of making female-specific coaching resources more available to coaches. Consequently, this study emphasizes the pressing need for female-specific contents in future CEPs.

THE PROBABILISTIC CREAM RISES: A LONGITUDINAL STUDY OF THE RELATIVE AGE EFFECT, RELATIVE AGE REVERSAL AND EXPERTISE ACROSS THE YOUTH TO ADULT TRANSITION IN ELITE EUROPEAN FOOTBALL PLAYERS.

HENDRY, D., HARVEY, P., BILALIC, M.

NORTHUMBRIA UNIVERSITY

The relative age effect is a well-established selection bias towards individuals born earlier within a selection year resulting in a disproportionate over representation of chronologically older players in talent development pathways. Despite over 20 years of research exploring this phenomenon across multiple domains, including football, longitudinal analysis are rare. In this study, we analyse over 5,000 elite male youth soccer players who participated in the UEFA Youth League over a ten year period. Player transfer market value and playing level were used as proxy measures of expertise and tracked

longitudinally. Consistent with the RAE, we found that players born in the first quarter of the selection year (Q1) were almost four times more likely to be selected in comparison to those born in Q4. However, longitudinal analysis indicated a type of relative age reversal, as Q4 players went on to command higher transfer values across their careers and lower dropout compared to their Q1 peers. Yet, when we selected the best Q1 players to match the number of Q4 players, the Q1 players exhibited significantly better careers and remained in the sport longer. Findings provide partial support for relative age reversal and highlight inefficiencies in the talent development pathways.

A PILOT TEST ON THE HOLISTIC SUPPORT SYSTEM FOR DUAL CAREER STUDENT ATHLETES

LEUNG, E., SUM, R., CHEUNG, T.F., YU, K., KWONG, A., CHIU, J.
THE CHINESE UNIVERSITY OF HONG KONG

Background: Dual career athletes who are enrolled in universities face significant demands in both their athletic pursuits and academic commitments. Failing to address their difficulties can lead to a decline in performance in both sports and academics.

Purpose: This pilot study aimed to investigate the available support systems for dual career student athletes pursuing higher education in Hong Kong, while identify the key challenges they face.

Methods: The study utilized a quantitative research method, employing an online questionnaire distributed to 107 student athletes at Hong Kong National Squad or Junior Squad level pursuing undergraduate studies in a university. The questionnaire gathered data on demographic information, the support measures provided by university and sports associations and the challenges of dual career student athletes. The questionnaire was adapted from Linnér and colleagues (2021) research. Eligibility criteria included: (a) full-time undergraduate students, (b) recipients of sports scholarships provided by the university, and (c) Hong Kong National Squad or Junior Squad members. The data was analyzed using descriptive statistics. Independent t-test was used to calculate between-group effects.

Results: A total of 38 student athletes (M: 20; F: 18) were recruited for the study. Among the various learning supports provided by the university, the participants identified the flexible attendance and assignment submission arrangements (25), extension of maximum study period (19), and scholarships (15) as the top three most important supports. Overall, the participants expressed satisfaction with the supports provided by their university, with a mean satisfaction rating of 4.80 out of 6 and a standard deviation of 0.7971. There was no significant difference in satisfaction levels between male and female students regarding the supports provided by the university. Regarding the training supports provided by sports associations, the participants highlighted flexible training attendance (18), sports development advice (13) and scholarships (9) as the top three most important supports. The participants also expressed satisfaction with the supports provided by their sports associations, with a mean satisfaction rating of 4.55 out of 6 and a standard deviation of 0.8870. There was no significant difference in satisfaction levels between male and female students. The major challenges reported by the student-athletes included time management (24), time conflicts between training/competitions and classes/examinations (10) and striving to balance sports and striving to balance sports and academics (8).

Conclusion: This study explored the experiences and perceptions of student-athletes regarding the supports provided by university and sports associations, and the challenges they encounter. The findings highlight the need for effective time management strategies and support systems to help student-athletes overcome their challenges.

Conventional Print Poster Presentations

CP-MH12 Health and Fitness II

EFFECTS OF EXERCISE AND AUTONOMY SUPPORT ON MOTIVATION, PHYSICAL, AND MENTAL HEALTH

ORTH, D., WALDRON, N., CAMERA, D.
BRUNEL UNIVERSITY, LONDON

INTRODUCTION: Exercise has beneficial effects on physiological and psychological health and wellbeing [2]. However, current neurophysiological literature indicates that depressed individuals require additional motivational support to undertake exercise training [2]. The aim of this study was to therefore investigate pre post effects of exercise training combined with autonomy support on fitness, depression symptoms, and motivation in individuals with depression.

METHODS: Sixteen participants (24.7 ± 5.6 years) with self-reported depression symptoms (scoring > 5 on the Patent Health Questonnaire-9), were recruited to perform 17 sessions of High Intensity Interval Training (HIIT) across six-weeks. Each session involved nine 20-second high-intensity sprints with 40-seconds of recovery. Exercise bouts were undertaken at Borg rating of perceived exertion (RPE) levels of 20, 18, and 16 (three each). Motivation was supported by giving participants the choice (autonomy) over the order of the intervals in which each intensity occurred across the nine bouts of each session. Changes in depression symptoms, motivation, and cardiorespiratory fitness (CRF) were measure pre- and post-intervention via validated questionnaires.

RESULTS: Comparing pre- to post-intervention outcomes, there was a significant decrease in depression symptoms ($p < .01$), improvement in autonomy ($p < .001$), and increase in CRF ($p < .05$). Exercise session-wise data (i.e., cycling intensity, crank entropy, HIIT self-efficacy) also significantly improved over the 17 sessions.

CONCLUSION: A six-week HIIT program combined with autonomy support was effective in decreasing depression symptoms, increasing fitness, and promoting motivation to exercise. Empirically grounded psychological frameworks (e.g., [3]) that can improve long term effects of exercise intervention (i.e., learning, autonomy, self-efficacy) should be integrated into professional guidelines for best practice in meeting the needs of adults with depression during proscribed exercise intervention. Further research should test broader biopsychosocial frameworks to understand how time-course changes in the neurobiological environment of individuals with depression might interact with psychological intervention.

[1] Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., McMurdo, M., & Mead, G. E. (2013). Exercise for depression. Cochrane Database of Systematic Reviews, 2013(9).

[2] Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: current status and future directions. Annual review of clinical psychology, 6(1), 285-312.

[3] Wulf, G., & Lewthwaite, R. (2016). Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. Psychonomic bulletin & review, 23(5), 1382-1414.

MEDIATING EFFECTS OF RESTING-STATE BRAIN ACTIVITY ON THE ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND VERBAL MEMORY

LOOSER, V.N., LUDYGA, S., GERBER, M.

UNIVERSITY OF BASEL

INTRODUCTION: Verbal memory is a crucial neuropsychological function involved in core cognitive abilities such as general intelligence, reasoning, and learning. Verbal memory is associated with subjective well-being, mental health, as well as academic and career achievement (Ludyga, Gerber, Pühse, Looser, & Kamijo, 2020). While experimental studies have reported evidence on the association between physical activity and verbal memory, the underlying neurophysiological mechanisms remain unclear.

The Individual Alpha Peak Frequency (IAPF) operates as a neurophysiological marker for general cognitive function and appears to be sensitive to physical activity (Gutmann, Hülsdünker, Mierau, Strüder, & Mierau, 2018). The purpose of the present study was to investigate the association between physical activity and verbal memory, as well as the potential mediating role of IAPF on this association in young adults.

METHODS: In young healthy adults (N = 115, 48% female) aged 18 to 35 years (M = 24.1, SD = 3.8), IAPF was detected from electroencephalographic recordings during resting-state. Afterwards, participant performed immediate and delayed recall tasks with a distractor task in between. Their physical activity levels were examined from accelerometer data collected over seven consecutive days.

RESULTS: Path analysis revealed no mediating effect of IAPF on the association of physical activity and recall performance. However, sex moderated the direct associations: While higher vigorous physical activity levels were associated with better recall performance in female participants, no association between these variables was found in male counterparts. Higher levels of physical activity however, were related to a higher IAPF exclusively in male participants.

CONCLUSION: The study did not support a mediating role of IAPF on the association between physical activity and verbal memory, but a moderating effect of sex on the association of physical activity and verbal memory. This highlights the need to pay attention to inter-individual differences, when examining underlying mechanisms of the relation between physical activity and verbal memory.

REFERENCES:

Gutmann, B., Hülsdünker, T., Mierau, J., Strüder, H. K., & Mierau, A. (2018). Exercise-induced changes in EEG alpha power depend on frequency band definition mode. Neuroscience Letters, 662, 271-275. doi:https://doi.org/10.1016/j.neulet.2017.10.033

Ludyga, S., Gerber, M., Pühse, U., Looser, V. N., & Kamijo, K. (2020). Systematic review and meta-analysis investigating moderators of long-term effects of exercise on cognition in healthy individuals. Nature Human Behaviour, 4(6), 603-612. doi:10.1038/s41562-020-0851-8

ACUTE PSYCHO-PHYSIOLOGICAL RESPONSES TO SUBMAXIMAL CONSTANT-LOAD CYCLING UNDER INTERMITTENT HYPOXIA-HYPEROXIA VS. HYPOXIA-NORMOXIA IN YOUNG MALES

BEHRENDT, T., BIELITZKI, R., BEHRENS, M., JAHNS, L.M., BOERSMA, M., SCHEGA, L.

OTTO-VON-GUERICKE-UNIVERSITY MAGDEBURG

INTRODUCTION: Hypoxia and hyperoxia can affect the acute psycho-physiological response to exercise. Assessing various perceptual responses to exercise is of particular importance for investigating behavioural changes to physical activity, given that the perception of exercise-induced pain, discomfort or unpleasure, and a low level of exercise enjoyment are commonly associated with a low adherence to physical activity. Nevertheless, data on the acute psycho-physiological responses to exercise under intermittent hypoxia-hyperoxia (IHHT) is still lacking. Therefore, this study aimed to compare the acute perceptual and physiological responses to aerobic exercise under intermittent hypoxia-hyperoxia, hypoxia-normoxia (IHT), and sustained normoxia (NOR) in young recreational active healthy males.

METHODS: Using a randomized, controlled, single-blinded, crossover design, 15 males (age: 24.5±4.2yrs) performed 40min of submaximal constant-load cycling (at 60% peak oxygen uptake, 80rpm) under IHHT (5x4min hypoxia and hy-

peroxia), IHT (5x4min hypoxia and normoxia) and NOR. Inspiratory fraction of oxygen during hypoxia and hyperoxia was set to 14% and 40%, respectively. Heart rate (HR) and muscle oxygenation (right vastus lateralis) were continuously recorded during cycling. Participants' peripheral oxygen saturation (SpO2), perceived motor fatigue, effort perception, perceived physical strain, affective valence, arousal, motivation to exercise, and conflict to continue exercise were surveyed prior, during (every 4min period), and after cycling. Prior to and after exercise, peripheral blood lactate concentration (BLC) was determined. Exercise enjoyment was ascertained after cycling. For statistical analysis, repeated measures analyses of variance were conducted.

RESULTS: No differences in the acute perceptual responses and exercise enjoyment were found between conditions ($p \geq .059$, $\eta p^2 \leq 0.18$). SpO2 was higher during the hyperoxic periods in the IHHT compared to the normoxic periods in the IHT ($p < .001$, $\eta p^2 = 0.91$). HR was higher during the hypoxic periods in the IHT compared to NOR ($p = .005$, $\eta p^2 = 0.33$). Moreover, BLC increased and was higher after IHT compared to NOR ($p = .033$, $\eta p^2 = 0.28$). No differences between conditions were found for vastus lateralis muscle oxygenation ($p \geq .093$, $\eta p^2 \leq 0.16$).

CONCLUSION: IHT is associated with a higher physiological response (i.e., greater HR) and metabolic stress (i.e., greater BLC), while IHHT did not lead to an increase in HR and BLC. In addition, compared to IHT, IHHT seems to improve reoxygenation indicated by a higher SpO2 during the hyperoxic periods. However, there were no differences in perceptual responses and ratings of activity enjoyment between conditions. These results suggest that replacing normoxic by hyperoxic periods during submaximal constant-load cycling under intermittent hypoxia reduced the exercise-related physiological stress but had no effect on perceptual responses and perceived activity enjoyment in young healthy males.

INVESTIGATING THE IMPACT OF DURATION AND FREQUENCY OF WALKING EXERCISE ON COGNITIVE FUNCTION, VITAL SIGNS AND EXERCISE CAPACITY: A COMPARATIVE STUDY

SHAMEL, F., EMIR, Z.

GAZI UNIVERSITY

INTRODUCTION: Exercise has beneficial effects on cognitive function besides its well-known benefits on physical health. However, the duration and daily frequency of exercise adequate to improve cognitive function is still unclear[1]. Therefore, we planned to determine whether individuals unable to sustain 30 minutes of continuous walking could achieve similar cognitive effects by performing shorter but frequent bouts of exercise. The aim of this study was to investigate the effects of varying durations and daily frequencies of walking exercise on cognitive function, vital signs, and exercise capacity.

METHODS: In this study, 35 females (18-24 years) were randomized into two groups: 17 participants into 30-minute continuous exercise group (30min), and 18 participants into 3 times 10-minute exercise bouts group (10min). Both groups walked 5 days a week for 6 weeks on a treadmill at 60% of their maximum heart rate. Stroop Test Writing Color-Meaning Color (STWC-STWMC), Digit Symbol Substitution Test (DSST) were assessed for cognitive function, Respiratory Frequency (RF), Blood Pressure Diastolic-Systolic (BPD-BPS), Resting Heart Rate (HR-Rest), Waist-to-Hip Ratio (WHR), Oxygen Saturation (SaO2) and 6-Minute Walk Test (6MWT) for cardiorespiratory function before and after the exercise training. Results were compared both within and between groups.

RESULTS: Both groups were similar regarding the baseline characteristics ($p > 0.05$). Within-group analyses revealed significant differences in DTWC, DSST, STMWC, 6MWT, BPS, and BPD results ($p < 0.05$) in both groups, while SaO2, HR-Rest, and RF were insignificant ($p > 0.05$). The results of comparison between the groups showed that all the parameters were similar ($p > 0.05$) except the WHR. It was lower in the 30min group than that in the 10min group ($p < 0.001$).

CONCLUSION: The results of this study showed that both 30 minutes continuous exercise and 10-minute bouts of exercise three times a day showed similar effects on cognitive and cardiorespiratory function after training. Only the waist-hip ratio decrease was superior after the 30-minute continuous exercise training, and it was not surprising as lipid mobilization is only possible with longer durations of physical performance. It is concluded that the individuals who are unable to complete a single 30-minute exercise bout, due to reasons such as pain, could achieve similar benefits for cognitive and cardiorespiratory function with 10-minute exercise bouts 3 times a day.

Reference:

[1] J. Young, M. Angevaren, J. Rusted, and N. Tabet, "Aerobic exercise to improve cognitive function in older people without known cognitive impairment(Review)," Cochrane Database Syst. Rev., no. 4, p. Art. No.: CD005381., 2015, doi: 10.1002/14651858.CD005381.pub4.www.cochranelibrary.com.

ALTITUDE EDUCATION IMPROVES ACUTE AND RETAINED KNOWLEDGE: IS 5-MINUTES ALL IT TAKES?

WILLMOTT, A., LILLIS, J., ROBERTS, J., HAYES, H., TIMMIS, M., MAXWELL, N.

ANGLIA RUSKIN UNIVERSITY, UNIVERSITY OF BRIGHTON, PARA-MONTE.

INTRODUCTION: Millions of travellers visit altitude annually and may be naive to the risks/dangers or signs/symptoms of altitude-related illnesses. Acute mountain sickness (AMS) is a common altitude illness, typically observed above 2500m. Worryingly, ~55% of altitude travellers possess limited knowledge of AMS, as reported by skiers in North America, visitors in Cuzco and trekkers in Nepal. As altitude education, awareness and knowledge are fundamental to altitude preparation, this study aimed to 1) quantify baseline altitude knowledge in young adults (18-35 years), 2) assess acute changes in knowledge following a lecture (30-min) or animated video (5-min), 3) assess 3-month retained knowledge and 4) compare educational method effectiveness.

METHODS: 124 participants (75 males, 49 females, 19±1 years) completed an online survey (via JISC.com) to assess "Baseline Altitude Knowledge" via 20 question related to 1) altitude exposure and physiological responses, 2) altitude-related illnesses and AMS symptoms, and 3) AMS prevention and treatment methods. Using a cross-over design, participants were randomly assigned to Group A (n=60) who initially watched a 30-min online lecture or Group B (n=64) who initially watched a 5-min animated video. These educational resources were developed to improve altitude knowledge and meet the desired minimum level of altitude illness awareness for laypersons traveling to altitude. Following educational interventions, participants immediately repeated the survey to assess "Acute Altitude Knowledge from Baseline". Three months later, participants completed the survey to assess "Retained Altitude Knowledge", and then, Group A watched the 5-min animated video, whilst Group B watched the 30-min online lecture. Finally, all participants repeated the survey to assess "Acute Altitude Knowledge from Retainment". Knowledge was categorised using the number of correct scores: 'Low' (≤25%), 'Moderate' (26-74%) and 'High' (≥75%).

RESULTS: For all 124 participants, 54±24% of questions were correctly answered, demonstrating Moderate "Baseline Altitude Knowledge" (Group A: 50±27%, B: 55±25%, P>0.05). Following educational interventions, High "Acute Altitude Knowledge from Baseline" was found in Group A (75±22%) and B (75±23%, both P<0.05). Three months later, Moderate "Retained Altitude Knowledge" was found in Group A (69±24%) and B (60±27%, both P<0.05). Finally, High "Acute Altitude Knowledge from Retainment" was then found in Group A (75±21%) and B (75±23%, both P<0.05) following the alternate educational interventions.

CONCLUSION: Both methods of education improved altitude knowledge. Young adults present a moderate baseline level of altitude knowledge, which significantly improves following an online lecture and animated video. Altitude knowledge is better retained after 3-months following a 30-min online lecture, however a 5-min animated video to "top up" education, restores a high level of altitude knowledge.

EFFECTS OF A REMOTELY SUPERVISED PHYSICAL TRAINING PROGRAM COMBINED WITH COGNITIVE TRAINING FOR OLDER INDIVIDUALS AT INCREASED RISK OF CLINICAL-FUNCTIONAL VULNERABILITY: A RANDOMIZED CLINICAL TRIAL

ALBERTON, C., BERNÍ, F., MIRANDA, C., OLIVEIRA, D., SCHAUN, G., KANITZ, A.

FEDERAL UNIVERSITY OF PELOTAS

INTRODUCTION: While substantial evidence supports the benefits of home-based physical exercise for older adults, there remains a lack of data regarding the efficacy of home-based cognitive training, particularly through telehealth programs. This study aimed to compare the chronic effects of a remotely supervised physical training intervention alone or combined with a cognitive training program in older adults at increased risk of clinical-functional vulnerability (CFV).

METHODS: A randomized clinical trial (NCT05309278; [1]) was conducted involving 26 sedentary older individuals classified as at increased risk of CFV based on their CFV Index score. Participants were randomly assigned to either an intervention (INT; physical training combined with cognitive training) or an active control (CON; physical training alone) group and underwent a 12-week remote supervised program. Cognitive function was assessed using the Mini-Mental State Examination (MMSE), Digit Span Test (DST), and Verbal Fluency Test. Physical function was measured using the Time Up and Go (TUG) Test, with and without a Dual-task, and the 30-s Chair Stand Test. Data are presented as mean [95%CI] and compared using Generalized Estimated Equations (α=5%).

RESULTS: Participants (mean age: 68.8 ± 6 y; 88% female) were randomized to INT (n=13) and CON (n=13) groups and included in an intention-to-treat analysis. Both the DST (p=0.03) and Verbal Fluency (p<0.01) scores increased after the intervention in the INT (7.5 [6.8-8.3]; 19.9 [15.6-24.2] animals, respectively) and CON (6.7 [6.0-7.4]; 18.6 [15.8-21.3] animals, respectively) groups, with no significant group x time interaction. Similar improvements were also observed post-intervention in the TUG (p=0.01; INT: 7.6 [6.7-8.4] s; CON: 8.5 [7.5-9.5] s), TUG with a Dual-task (p=0.02; INT: 9.8 [8.1-11.5] s; CON: 10.0 [8.5-11.5]), and 30-s Chair Stand (p<0.01; INT: 12.5 [10.5-14.5] repetitions; CON: 12.4 [10.0-14.7] repetitions) tests, again with no group x time interaction. MMSE scores remained similar post-training in both INT (25.9 [23.9-27.9]) and CON (27.4 [26.0-28.8]) groups.

CONCLUSION: No superiority effect was observed in the INT group, as physical training alone or combined with cognitive training resulted in positive effects on cognitive and physical outcomes in the studied population. Thus, the cognitive training proposed herein did not seem sufficient to promote additional benefits in older adults at increased risk of CFV after the investigated period.

Funding: CAPES and CNPq, Brazil.

Reference:

1. Berní, FC, et al., Effects of a remotely supervised physical training program combined with cognitive training for older individuals at increased risk of clinical-functional vulnerability: study protocol for a randomized clinical trial. Trials, 2023. 24(1): 547.

INCORPORATING VIRTUAL REALITY TECHNOLOGY INTO HOSPITAL CARE FOR YOUNG ADULTS: AN ASSESSMENT OF DIVERSE MOTOR-COGNITIVE TASKS

ŠLOSAR, L., RADO, P., MARUSIC, U.
SCIENCE AND RESEARCH CENTRE KOPER

INTRODUCTION: Prolonged hospitalization leads to a significant decline in functional and cognitive functions. Experimental bed rest studies explore the negative effects of inactivity, including lower limb muscle atrophy and reduced strength (Marusic et al., 2021). Altered neural processes, influenced by reduced sensory input and cognitive workload during bed rest, contribute to impaired motor-cognitive tasks. This simultaneous decline profoundly affects resuming daily activities post-hospitalization. Advances in virtual reality (VR) technology and increased accessibility prompt exploration of its application in clinical settings. VR systems, adaptable to various scenarios, offer potential for assessing motor-cognitive tasks beyond the limitations of hospital settings. Our study contributes to understanding the evolving applications of VR technology by investigating the effects of a 21-day bed rest on specific motor-cognitive tasks assessed through a VR system.

METHODS: Nine young adults (average age 22.9 ± 4.2) underwent a 21-day bed rest period, engaging in all activities lying down with minimal pillow support for the head. Using the Oculus Quest VR headset, participants completed a series of motor-cognitive tasks including single- and dual-task balance, walk the plank, manual dexterity, digits backwards and memory cards at pre, post and follow up bed rest. Movement data (total and segmented sway) and cognitive task performance (time and accuracy) were collected at 50 Hz via a Unity game design software function (MOViR, INCISIV Ltd., Belfast, UK). Variance analyses were applied to investigate potential differences between the pre- and post-assessment.

RESULTS: Single balance task parameters showed increased sway at post-assessment for both the forward-back (p=0.011) and diagonal moving conditions (p=0.021). Repeated measures ANOVA showed a significant effect of time for the same two conditions (forward back: p=0.042, diagonal moving: p=0.024) with a trend for the average sway (p=0.066). In dual-task balance, post-assessment showed significant increases in task time (p=0.011) and sway (p=0.033). Walk the plank revealed a significant time effect (p=0.001), while no pre-post differences were observed for manual dexterity, digits backward, and memory cards.

CONCLUSION: This study provides robust validation for the implementation of VR assessments in clinical settings. In comparison to other currently utilized methods, VR enables the integration of diverse scenarios for motor-cognitive assessments that are more ecologically valid and time-efficient. The observed effects of the 21-day bed rest period indicated a clear deterioration in movement data, while conclusive effects on cognitive functions remain undetermined.

REFERENCES:

Marusic, U., Narici, M., Simunic, B., Pisot, R., & Ritzmann, R. (2021). Nonuniform loss of muscle strength and atrophy during bed rest: a systematic review. Journal of applied physiology, 131(1), 194–206.

EIGHT WEEKS OF ADENINE FEEDING LEADS TO KIDNEY PATHOLOGY AND LOW-LEVEL MUSCLE DYSFUNCTION IN FEMALE RATS

HAYDEN, C., ROSHANRAVAN, B., BAAR, K.
UNIVERSITY OF CALIFORNIA DAVIS

INTRODUCTION: Chronic kidney disease (CKD) is associated with muscle wasting and poor exercise capacity. Exercise and nutritional interventions can improve both musculoskeletal function and kidney health in CKD. The difficulty, cost, and burden of this type of intervention, however, limits research throughput and the exploration of novel interventions. For this reason, we characterized a rat model of CKD to enable mechanistic understanding of how exercise alters physiological and molecular function in CKD.

METHODS: Female Sprague-Dawley rats (n=16, age=7wk) were evaluated for exercise tolerance by measuring maximal speed reached during an incremental treadmill run (10m/min + 2m/min every 3 min at a 10° incline) to volitional fatigue (sitting on the electrical grid > 5s). Plantar flexor muscle function was assessed under anesthesia using needle electrode stimulation (30mA) of the gastrocnemius muscle and a force transducer. Maximal strength was evaluated using a force-frequency curve from (20-200Hz) and fatigue through 180 repeated stimulations with 2s between contractions (70Hz, duration 0.350s). Animals were divided to equate exercise tolerance into a control group (CON, n=8) and a group that was fed a diet containing 0.25% adenine to induce kidney disease (CKD, n=8). Following 8wks on diet, performance measures were reassessed. Pooled time effects were measured via ANOVA. Effect sizes (post value – baseline value) were calculated for each group and compared by t-test.

RESULTS: After 8 weeks on 0.25% adenine diet rats presented with elevated creatinine (1.16 vs 0.57mg/dL, p=0.01), blood urea nitrogen (56.6 vs 21.3mg/dL, p=0.004), kidney mass (1.62 vs 0.86g, p<0.001), and lower hematocrit levels (37.4 vs 48.5%, p<0.001), mirroring human CKD. Final body weight did not differ (CKD vs CON, 282 vs 284g, p=0.9). Collectively both groups had decreased exercise tolerance (mean of 27 to 21 m/min, p=0.009), increased maximal plantar flexion torque (73 to 107mNm, p<0.001), and increased muscle fatigue (32 to 24% of initial force, p=0.003) over 8wk. Maximal plantar flexor force increased significantly more in CON than in the CKD group (difference between effect size =14.9mNm, p=0.0494) and there was a trend towards a greater increase in muscle fatigue in the CKD rats (-8% of initial force, p=0.098). There was no difference in the effect size on exercise tolerance (p=0.427). Interestingly, the soleus muscle of CKD rats was larger than CON (0.47 vs 0.41mg/g body weight, p=0.005), and in the CKD group alone the left kidney was larger than the right (1.87 vs 1.37g, p<0.0001).

CONCLUSION: Females are understudied in both animal and human CKD research and sex has been shown to augment the development of pathology in CKD. These results demonstrate that 8wks of adenine feeding leads to pathologic signs of CKD in young female rats and suggest that muscle dysfunction has begun to develop during this time. Longer interventions may be necessary to better model human musculoskeletal pathology in female rats.

Conventional Print Poster Presentations

CP-PN09 Hypoxia and oxygenation

THE EFFECTS OF SHORT-TERM SPRINT INTERVAL TRAINING AND MUSCLE ISCHAEMIA ON THE EXPRESSION OF MONOCARBOXYLATE TRANSPORTERS AND LACTATE RECEPTOR IN HEALTHY PEOPLE

MANRESA-ROCAMORA, A., GALVAN, V., GARCIA, E., GARCIA, G., MARTINEZ, M., GALLEGO, A., SANTANA, A., MORALES, D., FERNANDEZ, B., BOUSHEL, R., HALLEN, J., MARTIN, M., CALBET, J.A.L.

LAS PALMAS DE GRAN CANARIA UNIVERSITY

INTRODUCTION: Previous studies have investigated the effect of short-term sprint interval training (SIT) on skeletal muscle lactate transporters (i.e., monocarboxylate transporter 1 [MCT1] and 4 [MCT4]). The studies lasted 4 to 6 weeks, and their findings were controversial. Cell-culture experiments indicate that lactate accumulation stimulates MCT1 and lactate receptor (i.e., G protein-coupled receptor 81 [GPR81]) protein expression. Besides, repeated myocardial ischaemia in rodents is accompanied by increased expression of MCT1 after 15 min reperfusion. No study has determined whether repeated periods of post-exercise ischaemia applied at the end of SIT may enhance MCT1 and MCT4 protein expression as adaptation mechanisms. In addition, only one study has studied GPR81 expression in human skeletal and reported no significant changes after resistance exercise or lactate infusion. However, the effect of SIT and ischaemia on GPR81 protein expression in human skeletal muscle remains unknown.

METHODS: Thirteen physically active subjects (6M, 7F) performed a SIT programme (4-6 × 30-s isokinetic sprints with 4-min recovery periods, 3 d/w for 2 weeks). The circulation of one leg was immediately occluded (300 mmHg) after each sprint for 30-50 s, followed by unloaded pedalling without occlusion. Pre- and post-training (PRET and POSTT), each participant carried out a maximal incremental exercise test (IET), followed by a 90-min rest period, and a supramaximal exercise test (SET) (i.e., 6 × supramaximal bouts at 120% of VO2 max to exhaustion followed by 20-s recovery periods with occlusion of the two legs). Vastus lateralis muscle biopsies were obtained at rest, 90 min after IET (post-IET), and after SET (post-SET). MCTs and GPR81 protein expressions were determined by western blot in muscle biopsies. Analysis of variance and partial eta squared were used to carry out analyses.

RESULTS: No significant changes in any of the analysed proteins were observed in MCTs and GPR81 with acute exercise neither before training ($p > .050$) nor after training in the leg trained without ischaemia. Similar results were observed in the leg trained with ischaemia ($p > .050$). SIT did not significantly modify the resting expression levels of MCTs or GPR81 in the leg trained with free circulation nor in the leg trained with ischaemia ($p > .050$).

CONCLUSION: MCT1 and MCT4 protein expression in the sarcolemma may increase by 2-fold with 15 × 1 min knee extension exercise performed 4 d/w for 7-8 weeks. Our study shows that with a shorter duration training programme, despite a much higher exercise intensity and adding post-exercise ischaemia to stimulate lactate accumulation further, neither MCT1 nor MCT4 significantly increase. These findings may explain why peak lactate accumulation after short-term SIT does not increase in humans. As a novelty, we have shown that GPR81 protein expression does not seem responsive to short-term SIT in humans in human skeletal muscle.

GRANT: PID2021-125354OB-C21/C22.

INDIVIDUAL GENDER-BASED VARIABILITY TO ALTITUDE TRAINING IN ELITE BADMINTON PLAYERS

PRECART, C., BOUTEN, J., GIROUX, C., MORALES, A., ROUSSEAU, Q., RABITA, G., HOLLVILLE, E., DE LA CALLE, J., BROCHERIE, F.

UNIVERSITÉ PARIS CITÉ AND INSEP

INTRODUCTION: This study aimed to assess how altitude training impacts force-velocity-power (F-V-P) profiling and Wingate test in elite badminton players in reference to intra- and inter-individual gender-based variability.

METHODS: Fourteen players (6 females, 8 males) from the French national badminton doubles team performed a 3-week "living high-training high" camp in natural altitude (2320 m). F-V-P profile and Wingate test were assessed Pre- and Post-intervention.

RESULTS: No significant interaction nor time (Pre- vs. Post-) effect was observed for any of the variables (all $p > 0.05$). However, a significant gender effect ($p < 0.05$) was observed for maximal theoretical velocity and relative maximal theoretical power (Pmaxrel) for F-V-P profile and for peak and mean power outputs (both $p < 0.001$) for Wingate test. Pre-to-Post changes did not significantly differ between genders, except for Pmaxrel ($p < 0.05$) in favor of female athletes. Hedge's g effect sizes (male minus female) revealed moderate and large effects for F-V-P profiling-derived variables.

CONCLUSION: Mean conventional statistics did not reveal a significant effect of altitude training, mainly due to high intra- and inter-variability across F-V-P profiled-derived variables and Wingate performance. Substantial gender-based differences contributed to this variability, emphasizing the importance of an individualized approach to enhance participant responsiveness to altitude training.

EFFECTS OF HYPERBARIC HYPEROXIA EXPOSURE DURING REST PERIODS ON ANAEROBIC INTERMITTENT EXERCISE PERFORMANCE

HU, X., NAKAGAWA, Y., KANATANI, K., TAKAGI, T., KAWABATA, T.

KANSAI UNIVERSITY

INTRODUCTION: Participating in multiple high-intensity races in a short period can accumulate fatigue, negatively impacting subsequent performance. (1). Recognizing this, it is crucial to promptly employ fatigue recovery techniques, ensuring athletes can recover and maintain proper conditioning during rest periods whenever possible. Hyperbaric oxygen (HBO2) has been proposed to inhibit the progression of muscle fatigue and promote recovery (2). However, research on the effectiveness of HBO2 interventions during rest periods on subsequent exercise performance in competitive events with multiple races per day is still limited. Hence, this study aims to ascertain the effects of inter-exercise HBO2 exposure on subsequent anaerobic exercise performance and explore its potential to enhance athletes competitive performance.

METHODS: Eight athletes performed the Wingate Test (WAnT,30s) on a bicycle ergometer twice with a 60-minute break in between. Participants also underwent two trials under different rest conditions: normobaric normoxia (NN) at 1.0 ATA with 20.93% oxygen, and hyperbaric hyperoxia (HH) at 1.3 ATA with 100% oxygen. The Wingate Test assessed both mean power and maximal power. Blood lactate concentration (BLa) and percutaneous oxygen saturation (SpO2) were measured 40 seconds before and after exercise, as well as at 3 minutes, 5 minutes, and every 10 minutes during the rest periods. Heart rate (HR) was continuously monitored from the beginning of the experiment using a heart rate monitor. The Rating of Perceived Exertion (RPE) was recorded using the Borg scale through interviews after completing the WAnT. All experimental data are presented as mean ± standard deviation. Corresponding T-tests were utilized to compare exerted power, and BLa and HR were analyzed using two-way ANOVA (condition x time). The significance level for all statistical analyses was set at less than 0.05.

RESULTS: In the NN condition, the mean anoxic power after exposure was significantly reduced compared to pre-exposure ($p<0.05$). In contrast, in the HH condition, pre- and post-exposure values were nearly identical ($p>0.05$). However, there was no significant difference in maximum power between pre- and post-exposure in both conditions ($p>0.05$). Moreover, the HH condition exhibited significantly lower BLa and higher SpO2 after the WAnT compared to the NN condition ($p<0.05$). However, resting HR and post-exercise RPE showed no significant differences between the HH and NN conditions ($p>0.05$).

CONCLUSION: For athletes who participate in multiple high-intensity races per day, our results suggest that HBO2 intervention between exercises may inhibit the accumulation of BLa and have a positive effect on physiological parameters related to oxygen saturation. These findings increase the likelihood that exposure to HBO2 during the rest period between repetitive, high-intensity exercises may contribute to promoting post-exercise recovery and maintaining subsequent exercise performance.

EFFECT OF BLOOD FLOW RESTRICTION ON RSO2 OF LOCAL MUSCLE DURING MODERATE TO LOW INTENSITY ENDURANCE EXERCISE

KE, S., XIAOLEI, J.

BEIJING INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: It has been suggested that blood flow restriction combined with endurance training can improve aerobic capacity. But in those studies, the magnitude of improvement in aerobic capacity, the type of intervention, the participants and other factors varied. Blood flow restriction leads to greater metabolic stress on local muscles, but there have been few studies on the effects of local muscle physiological indexes. The aim of this study was to discover the changes of oxygen saturation（rSO2） of lower limb muscles during moderate and low intensity endurance exercise with blood flow restriction, and to explore the mechanism of blood flow restriction in improving aerobic capacity.

METHODS: Eight young male rugby players performed ergometer cycling at 40% of maximum aerobic intensity in two exercise, one with lower extremity blood flow restriction（BFR）and one without(CON). Each exercise includes three 5-min sets with 2 min interval, and the interval between BFR and CON condition was more than 48h. Another eight subjects performed the same exercise at 75% of maximum aerobic intensity. To restrict the blood flow, the subject wear a 5cm wide inflation band at the base of each thigh for a binding pressure of 40mmHg and an inflation pressure of 200mmHg. The rSO2 of the muscles in the middle front of left thigh pre-and in the last 10s of each set（POST） were recorded, and the heart rate and blood lactic acid were recorded immediately post exercise. The paired T-test was performed between BFR and CON condition at each intensity, pre- and post- exercise. Repeated measurement ANOVAs were performed among the three sets.

RESULTS: At 40% of the maximum aerobic intensity, there was no difference in muscle rSO2 between BFR (the 3rd set: PRE: 59.1±3.22%, POST: 57.1±3.76%) and CON (the 3rd set: PRE: 60.8±2.57%, POST: 59.8±2.14%)($P>0.05$), and no difference among the three sets ($P>0.05$). Only in the 3rd set, the heart rate of BFR（135.7±12.83 bpm）was higher than that of CON

(129.4±8.31 bpm) (P<0.05). There was no difference in blood lactate concentration between BFR（4.4±1.2mmol/l）and CON (4.2±1.0mmol/l) post exercise (P>0.05).

At 75% maximum aerobic intensity, the muscle rSO2 of both conditions decreased during exercise (P<0.05).The muscle rSO2 post exercise of BFR was lower than CON in 2 sets（2nd set:BFR:48.8±4.38% vs CON:51.8±2.25%; 3rd set: BFR: 46.8±4.21% vs CON: 50.5±2.23%）(P<0.05). The BFR showed an decrease with the number of exercise sets (P<0.05). The heart rate of BFR was higher than that of CON condition (P<0.05), and showed an increasing trend with the set. There was no difference in blood lactate concentration between BFR（7.8±1.8mmol/l）and CON (7.0±1.5mmol/l) post exercise (P>0.05).

CONCLUSION: Blood flow restriction did not significantly affect the physiological load of local muscle during short intermittent low-intensity aerobic exercise, but increased the physiological load of local muscle during medium intensity aerobic exercise.

REGULATION OF BLOOD GLUCOSE AND CIRCULATING MICRORNAS BY EXERCISE MODALITY IN MODERATE HYPOXIA

TEE, C.C.L., CHONG, M.C.2, COOKE, M.B.3, RAHMAT, N.1, YEO, W.K.1, CAMERA, D.M.2

1 NATIONAL SPORTS INSTITUTE OF MALAYSIA, KUALA LUMPUR, MALAYSIA; 2 SWINBURNE UNIVERSITY OF TECHNOLOGY, MELBOURNE, MALAYSIA; 3 LA TROBE UNIVERSITY, MELBOURNE, AUSTRALIA

INTRODUCTION: Combining exercise and hypoxia may have synergistic effects to mediate multiple health responses in adults with overweight. The purpose of this study was to investigate the acute effect of moderate hypoxia (MH) combined with three different modes of exercise (e.g., aerobic, sprint-interval, or functional exercise) on blood glucose regulation and expressions of selected circulating microRNAs.

METHODS: Thirteen men (31±4 years, 80.1±6.3 kg, 26.3±3.2% fat) performed three acute exercises (60 min low-intensity cycling exercise, 20 x 4 s at 7.5% sprint interval cycling, and bodyweight functional exercises: 4 x 20-s half-squat, gluteal contractions, calf-raises and knee raises) under moderate normobaric hypoxia (MH; FiO2 = 16.5%). Plasma levels of glucose, insulin iAUC, and circulating microRNAs expression (c-miRs-486-5p, -126-5p, and -21-5p). Heart rate, oxygen saturation, physical activity enjoyment scale, and perceptual measures were recorded during exercise.

RESULTS: Following an acute sprint interval (p=0.028) and low-intensity cycling (p=0.006) under MH, plasma glucose, and insulin concentration were lower vs control. No differences were observed in functional exercise vs control, low-intensity vs sprint interval cycling, low-intensity cycling vs functional exercises and sprint interval cycling vs functional exercises. Heart rate was greater in sprint interval cycling (p<0.001) vs other exercise modalities while oxygen saturation and physical activity enjoyment scale were not different between exercise modalities. No differences were observed in the expression of circulating miRNAs (c-miR-486-5p, -126-5p, or -21-5p) (p>0.05).

CONCLUSION: Our findings indicate that engaging in acute sprint interval cycling exercise under MH offers a more effective stimulus for enhancing post-exercise glucose regulation in overweight adults. This approach can be deemed a preferred choice for exercise prescription by both exercise practitioners and clinicians aiming to promote metabolic health.

FUNDING: Tee C.C.L is supported by a grant from the National Sports Institute of Malaysia and Swinburne University of Technology, Melbourne, Australia.

REFERENCES:

1) Tee at al. (2023) Sports Med. 52(2):327-348.

2) Tee at al. (2023) Front Physiol. 14:1174926

TEST-RETEST RELIABILITY OF POST-OCCLUSIVE REACTIVE HYPERAEMIA USING GOMPERTZ MODELS

FELSTEAD, A., AGGETT, J., ORDISH, C., BATES, M., HEFFERNAN, S.M., WALDRON, M.

SWANSEA UNIVERSITY

INTRODUCTION: Near-Infrared Spectroscopy (NIRS) has been extensively used for the measurement of post-occlusive reactive hyperaemia (PORH), which reflects the time-course and magnitude of skeletal muscle microvasculature reperfusion following a brief period of limb ischemia. It has been proposed that the oxyhaemoglobin concentration response ([O2Hb]) to PORH was best described by a Gompertz model [1]; however, the reliability of all model parameters and the goodness of fit among different Gompertz models has not been investigated. This study evaluated the test-retest reliability of NIRS-derived PORH tests of the lower-limb, using Gompertz models to characterise the [O2Hb] response.

METHODS: Five healthy participants (1 female, 4 males; 23 ± 1 years) undertook two PORH measurements (45-min apart). After 10-min of supine rest, a 10 Hz NIRS device was positioned on the right medial calf and raised above the level of the heart. An occlusion cuff was fitted immediately proximal to the knee and inflated to occlude the lower-leg for 5-min at 300 mmHg. Following release of the cuff, changes in [O2Hb] were measured and the reperfusion kinetics were analysed using a custom-written script in R-Studio. The period between the start of the reperfusion and the peak hyperaemic response was used across all participants. Both three and four-parameter Gompertz models were used to characterise the response. Two reperfusion parameters were selected: Amplitude (A) as the peak vascular response relative to baseline, and rate constant (k). Goodness of Fit (GoF) statistics were calculated. Systematic differences between test 1 and test 2 were identified using a paired samples t-test and agreement between tests was calculated using Coefficient of Variation (CV) and 95% confidence intervals.

RESULTS: A four-parameter Gompertz model would not converge for the current data, thus a three-parameter model was used. There were no differences in the means between the two trials (A: p=0.591, k: p=0.694), demonstrating no mean bias for both variables. The CV% of the A was 2.9%; 95% CI 0.7 to 5.0% and k was 19.0%; 95% CI 12.2 to 25.7%. The GoF, denoted by R2 values, across all three-parameter models was 0.983±0.015.

CONCLUSION: The NIRS-derived A parameter from a three-parameter Gompertz model was more reliable than the k parameter during a PORH test. Based on reports that trained males have a ~30% and ~45% increase in the NIRS-derived amplitude and recovery rate during a PORH test, respectively, compared to untrained males [2] demonstrates that the measurement errors of the current test would be acceptable and permit identification of larger differences between phenotypes. However, potential users of this test should consider whether it could be used to identify analytical goals of smaller magnitude, particularly if k values are to be used, as the CV% was appreciably larger for this parameter.

References

1. Bopp et al. 2011, Eur. J. Appl. Physiol.

2. Rasica et al. 2022, Med Sci Sport Exerc

PREDICTION OF ACUTE MOUNTAIN SICKNESS OCCURRENCE FROM OVERNIGHT PULSE OXIMETRY .

JOYCE, K., ASHDOWN, K., TRENDER, W., CLARKE, S., SIMPKINS, C., DELAMERE, J., BRADWELL, A.R., LUCAS, S.J.E.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Acute mountain sickness (AMS) affects a large proportion of individuals ascending to high altitude each year. If left untreated, AMS can progress to serious illness (e.g., high-altitude cerebral oedema), which can be fatal or require emergency rescue. Despite this well-established observation and outcome, predicting AMS occurrence and severity for an individual prior to the onset of symptoms remains elusive. The objective of this study was to collect nightly pulse oximetry data during an ascent to 4554m (Margherita Hut) and, together with a classification model trained on data from a previous ascent to 4800m, utilise it to predict AMS severity at 4554m.

METHODS: Twenty lowlanders (5 females) completed a 4-day ascent to 4554m where they spent two nights. Oximetry data were recorded continuously each night using wrist-worn pulse oximeters (WristOx2, Nonin Medical). Clinical evaluation was performed daily and Lake Louise Scores (LLS) collected each morning (AMS-positive: LLS greater than or equal to 3 with headache). AMS predictions were made using a classification model (Weighted K-Nearest Neighbour) that was developed (Kruskal-Wallis-based feature selection) and trained (MATLAB, 2022a, Mathworks) on data from a previous field expedition to 4800m. Sensitivity, specificity, and accuracy of the model were assessed by comparing model predictions against the LLS and clinical classifications (AMS-positive or AMS-negative). Similarly, model predictions based on overnight data from 3647m were compared to the occurrence of AMS at 4554m.

RESULTS: Ninety three out of 100 oximetry recordings were successful with 743.1hrs (avg. recording length: 8.0±1.0hrs) of data collected, and minimal artifact observed (1.1±1.3%). Across the two nights at 4554m the model predictions exhibited: sensitivity: 36%; specificity: 92%; accuracy: 54%, for LLS classification, and sensitivity: 57%; specificity: 91%; accuracy: 76% for clinical classification. From the overnight data collected at 3647m, model predictions exhibited sensitivity: 57%; specificity: 83%; accuracy: 65% for LLS classification at 4554m, and sensitivity: 60%; specificity: 78%; accuracy: 65% for clinical classification at 4554m.

CONCLUSION: Occurrence of AMS at 4554m can be predicted from overnight oximetry at 3647m using the present model. However, further research is required to optimise the model's sensitivity, specificity, and accuracy for greatest impact and best real-world application. Future research should revaluate model predictions among a larger ascending cohort and also explore alternative overnight oximetry features for inclusion, as well as features from other sources (e.g., actigraphy, facial imaging).

ACUTE EFFECT OF LOW-LOAD BLOOD FLOW RESTRICTION AND HIGH-LOAD RESISTANCE TRAINING ON ADRENALINE LEVEL AND JUMPING PERFORMANCE

LATOCHA, A., GREN, A., GEPFERT, M.

AKADEMIA WYCHOWANIA FIZYCZNEGO IM. JERZEGO KUKUCZKI W KATOWICACH

INTRODUCTION: The utilization of blood flow restriction (BFR) during low-load resistance training has proven to be an effective method for inducing muscle hypertrophy comparable to high-load resistance training. The mechanisms underlying the effectiveness of BFR are not fully understood, but available evidence suggests that it contributes to increased endocrine responses, while also eliciting low levels of exercise-induced muscle damage and local fatigue. Therefore, this study aimed to compare acute effects of low-load with and without BFR and high-load resistance training on epinephrine level and jumping performance.

METHODS: The study included 23 healthy and physically active participants (age: 24±3years; body mass: 70.8±11.6kg; body height:174.1±8.9cm; one-repetition maximum [1RM] leg press: 289±70kg). After familiarization session and 1RM leg press assessment participants were randomly assigned to one of the leg press workout under following conditions: i) low-load (30% 1RM 30/15/15/15); ii) high-load (70%1RM 10/10/10/10); iii) BFR (30%1RM 30/15/15/15 at 80% arterial occlusion pressure). In the experimental session, blood was initially collected (pre-workout), and then the participants performed an individual warm-up, after which they began to perform baseline measurements of countermovement jumps (CMJ; pre-

workout). To induce BFR, inflatable cuffs were applied on most proximal part of both lower limbs with individually adjusted arterial occlusion pressure of 80%. Immediately after the workout post-test has been performed (post-workout).

RESULTS: The two-way repeated measures ANOVA didn't show a significant interaction on AD level (p=0.591), nor a main effect of group (p=0.954) but it did show significant main effect of the time (p<0.05; p=0.020), indicating an increase in AD level from pre- to post-workout (11.5±8.89 vs 22.4±22.6µg). There was also no significant interaction for jump height (p=0.853), nor main effect of group (p=0.011), but there was a significant main effect of time (p<0.05; p=0.020), to decrease jump height from pre- to post-workout (37.2±10.8 vs 34.8±11.3cm). Additionally, the two-way repeated measures ANOVA didn't show a significant interaction (p=0.979), nor main effect of group (p=0.014), and time (p=0.064) for relative peak power.

CONCLUSION: This study showed that both low-load resistance training with and without BFR, as well as high-load resistance training, led to a significant acute increase in adrenaline levels and fatigue assessed by CMJ performance. Surprisingly, the results of this study suggest that neither BFR nor the load used during resistance training significantly moderated changes in adrenaline levels. Consequently, even low-load lower-limb resistance workout resulted in a significant increase in adrenaline levels and a concomitant decrease in subsequent jump performance. Future long-term studies involving larger samples are necessary to confirm these findings.

ADAPTIVE RESPONSE TO ADDITIONAL REPEATED SPRINT TRAINING IN HYPOXIA IN HIGHLY-TRAINED ATHLETES FOLLOWING 2 WEEKS OF REPEATED SPRINT TRAINING IN NORMOXIA

HAGIWARA, M., YAMAGISHI, T., YAMASHITA, D.

JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Repeated sprint training in hypoxia (RSH) has gained popularity among high-performance sports because it brings about various training benefits in a time-efficient manner [1]. Indeed, 2-5 weeks of RSH has been shown to improve anaerobic power, repeated sprint ability, and aerobic power [1]. While repeated sprint training in normoxia (RSN) also induced physiological adaptations such as maximal oxygen uptake (VO2max) within 3 weeks, no further improvements of VO2max were observed with additional 3-6 weeks of the training despite an increase in training volume (number of sets) [2]. This suggests that increase in training volume alone is not sufficient for further physiological adaptations. Thus, this study aimed to evaluate the effects of additional hypoxic stimulus while simultaneously increasing training volume.

METHODS: Sixteen highly-trained basketball players (age: 20 ± 1 years, height: 182.6 ± 7.8 cm, weight: 74.8 ± 8.4 kg, VO2max: 55.2 ± 5.4 ml/min/kg) completed physiological and performance tests on a cycle ergometer (Wattbike ATOMX) three times: before, during and after the training intervention (Pre, Mid, Post). Main parameters were peak power (PP) and mean power (MP) during a 6-s cycle sprint test, and maximal aerobic power (MAP) and VO2max achieved in a cycle incremental test. All subjects performed RSN with maximal efforts 3 times per week for 2 weeks (i.e., 6 sessions in total) as the first half of the training (2 sets of 5-7 6-s sprints with 30-s recovery, 5-min recovery between the sets), after which they were divided into 2 groups (hypoxic training group: HYP, normoxic training group: NOR) based on the results obtained from Pre and Mid tests. The second half of the training consisted of 3 sets of 5-7 6-s sprints with 30-s recovery, 5-min recovery between the sets, where HYP completed 5 sessions under normobaric hypoxia (FIO2: 14.5%, equivalent to a simulated altitude of 3000 m) with one more session under normoxia (i.e., 6 sessions in total), whereas NOR completed 6 sessions under normoxia.

RESULTS: Both groups significantly improved PP and MP from Pre to Post (PP [Pre vs. Post]: HYP, 14.8 ± 2.2 vs. 16.4 ± 1.5 W/kg; NOR, 14.1 ± 1.5 vs. 15.2 ± 2.0 W/kg, $p < .05$, MP [Pre vs Post]: HYP, 12.5 ± 1.8 vs. 13.9 ± 1.2 W/kg; NOR, 11.7 ± 0.9 vs. 13.0 ± 1.6 W/kg, $p < .01$) with no difference between the groups. Both groups significantly improved MAP and VO2max from pre to Post (MAP [Pre vs. Post]: HYP, 4.26 ± 0.35 vs. 4.42 ± 0.31 W/kg; NOR, 4.02 ± 0.36 vs. 4.28 ± 0.30 W/kg, $p < .001$, VO2max [Pre vs. Post]: HYP, 57.2 ± 4.2 vs. 60.2 ± 3.6 ml/kg/min; NOR, 53.0 ± 6.2 vs. 56.4 ± 5.3 ml/kg/min, $p < .001$) with no difference between the groups.

CONCLUSION: 12 sessions of repeated sprint training over 4 weeks improved both anaerobic and aerobic capacities, whereas no additional benefits were obtained from 5 sessions of RSH when preceded by 6 sessions of RSN over 2 weeks.

References

1. Brocherie et al. (2017)

2. Yamagishi & Babraj (2017)

Conventional Print Poster Presentations

CP-SH06 Physical Education and Pedagogics

EVALUATION OF A LIFE SKILL COACH DEVELOPMENT PROGRAMME IN PRIMARY SCHOOL PHYSICAL EDUCATION

NOLAN, D.
UNIVERSITY OF HERTFORDSHIRE

Introduction

PE is an ideal context to foster life skill development. Life skills are skills that are developed in one context, such as PE, and applied in another, such as the home. Primary PE coaches are often expected to plan and deliver lessons that prioritise holistic and life skill development, despite their limited understanding of life skill development and associated coaching behaviours. Kirkpatrick's (1959, 1976, 1996) training evaluation model was used to evaluate the effectiveness of a Life Skills Coach Development Programme, aimed at enhancing primary PE coaches' ability to embed life skills in lessons. The model is conceptualised across four levels: reaction, learning, behaviour, and results.

Methods

Data was collected using semi-structured interviews and unstructured observations. Eleven primary school P.E. coaches were recruited from a community football foundation (CFF). Fifty-nine unstructured PE lesson observations were conducted. Due to participant attrition, one semi-structured interview was conducted with eight of eleven participants. A modified form of thematic analysis was used to analyse data.

Results

Themes were based on the four levels of Kirkpatrick's model. The Reaction theme contained two subthemes; 'Experience of the Coach Development Programme', and 'Proposed alterations to Coach Development Programme'. The Learning theme contained two subthemes; 'Understanding of the research project and its purpose', and 'Understanding of life skill development'. The Behaviour theme contained three subthemes; 'Application of new knowledge', 'Non-application of new knowledge', and 'Utilising the life skill lesson resources'. The Results theme contained two subthemes; 'Change in coaching behaviours' and 'P.E. prioritisation and project legacy'.

Discussion

Coaches expressed how programme involvement was novel and engaging. The autonomy-supportive climate and situated learning environment facilitated improvements in their coaching practice and enhanced their understanding of life skills. Yet application of this knowledge in PE lessons could be inconsistent. To improve the programme, coaches recommended greater communication between the CFF and schools about the project and advocated for more peer learning opportunities. Overall, there was an increase in coaching behaviours that promoted life skill development post-programme, as coaches planned and delivered lessons in which life skills were embedded. Coaches noted that lasting changes to their practice may be threatened by the low prioritisation of PE in schools.

References

Kirkpatrick, D. (1959) Techniques for evaluating training programs. Journal of the American Society of Training Directors, 13,3–9

Kirkpatrick, D. (1976) Evaluation in training. In R. Craig (Ed.), Training & development handbook: A guide to human resource development (2nd ed., pp. 301–319). McGraw-Hill

Kirkpatrick, D. (1996) Invited reaction: reaction to Holton article. Human Resource Development Quarterly, 7,23–25

DEVELOPMENT OF A LIFE-SKILLS PROGRAM FOR JUNIOR HIGH SCHOOL ATHLETIC CLUB ACTIVITIES

SAEKO, W., YUKO, T.
KEIO UNIVERSITY

BACKGROUND:

The Japanese school system involves a club activity initiative in which students interested in sports participate and are coached by schoolteachers. A wide range of students participate there, from beginners to developing elite athletes. However, the measures to reduce the burden on schoolteachers, who carry out a variety of duties, and to enable students with different needs to participate in meaningful club activities are still under consideration.

OBJECTIVE:

To clarify the current status of club activities at public junior high schools and develop a life-skills program that enhances self-efficacy.

METHODS: The participants were 40 junior high school students (age range 13–14) in the soft tennis ball and soccer clubs of a public junior high school in Kanagawa Prefecture. The students' characteristic self-efficacy scale [1] and club activity desire satisfaction [2] were measured.

RESULTS: Correlation analysis of the two scales in the preliminary survey revealed that the overall correlation coefficient was r=0.43 with r=0.17 for the soft tennis ball club (n=18) and r=0.57 for the soccer club (n=22). Furthermore, the correla-

tion coefficients by grade were r=0.32 for the first grade (n=17) and r=0.53 for the second grade (n=23). The interviews indicated that schoolteachers were aware of the issues of the students' lack of proactive behavior toward competition and lack of confidence in their play but were confused by the measures for improvement.

DISCUSSION:

There was almost no correlation found for the soft tennis ball team, where the influence of others on competition results is small and differences in ability are pronounced; yet there was a correlation for the soccer team, where students do collaborate with others. However, the correlation was generally weak, suggesting that the participants had few successful experiences in competitions and human relations. Based on these results, we designed a seven-session life-skills program that (1) promotes individual goal setting and achievement, and (2) encourages discussion across grade levels, with the aim of enabling students to experience success both as teams and individually.

REFERENCES:

1. Narita K, J Shimonaka, K Nakazato, C Kawai, S Sato, and Y Nagata. A study of the trait self-efficacy scale. An examination of the trait self-efficacy scale: exploring the possibility of lifelong developmental use. Journal of Educational Psychology, 1995. 43: p. 306-314.

2. Kakutani, Shiori, and Takashi Muto. The significance of junior high school club activities for those who continue club activities: In relation to the sense of fulfillment and satisfaction with school life. Japanese Psychological Association, 2001. 72(2): p. 79-86.

EFFECTS OF STRENGTH- & FLEXIBILITY-BASED PHYSICAL EXERCISE ON ATTENTIONAL AND EMOTIONAL PARAMETERS IN CHILDREN DIAGNOSED WITH AD(H)D

ELSNER, S., OSTER, A., ASCHERMANN, E., FRÄNKEL, S., GROßSCHEDL, J.

EDUCATIONAL PSYCHOLOGY

Introduction

There is overwhelming consensus that physical exercise has the potential to facilitate cognitive functioning via neuromodulatory factors, in the long-term [1] and acutely [2]. These effects are particularly relevant to groups with impaired cognitive functioning such as children diagnosed with AD(H)D, a neurodevelopmental disorder with atypical symptoms of inattention, impulsivity and hyperkinetic behaviour [3]. Experimental studies reveal cognitive improvements following endurance training in children diagnosed with AD(H)D [4] [5] [6]. As an alternative to potentially monotonous movement patterns in endurance training, we investigated effects of strength- and flexibility-based physical exercise on attentional and emotional parameters in this study.

Methods

A total of 24 children (7 to 12 years old) participated in this study. Thirteen children took medication regularly and either refrained from taking them on the day of testing or testing was scheduled to reduce effects of medication. In a within-subjects study design, each child completed three sessions (strength-based exercise vs. flexibility-based exercise vs. inactive control session) in a randomised order with one week in between sessions. Before and after the 30-minute training, children performed an adapted flanker task [7]. Self-reports [8] and parents' observations of emotional responses ('pleasure', 'arousal') were captured. Nonparametric tests for repeated measured were applied.

Results

We observed no effects of physical exercise on attention via the inverse efficiency score (IES)* in congruent trials; $\chi2(2) = 1.41$, $p = .494$ and incongruent trials; $\chi2(2) = 3,85$, $p = 0.146$. Children reported an immediate increase in 'pleasure' after inactivity; $\chi2(2) = -2.46$, $p = .014$ and an immediate increase in 'arousal' after strength-based training; $\chi2(2) = -1.98$, $p = .048$. Parents reported a prolonged increase in 'pleasure' after strength-based training $\chi2(2) = 2.19$, $p = .029$ and a prolonged decrease in 'arousal' after inactivity; $\chi2(2) = -2.54$, $p = .011$.

* IES allows a combined assessment of reaction time and accuracy

Discussion

No effects of strength- and flexibility-based training on attentional parameters in children diagnosed with AD(H)D were evident. However, emotional states were altered as reported by children and observed by their parents. We assume that effects of strength- and flexibility-based exercise on attentional parameters are inferior to those of endurance training. We propose long-term effects on attentional parameters via emotional states instead of acute effects. Initially apparent discrepancies between children's self-reports and parents' observations will be explained.

References

[1] Audiffren & André, 2019

[2] Tomporowski, 2003

[3] Schlottke et al., 2019

[4] Chuang et al., 2015

[5] Pontifex et al., 2013

[6] Piepmeier et al., 2015

[7] Ludyga et. 2017

[8] Bradley & Lang, 1994

EFFECTIVENESS OF PHYSICAL ACTIVITY, AND PSYCHOLOGICAL TREATMENT ON EMOTION DYSREGULATION IN CHILDREN WITH NEURODEVELOPMENTAL DISORDERS: A SYSTEMATIC REVIEW AND NETWORK META-ANALYSIS

TAO, R.R., SIT, C.H.P., YANG, Y., LIU, C.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: Emotion dysregulation is defined as the inability to modify the intensity and quality of emotions in an adaptive manner that is necessary to achieve goals, resulting in emotional over-reactivity, lability, and irritability. Physical activity and psychological treatment have demonstrated the potential to improve emotion dysregulation in children with Neurodevelopmental Disorders (NDDs), however, there have been no studies to synthesize such evidence systematically. This meta-analysis aimed to evaluate the effects of physical activity and psychological treatment (i.e., behavioral therapy and cognitive training) on emotion dysregulation in children with NDDs, and their comparative effectiveness.

METHODS: Web of Science, PubMed, Medline, PsycINFO, and SPORTDiscus were searched for randomized controlled trials (RCTs) from database inception to December 2023. RCTs examining the effectiveness of physical activity or psychological interventions for addressing emotion dysregulation in children aged 5-17 years diagnosed with NDDs were included. Frequentist network meta-analyses were conducted utilizing standardized mean differences (SMD) along with 95% confidence intervals (95% CI), employing random effects models. These analyses aimed to assess post-intervention differences in emotion dysregulation, encompassing multiple processes such as emotion recognition/understanding (ERU), emotion reactivity/negativity/lability (ERNL), and emotion regulation (EREG).

RESULTS: Eighteen RCTs involving 1,068 participants were included in the analyses. Both physical activity intervention (SMD=0.41; 95%CI: 0.05 to 0.77) and psychological treatment (SMD=0.43; 95%CI: 0.15 to 0.71) showed superior effectiveness in improving emotion dysregulation compared with usual care controls. Regarding specific processes of emotion dysregulation, regular physical activity interventions had the highest probability of being the most effective for EREG with a moderate positive effect (SMD=0.47; 95%CI: 0.08 to 0.85), followed by psychological treatment (SMD=0.44, 95%CI: 0.14 to 0.73) compared to usual care control. However, no significant effects were observed in attenuating ERNL for either physical activity intervention (SMD=0.51; 95% CI: -0.04 to 1.06) or psychological treatment (SMD=0.59; 95% CI: -0.27 to 1.45). To date, there have been no RCTs examining the effectiveness of physical activity intervention on ERU.

CONCLUSION: The findings of our study support the utilization of both physical activity and psychological treatment for improving emotion dysregulation in children with NDDs. Further RCTs are warranted to validate the potential effects on various aspects of emotion dysregulation and to explore potential differences in effectiveness across specific processes.

THE IMPACT OF PRESCHOOL TEACHER INTERVENTION ON PRESCHOOLERS MOTOR BEHAVIORS DURING PLAY DEPENDS ON THE FREQUENCY OF THOSE BEHAVIORS IN DAILY LIFE

IIDA, M., OGISO, K.

AOYAMA GAKUIN UNIVERSITY

Experiencing a variety of movements in infancy is crucial for acquiring and refining diverse movements skills. This suggests that exposing infants to a greater range of movements is important, and the involvement of preschool teachers significantly contributes to this exposure. The aim of this study was to investigate whether the impact of preschool teachers intervention on physical movements observed during childrens play in kindergarten varies depending on three types of movements—balancing, locomotor, and manipulative—that occur with different frequencies during daily play. The study focused 24 four-year-old children in a kindergarten class, with a preschool teacher documenting weather conditions, play locations, types of play, and childrens activities. She also rated the frequency and proportion of children engaging in 45 categorized physical movements on a five-point scale. The observed physical movements were categorized into locomotor, manipulative, and balancing movements. The frequency of occurrence and changes in the number of participants were compared between intervention and non-intervention periods. The intervention by preschool teachers, aimed at exposing children to less frequently occurring manipulative movements in daily play, increased in both the frequency and the number of participants engaging in these movements during spontaneous play. However, this impact decreased over time when the intervention was discontinued. In contrast, frequent locomotor movements observed during daily play did not show a noteworthy increase in frequency and number of participants with preschool teacher intervention. Furthermore, there was no noteworthy decrease when the intervention was discontinued. To conclude, the impact of preschool teacher intervention in physical movements observed during childrens play seemed to depend on the frequency of the childrens movements occurred during daily play. The intervention significantly increased less frequently occurring movements during daily play; however, the effects did not persist once the intervention was discontinued.

FACTORS ASSOCIATED WITH OUTDOOR PLAY DURING RECESS TIME IN ELEMENTARY SCHOOLS: A MIXED METHODS RESEARCH

IMAI, N., KIDOKORO, T.

TOKYO KASEI UNIVERSITY

1. Background

Although school recess has a potential to increase outdoor play among school-aged children,

most of previous studies in this research area investigated outdoor paly using subjective methods (e.g., questionnaire). Therefore, this study examined factors associated with children's outdoor play during recess in elementary schools using a mixed methods approach.

2. Methods

2.1. Study design

This study was conducted using mixed methods approach (explanatory sequential design). The participants were 2200 primary school children from five public elementary school in Japan. Quantitative data were collected in September 2023 and qualitative data in November 2023.

2.2. Measures

Quantitative data were collected using the System for Observing Childrens Play. The items collected were sex, grade, content of outdoor play, percentage of children out in the school yard during recess, and intensity of physical activity. Qualitative data were collected through semi-structured interviews with five school nurses at the same elementary school.

3. Results

3.1. Quantitative results

Our findings revealed that compared to boys (20.8%), a much smaller percentage of girls (5.9%) were outside during recess. Compared by school, elementary schools with the least number of children and the smallest schoolyard area had the highest percentage of both boys and girls (44.3% and 9.8%, respectively) in the school yard during recess. Contrarily, elementary schools with the shortest recess had the lowest percentage of children playing outside during recess (boys: 16.8%, girls: 5.8%).

3.2. Qualitative results

Three themes emerged from interviews with five school nurse teachers at the five elementary schools. 1) Gender differences were observed in the way students spent their recess. In other words, girls were more likely to chat with teachers and other children, and hence were less likely to engage in outdoor play during recess. 2) Elementary schools with child-centered events and habitual activities showed a higher percentage of children playing outside, regardless of differences in the environment. For instance, in one school, every Thursday, lunchtime was eliminated from cleaning time to allow time to freely go outside and play. 3) Elementary schools where teachers played outdoors with children had a higher likelihood that children played more frequently in the school yard compared to schools where teachers were involved in activities such as contacting parents, looking at diaries etc., during recess.

4. Considerations

The results of this study indicate that the length of recess, school initiatives, and teacher involvement may influence children's outdoor play during recess. Efforts should be made to organize school events and to relieve teachers busy schedules.

FACTORS AND STRUCTURES THAT MAKE STUDENTS WHO HATE PHYSICAL EDUCATION ADAPT TO THE CLASS

HOMARE, O., TOSHIHIRO, N.

HOKKAIDO UNIVERSITY OF EDUCATION GRADUATE SCHOOL

Introduction

During physical education classes, students are acutely conscious of the attention directed towards them during physical activities. This awareness significantly influences their preferences and aversions towards physical education activities. Previous study indicates that implementing relaxing exercises[1)] and providing positive feedback at the start of the school year[2)] enhance students sense of adjustment to the classroom environment. This study focuses on students who harbor a dislike for physical education, a sentiment that tends to intensify during middle school years. However, the factors and structural aspects influencing their adaptation to the classroom environment remain unclear. Therefore, the purpose of this study is to clarify the factors and structures that help students who dislike physical education adapt to the classroom.

Methods

In this study, we conducted a questionnaire survey of 263 first- to third-year junior high school students regarding their goal orientation and sense of adaptation to the classroom. Based on the scale of goal orientation, the subjects were divided into two groups: a group with a tendency to dislike physical education and a group with a potential to dislike physical education[3)]. Afterward, we conducted a covariance structure analysis from the scale related to classroom adjustment and clarified the structure for the two groups.

Results

The results of covariance structure analysis showed positive paths for the factors of "friendship" and "motivation to learn in both groups. Differences between the two groups were found in terms of their perception of having fun and being good at other subjects and their sense of valuing their friends.

Discussion

A comparison between the two groups suggests that group activities that take into account friendships during physical education situations will help prevent dislike of physical education. It is necessary to come up with a way to feel fun when

doing activities with friends. In addition, since they do not feel that they are good at other subjects, it is necessary to improve their motivation for other subjects and physical education.

Reference

1）Kawamura, Y., Inoue, K., & Kinugasa, M. (2019) The Influence of the "Exercises for Physical Release" of Semester Beginning on the Subjective Adjustment to the Class: Targeting Upper Grades of Elementary School. Osaka University of Education Bulletin, 67, Pp25-32.

2）Matsushita, R., Ishizu, K., & Shimoda, Y. (2011) Factors affecting the feeling of school adjustment among junior high school freshmen: from the aspects of self-esteem, anti-exclusion, and positive feedback. Toyama University, 5, Pp61-68.

3）Toyama, T., Nakasuga, T.(2018) Goal Orientations on Physical Education Class in Junior High School Students: Comparative of Perceived Physical Competence Score and Perceived Inferiority Complexes Score. Hyogo University of Education, 31, Pp33-38.

PERSONALITY PREDICTORS OF EXERCISE ADDICTION IN COMPETITIVE SPORT

VITKOVA, T., RUSNÁKOVÁ, K., MUDRÁK, J.

FACULTY OF ARTS, CHARLES UNIVERSITY

Intorduction

Exercise addiction is becoming a recognized concern, particularly prevalent in elite athletic environments where the pursuit of perfection is emphasized. Despite growing awareness of problematic exercise behaviors, research investigating the underlying risk factors remains limited. Therefore, the objective of this study was to map the issue of sport addiction in Czech elite sport and to explore the personality correlates of this specific addictive behaviour.

Methods

A sample of 168 competitive athletes, aged 18 to 30 years, completed quantitative online assessments including the Exercise Addiction Inventory (EAI), Sport Motivation Scale-6 (SMS-6), the Athletic Identity Measurement Scale (AIMS), Performance Perfectionism Scale-Sport (PPSS), and the neuroticism scale from Big Five Inventory (BFI-N). The participants were recruited from endurance (28.3 %), power (32.7 %), and mixed sports (40.0 %). It was hypothesized that endurance athletes will show greater symptoms of exercise addiction due to the high volume and intensity of training that promotes physical and psychological tolerance, one of the early signs of addiction.

Results

In terms of prevalence, the findings revealed that 16.5 % of athletes exhibited problematic signs of exercise addiction, while 76.7 % were potentially at risk with low severity of symptoms. No significant differences were observed between different groups of sports. Correlation analysis indicated a significant positive relationship of exercise addiction with all variables, with the strongest correlation between addiction and sport identity (r = .52). Using multiple linear regression, the study demonstrated a significant overall effect of personality predictors on exercise addiction. Neuroticism, introjected regulation, and athletic identity were identified as significant predictors of exercise addiction.

Discussion

These findings highlight the importance of psychological factors such as personality traits and motivational regulation in understanding exercise addiction among athletes. The results identified neuroticism, introjected regulation, and athletic identity as risk personality attributes for developing exercise addiction and thus support early screening of at-risk athletes and the possibility of introducing prevention programs in specific sports.

This work was supported by the project : GAUK no. 165023.

FROM ATHLETIC EXCELLENCE TO ACADEMIC INFLUENCE: A STUDY OF RETIRED ATHLETES TRANSITIONING INTO THE HIGHER EDUCATION SECTOR

FAN, C., YUTAO, Z., ZHIMING, Z., SHUGE, Z.

HUNAN UNIVERSITY OF TECHNOLOGY

Background: Transiting from an athletic career to a post-athletic career is a complex process, shaped by various factors, such as the psychology, academic, and vocation. While numerous studies have offered insights into the subjective experience and perceived challenges of athletes career transitions, to date, knowledge is scarce regarding the pathways and challenges of retried athletes in pursuing specific vocational roles. In this research, we aimed to address this significant gap by investigating a specific, popular, and challenging pathway of career transition in retired athletes; that is, the transition from the athletic settings to the academic domains within higher education. More specifically, we conducted the study to understand the motivations, challenges, and barriers/difficulties retired athletes may encounter when transitioning into the higher education sector.

Methods: We recruited 17 retired national-level athletes from China (aged 26-37; 8 are currently employed full-time in 6 universities whilst the rest were seeking positions in higher education at the time of data collection) for 1-1 semi-structured interviews to understand the motivations, challenges and barriers from them. Moreover, the research used a Delphi approach to investigate 17 human resource managers in Chinese higher education settings to gain consensus only on the barriers/difficulties faced by retired athletes when transitioning into the higher education sector.

Results: The thematic analysis revealed a significant discrepancy between retired athletes educational qualifications and the requirements for teaching positions. Despite their athletic expertise, these individuals often lack the necessary cultural literacy and require professional education training to obtain teaching credentials or formal qualifications. This deficiency, along with challenges in psychological and physical adjustment, leads to difficulties in securing employment. The study also identified a prevalent undervaluation of physical education roles in higher education, which exacerbates the challenges retired athletes face professional identity and satisfaction in obtaining teaching roles. Furthermore, applying the Delphi method emphasised the importance of developing a professional identity and recognising the teaching profession within the higher education sector. It also highlighted the need for psychological support to help athletes overcome the difficulties and challenges of adjusting to new professional and societal roles. Additionally, there was a consensus on key challenges, including legal and regulatory safeguards, which emerged as significant concerns.

Conclusions: This study highlights the distinct challenges retired athletes in China encounter when shifting to teaching roles within higher education. The findings inform the development of future career development programs and targeted policy-level interventions to aid retired athletes through the intricacies of such transitions.

THE RELATIONSHIP BETWEEN ATHLETES' IDENTITY AND ATTITUDES TOWARD SOCIAL CONTRIBUTION AMONG FEMALE PROFESSIONAL SOCCER PLAYERS

YUKO, T.

KEIO UNIVERSITY

Background

Established in 2021, the Women's Empowerment League (WE League) is Japan's first professional womens soccer league. Its mission is to be "the best in the world" and to "solve social problems" at the same time. Until now, it has been uncommon in Japans athlete development system for athletes to spend time outside of competitions on social contribution activities.

Purpose

The purpose of this study is to elucidate the characteristics of players who aim to be both "the best in the world" and to "solve social problems," and the reality of their social contribution awareness.

Methods

Subjects included total of 114 players (age range 18-40) in the WE League. Based on the Athletic Identity Measurement Scale (AIMS) (Brewer and Cornelius, 2001: Hagiwara and Isogai, 2020) sub-scales (social identity, exclusiveness, and negative emotions) and philosophy understanding scores, we conducted hierarchical cluster analysis using the Ward method to classify interpretable clusters. Based upon these clusters, we calculated differences in "environmental changes surrounding professional soccer" and "awareness of social contribution."

Results

The analysis resulted in the following three clusters: one with high scores on the three AI factors but low scores on philosophical understanding (n=39; competition priority group), one with low scores on all three AI factors and philosophical understanding (n=27; overall low cluster), and one with high scores on social identity and philosophical understanding but average scores on exclusiveness and negative feelings (n=48; philosophy-compatible group).

Utilizing these three clusters as factors, we conducted a single-factor variance analysis with no correspondence and found significant main effects for "changes in the environment surrounding professional soccer" ($F(2,111)=12.353$, $p<.001$) and "social contribution awareness" ($F(2,111)=5.699$, $p<.05$). The scores of the philosophy-compatible group were significantly higher than those of the other two groups ($p<.05$).

Discussion

Subjects in the philosophy-compatible group had a higher understanding of off-the-pitch initiatives to raise awareness of social contribution, and were more involved in the games. Sharing social issues among various stakeholders and raising them as issues may deepen the connection with society.

Reference

Brewer, B. W. and Cornelius, A. E. (2001) Norms and factorial invariance of athletic identity measurement scale, Academic Athletic Journal., 15: 103-113.

Goich Hagiwara (2020) Validity and reliability evaluation of the multidimensional Japanese athletic identity measurement scale. Journal of Human Sport and Exercise, 15(2): 380-386.

Conventional Print Poster Presentations

CP-MH15 Exercise and metabolic fitness

ASSOCIATION OF SKELETAL MUSCLE HYPERTROPHY WITH FAT MASS AND GLUCOSE HOMEOSTASIS - A SYSTEMATIC REVIEW OF HUMAN AND ANIMAL STUDIES

HAVERS, T., SCHÖNFELDER, M., WACKERHAGE, H., GEISLER, S.

IST UNIVERSITY OF APPLIED SCIENCES; TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Studies in humans (Heymsfield et al., 2021) and animal models (Izumiya et al., 2008) show that muscle hypertrophy is often associated with a reduction in fat mass and improvement of glucose homeostasis. However, this has not been systematically investigated. Thus, the aim of this project was to systematically review the literature on the effects of global muscle hypertrophy on fat mass and glucose variables (i.e., HbA1c or blood glucose) in humans and animals.

METHODS: PubMed, SportDiscus and Scopus were searched in August 2023 for articles in which global muscle hypertrophy was induced in humans (i.e. resistance training, pharmacological intervention or both) or animals (mice, rats, pigs; resistance training, pharmacological intervention, genetic modification) and fat mass and/or glucose homeostasis (i.e. HbA1c or blood glucose) was reported. We considered lean body mass (LBM), fat-free mass (FFM) or skeletal muscle mass (SMM) measured by dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) as muscle size variables. We calculated the percentage change from pre- to post-intervention for the respective outcome. In animal studies, muscle mass and fat mass post-intervention (DXA or dissection) were normalised to the animals body weight and the percentage difference between the treatment and animal control condition was calculated. In addition, blood glucose data were obtained. The percentage change/ difference in muscle mass was plotted against the percentage change/difference in fat mass or HbA1c/blood glucose.

RESULTS: A total of 114 studies (93 human, 21 animal) met the inclusion criteria. Overall, across all human interventions, muscle mass increased by 2.6% (DXA) and 3.2% (BIA), HbA1c decreased by 4.1%, and fasting glucose decreased by 5.8%. When each outcome was related to its percentage change of muscle mass, HbA1c decreased by 4.1%, fasting glucose by 5.8% and fat mass by 4.00%, while muscle mass increased by 1.9%, 3.3% and 2.7% respectively. Similarly, animal models with more muscle mass relative to body weight had better blood glucose (-16.2%) and reduced fat mass relative to body weight (-25.1%) compared to their controls.

CONCLUSION: This systematic literature analysis suggests that skeletal muscle hypertrophy results in fat loss and improved glucose homeostasis variables such as HbA1c.

References

1) Heymsfield et al., JAMA Netw Open, 2021

2) Izumiya et al., Cell Metab, 2008

COMPARISON OF THE MEASUREMENT ACCURACY OF CONTINUOUS AND CAPILLARY BLOOD GLUCOSE MEASUREMENTS: A VALIDATION STUDY

FELLINGER, E., BRANDT, T., CREUTZBERG, J., ROMMERSKIRCHEN, T., SCHMIDT, A.

UNIVERSITY OF THE BUNDESWEHR MUNICH

INTRODUCTION: Continuous Glucose Monitoring Systems [CGM] can not only be used for glycemic control in chronic diseases (e.g. diabetes mellitus) but are increasingly being utilized by individuals and athletes to monitor glucose fluctuations in training and everyday life. However, it is not clear how accurately [CGM] measurements reflect plasma glucose concentration in a healthy population in the absence of chronic diseases.

METHODS: 44 healthy male subjects (25.5 ± 4.5 years) performed an oral glucose tolerance test [OGTT]. The interstitial fluid glucose concentration [ISFG] obtained by a CGM sensor was compared against finger-prick capillary plasma glucose concentration [CPG] at fasting baseline (T0), -30 (T30), -60 (T60), -90 (T90), -120 (T120) min post [OGTT] to investigate differences in measurement accuracy.

RESULTS: Overall mean absolute relative difference (MARD) was 12.9 ± 8.7 %. 100 % of [ISFG] values were within zones A and B in the Consensus Error Grid, indicating clinical accuracy and being in line with the ISO 15197:2013 criteria (having at least 99 % of results within these zones). Paired t-test revealed statistically significant differences between [CPG] and [ISFG] at all time points (T0: 97.3 mg/dl vs. 89.7 mg/dl, T30: 159.9 mg/dl vs. 144.3 mg/dl, T60: 134.8 mg/dl vs. 126.2 mg/dl, T90: 113.7 mg/dl vs. 99.3 mg/dl, T120: 91.8 mg/dl vs. 82.6 mg/dl, respectively; $p < 0.05$) with medium to large effect sizes ($d = 0.57 – 1.02$) and with [ISFG] systematically under-reporting the reference system [CPG]. Bland-Altman plot analysis indicated 5.4 % of measurements not falling into the limits of agreement (mean difference ± 1.96*SD of difference).

CONCLUSION: CGM sensors provide a convenient and reliable method for monitoring blood glucose fluctuations in clinical settings as well as in the everyday life of healthy adults.

THE ACUTE IMPAIRMENT OF GLUCOSE TOLERANCE FOLLOWING ONE NIGHT OF SLEEP RESTRICTION IS NOT RESCUED BY MODERATE-INTENSITY WALKING IN YOUNG ACTIVE MALES

CHEN, Y.C., HSU, C.1, TSENG, C.1, METCALFE, R.2, WANG, H.1
1 NATIONAL TAIWAN NORMAL UNIVERSITY & 2 SWANSEA UNIVERSITY

INTRODUCTION: High-intensity interval exercise ameliorates the impairment of postprandial metabolic health (i.e., glucose control) that is observed after a night of sleep restriction (SR). However, it is unknown whether moderate-intensity aerobic exercise can elicit similar effects.

METHODS: 11 young healthy active males (age: 26 ± 2 yr; BMI: 22.8 ± 2.6 kg/m2) were recruited in a randomised repeated measures cross-over study with three trials: 1) normal sleep (8 h sleep opportunity, NS); 2) sleep restriction (3 h sleep opportunity, SR); and 3) sleep restriction with exercise (3 h sleep opportunity + 30 min brisk walking, SRE). After waking at 7 a.m., participants engaged in either 30 min of sedentary behaviours in the NS and SR trials, or 30 min brisk walking at 50% VO2max in the SRE. This was followed by a 2-h oral glucose tolerance test (OGTT), with blood (plasma) samples collected at baseline, immediately post-exercise (or sedentary), and then at 15-, 30-, 45-, 60-, 90-, and 120-min following glucose ingestion. The primary outcome was glucose total area under the curve (tAUC) over the 150-min sampling period, with insulin tAUC and the early (0-90 min) and late (90-150 min) phase glucose tAUC as secondary outcomes.

RESULTS: tAUC for glucose was lower in the NS trial (924 [95% CI = 865, 982] mmol/L) compared to both SR (1012 [95% CI = 945, 1080] mmol/L, p = 0.018) and SRE trials (1006 [933, 1080] mmol/L, p = 0.002) and there was no difference between SR and SRE (p = 1.00). There were no differences in the early phase glucose tAUC0-90 between trials. tAUC90-150 for glucose was lower in NS compared to SR (p = 0.002), but there were no differences between NS and SRE (p = 0.076) or between SR and SRE (p = 0.639). The tAUC for insulin did not differ between trials (p = 0.472).

CONCLUSION: Postprandial glycaemia during a 2-hour OGTT was impaired after a single night of SR in young healthy active males and this was not rescued by a single 30 min bout of brisk walking performed immediately prior to the OGTT.

EFFECT OF AMBULATORY TRAINING ON BLOOD GLUCOSE AND BLOOD PRESSURE IN PERSONS WITH TYPE 2 DIABETES

ABONIE, U., ADDO, R., KUMAH, L., OFORI-AMPOMAH, A., MAKINYI, V.
NORTHUMBRIA UNIVERSITY

INTRODUCTION: Participation in regular physical activity is low among persons with type 2 diabetes in comparation to persons without the condition. Lack of time is often cited by persons with type 2 diabetes for non-participation in regular exercise. A short duration norm intensity ambulatory exercise could be perceived as achievable and can improve motivation to adopt and maintain an active lifestyle in persons with type 2 diabetes. The purpose of this study was to evaluate the effect of a short duration norm intensity ambulatory exercise on blood glucose and blood pressure in persons with type 2 diabetes.

METHODS: Twenty adults with type 2 diabetes (age 51 ± 8 years) were randomly assigned to training group (n = 10) or control group (n = 10). The training group received 4-weeks ambulatory training on a motor-driven treadmill (2 x 20 min per week at 60% target heart rate). The control group received no training. Blood glucose and blood pressure (systolic and diastolic) were assessed with a digital automated glucometer and an automated blood pressure monitor respectively, before and after the 4-weeks training. Repeated measures ANOVA were used to examine training effect (p =.05).

RESULTS: The average velocity during training was 5.13 ± 0.56m/s (range, 4.56 – 5.81m/s). The average training heart rate was 100.58 ± 3.22bpm (range, 95.30 – 104.29bpm). Training significantly improved blood glucose (mean difference= -2.73; p = 0.03). No effects were found for systolic blood pressure (mean difference= -0.30; p = 0.96) and diastolic blood pressure (mean difference = -0.90; p = 0.82).

CONCLUSION: Training improved blood glucose but not blood pressure. A short-duration ambulatory exercise is an appropriate exercise mode to elicit beneficial effect and could help persons with type 2 diabetes in the adoption of an active lifestyle.

EFFECT OF WEIGHT LOSS INTERVENTION ON DIABETES RISK AND SUBJECTIVE QUALITY OF LIFE

SIMKO, G., UVACSEK, M.
HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: Today, 537 million people worldwide have diabetes, 61 millions of whom live in Europe (IDF Diabetes Atlas, 2021). In Hungary, the number of adult diabetics per 100 inhabitants has tripled in 20 years (KSH 2020). Overweight is a major contributor to T2D. Genetic predisposition contributes to the risk of T2D, but the development of the disease is strongly associated with overweight and lifestyle factors, including diet and inactivity. Low health-related quality of life (HRQoL) is significantly and directly associated with an estimated risk of developing T2D (Väätäinen et al., 2016). Changes in HRQoL are associated with increases in physical activity level (Florez et al., 2012). The aim of our study was to investigate the effect of a 12-week weight loss programme on T2D risk, HRQoL and body composition.

METHODS: The 12-week lifestyle programme was fulfilled by 30 healthy Hungarian overweight women. Body composition was assessed using the InBody 720 device and diabetes risk was evaluated with the Hungarian version of the Finnish Diabetes Risk Questionnaire. Quality of life scores were assessed using the EQ-5D-5L questionnaire. Statistical analyses were performed using TIBCO Statistica 13.40.14. All statistical tests were performed at 5% significance level.

RESULTS: The mean age of the participants was 33.4±4.28 years and all of them were overweight or obese. Regarding the risk of T2D we found a significant difference between the baseline and final score (8.36±2.51 vs. 6.96±2.48). There was also a significant change in the mean HRQoL score (73±15.08 vs. 83±11.10). No significant differences were found in body weight (79.16±9.46 kg vs 76.26±9.87 kg) and BMI (28.09±3.25 kg/m2 vs 26.89±3.38 kg/m2) but the number of participants who reached the recommended physical activity (minimum 30 minutes of moderate-intensity activity/day) increased significantly (8 vs 21).

CONCLUSION: Based on this study, we conclude that the risk of T2D evaluated within 10 years can be modified in a 12-week long weight loss program. Our results suggest that T2D is preventable through lifestyle intervention. Additionally, a 12-week intervention in the areas of nutrition and physical activity can lead to better subjective quality of life promoting healthier behaviors and health-conscious lifestyles.

EFFECT OF A 10-MINUTE WALK ON POSTPRANDIAL GLUCOSE LEVELS

HASHIMOTO, K., DORA, K., MURAKAMI, Y., MATSUMURA, T., SU, Y., HASHIMOTO, T.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: A rapid increase in blood glucose levels associated with meals is linked to various diseases such as cardiovascular diseases and cognitive disorders (1). For post-meal blood glucose control, a previous study reported a better effect of 30-min walking immediately after meals (2), compared with 30-min walking 30-min after meals, which is generally recommended for blood glucose control (3). Regarding exercise duration for blood glucose control, a previous study reported that the chronic effect of 10 minutes of walking after each meal, which might be easily implemented, was greater than walking for 30 minutes before breakfast (4). However, this is a comparison with pre-meal walking, which is considered to have a lower effectiveness for blood glucose control compared to exercise immediately after meals (2). The purpose of this study was to assess the impact of 10-min walking immediately after glucose ingestion (i.e., 10 min-walk condition) on blood glucose control, compared with that of 30-min walking 30-min after a meal (i.e., 30 min-walk condition).

METHODS: Twelve healthy young adults (6 females; aged 20 ± 1 yrs) participated in the crossover trial. The study included three conditions: rest, 10 min-walk condition, and 30 min-walk condition. The walking speed during the walking conditions was self-selected by the participants to be comfortable. In place of a meal, a 75 g oral glucose ingestion was used as a glucose tolerance test (OGTT). Blood glucose levels were measured every 10 minutes for up to 2 hours after glucose ingestion. Area under the curve for glucose (glucose AUC), mean blood glucose levels, the peak blood glucose level, and Borg Rating of Perceived Exertion (RPE) were measured. ANOVA and Fisher's LSD were used to compare the three conditions regarding blood glucose indicators. The Wilcoxon signed-rank test was used to compare RPE between walking conditions.

RESULTS: Glucose AUC and mean blood glucose levels at 2 hours after glucose ingestion were significantly lower after 10 min-walk condition (15607 ± 702 mg•h/dL, p = .011; 127.9 ± 19.4 mg/L, p = .010) and 30 min-walk condition (15732 ± 731 mg•h/dL, p = .030; 128.9 ± 5.8 mg/L, p = .034) compared to the rest condition (16605 ± 745 mg•h/dL, 135.8 ± 20.5 mg/dL), respectively. Interestingly, the peak blood glucose level was significantly lower only 10 min-walk condition (164.3 ± 8.9 mg/dL, p = .028) compared to the rest condition (181.9 ± 8.4 mg/dL), while that of 30 min-walk condition (175.8 ± 9.6 mg/dL, p = .184) was not different from the rest condition. Furthermore, RPE was significantly lower during the 10 min-walk condition (7 [6-7]; median [IQR], p = .003) compared to the 30 min-walk condition (9 [8-10]; median [IQR]).

CONCLUSION: Even a brief 10-minute walk immediately after a meal was suggested to be effective for suppressing post-meal blood glucose elevation.

1.Zuo & Wu. Ther Adv Chronic Dis, 2022

2.Solomon et al. Pflugers Arch, 2020

3.Chacko. Scientifica, 2016

4.Pahra et al. Diabetol Metab Syndr, 2017

THE EFFECTS OF PALM COOLING ON HIGH-INTENSITY INTERVAL TRAINING DONE BY WOMEN

MAGUIRE, K., WYDOTIS, M.M., QUESADA, P.M., JAGGERS, J.R., COCCO, A.R., DAILY, J.P., CARUSO, J.F.

UNIVERSITY OF LOUISVILLE

INTRODUCTION: High-intensity interval training (HIIT) entails brief repetitive bouts of supramaximal activity separated by longer periods of active recovery. Due to its rigor, improving HIIT performance, as well as physiological function during and after such activity, is difficult. Since body heat accrues rapidly during HIIT, palm cooling may yield ergogenic and physiological benefits from greater conductive heat transfer.

METHODS: In a randomized fashion, healthy (n = 11) women did two workouts; one with, and one without, palm cooling (PC, no PC). Workouts began as they sat quietly for ten minutes, followed by collection of the following variables: heart rate (HR), auditory canal and the hand's palm temperatures (ACT, HT), and thermal flux (TF) from the hand's palm. A telemetry-based watch measured HR. ACT was recorded by a handheld device (Braun; Winamac, IN). A sensor (FluxTeq; Blacksburg VA), taped to the palm of their left hands, obtained HT and TF data. After pre-exercise data collection, they did a 3-minute stationary cycling warm-up. Immediately after the warm-up and as the cycle's braking system restricted pedal rates to 100 rpm, subjects did three 20-second supramaximal sprints. Each sprint was followed by two minutes of active recovery as

subjects pedaled at 50 rpm against a 0 kg load. Per sprint, peak and average power (PP, AP) and fatigue rate (FR) were calculated. ACT, HR, HT and TF were recorded one minute after each sprint as active recovery occurred. Those same variables were measured five, ten, 20, and 30 minutes post-exercise as subjects sat quietly. For PC workouts, 10.6o C gel packs were applied to the palm halfway through the warm-up, removed once the post-exercise period began, and reapplied ten minutes post-exercise. Dependent variables were compared using 2-factor (condition, time) ANOVAs, with repeated measures per independent variable. Paired t-test served as the post-hoc, and a 0.05 a denoted significance.

RESULTS: ACT had non-significant differences. HR elicited a time effect. HR values after each sprint were significantly higher than those collected post-exercise; in turn were significantly higher than pre-exercise values. HT had a significant two-way interaction, with no PC > PC after each sprint. Conversely, TF had a significant two-way interaction whereby PC > no PC after each sprint and ten, 20, and 30 minutes post-exercise. PP had a significant time effect (sprints 1 and 2 > sprint 3). AP also had a significant time effect (sprints 1 > sprints 2 and 3) and a trend for condition (PC > no PC). Finally, FR had a significant condition effect (no PC > PC).

CONCLUSION: TF data show PC increased conductive heat transfer. In turn, that heat loss may be responsible for the AP trend and significant FR differences, with better values from the PC condition. Continued data collection from women is warranted to further understand PC's effect on HIIT.

THE IMPACT OF THE TIME OF DAY ON MUSCLE AND METABOLIC RESPONSES TO RESISTANCE EXERCISE IN HEALTHY ADULTS: A RANDOMISED CONTROLLED TRIAL

DIGHRIRI, A., LITHGOW, H., LOGAN, G., GABRIEL, B., DUNNING, E., JOHNSTON, L., BOYLE, J., GRAY, S.
UNIVERSITY OF GLASGOW

INTRODUCTION: There are many health benefits associated with resistance exercise, including stimulation of glucose metabolism, improved cardiovascular fitness and enhanced muscular strength. However, it is still unclear when is the best time to perform resistance exercise. We conducted a randomised controlled trial to examine the impact of time of day on muscle and metabolic responses to resistance exercise in healthy adults.

METHODS: We recruited 36 participants, inclusion criteria age between 18-45 years old with body mass index (BMI) >23.0kg/m². Exclusion criteria included having undergone surgery for weight loss, had prior history of heart, lung, cancer, kidney, endocrine, or liver disease. Participants were randomised into either a control, exercise in the morning (6:00-10am) or exercise in the evening (4:00-8:00pm) group. Those in the exercise groups performed 8 resistance exercises (1 set to failure) 3 times a week for 6 weeks, at their allocated time of day. At baseline and during the last visit, we measured insulin sensitivity during an oral glucose tolerance test along with measurements of grip strength, vastus lateralis muscle thickness and knee extensor maximal torque.

RESULTS: We randomly assigned participants to three groups: morning exercise (n= 12); evening exercise (n= 11); or control group (n= 13). Two way repeated measured ANOVA showed effects of time for maximal torque ($p<0.001$), insulin sensitivity ($p=0.015$) and muscle thickness ($p=0.008$) but not grip strength ($p=0.633$). No group or interaction effects were observed. In the morning group there were increases in maximal torque (+5.54 (1.87 to 9.21) Nm $p=0.007$) and insulin sensitivity (+15.39 (2.93 to 27.85) mg l2 mmol−1 mU−1 min−1 $p=0.020$) with no increases in muscle thickness (+1.17 (-0.02 to 2.25) mm $p=0.054$). In the evening group there were increases in muscle torque (+5.68 (2.36 to 8.99) Nm $p=0.003$) and muscle thickness (+1.20 (0.37 to 1.97) mm $p=0.009$), with no increases in insulin sensitivity (+10.68 (-7.77 to 29.13) mg l2 mmol−1 mU−1 min−1 $p=0.223$). No increases in any variable in the control group were seen.

CONCLUSION: The results of the present study indicate, although sample size was limited, that resistance exercise increases muscle strength, muscle size and insulin sensitivity with very little difference in magnitude of effect between performing exercise in the morning versus the evening.

EFFECTS OF COVID-19 RESTRICTIONS ON PERFORMANCE CHARACTERISTICS IN SPECIAL-POLICE FORCES: A 5-YEAR LONGITUDINAL STUDY AND COMPARISON WITH NEWLY RECRUITED CADETS

NIMMERICHTER, A., PRINZ, B., ZÖGER, M., WIRTH, K.
UNIVERSITY OF APPLIED SCIENCES WIENER NEUSTADT

INTRODUCTION: Previous studies have shown that the COVID-19 restrictions had negative effects on physical activity and fitness. Law-enforcement officers are exposed to high levels of physical stress during their occupational tasks and required to quickly adapt from passive functions to situations where maximal physical exertion is needed. Physical fitness is therefore an essential component to be prepared to complete critical tasks. While most of the special-force staff are experienced officers between 30 to 50 years of age, regular recruitment of new trainees is required to ensure the operating capability of the unit. This study aimed to i) assess performance characteristics of cardiorespiratory endurance and upper- and lower-body strength over a 5-year period in special-police force officers, and to ii) compare these characteristics with newly recruited cadets.

METHODS: Maximal oxygen consumption (VO2max) during a treadmill ramp-exercise test, one-repetition maximum (1-RM) of bench-press (BP), squats (SQ), latissimus-pull (LP) and leg-curl (LC) of 222 male officers (OLD) of the Austrian special-police forces COBRA and WEGA was assessed at four occasions: once before, twice during and once after the COVID-19 restrictions. A 2-way repeated-measure ANOVA was used to identify changes in OLD and to compare the results from 29 cadets (NEW) within the first 3-months after recruitment.

RESULTS: There was a significant difference (p<0.001) in age between OLD (34.5±6.5 y) and NEW (30.3±3.8 y). Body mass (p=0.858) and percentage body fat (p=0.588) did not significantly change in OLD and were not significantly different from NEW (p=0.250; p=0.498). VO2max significantly decreased from 51±5 ml/min/kg in years 1+2 to 49±5 ml/min/kg in years 3+4 (p<0.001) with no significant difference to NEW (51±5 ml/min/kg; p=0.260). 1-RM for SQ was significantly lower in year 1 (115±26 kg; p<0.001) compared to years 2-4 (125-129 kg) and significantly different to NEW (136±17 kg; p=0.012). The 1-RM for LP was significantly lower in year 1 (81±13 kg; p<0.001) compared to years 2-4 (91-97 kg) with significant differences found for years 1+2 to NEW (102±12 kg; p<0.001). No significant changes over time or differences between OLD and NEW were observed for BP (104-108 kg, p=0.155; vs. 112±14 kg; p=0.135) and LC (64-65 kg, p=0.915; vs. 69±13 kg; p=0.074).

CONCLUSION: The present study showed a significant decline in endurance performance during the COVID-19 restrictions. In contrast, upper- (LP) and lower-body (SQ) strength significantly improved. Since special forces were exposed to a constrained working and training environment (i.e. "bubble") to enable maintenance of physical fitness, this interaction might be indicative of changes from outdoor to indoor activities as a result of the lockdown restrictions. Newly recruited cadets had higher 1-RM in SQ and LP compared to the initial measures in OLD. It is unclear however, whether these differences resulted also from an outdoor-to-indoor training shift.

Conventional Print Poster Presentations

CP-AP02 Training and Testing in Sports II

DIFFERENCES IN VISUAL MOTOR RESPONSE TIME IN PROFESSIONAL/HIGH-LEVEL ATHLETES FROM OPEN-SKILL AND CLOSED-SKILL SPORTS. WHO IS FASTER?

CROGNALE, D., LEINEN, P., BAUMANN, T.
UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Fast response times are an essential skill required across various actions and sports. Sports are categorized based on the degree of interaction with the environment and the demand for quick responses. Open-skill (OS) sports such as volleyball and tennis are highly reactive, while closed-skill (CS) sports like swimming or running are characterized by a predictable and repetitive environment. For instance, a goalkeepers ability to save a penalty heavily relies on rapid movement once the direction of the shot is recognized and processed. However, there is no consensus on the extent to which response times differ between these groups. Therefore, this study aims to investigate differences in visual motor response times among high-level and professional athletes in OS and CS sports using the BATAK Pro™.

The BATAK Pro™ is a reaction time apparatus designed for standardized reaction time assessments in a controlled environment. It consists of a board with a series of illuminated targets arranged in a grid pattern. These targets light up randomly, and the participants task is to quickly and accurately touch or hit each target as it lights up.

METHODS: Sixty-three professional/high-level athletes (26 female; 37 male) competing in the highest tier/level of their respective OS or CS sport were recruited for the study (age = 21.35 ± 3.49 years). OS sports included martial arts, tennis, table tennis, badminton, basketball, volleyball, rugby, and soccer. CS sports included athletics, swimming, cycling, triathlon, rowing, and gymnastics. Height, wingspan, and weight were also recorded to account for limb length and reach.

All athletes performed two pre-set protocols on the BATAK Pro™, including two practice and eight test trials for each protocol. The average scores, calculated from the number of targets struck (Accumulator) and the rate of completing 50 targets (Mirror Race), were used for analysis. The variables wingspan, height, years of sport experience, and training volume were tested for moderating effects.

RESULTS: A two-way independent ANOVA (2 x 2) was performed to analyze the effect of sports categories (OS vs. CS) and participants (male vs. female) on each of the demographic variables: age, weight, height, wingspan, experience, and training volume. Two additional ANOVAs were subsequently performed for the two Batak Pro protocols employed.

There was no significant difference (p > .05) in response times (mean OS 49.9s vs. CS 49.9s) and number of targets struck between OS (mean: 74.7 targets) and CS (mean: 75.5 targets) athletes. Males performed superiorly in both protocols, partially explained by greater height and wingspan (p < .001).

CONCLUSION: The findings provide further evidence that differences in response time of OS and CS athletes do not transfer to a general reactive context using a movement-oriented response apparatus. The remaining variance and the source of response differences in males and females require further investigation.

SPECIALIZED AGILITY ABILITIES OF ELITE TABLE TENNIS PLAYERS IN DIFFERENT AGE GROUPS

LIEW, E., WU, S.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: Table tennis (TT) is characterized by its rapid and dynamic nature, highlighting the critical importance of agility for players in its sporting discipline [1]. Consequently, the main purpose of this study is to employ the TT-specific agility test to assess the lower limb agility capabilities of elite male TT players within distinct age groups (i.e., college and U16). Moreover, agility encompasses both motor and cognitive abilities, including inhibitory control [2], which aids in maintaining focus on the assigned task and preventing impulsive actions that may potentially lead to errors. This attribute is

considered indispensable in executing nimble movements [3]. Thus, the secondary objective of this study is to quantify the correlation between these two variables. We hypothesize that the college group will demonstrate superior performance in both assessments, as well as stronger inhibitory control, thus corresponding to a greater agility capacity.

METHODS: Twenty-nine Taiwanese TT players were recruited as participants and divided into two groups: college (n=14, average age 20.07±1.89; height 172.57 ± 5.60; weight 67.07 ± 8.63; BMI 22.45 ± 2.18) and U16 (n=15, average age 14.27±0.96; height 172.02 ± 6.88; weight 58.56 ± 8.52; BMI 19.75 ± 2.42). The TT-Agility Test (TTAT) was used to assess agility, and the Covert Orienting of Visuo-spatial Attention Tasks (COVAT) was used to assess inhibitory control ability of the lower limb. Independent samples t-tests were used to analyze the difference between groups, and Pearson correlation was used to measure the linear relationship between TTAT and COVAT.

RESULTS: We found that the college group performed better than the U16 group in TTAT ($p < .001$) but not in COVAT. Correlation analysis between TTAT and COVAT did not show significant differences.

CONCLUSION: The findings demonstrate that collegiate TT players possess notably superior agility capabilities specific to the sport when compared to U16 players. Conversely, traditional inhibitory control tests, such as COVAT, prove to be insufficient in discerning discrepancies among TT players across different age groups. Therefore, there is a need for the development of more tailored assessment tools for sport-specific inhibitory control. Although no significant differences were observed in the correlation analysis between TTAT and COVAT, it can be inferred that enhanced agility is likely accompanied by improved inhibitory control abilities.

COMPARISON OF AEROBIC CAPACITY ON DIFFERENT LEVELS OF TABLE TENNIS PLAYERS: USING TWO COMPETITIVE TABLE TENNIS-SPECIFIC AEROBIC TEST

SONG, T.F., LIEW, E., WU, S.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: Aerobic endurance is important for table tennis (TT) players. At an elite level, it is also paramount to facilitate recovery between matches. While the majority of prior research has already developed a sport-specific aerobic capacity test for TT, it did not cover enough intensity variation for reliable testing. The purpose of the current study was to estimate the differences in aerobic performance between the two groups of TT players in two kinds of TT-specific aerobic test.

METHODS: Twenty-two male elite TT players were recruited, eleven of whom were adult athletes aged between U18 and U22, and the other eleven were youth athletes (U14-17). Two TT-Specific Aerobic Tests were used to assess players' aerobic capacity, which comprised the Incremental TT-Specific Aerobic Test (ITTSAT) and the Multistage TT-Specific Aerobic Test (MTTSAT). In the ITTSAT, TT players performed from session 1 to session 2 (with frequencies of approximately 48 and 57 balls/min, respectively, with 6 minutes per stage) until voluntary exhaustion, with a mechanical ball thrower simulating forehand two-point mobile attacks. Regarding the MTTSAT, it consisted of an initial frequency of 44 balls/min and increments of 4 balls/min every 3 minutes (e.g., 48, 52, 56, 60, and 64 balls/min). Changes in heart rate and total sporting times were measured to determine the TT players' physiological responses and sport performance.

RESULTS: The results revealed that the time spent in individual practice showed significant differences among two groups. U14-17 TT players were more time than the U18-22 TT players. There were no significant differences in ITTSAT total sporting times (668.73s vs. 548.45s, $p = .05$) and heart rate among groups. In contrast, the U14-17 group demonstrated higher total sporting times than the U18-22 group (932.18s vs. 736.10s, $p < .05$), especially in aerobic endurance duration, which was significantly more strongly related to sport performance in the MTTSAT.

CONCLUSION: These findings suggest that weekly training hours are associated with body composition and aerobic capacity levels in competitive TT players and it is necessary to maintain an adequate aerobic endurance base. The beneficial effects of having a TT-specific high aerobic status could therefore be extended to assessing the improvement of superior athletic performance. Secondly, our results appear to support evidence that MTTSAT may be more useful method within evaluating sport-specific test of aerobic endurance performance in TT.

SIGNIFICANT DIFFERENCES IN CARDIOPULMONARY AND METABOLIC LOAD OF GUIDED VS. UNGUIDED LOW-INTENSITY ROWING IN ELITE ATHLETES

WINKERT, K., ALIMORADINASRABADI, B., TREFF, G., STEINACKER, J.M.
UNIVERSITY OF ULM

INTRODUCTION: Elite rowers spent about 11 hours/week with specific endurance training in the boat, with low-intensity training being the main component. As external intensity metrics like boat velocity are highly dependent on environmental conditions and power meters are missing, athletes and coaches rely mainly on internal metrics like heart rate (HR) and rating of perceived exertion (RPE). While in the context of optimal training stimulus management adequate pacing during daily training is needed, athletes tend to over pace during LIT. Therefore, we aimed to evaluate differences in cardiopulmonary (CP) and metabolic (MB) load of guided vs. unguided rowing at three LIT zones in elite rowers.

METHODS: Fifteen elite male and female rowers (age 23 ±3/23 ±2 years, body mass 82.6 ±6.5/74.6 ±8.4 kg, maximal oxygen consumption ($\dot{V}O_2max$) 75.3 ±4.0/63.5 ±2.5 ml/min/kg) completed one laboratory test and four on-water session. Laboratory tests included an ergometer ramp test to determine $\dot{V}O_2max$ and HRmax. On-water sessions in the single scull consisted of two unguided and two guided trials of six 15-minute stages, separated by 24 hours. During the

unguided trials, the rowers were instructed to row two self-paced consecutive stages each, in a compensation zone (zone1), a lower (zone 2.1), and an upper (zone2.2) basic endurance zone, according to their usual RPE. The guided sessions were based on specific rates of HRmax, being 60-72% zone 1, 72-79% zone 2.1, and 79-82% zone 2.2. CP and MB load were determined continuously using a portable metabolic analyzer in dynamic mixing chamber mode. Blood lactate concentration (BL) and RPE were determined after each stage. Mean values with 95% confidence intervals (95%CI) were calculated based on the V̇O2 steady-state phase of each stage. Inter-mode differences were calculated based on a linear mixed model approach.

RESULTS: Differences in CP and MB load for guided vs. unguided rowing in zone 1/zone 2.1/zone2.2 amounting to %HRmax −3.2% 95%CI [−4.5; −1.8]/−2.9% 95%CI [−4.0; −1.8]/−3.2% 95%CI [−4.1; −2.3]; %VO2max −3.5% 95%CI[−5.1; −1.9]/−1,9% 95%CI [−3.2; −0.6]/−1.9% 95%CI [−3.1; −0.8]; BL −0.1 mmol/l 95%CI [−0.1; 0.0]/−0.2 mmol/l 95%CI [−0.3; −0.1]/−0,5 mmol/l 95%CI [−0.6; −0.3] and RPE −0.1 95%CI [−0.3; 0.1]/−0.1 95%CI [−0.4; 0.1]/−0.3 95%CI [−0.6, −0.0], respectively. Besides BL in zone 1 and RPE in zone 1, 2.1 there were significant differences for all metrics in all zones between guided vs. unguided trials.

CONCLUSION: While RPE ratings between guided and unguided on-water training in the single scull were similar, CP and MB loads were significantly higher during unguided trials. Therefore, even elite rowers tend to underestimate the intensity of their self-paced rowing training compared to CP and MB load. This might lead to a mismanagement in total training load and risk of maladaptations. Consequently, external guidance like HR in combination with RPE should be used for precise intensity management during on-water rowing.

VALIDITY AND RELIABILITY OF AN ON-GYMNASTICS-FLOOR 12 M SHUTTLE RUN TEST FOR YOUNG GYMNASTS

FAY, L., HELD, S., RAPPELT, L., ROHLEDER, J., DONATH, L.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: The relevance of general endurance capacity in gymnasts is debated. Adequate endurance capacity can be however considered a prerequisite for maintaining training quality, recovery and long-term athlete development1. As Vo2max testing is resource consuming, the Shuttle Run Test might serve as a valid and efficient endurance field test for children and adolescents on group level to estimate the maximum oxygen uptake (VO2max)2. In order to meet the requirements of artistic gymnastics, a new 12 m on-gymnastic-floor Shuttle Run Test was developed with a shorter running shuttle distance resulting in more agile change of directions. The study aims to assess validity and absolute and relative reliability data of the newly developed 12 m Shuttle Run Test.

METHODS: Sixty-nine young gymnasts (age: 12.33 ± 1.6 years; BMI: 17,45 ± 2.03 kg/m2; trainings experience 6.6 ± 2.27 years), competing on state and national level from artistic, trampoline and rhythmic gymnastics disciplines performed a laboratory treadmill test and two subsequent 12 m Shuttle Run Test on a gymnastics floor. VO2max was assessed via spiroergometric testing until objective exhaustion.

RESULTS: The intraclass coefficient (ICC) 0.82 (95CI: 0.72 < ICC <0.88) with a moderate Limits of agreement (LoA) (9,18 till -10,7 ml/kg/min) indicated a good validity. The between-day-reliability revealed a solid ICC of 0.79 (95CI: 0.64 < ICC < 0.89), with a moderate LoA for VO2max (7,78 till -7,55 ml/kg/min). The good and moderate ICC and small LoA indicated moderate validity and good reliability for HRmax. The estimated VO2max based on 12SRT Performance, body mass and gender correlated moderate (ICC 0.69 (95CI: 0.54 – 0.79) with the measured VO2max.

CONCLUSION: The shortened on-gymnastics-floor 12 m Shuttle Run Test can be considered a valid and reliable basic endurance diagnostic testing tool for young gymnasts in order to adequately estimate cross-sectional and longitudinal training-induced endurance performance changes. The feasible and practical 12SRT yields sufficiently valid VO2max estimates for gymnasts and can be used for endurance capacity flagging (green, yellow and red).

1 Sawczyn S, Biskup L, Zasada M, Mishchenko V. Special endurance of young gymnasts. The role of aerobic capacity in fatigue development in the training. Central European Journal of Sport Sciences and Medicine. 2018;23(3).

2 Mayorga-Vega D, Aguilar-Soto P, Viciana J. Criterion-related validity of the 20-m shuttle run test for estimating cardiorespiratory fitness: a meta-analysis. Journal of sports science & medicine. 2015 Sep;14(3):536.

EXAMINING THE OPTIMAL WORK-REST CYCLE FOR HAZARDOUS MATERIALS (HAZMAT) RESPONSE: EFFECTS OF HAZMAT OPERATIONS ON COGNITIVE AND PHYSIOLOGICAL PERFORMANCE

CHONG, L., YONG, X., ROSLIE, N., LEE, S.H., NISHA, V., KOH, J., ANG, J.
HOME TEAM SCIENCE & TECHNOLOGY AGENCY

INTRODUCTION: To detect, handle, and contain hazardous chemicals and toxins, Singapore Civil Defence Force Hazardous Materials (HazMat) specialists may be deployed multiple times in a single operation. Based on current standard operating procedures, the recommended rest period after each deployment differs depending if it is the first, second, or third deployment. An open question is how the cognitive and physiological performance of our HazMat specialists is affected by the different lengths of rest durations between deployments. This study presents the first attempt to systematically examine current practices, and to determine the optimal work-rest cycle (WRC) based on cognitive and physiological measures.

METHODS: 120 HazMat specialists were recruited and randomly assigned to Group 1 (15 minutes rest), Group 2 (30 minutes rest), or Group 3 (45 minutes rest) between two HazMat deployments. During the deployments, they don their

personal protective equipment and breathing apparatus to perform tasks that mimic an actual incident. Cognitive and physiological measures were administered periodically before and twice after the HazMat deployments. The Psychomotor Vigilance Task and the Operation Span Task were used to measure vigilance and working memory (WM) respectively. Maximal and average heart rate (HR), body temperature, and oxygen saturation levels were taken as indication of physiological fitness. Self-reported measures, the Rating-of-Fatigue scale and the Borg Rating of Perceived Exertion scale were also administered.

RESULTS: Findings suggest that while there is improvement in WM performance after the second deployment, this improvement was not proportional to the resting durations. The best performing group was Group 3 while the worst performing was Group 2. These two groups, however, had similar HR by the end of the experiment while HR for Group 1 remained slightly elevated. Conversely, while vigilance performance decreased after two deployments for all groups, Group 1 performed the worst and reported feeling the most fatigue and exertion after two.

CONCLUSION: As WM after 45 minutes was found to be better than that after 30 minutes despite HR in both groups being similar, it seems that WM might be underpinned by a non-linear relation between arousal and performance. In addition, the non-linear changes in WM in contrast to the decrease in vigilance for all groups suggests that the different cognitive functions of WM and vigilance respond differently to the exertion and fatigue of two deployments.

This study highlights the importance of assessing both cognitive and physiological performance when designing WRC, especially where HazMat specialists are required to be physically fit to endure the bouts of rigorous tasks and maintain alertness to react quickly to ever-changing situations. Considering that there are differing roles and intensities during an actual operation, future studies could also explore varying task types and demands when designing the optimal WRC for HazMat response.

CAN CRITICAL FLICKER FUSION FREQUENCY SERVE AS AN EFFECTIVE TOOL FOR ASSESSING COGNITIVE PERFORMANCE IN EXTREME ENVIRONMENTS?

VON HERTLEIN, D., LABORDE, S., SCHIPKE, J., WOLFF, K., VOGT, T., MÖLLER, F.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Critical Flicker Fusion Frequency (CFFF), defined as the threshold at which a blinking light is seen as constant, is discussed as a diagnostic tool for rapid cognitive function (CF) assessments in clinical[1], psychological[2], and extreme environmental[3] settings.

However, the effects of environmental factors on the validity of CFFF are still poorly understood[4].

Performance assessment in underwater and spaceflight contexts would benefit from fast and valid cognitive diagnostics to assess task readiness and determine further procedures, but environmental factors like changing illumination, immersion, or weightlessness, and altered ambient and inspiratory gas pressures might act as moderators. Furthermore, environmental conditions might affect vagus nerve activity, which is known to interact with cognition.

We hypothesised that (I) different environmental conditions (Water immersion, bright light, darkness, elevated inspiratory oxygen pressures (P_iO_2) and their combination) would alter CFFF and (II) that transcutaneous vagus nerve stimulation (tvns) would positively affect CFFF.

METHODS: CFFF was assessed in 19 subjects (Age:23.8+2.9;10 females) in the conditions Illumination (Bright/Dark), Immersion (Land/Underwater), and P_iO_2 (0.56/1.4 bar) in a crossover design. In a different cohort, 18 participants (Age:23.6+2.3;12 females) conducted the same CFFF tests after either tvns (NEMOS) or a sham condition. HRV was recorded using an ECG (Bittium Faros).

Paired samples t-tests were conducted on the factors Illumination, Immersion, and P_iO_2 in the 1st cohort and separately for the effects of tvns in the 2nd cohort. Effect sizes are displayed as Cohen's d.

RESULTS: A significant effect was observed for illumination outside on land (p=.028, d=.467; Bright: 36.47Hz, Dark: 35.84Hz). Main effects were also observed for immersion during Bright (p=.009, d=.593/Land: 36.28Hz, Underwater: 37.9Hz) and Dark illumination (p=.045, d=-.412/Land: 36.38Hz, Underwater: 37.3Hz). Tvns showed no effects on CFFF (p=.112, d=-.218/tvns: 35.4Hz, sham: 35.0Hz).

CONCLUSION: Despite the effects of illumination and immersion, the small absolute differences do not suggest a major impact on CFFF validity. A potential explanation for the effect of illumination on CFFF is the eye's adaptation changes to ambient light[4]. No direct influence of autonomic stimulation on CFFF was observed, supporting robustness for an application in extreme environments. Future work might focus on the link of CFFF to executive function and operational performance in extreme environments and sports contexts to increase safety for planning and decision-making.

[1]Fu et. Al (2021). DOI: 10.1016/j.aopr.2021.100011

[2]Curran & Wattis (2000). DOI: 10.1002/(SICI)1099-1077(200003)15:2<103::AID-HUP149>3.0.CO;2-7

[3]Lafère et. Al (2019). DOI: 10.28920/dhm49.2.119-126

[4]Schipke et. al (2023). DOI: 10.3390/medicina59040800

EFFECTS OF AGE DIVISION ON GENERAL AND SPECIFIC PERFORMANCE IN COMPETITIVE TAEKWONDO ATHLETES

DEL VECCHIO, F.B., VEIGA, R., SIQUEIRA, G., IAHNKE, N., DINIZ, R.

FEDERAL UNIVERSITY OF PELOTAS

INTRODUCTION: In taekwondo (TKD), physical demands are relevant for competitive success [1]. Additionally, due to combat dynamics, high levels of power and speed can increase the chance of victory [2]. Recently, specific kicking tests have been developed to measure the speed and anaerobic capacity of TKD athletes, but we found no comparisons between age divisions. Thus, the objective of the present study was to evaluate the physical competition of male TKD athletes, and to compare according age divisions (cadet and senior).

METHODS: A cross-sectional observational study was carried out, in which male TKD athletes (5 cadets and 6 seniors) were evaluated. Age, practice time and weekly training frequency were recorded. Body mass and height were measured. The power of the lower limbs was estimated with Squat Jump (SJ), the speed was measured with the 10-second Frequency Speed of Kick Test (FSKT10), which consists of performing bandal tchagui rotating kicks, alternating right and left legs against a kick shield positioned at the height of athletes' torso. Anaerobic capacity was quantified with the 5 sets of FSKT test (5FSKT), with 10 s recovery between sets [3]. Comparison between age divisions (12-14 versus +18 years old) was performed with an independent samples test. For the entire sample, we also applied Pearsons correlation test. Comparison of performance between sets on the 5FSKT was performed with an ANOVA with repeated measures.

RESULTS: Regarding the characteristics of the athletes, differences were observed between seniors and cadets for age (21.5±2.3 and 13.0±1.0 years; p<.001), practice time (84±30 and 34 ±24 months; p=.017), weekly frequency (8.6±0.8 and 4±1 sessions; p<.001). Regarding anthropometry, the elderly were heavier (68.5±8.2 and 52.9±10.5 kg; p=.023), with no differences in height (174.5±8.5 and 161.6±18.0 cm; p=.15). Seniors performed better in the SJ (53.6±6.6 versus 30.3±5.2 cm; p<.001) and in the FSKT10 (23.8±0.6 versus 21.8±1.1; p=.004). In the 5FSKT, seniors performed better only in the first set (23.3±1.2 versus 20±2.1 kicks; p=.01), with no differences in following sets, as well as in fatigue index (13.1±2.7% and 9.9±5.9%; p=.27). In 5FSKT, a reduction was observed in the number of kicks applied throughout the sets (F=9.79; p<.001), with the first (p=.005) and third (p=.03) being different from the fifth.

CONCLUSION: In the present study, senior TKD athletes exhibited greater body mass and superior performance in power and speed tests. In anaerobic capacity, in addition to the slight better results among senior athletes, there was a systematic reduction in the number of kicks throughout the sets.

REFERENCES:

[1] Markovic et al. Coll. Antropol. 2005;29:93-99.

[2] Del Vecchio et al. Biol. Sport 2011;28:75-78.

[3] Santos; Franchini. Sport Sci. Health. 2016;12:377-382.

RELATIONSHIP BETWEEN STRENGTH AND POWER VARIABLES AND SPECIAL JUDO FITNESS TEST PERFORMANCE IN MALE JUDO ATHLETES

YUE, M.1, MANYING, R.2

1.BEIJING SPORT UNIVERSITY 2.BEIJING RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: The Special Judo Fitness Test (SJFT) has been reported as the most widely used test in judo studies(1) due to its correlation with the number of attacks in a simulated combat scenario(2) its ability to effectively discriminate between judo athletes of varying competition levels and its simulation of a metabolic demand similar to that of an actual judo match(3).While the SJFT has shown correlations with some variables associated with aerobic(4,5) and anaerobic fitness(6,7), as well as lower body muscle power(5). Whether additional essential neuromuscular factors of upper body pull, torso, lower body or a combination of these variables could explain the better performance during SJFT is unclear.Therefore, the aim of this study was to identify the relationship of strength and power variables with SJFT performance and determine which variables could better explain the variance in SJFT performance.

METHODS: All subjects performed the SJFT, a judogi pull-up, countermovement jump (CMJ), and torso isometric strength test. For the SJFT, the total number of throws, heart rate immediately and 1 minute after, and SJFT index were determined. For the judogi pull-up test, relative maximal time in isometric (IJPUT), mean velocity (DJPUV) and power (DJPUP) in single dynamic, and number of correct judogi's pull-ups until failure (DJPUR) were determined. For the CMJ test, mean height (CMJMH) and loss of height between initial and final 10 jumps (CMJHL) were determined. For torso isometric strength test, relative peak torque in left lateral flexion (TFLRPT), right lateral flexion (TFRRPT), left rotation (TRLRPT), and right rotation (TRRRPT) were determined.

RESULTS: Pearson's correlation coefficient identified significant variables for inclusion in the stepwise multiple linear regression analysis, which showed that TFRRPT and DJPUP explained 77% (p = 0.000) of the total number of throws in SJFT variance and 57% (p = 0.002) of the SJFT index variance, respectively.

CONCLUSION: Our findings suggest that several strength and explosive strength variables have a strong correlation with specific judo performance (SJFT). The mean power in single dynamic judogi pull-up and the relative peak torque of torso lateral right flexion could explain 77% of the variance of the total number of throws in SJFT and 57% of the SJFT index. The finding sheds light on the explosive strength profile of the upper body pull movement, which contributes a lot to this sport. Compared to the SJFT index, two variables can better predict the total number of throws in SJFT. This is because, in addi-

tion to the neuromuscular elements, the SJFT index is additionally affected by physiological factors, including aerobic and anaerobic metabolism.

1.Casals C et al.(2017) 2. Lwai K et al.(2008) 3. Franchini E et al.(2011) 4.Franchini E et al.(2008) 5.Hesari A et al.(2013) 6. Sterkowicz S et al.(2012) 7.Wolska B et al.(2010)

SPECIFIC STRESS TEST DESIGN AND PERFORMANCE PROFILING OF HIGH-LEVEL ATHLETES IN FRENCH BOXING

GUERRERO, M., GARGAGLI, M.
UNIVERSITÉ OF TOULOUSE III - PAUL SABATIER

INTRODUCTION: French boxing remains insufficiently explored regarding physical and physiological performance with studies highlighting performance in boxing, but not specifically in French boxing and under ecological conditions [1]. Other studies analysed boxing punches during three rounds of three minutes each, but French boxing is characterised by punches and kicks and rounds of two minutes. [2][3]. A complementary study has assessed physiological boxing performance in ecological conditions by designing a boxing test using a punching bag with an imposed stroke rate similar to competition [4]. Therefore, the aim of this study was twofold: (i) to establish a discipline-specific reference stress test and (ii) to collect data from this protocol on punching bag and in the ring in order to quantify the internal and external training load of top-level athletes.

METHODS: Thirteen athletes from the French boxing national training centre took part in the study. The experimental protocol consisted of a maximal effort exercise on a punching bag designed to assess individual physiological performance. The following day a one-on-one confrontation in the ring during three rounds of two minutes each or five rounds of two minutes each was carried out, depending on each athlete competition format (assault or combat). During the two exercises, various physiological data were collected, including blood lactate and glucose levels, and heart rate. Gas exchange was measured during the punching bag task. The number and accuracy of punches and kicks were also recorded

RESULTS: This study showed that the athletes reached their maximum physiological capacity in the punching bag task (184±10bpm; 52,6±7ml/min/kg) , suggesting that this exercise is a relevant discipline-specific reference stress test. A random slope model showed that the type of exercise had no significant effect on the metabolic response of each athlete, unlike the rounds ($p<0,001$): each parameter (heart rate, blood glucose, lactate) increased as the rounds progressed. Moreover, athletes spend 80% of their boxing time between 90% and 100% of their maximal heart rate. The format had a significant effect on the number of hits in the ring, with assault athletes throwing more punches (97 hits per round) than combat athletes (59 hits per round) depending on the time spent in the ring.

CONCLUSION: A better understanding of the issues involved in this discipline has been achieved through a complete analysis of the French boxing task. Responses to effort varied individually in intensity, but the trends were generally similar for all athletes depending on the number of rounds. The objective of developing an exploratory profiling test has been achieved, now making possible to individualise French boxing training.

1. Chaabène et al.(2015) 2.Davis et al.(2015), 3. Davis et al.(2017), 4. Finlay et al.(2018)

Conventional Print Poster Presentations

CP-PN11 Energy and muscle metabolism

EFFECT OF ACCUSTOMED ENDURANCE EXERCISE ON NEXT-DAY RESTING METABOLIC RATE IN MALE ATHLETES

EOIN RUA ONEILL, J., JOYCE, R., MC LOUGHLIN, N., ROBINSON, J., MC PHILLIPS, C., O CONNELL, B., HORNER, K.
UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Best practice guidelines recommend avoiding physical activity for 12-48 hours before RMR testing [1], a challenge for athletes training daily. Recent findings suggest resistance but not aerobic exercise elevates RMR in non-athletes [2]. This study investigates the effect of accustomed exercise on next-day RMR in male endurance athletes, using a randomised crossover design, offering insights for RMR assessment in this population.

METHODS: Thirteen male endurance athletes undertook rest and exercise conditions in random order one week apart. For the rest condition participants were instructed to perform no exercise for 24 hours before RMR measurement. For the exercise condition they were instructed to undertake a routine steady-state session rated 3-4 on the CR-10 scale [3] on the day prior to RMR measurement. Characteristics of exercise including heart rate were recorded. RMR was measured using a Q-NRG indirect calorimeter, with a within-subject CV of 2.4%±1.6% (range: 0.2%-6%) for day to day reliability based on unpublished data from our lab (n=30) measured following best practice guidelines. In the present study, if participants inter- day CV fell outside this range (>6%), their activities in the preceding 72 hours were further characterised for reasons that may explain a greater variability. Recovery markers were also assessed including blood urea and wellness questionnaire scores [4]. Paired t-tests and Wilcoxon tests compared differences between conditions, CVs assessed inter- day consistency, and Pearsons correlations tested associations between RMR and recovery markers. Significance was set at $P<0.05$.

RESULTS: Exercise modalities included 5 undertaking indoor and 4 outdoor cycling, 3 outdoor running, and 1 indoor rowing, with mean (SD) session duration 01:51±01:11 (hh:mm), heart rate 128±16 bpm and RPE score 3.33±0.47. No significant

differences were found in post-exercise vs rest RMR (1979±289 vs 1958±251 kcal/day, P=0.74), urea (42±6 vs 39±10 mg/dl, P=0.43), or RQ (0.77 vs 0.78, P=0.62). Wellness scores were lower post-exercise than rest (16.5 vs. 18.8, P=0.03); only sleep quality approached, but did not reach, significant difference (P=0.06). No correlations were observed between recovery markers and RMR changes. Inter-day CVs indicated consistency in RMR between days: 3.8%±3.4%. However, on an individual basis two participants had CVs >6%. Both adhered to guidelines on the day prior to measurement but undertook a high intensity session/competition approximately 48 hours prior.

CONCLUSION: These findings suggest moderate intensity accustomed endurance exercise may be undertaken on the day prior to RMR measurement without altering results. However, practitioners may need to consider restriction of high intensity exercise in the 48 hours prior to testing. This warrants further study.

[1] S. Fullmer et al. 2015

[2] K. MacKenzie-Shalders et al. 2020

[3] C. Foster et al. 2001

[4] B. D. McLean et al. 2010

MITOCHONDRIAL RESPIRATORY FUNCTION IS NOT IMPAIRED FOLLOWING SEVERE-INTENSITY CYCLING EXERCISE IN HEALTHY MALES

ACTON, J., ALSHARIF, N.S., COCKSEDGE, S.P., PEDEN, D.P., FERGUSON, R.A., MITCHELL, E.A., BAILEY, S.J.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Impaired mitochondrial respiratory function [increased uncoupled leak respiration through complex I (CIL) or lower coupled respiration through complexes I+II (CI+IIP)] following high-intensity exercise has been reported in some, but not all previous studies. Therefore, the purpose of the current study was to determine the effect of severe-intensity cycling exercise on mitochondrial respiratory function compared to resting values.

METHODS: Thirteen recreationally active (VO2peak, 48.0 ± 6.6 ml/kg/min) male participants reported to the laboratory on three separate occasions. Initially, participants performed a 30 W/min linear ramp incremental cycle test until the limit of tolerance (Tlim), to determine the gas exchange threshold (GET) and VO2peak. On visit two, participants were familiarised to a constant-load cycling exercise test at a work-rate equivalent to the GET, plus 70% of the difference between VO2peak and GET (70%Δ), until Tlim. Time taken to reach Tlim was recorded to the nearest second and 80% of this time was calculated and termed 80%Tlim. On the final visit, muscle biopsies were taken from the m. vastus lateralis, at rest and following performance of the 70%Δ constant load exercise test to 80%Tlim. Mitochondrial respiratory variables in permeabilised muscle fibres were assessed using high-resolution respirometry. Specifically CIL, coupled respiration through complex I (CIP) and complexes I+II (CI+IIP), and noncoupled maximal electron transfer system capacity through complexes I+II (CI+IIE), complex II (CIIE) and complex IVE were determined. The following flux control ratios (FCRs) were subsequently calculated Leak control ratio (LCR; CIL/CI+IIE), phosphorylation control ratio (PCR; CI+IIP/CI+IIE), inverse respiratory control ratio (INV-RCR; CIL/CI+IIP), substrate control ratio (SCR; CIp/CI+IIP) and complex IV reserve control ratio (CIVres; CI+IIP/CIVE). All samples were analysed in quadruplicate and analysis order was counterbalanced. Citrate synthase activity was used as a validated surrogate of mitochondrial content. Paired T-tests were used to assess the difference between the mitochondrial respiratory variables at rest and post exercise.

RESULTS: Mass-specific CIP¬ (12%), CI+IIP (9%) and CI+IIE (9%) respiration was greater post exercise compared to rest (all P =0.048). There were no differences between time points for CIL, CIIE and CIVE and the FCRs (P > 0.05). There were no differences in CS activity or in mitochondrial respiration parameters or FCRs between time-points when mass-specific respiration was corrected to CS activity (P > 0.05).

CONCLUSION: Mitochondrial respiratory function was not impaired following acute severe-intensity cycling exercise to 80% of Tlim. These findings conflict with some previous research and could be explained by this study counterbalancing the order in which the resting and post-exercise biopsies were analysed, thus mitigating the potential carry over effect of chemical inhibitors.

THE EFFECT OF WORK AND REST REDISTRIBUTION ON DIFFERENT PHYSIOLOGICAL AND PERCEPTUAL VARIABLES DURING THREE HIIT PROTOCOLS.

MÉNDEZ, K., VIÁN, G., COLOMER-POVEDA, D., MERA-GONZÁLEZ, I., MÁRQUEZ, G.
UNIVERSITY OF CORUÑA

INTRODUCTION: During High Intensity Interval Training (HIIT), work and rest time could be modified to induce different metabolic, mechanical, and perceptual responses (Buchheit & Laursen, 2013). However, up to date, it was not investigated the effect of different work and rest distribution maintaining the same amount of workload and recovery time during a HIIT session. Therefore, the aim of the present study is to compare acute physiological (e.g. ventilatory), metabolic (e.g.: lactate), and perceptual (e.g.: RPE) responses during three HIIT protocols matched in volume and intensity but performed with different work and rest distribution.

METHODS: Five males and five females (n=10, 27,4 ± 5,4 years, 52,3 ± 7,8 ml/kg/min, 184,9 ± 10,2 bpm, 4,8 ± 0,7 w/kg) underwent graded exercise testing to volitional exhaustion in a cycle ergometer to test they maximal aerobic power (Wmax). Then, they were required to complete three different HIIT training sessions that consisted of a total work time of 12 minutes at 80% of Wmax interposed with a total recovery time of 8 minutes at 25%of Wmax. These protocols have differ-

ent configurations as described below: 1) 3 x 4 minutes bouts with 4 minutes recovery in between, 2) 6 x 2 minutes bouts with 1 minute and 36 seconds recovery in between; and 3) 12 x 1 minute bouts with 44 seconds in between. Ventilatory (VO2 Master 3230, British-Columbia, Canada), cardiovascular (Polar H10, Finlandia), metabolic (Lactate Pro-2, Arcray Inc) and perceptual (Borg CR-10 scale) response were recorded in each training session and analysed off-line. A one-way repeated measures ANOVA was performed to detect differences between all protocols performed. A statistical level of $p < 0,05$ was accepted. All data were presented as mean ± SD.

RESULTS: All the variables analysed in the present study showed higher respiratory (ventilation (+14% and 22%) and tidal volume (+9% and +14%)), metabolic (Lactate, +28% and +91%), cardiovascular (heart rate, +5% and +8%) and perceptual (RPE (+7% and +22%) and leg pain (+2% and +19%)) demands during the protocol configured with larger intervals (4 min) compared to those configured with shorter intervals (2 and 1 min, respectively), despite the total workload and total rest time were matched.

CONCLUSION: Shorter interval duration shows an attenuated ventilatory, cardiovascular, metabolic and perceptual responses compared with longer interval duration although the equalised volume and intensity resulting in same total workload. This results should be taken into account when prescribing HIIT to enhance performance.

PHYSIOLOGICAL RESPONSE IN TABLE TENNIS PLAYERS OF PROFESSIONAL GROUP AND AMATEUR GROUP DURING A SEVEN-GAME MATCH

YU, T., WANG, Y.F., TANG, C., CHEN, C., YU, J.

UNIVERSITY OF TAIPEI

INTRODUCTION: Biochemical data collected before and after training have been instrumental in designing a training and physical fitness program for table tennis athletes, enabling precise control over training intensity and exhaustion levels at each stage (1). Despite existing research on the energy metabolism during multi-ball feeding training in table tennis, theres limited understanding of energy utilization during actual matches. This study, therefore, seeks to investigate the physiological responses by table tennis players during a match.

METHODS: This study involved 26 table tennis players, split evenly between 13 professional and 13 amateur athletes. Each participant played 7 games in a match, with evaluations conducted before, during, and after the match on variables such as blood lactate acid, body temperature, blood glucose, heart rate, perceived exertion, and biceps brachii muscle circumference.

RESULTS: The study revealed that professional athletes exhibited significantly higher blood lactate acid levels than amateur athletes following the seventh game (5.3±2.1 mmol/L vs. 4.1±1.9 mmol/L), and at the third (6.5±2.7 mmol/L vs. 5.1±1.5 mmol/L), seventh (5.6±2.7 mmol/L vs. 4.8±1.7 mmol/L), and tenth minutes (4.8±1.5 mmol/L vs. 4.1±2.9 mmol/L) post-match. Conversely, amateur athletes showed significantly higher heart rates at baseline (68±2.7 bpm vs. 61.5±3.6 bpm) and ten minutes after the match (73.2±2.1 bpm vs. 66.4±3.7 bpm) compared to professionals. Additionally, amateur athletes perceived exertion ratings were significantly higher than professionals at the fifth (12.6±1.8 vs. 9.3±2.4) and tenth minutes (10.7±1.9 vs. 7.5±2.2) post-match. However, no significant differences were observed in blood glucose, body temperature, and muscle circumference between the groups.

CONCLUSION: This studys results demonstrate that professional athletes exhibit higher blood lactate acid levels during the recovery period than amateur athletes, indicating more intense competition and engagement levels among professionals. Despite facing higher competition intensity, professional athletes report significantly lower perceived exertion ratings, likely reflecting their accustomedness to rigorous training regimes. Additionally, professionals show quicker heart rate recovery post-match, suggesting superior readiness for subsequent high-intensity encounters. These findings highlight a link between anaerobic metabolism efficiency and athletic skill level, suggesting that enhancing physical capabilities can significantly boost competitiveness in players with advanced skills.

METABOLISM RESPONSES TO ACUTE BOUT OF HIGH-INTENSITY INTERVAL EXERCISE COMBINED WITH GREEN TEA CONSUMPTION IN MORBIDLY OBESE PATIENTS.

WORASETTAWAT, T., SIRIPATT, A.

HRH PRINCESS CHULABHORN COLLEGE MEDICAL SCIENCE CHULABHORN ROYAL ACADEMY

INTRODUCTION: High-intensity interval exercise (HIIE) and green tea (GT) tend to be more beneficial in improving a wide range of health outcomes and metabolisms across numerous populations. However, the feasibility of metabolism responses to acute bouts of HIIE combined with GT consumption is unknown in patients with morbid obesity. This study evaluated and compared the metabolic responses to acute bouts of HIIE vs. HIIE+GT in morbidly obese patients.

METHODS: 12 morbidly obese patients (BMI=41.49±3.14) aged 20-45 years were studied. All participants were assessed in a cross-over design on two visits separated by at least 72 hours. HIIE consisted of 6 sets of 1 min of high-intensity exercise at 80-85% of HRR followed by with 4 min of low-intensity exercise at 40-45% of HRR. All participants were received green tea 2 capsules before HIIE for an hour, with 1 capsule containing 400 mg of green tea and 200 mg of catechin. Metabolism was assessed by gas analyzer.

RESULTS: Fat oxidation increased considerably ($p<0.05$) following HIIE and HIIE+GT interventions for 5, 30, and 60 minutes. However, there were no significant differences between HIIE and HIIE+GT interventions. The maximum fat oxidation occurred 30 minutes after HIIE and HIIE+GT (205.8±19.7 vs 189.8±19.7 g/day). After 30 and 60 minutes of both interventions,

carbohydrate oxidation decreased (all p<0.05), but protein oxidation increased for 5 and 30 minutes (all p<0.05). There were no significant changes between the HIIE and HIIE+GT regimens. Resting metabolic rate (RMR) increased after 5 minutes of HIIE, as well as 5 and 30 minutes of HIIE+GT (3,349.4±368.8 and 2905.6.4±279.1 kcal/day). RMR decreased after 1 hour of HIIE (p<0.05), but not significantly following HIIE+GT intervention compared to prior exercise and green tea consumption.

CONCLUSION: In morbid obesity patients, HIIE+GT is a viable option for increasing fat oxidation and improving metabolism. Future research is needed to assess the chronic effects of HIIE+GT in morbidly obese patients.

CRITICAL POWER ESTIMATION PROVIDES A GOOD APPROXIMATION OF THE POWER OUTPUT ASSOCIATED WITH THE MAXIMAL METABOLIC STEADY STATE IN BOTH TRAINED AND UNTRAINED PARTICIPANTS

LINDSTROM, B., FLEITAS-PANIAGUA, P.R.1, MARINARI, G.1, RASICA, L.1, ZAGATTO, A.M.1,2, MURIAS, J.M.1,3

1 UNIVERSITY OF CALGARY, CALGARY, AB, CANADA; 2 SAO PAULO STATE UNIVERSITY, BAURU, BRAZIL; 3 HAMAD BIN KHALIFA UNIVERSITY, DOHA, QATAR

INTRODUCTION: Critical power (CP) estimation is a well-established method to identify the power output (PO) associated with the maximal metabolic steady state (MMSS) of exercise. CP estimation requires multiple time to task failure (TTF) trials and the precision of this evaluation in untrained individuals could be questionable due to their inexperience with performing maximal efforts up to volitional exhaustion. Thus, the goal of this study was to compare whether the accuracy of CP to approximate the MMSS was affected by the training status of the individuals.

METHODS: Twelve trained (5 females) and 12 untrained (6 females) participants underwent: i) a ramp incremental test (males 30 females 20 W/min) to task failure to determine maximal oxygen consumption (VO2max) and peak PO (POpeak); ii) a series of 4-5 TTF trials at POs ranging from 70 to 90% of POpeak performed on separate days, to obtain TTF durations of ~2-20 min for CP estimations. CP was calculated from three different models (CP2hyp, CPlinear, and CP1/time) and the one demonstrating the lowest combined error of its parameters was selected as the final value; iii) at least 2 (or as many as needed) 30-min constant PO rides to establish MMSS. Measurements of VO2 and blood lactate concentrations ([La-]b) were performed. MMSS was defined as the highest PO associated with steady-state VO2 (<120 ml/min) and stable [La-]b values (<1 mM) between the 15th and 30th min of the ride.

RESULTS: VO2 and [La-]b at MMSS were stable in both trained (3.22±0.58 L/min-3.25±0.57 L/min, 6.18±1.6 mM-6.65±1.8 mM; p>0.05) and untrained (2.23±0.43 L/min-2.28±0.45 L/min, 6.72±1.57 mM-7.16±1.62 mM; p>0.05). The PO at CP was greater than that at MMSS in both trained (233±37 W vs. 225±39 W, respectively; p<0.05; effect size d=0.19; mean bias= +7.5 W, 95% LOA= -11-26 W) and untrained (155±39 W vs. 147±34 W, respectively; p<0.05; effect size d=0.20; mean bias= +7.5 W, 95% LOA= -13-28 W). A mixed-model ANOVA revealed no significant differences in the variances of CP and MMSS values between the trained and untrained groups (p=0.99, statistical power =99%).

CONCLUSION: These findings indicate that, despite a significant (albeit small) difference between CP and MMSS, the CP model provided a close approximation of the PO associated with the MMSS. Most importantly, the quality of the CP model was not affected by training status, which suggests that previous experience with maximal efforts is not a key component of the quality of the prediction. (Dr. Juan M. Murias' work was supported by the Natural Sciences and Engineering Research Council of Canada (RGPIN-2016-03698) and the Heart & Stroke Foundation of Canada (1047725).

PHYSIOLOGICAL RESPONSE TO FLUCTUATION OF RUNNING SPEED DURING 10 KM RUNNING.

SUMI, D., TAKII, Y., ABE, S., SAKAGUCHI, M.

ASICS CORPORATION

INTRODUCTION: Running speed frequently changes during a long-distance running event (e.g., 10000 m race in World Athletics Championships) [1]. Although it is anecdotally believed that fluctuation of running speed during long-distance event has a negative impact on running performance, its influence on physiological responses during running remains unclear. Therefore, the purpose of the present study was to determine the effect of fluctuating running speed during 10 km running on physiological variables compared to constant running speed.

METHODS: Six male endurance runners completed two trials on different days, consisting of either fluctuating (FLU trial) or constant (CON trial) running speed during 10 km running on a treadmill. In the CON trial, running speed during 10 km running was constant at 80% of maximal oxygen uptake (VO2max), while running speed during 10 km running fluctuated between 75% and 85% of VO2max in the FLU trial. Running speed in the FLU trial fluctuated gradually (i.e., 75% - 80% - 85% of VO2max) every 600 m during 10 km running. Blood lactate levels and height of counter movement jump (CMJ) were evaluated before and after 10 km running. Moreover, respiratory gas variables [oxygen uptake (VO2) and expired minute ventilatory volume (VE)], heart rate (HR), rate of perceived exertion (RPE) using Borg's CR10 scale, cadence and step length were measured during 10 km running.

RESULTS: Actual running speeds were 14.0 ± 1.7 km/h, 15.1 ± 1.7 km/h, 16.1 ± 1.7 km/h for the 75%, 80% and 85% of VO2max, respectively. The time to completing 10 km running was same between two trials (40.4 ± 5.1 min). Blood lactate levels increased significantly in both trials (P = 0.042), whereas FLU trial showed greater blood lactate elevation (P = 0.015) after 10 km running (FLU: 4.3 ± 1.8 mmol/L, CON: 2.6 ± 1.8 mmol/L). Furthermore, the height of CMJ following 10 km running was significantly lower (P = 0.04) in the FLU trial (28.6 ± 4.3 cm) than in the CON trial (31.2 ± 3.1 cm). VO2, VE, HR and RPE during 10 km running fluctuated in the FLU trial, while these variables increased linearly in the CON trial. However, the mean values of VO2 (FLU: 48.2 ± 3.3 ml/kg/min, CON: 46.2 ± 3.5 ml/kg/min, P = 0.105), VE (FLU: 95 ± 13 L/min, CON: 86 ±

11 L/min, P = 0.09) and RPE (FLU: 5.3 ± 2.2, CON: 4.4 ± 1.5, P = 0.09) during 10 km running were tend to be higher in the FLU trial than in the CON trial. There was no significant different for mean values of HR (FLU: 164 ± 18 bpm, CON: 164 ± 19 bpm), cadence (FLU: 181.8 ± 11.9 steps/min, CON: 181.1 ± 11.9 steps/min) and step length (FLU: 1.36 ± 0.1 m, CON: 1.38 ± 0.2 m) during 10 km running between two trials.

CONCLUSION: Fluctuating running speed partially exacerbated physiological response compared to constant running speed during 10 km running, even though the time to completing 10 km running was same.

[1]Quentin Mercier, Amandine Aftalion and Brian Hanley. Front Sports Act Living, 2:636428, 2021.

IN WITH THE MODIFIED, OUT WITH THE TRADITIONAL: DOES THE NEW CHESTER STEP TEST (CST2) PROVIDE A MORE ACCURATE ESTIMATE OF VO2MAX?

BURT, D., JONES, S., PHEASEY, C., BUCKLEY, J.

KEELE UNIVERSITY

INTRODUCTION: Maintaining and assessing aerobic fitness (VO2max) is important for health, longevity, and ascertaining suitability to work and undergo medical treatment. The Chester Step Test (CST) is a safe, inexpensive, and popular, sub-maximal exercise test capable of predicting VO2max from the assumed linear relationship between exercise intensity, heart rate (HR), and oxygen uptake; however, its accuracy is questionable (1). To overcome previous limitations, a modified version (CST2) that follows the same procedures as the traditional method (CST1) with the exception that HR is recorded every minute, has recently been developed (2). The additional HR data is claimed to provide a more accurate prediction of VO2max (3), however, to date, no research has confirmed if the CST2 provides a more accurate prediction of VO2max when compared against the CST1.

METHODS: Fifty healthy participants (18 females, 32 males) completed the CST1, the CST2, and a treadmill-based VO2max test. Tests were conduced in a randomised order, at the same time of day, in similar environmental conditions, and with at least 24 hours rest between trials. Systematic measurement bias across all three trials (CST1, CST2, and VO2max) was examined using a repeated measures ANOVA. Validity of the CST1 and CST2 predicted VO2max were further examined using the 95% limits of agreement (95% LoA = bias ± 1.96 x SDdiff).

RESULTS: Mean ± SD of the CST1 and CST2 predicted VO2max, and actual VO2max were 42.9 ± 7.9, 42.9 ± 7.6, and 41.8 ± 7.4 ml.kg-1.min-1, respectively. No significant bias was shown between the CST1 and CST2 predicted VO2max and actual VO2max ($P > 0.05$). The 95% LoA between the CST1 predicted VO2max and actual VO2max and the CST2 predicted VO2max and actual VO2max were similar (1.04 ± 10.7 ml.kg-1.min-1 and 1.08 ± 11 ml.kg-1.min-1, respectively), translating to 28% and 29% prediction error in the worst case.

CONCLUSION: Despite claims that the collection of additional HR data during the CST2 provides a more accurate prediction of VO2max (3), findings from the current study reveal no difference between the estimation of VO2max obtained from the CST1 or CST2. Provided the same version is used during repeated trials, either test can be used to provide an estimation of VO2max.

1. Buckley JP, Sim J, Eston RG, Hession R, Fox R. (2004). Reliability and validity of measures taken during the Chester step test to predict aerobic power and to prescribe aerobic exercise. Br J Sports Med, 38, 197–205. https://doi.org/10.1136/bjsm.2003.005389

2. Sykes K. (2019). Chester step test 2. Cartwright Fitness.

3. Sykes K. (2020). Chester step test 2 – an online submaximal test for the assessment of aerobic capacity (VO2max). EC Pulmonol and Respir Med, 9(3), 01–03

Conventional Print Poster Presentations

CP-MH04 Sports Medicine II

WEARABLE TECHNOLOGY TO GUIDE RETURN TO PLAY FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

SESHADRI, D., AMITRANO, J., ZARRINFAR, M., GIULIANI, M., CAHILL, K.

LEHIGH UNIVERSITY

INTRODUCTION: Return to play (RTP) metrics post ACL-R are measured through six different external parameters. Four of these parameters compare the ACL-R limb to the contralateral limb, attempting to approach symmetry in the limbs. While external symmetry aids in the ability to understand where in the recovery process the athlete is, an internal parameter could increase the accuracy of the assessment by providing insights into the underlying biomechanical and physiological factors influencing the athletes performance. Muscle oxygen saturation (SmO2) has emerged as a biomarker of interest to quantify changes in muscle function during workouts. We hypothesize that differences in SmO2 could be attributed to less efficient O2 use in the ACL-R limb compared to the contralateral limb. The ultimate objective is to mitigate reinjury risks by tailoring rehabilitation strategies based on a comprehensive understanding of the athletes physiological responses and promoting symmetrical recovery patterns. This study seeks to utilize SmO2 as an objective internal variable to guide return to sport following ACL-R.

METHODS: In this study, approved by the Lehigh University Institutional Review Board at Lehigh University, we utilized near-infrared spectroscopy (NIRS) to assess SmO2 differences in the vastus medialis muscle. Additionally, we utilized a heart rate monitor to assess alterations in cardiac function among four Division 1 football athletes, aged 18-22, at various stages after ACL-R surgery. Measurements were taken during distinct rehabilitation time points. The athletes performed two sets of 20 repetitions of quad sets and single-leg raises.

RESULTS: Our ongoing study has yielded promising initial evidence regarding SmO2 convergence between the collateral and surgical legs during rehabilitation exercises for athletes within 4 months post ACL-R surgery. The data collected showed an average SmO2 of 70% for surgical and 50% for contralateral within one month of surgery. At around 4 months, on average, SmO2 for surgical was 58% and contralateral was 62%. Notably, we observed a convergence in SmO2% after this relatively short period, which deviates from the expected 6-month timeline. To further validate these findings, our future work will focus on expanding the sample size to ensure robustness and generalizability. By doing so, we aim to provide valuable insights that can inform rehabilitation strategies and enhance return-to-play protocols for Division 1 football athletes recovering from ACL-R surgery.

CONCLUSION: Our investigation into SmO2 variations in the vastus medialis following ACL-R surgery has found asymmetries between the surgical and contralateral legs. This highlights the critical importance of continuous monitoring of SmO2 during rehabilitation to tailor recovery strategies effectively. The findings not only contribute valuable insights for optimizing physiological responses and refining return-to-play protocols in athletes but also to other areas in medicine where atrophy occurs.

LOWER-EXTREMITY LEAN MASS ASYMMETRY IS NOT ASSOCIATED WITH LOWER-EXTREMITY INJURY IN RECREATIONAL ENDURANCE RUNNERS

AUDET, A., MELVIN, A., BROWN, M., HILL, L., LEPLEY, A., KOZLOFF, K.
UNIVERSITY OF MICHIGAN-ANN ARBOR

INTRODUCTION: Long distance running is a popular recreational activity, and participation in marathon and half marathon races has increased over the past several decades. Running-related injuries (RRI) are common and have a multifactorial etiology based on location and type of injury. Asymmetries in lower extremity lean mass may contribute to unbalanced muscle strength and functional loading between limbs. The impact of asymmetries in lower extremity lean mass (LELM) on RRI incidence remains unclear, particularly in recreational endurance runners. The purpose of this study was to prospectively evaluate the impact of LELM asymmetry on incidence of RRIs in a cohort of runners training for a half or full marathon.

METHODS: 153 (77M/76F; Age: 35.8+/-11.7yrs) recreational runners performed a maximal graded treadmill exercise test 10-12 weeks before their event (baseline), and a second test 3-4 weeks pre-race (83.8+/-29.7 days apart). Total body Dual Energy X-ray Absorptiometry scans were performed at each visit to evaluate total LELM and LELM asymmetry. Participants were instructed to maintain their typical training habits over the course of the study and were classified as injured or healthy based on self-reported injury status between visits. Injuries were defined as any running-related musculoskeletal impairment causing a self-reported disruption in training. Independent t-tests were used to evaluate differences in LELM asymmetry and VO2max between healthy and injured groups.

RESULTS: Baseline VO2max (M=51.6+/-7.6ml/kg/min, F=46.2+/-6.7ml/min/kg; p<.001), and total LELM (M=76.7+/-4.7%, F=67.0+/-5.9%; p<.001) were significantly different between genders, but LELM asymmetry did not differ by gender (p>.05). 18 participants (11.7%) sustained an injury between visits. No significant differences in LELM asymmetry were present between healthy and injured participants or when divided by gender (p>.05). Injuries were subdivided by type (muscle, tendon, bone, ligament, or unknown; n=6 ,4, 3, 2, 3 respectively), and by location (hip/pelvis, knee/thigh, shank, foot/ankle; n=4, 8, 2, 4 respectively). Despite some difference in LELM asymmetry across injury types (ligament injury asymmetry of 4.86+/-0.57% vs. muscle asymmetry of 2.86+/-1.49%) and site (shank injury asymmetry of 4.39+/-0.28% vs. healthy participants 3.36+/-2.35%), low injury incidence precluded a meaningful assessment of those numbers.

CONCLUSION: LELM asymmetry was not associated with RRI in our sample of recreational endurance runners training for a half or full marathon. The magnitude of asymmetry related to incidence of RRI may be greater than what was observed in the present sample. Alternatively, asymmetries in muscle functional capacity, independent of lean mass, may play a larger role on incidence of RRI in recreational runners.

This study received funding from Apple Inc. The funding source had no role in the analysis and

interpretation of the data or in the submission of this abstract.

THE RISK FOR THE FEMALE ATHLETE TRIAD IN BRAZILIAN ENDURANCE ATHLETES

DE MARIA, Y., PROL, A.K.A., JUZWIAK, C.R.
FEDERAL UNIVERSITY OF SÃO PAULO

INTRODUCTION: The Female Athlete Triad (TRIAD), a syndrome affecting female athletes and physically active women, is characterized, in its most severe manifestation, by the presence of low energy availability (LEA), with or without the presence of eating disorder, along with amenorrhea and osteoporosis (1). The aim of this study was to identify the risk frequency for the TRIAD among female Brazilian endurance athletes and the self-reported eating practices of those at risk.

METHODS: Brazilian female runners (n=60) and triathletes (n=44) aged 18-39 years old, training at least 5 hours/week, and regularly competing answered online to the validated Brazilian version of the Low Energy Availability in Females Questionnaire (LEAF-Q) (2). Chi-square test, Mann-Whitney test and independent t-test were used to assess association between variables. Athletes at TRIAD risk (LEAF-Q score equal or above 8) answered 4 additional questions about their eating practices.

RESULTS: Athletes' mean age and BMI were of 30.2 (5.2) years old and 21.7 (2.0) kg/m2, with no difference between runners and triathletes. Mean training load was of 10 (4.7) and 14.4 (8.1) hours/week for runners and triathletes, respectively ($p<0.001$). TRIAD risk was identified in 36 (34.6%) participants. There was no association between training load (hours/week), BMI, and TRIAD risk. Among the three dimensions of the LEAF-Q, gastrointestinal dysfunction had the higher frequency (n=50; 48.1%), while injuries and menstrual disfunction were observed in 37 (35.6%) and 46 (44.2%) of the participants, respectively. There was an association between injuries presence and menstrual disfunction ($p<0.02$). In this study, 45 (43.3%) of athletes noticed changes in their menstruation due to increased training intensity and 12 (11.5%) were amenorrheic (more than 4 months without menstruation). There were no statistical differences between runners and triathletes regarding the scores of each LEAF-Q domain, indicating that athletes from both endurance sports disciplines have similar risk to present signs and symptoms of LEA and, consequently, risk for the TRIAD. Of the athletes at risk for the TRIAD, 25 (69.5%) were dissatisfied with their bodies and 29 (80.5%) reported to adopt dietary weight control strategies, with only 11 (37.9%) doing so with nutritional monitoring.

CONCLUSION: The relatively high frequency of TRIAD risk among female Brazilian endurance athletes draws attention to the fact that it is necessary to raise awareness among these athletes of the risks related to the development of LEA and the TRIAD.

1. Nattiv et al. (2007). Medicine and Science in Sports and Exercise, 39 (10): 1867-82.

2. De Maria & Juzwiak (2021). Revista Brasileira de Medicina do Esporte, 27 (2): 184-88.

SEX/GENDER-SPECIFIC DIFFERENCES IN INCIDENCE PROPORTION, TYPES OF INJURIES, AND RELATED POTENTIAL RISK FACTORS IN RECREATIONAL MOUNTAIN-BIKING

POCECCO, E., RUEDL, G.

UNIVERSITY OF INNSBRUCK

INTRODUCTION: As 99.0% of fatally injured mountain bikers in the Austrian Alps are males (Pocecco et al. 2022), it can be supposed men being at higher risk for severe injuries during recreational mountain-biking (MTB). However, as far as we know, possible risk factors for accidents and injuries during MTB have not been specifically assessed for and compared between males and females in Austria so far.

Therefore, the objective of the present study was to investigate possible sex/gender-specific differences in incidence proportion, types of injuries, and related po-tential risk factors in recreational MTB.

METHODS: This retrospective survey was conducted in the surroundings of Innsbruck (Austria) in 2017-2019, involving randomly selected recreational mountain-bikers (n=1465, 37.8±14.3 years, 33.3% females). A standardized questionnaire was used to collect data on accidents and injuries ever experienced during MTB including circumstances related to the most severe injury.

RESULTS: In total, 492 (33.6%) mountain-bikers suffered one or more injuries requiring medical attention. Females showed a significant lower incidence proportion compared to males (26.6% vs. 37.1%, $p<0.001$). The most frequent injury types were fractures in male (30.1%) and open wounds in female (20.9%) mountain-bikers ($p=0.029$).

At the time of the accident, men showed higher MTB skills ($p<0.001$) and engaged in riskier riding behavior ($p<0.001$) compared to women. Additionally, males were more likely to be biking alone on the day of the accident compared to females (29.6% vs. 14.9%, $p=0.007$), who tended to ride in groups.

CONCLUSION: Comparably to other similar leisure mountain sports such as alpine skiing and snowboarding (Ruedl et al. 2010), men were found to exhibit a higher skill level and engage in riskier driving behavior more frequently than women. Considering also the relation between riskier behavior and ACL-injuries in recreational alpine skiing (Ruedl et al. 2022), the present data support the hypothesis that individual risk factors and in particular the riding behaviour are associated with MTB injuries among males. On the other hand, biking in a group, which was more common among women, did not appear to result in higher incidence proportion due to peer pressure.

These findings should be considered when proposing sex/gender-specific preventive measures for recreational mountain-bikers.

References

1. Pocecco E, Wafa H, Burtscher J, et al. (2022) Mortality in recreational mountain-biking in the Austrian Alps: a retrospective study over 16 years. Int J Environ Res Public Health 19(19):11965

2. Ruedl G, Pocecco E, Sommersacher R, et al. (2010) Factors associated with self-reported risk-taking behaviour on ski slopes. Br J Sports Med 44(3):204-206

3. Ruedl G, Posch M, Tecklenburg K, et al. (2022) Impact of ski geometry data and standing height ratio on the ACL injury risk and its use for prevention in recreational skiers. Br J Sports Med. doi: 10.1136/bjsports-2021-105221

DOES MUSCLE CONTRACTILITY MEASURED WITH TENSIOMYOGRAPHY VARY ACROSS THE MENSTRUAL CYCLE? – A COHORT STUDY.

BERNSTEIN, C., NIEDERER, D., BEHRINGER, M.
GOETHE UNIVERSITÄT FRAMKFURT AM MAIN

INTRODUCTION: Hormonal fluctuations related to menstrual cycle phases do not seem to affect strength parameter. In contrast, data from studies in animals and postmenopausal women suggest that steroid hormones such as estrogen and progesterone may affect force generating capacity by enhancing the number and quality of cross-bridges. The ability to generate force is impaired in an estrogen-deficient state, while estrogen supplementation may restore these capacities. It is therefore conceivable that contractility varies across the menstrual cycle. However, research investigating skeletal muscle contractility across the menstrual cycle is sparse. Hence, the aim of the study was to investigate the contractility of m. rectus femoris in an eumenorrheic population.

METHODS: Fifteen (15) regularly menstruating women not taking oral contraceptives (age 24.8 ± 3.0 yrs; body mass 59.7 ± 5.8 kg; height 1.68 ± 0.04 m; cycle length 28.2 ± 1.2 d; BMI 21.1 ± 1.3) were included. We assessed muscle contractility in in the early follicular phase, at ovulation, and in the mid-luteal phase. The onset of menses determined the early follicular phase, while a rise of luteinizing hormone in urine detected ovulation. The mid-luteal phase was set 7 to 9 days after ovulation. We used Tensiomyography (TMG-BMC Ltd., Slovenia) as a non-invasive method to assess muscle contractility by obtaining spatial and temporal parameters such as displacement of the muscle belly (Dm), contraction time (Tc), initial delay time (Td) and the velocity of contraction (Vc = Dm/(Tc+Td)) in response to a supramaximal stimulation. Repeated measurements analyses of variance were performed to detect potential between-phases differences.

RESULTS: No between-phases differences occurred (Dm: $F(2,24) = 2.5$, $p = .103$, $n2p = .172$, Tc: $F(2,24) = 3.05$, $p = .0.066$, $n2p = .0.203$, Td: $F(2,24) = 0.687$, $p = .0.512$, $n2p = .054$, Vc: $F(2,24) = 0.687$, $p = .0.512$, $n2p = .054$). However, a high inter-individual variability across the cycle phases was evident.

CONCLUSION: Although there were no changes on a group level, the inter-individual variations indicate that muscle contractility may change across the menstrual cycle according to hormonal fluctuations in some participants but not in others. Since estrogen alters muscle properties on a molecular level, we assume that some individuals are either more responsive to hormonal fluctuations or that other factors overshadow the effects of steroid hormones on muscle properties. In conclusion, according to the current understanding, the responsiveness of muscle tissue to cycle-related hormone fluctuations needs to be assessed individually regarding the individual hormonal status.

EPIDEMIOLOGY OF HEAD INJURIES AND CONCUSSIONS AMONG FOOTBALL AND RUGBY PLAYERS - A SYSTEMATIC REVIEW

GORGONI, G., LOZANO, R., POPPERWELL, J., KUNOROZVA, L., BALAKRISHNA, Y., BROWN, J., MEYER, T.
UNIVERSITY OF SAARLAND

INTRODUCTION: Football and rugby union ('rugby') are collision sports that are associated with head injuries, including sports-related concussions (SRC). This systematic review aimed to compare the incidence of SRCs and other head injuries between football and rugby players, according to different variables (i.e., age, sex, level of participation, type of injury and setting), to derive mechanistic and other causal insights from it.

METHODS: Three electronic databases (EBSCOhost, Web of Science, PubMed) were searched. Studies on the incidence of head injuries and/or SRCs in players aged 12 years and older that were published in the English language in peer-reviewed journals from 2001 until 2022 were included. Four authors independently evaluated the studys eligibility and quality. The extracted data on head injuries and SRC were pooled in a meta-analysis.

RESULTS: The search yielded 1973 results of which 55 articles for rugby and 13 for football were included in the final analysis. Overall, the comparison between sports showed that rugby players registered higher rates of head injuries (including SRCs) than football players (7.29/1000 hours vs. 0.48/1000 hours), and the difference is significant (< 0.0001). The incidence rate ratio (IRR) between the two sports is 15.2 per 1000 hours, meaning that the injury occurrence is 15 times higher in rugby compared to football. Across variables, such as, age, gender and level of participation, the injury incidence rate was not significant.

CONCLUSION: The higher rate of SRCs in rugby is most likely due to the difference in the frequency and severity of collisions between the two sports. In fact, the nature of physical contact in rugby, including tackles and scrums, contributes significantly to the increased risk of head injuries when compared to football. The absence of significant differences in concussion incident rates across variables such as sex, age, and level of participation within sports might suggest a degree of parity between football and rugby concerning head injuries risks.

EPIDEMIOLOGY OF FEMALE JAPANESE COLLEGIATE FOOTBALL TEAM INJURIES: A NINE-YEAR STUDY

ODA, K., BUNGO, A., YAMAGUCHI, T.
SENDAI UNIVERSITY

INTRODUCTION: Football involves physical contact and is therefore associated with numerous injuries in both sexes. Injuries in male football have been extensively studied. However, reports on injuries in adult female football are scarce, and epidemiological data on Japanese collegiate female football players are exceedingly rare. The aim of this study was to determine the incidence and characteristics of injuries in Japanese collegiate female football players over nine seasons.

METHODS: Time-loss injuries, along with match and training exposure, were collected over nine seasons (2014-2022) from a Japanese collegiate female football team. We investigated the injury rate, the context of injuries (matches or training, contact or non-contact), the type of injury (traumatic or overuse), location, and severity. Injuries were classified into the following categories according to FIFAs severity criteria: minimal (absence from matches or training for 1 to 3 days), mild (absence for 4 to 7 days), moderate (absence for 8 to 28 days), and severe (absence for more than 29 days). Each injury was diagnosed by an orthopedic surgeon. All injuries that resulted in absence from at least one scheduled practice session or game were recorded by the teams physiotherapist.

RESULTS: A total of 357 injuries were recorded during 66,490.2 hours of exposure, resulting in an injury incidence of 5.4 per 1000 player hours. The overall match injury rate (9.5 per 1000 player hours) was significantly higher than the training injury rate (4.3 per 1000 player hours). Non-contact injury rates (3.4 per 1000 player hours) were significantly higher than contact injury rates (2.0 per 1000 player hours). Traumatic injury rates (4.2 per 1000 player hours) were significantly higher than overuse injuries (1.2 per 1000 player hours). Most injuries were located in the lower extremities, affecting the ankle (26.6%), knee (21.8%), thigh (21.0%), and lower leg/Achilles (7.6%). The single most common injury subtype was thigh muscle strain, representing 16.2% of all injuries. In terms of injury severity, among injuries that occurred during matches, 38.1% were moderate and 26.2% were severe. On the other hand, of the injuries that occurred during training, 41.8% were moderate and 30.1% were severe.

CONCLUSION: This study highlights the need for injury prevention strategies in Japanese collegiate female football, revealing that match injuries significantly outnumber those during training, with non-contact and traumatic injuries being more prevalent than contact and overuse injuries, respectively. A comprehensive approach focusing on improving physical capabilities, recovery strategies, and player education is essential for effective injury prevention in female collegiate football players.

AN ANALYSIS OF KINEMATIC DIFFERENCE BY LANDING TYPE IN KOEAN YOUNG ATHLETES

PARK, J., KANG, J., PARK, S., YOON, S.

KOREA NATIONAL SPORT UNIVERSITY

INTRODUCTION: Landing is a movement frequently performed in sports situations, and athletes seek to minimize the impact of landing through smooth flexion movements of lower extremity joints [1]. The athletes with low proficiency, however, are exposed to musculoskeletal injuries since their lower extremity joint movements are stiff [2]. The purpose of this study was to provide basic data for preventing injuries in young athletes by confirming the shock absorption mechanism according to the landing type of those with low proficiency.

METHODS: The landing type of 105 youth athletes who are registered as Korean ahtletes association were observed and, for the purpose, 24 of those were classified into heel contact group [HCG] (n=12, height: 168.7 ± 9.7 cm, weight: 60.9 ± 11.6 kg, age: 14.1 ± 0.9 yrs., career: 4.3 ± 2.9 yrs.) and toe contact group [TCG] (n=12, height: 174.8 ± 4.9 cm, weight: 66.9 ± 9.9 kg, age 13.9 ± 0.8 yrs., career: 4.7 ± 2.0 yrs.). Then, they were asked to perform three times drop landing. For the analysis, 19 infrared cameras and two ground reaction devices were set and independent t-test was conducted to check the difference between two groups with the statistical significance level of .05.

RESULTS: In this study HCG showed higher peak force and higher loading rate compared to TCG($p<.05$). Also HCG revealed smaller RoM of ankle and knee joint than those of TCG ($p<.05$). Finally, HCG showed smaller plantar flexion moment compared to TCG($p<.05$).

CONCLUSION: Based on the results, it was considered that, while TCG appropriately distributes the peak force and loading rate shock that occurs during landing through an increase in knee and ankle RoM and the plantar flexion moment of the ankle joint, HCG experienced high peak force and loading rate due to failure to distribute the shock. It was determined, therefore, that heel contact landing in young sports athletes has no advantage in terms of injury prevention through joint absorption and distribution of shock from contact with the ground and that, if this movement continues for a long period of time, this may lead to a decrease in performance due to injury [3]. An education on safer landing methods through appropriate posture control is required for young athletes whose musculoskeletal growth is important.

REFERENCES:

1) Shin, J. M. Journal of Sport and Leisure Studies. 2016.

2) Kovacs et al. Medicine & Science in Sports & Exercise. 1999.

3) Shin & Kim. Journal of the Korean Orthopaedic Association. 2018

Conventional Print Poster Presentations

CP-PN04 Nutrition III

THE EFFECT OF CAFFEINE SUPPLEMENTATION ON MOVEMENT PATTERNS IN RUGBY SEVENS MATCHES IN COLLEGIATE MALE PLAYERS: A CROSSOVER STUDY WITH GLOBAL-POSITIONING SYSTEM

HSUEH, C.L., CHANG, C.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: This study investigated the effect of pre-match caffeine supplementation on the performance in rugby seven matches in collegiate male players.

METHODS: This study adopted a placebo-controlled crossover design. Seven participant engaged in two rugby sevens friendly matches each day on two consecutive days, separated by a 13-day washout period. The participants in the caffeine trial (CA) consumed 3 mg/kg body weight caffeine in a capsule 1 h before each match, while those in the placebo trial (PL) consumed a capsule containing starch. Movement patterns during the matches, including total distance, distance in several speed zones, distances and frequency of acceleration and deceleration, and frequency of collisions and repeated high-intensity effort (RHIE), were recorded using wearable GPS devices. The differences between the two trials in movement patterns in the entire match and first and second halves were analyzed with paired t-test and effect size was calculated using Cohen's d.

RESULTS: The participants in CA exhibited longer total distance in the match 1 (CA: 1485.8 ± 67.9 ; PL: 1346.9 ± 83.8 m, d=0.743), 3 (CA: 1394.7 ± 50.3; PL: 1312.9 ± 46.6 m, d=0.690), and 4 (CA: 1502.5 ± 89.9; PL: 1359.2 ± 67.5 m, d=0.736) with moderate effect sizes. The increased distance came mostly from faster speed zones. The participants in CA had longer distance in high intensity running (18-20 km/h) in match 1 (CA: 90.6 ± 25.1; PL: 54.1 ± 10.6 m, d=0.773) and 4 (CA: 76.5 ± 18.1; PL: 58.7 ± 11.6 m, d=0.479). The participants in CA had longer distance in acceleration in match 1 (CA: 58.03 ± 3.76; PL: 49.89 ± 5.45 m, d=0.710) and 3 (CA: 64.51 ± 5.59; PL: 51.85 ± 9.54 m, d=0.661). Conversely, the participants in PL walked (0-6 km/h) longer distance in match 4 (CA: 585.9 ± 21.8; PL: 629.4 ± 21.3 m, d=0.824) with large effect size. The participants in CA had higher frequency of RHIE in the first half in match 1 (CA: 4.83 ± 0.75; PL: 3.50 ± 0.56, d=0.822) and 3 (CA: 4.67 ± 0.42; PL: 3.33 ± 0.49, d=1.185) and the second half in match 4 (CA: 5.00 ± 0.45; PL: 4.17 ± 0.70, d=0.577). The participants in CA also had higher frequency of collision in the first half in match 1 (CA: 2.50 ± 0.89; PL: 1.00 ± 0.52, d=0.845) and 4 (CA: 2.17 ± 0.48; PL: 1.33 ± 0.62, d=0.618) and the second half in match 4 (CA: 2.67 ± 0.80; PL: 1.17 ± 0.40, d=0.965). Moreover, the participants in CA exhibited higher frequency of deceleration in the first half in match 1 (CA: 9.50 ± 1.20; PL: 7.00 ± 0.73, d=1.025), 2 (CA: 9.00 ± 1.21; PL: 7.33 ± 1.17,d=0.571), 3 (CA: 10.50 ± 1.71; PL: 6.17 ± 1.01, d=1.260), and 4 (CA: 9.67 ± 1.17; PL: 8.17 ± 1.14, d=0.530).

CONCLUSION: The results of this study suggested that caffeine supplementation before rugby sevens matches may improve overall and high intensity running distance and increase the frequency RHIE, collision, and deceleration in male collegiate players.

SIMILAR ERGOGENIC RESPONSE TO ACUTE CAFFEINE INTAKE IN MUSCULAR STRENGTH, POWER AND ENDURANCE BETWEEN RESISTANCE-TRAINED MALES AND FEMALES

MONTALVO ALONSO, J.J., DEL VAL MANZANO, M., FERRAGUT, C., VALADÉS, D., PÉREZ-LÓPEZ, A.
UNIVERSIDAD DE ALCALÁ

INTRODUCTION: The ergogenic effect of caffeine on sports performance has been analyzed in numerous studies, becoming one of the sports supplements with the greatest proven benefits. Scientific evidence shows that acute caffeine intake improves muscle strength, power and endurance in upper and lower body exercises. However, in these studies, female participants are underrepresented, and consequently, we have limited evidence about the effect of caffeine on women. Moreover, the sex differences in the ergogenic effect of caffeine on muscular strength, power, and endurance performance have been scarcely explored.

METHODS: Seventy-six resistance-trained participants (male/female: 38/38; age: 23±3 years; resistance training experience: 2.7±2.0 years; 1RM/kg bench press: >1.0; 1RM/kg back squat: <1.2) participated in a double-blind, placebo-controlled, cross-over and randomized study. Participants were provided with either 3 mg/kg of body mass of caffeine or a placebo, and sixty minutes after the ingestion, they performed muscular strength and power assessment for the bench press and back squat exercises at 25%, 50%, 75%, and 90% 1-repetition-maximum (1RM), performing 3, 2, 1 and 1 repetitions, respectively. Muscular endurance was then assessed for both exercises at 65% 1RM, performing one set until task failure for each exercise.

RESULTS: Compared to placebo, caffeine improved mean and peak velocity and power output (ANOVA effect, P<0.001), but no supplement by sex effect was found for any of these variables. Nonetheless, supplement by exercise type effect in Vmean (P=0.049). Caffeine increased Vmean in the back squat exercise in males and females at 50%1RM (males and females, 4.5% and 4.6%, P=0.001), 75%1RM (5.2% and 5.7%, P=0.001) and 90%1RM (7.9% and 7.8%, P<0.030). Similarly, in Wmean, supplement by exercise type by load was found (P = 0.045), caffeine increased in the back squat exercise in males and females at 50%1RM (5.3% and 4.6%, P < 0.040), 75%1RM (5.7% and 5.5%, P<0.001) and 90%1RM (8.5% and 6.5%, P<0.028) compared to placebo. In muscular endurance, a supplement effect was detected in the number of repeti-

tions (reps), Vmean, Wmean and Wpeak (ANOVA, P < 0.001). However, no supplement by sex effect was found for any of these variables.

CONCLUSION: Low doses of caffeine (3 mg/kg) cause a similar ergogenic effect on muscular strength, power and endurance performance in upper- and lower-body exercises between male and female resistance-trained participants. Moreover, caffeines effect was more pronounced at moderate-high loads (>50%1RM) and according to muscle size groups (back squat vs. bench press) but irrespective to sex, which indirectly reinforced the idea of the central mechanism of action of caffeine.

EFFECTS OF INDIVIDUAL AND COMBINED CAFFEINE AND NITRATE SUPPLEMENTATION ON ANAEROBIC EXERCISE CAPACITY IN HIGHLY TRAINED JUDO ATHLETES – PRELIMINARY RESULTS

KASZUBA, M.1,2, GREN, A.2, HELBIN, J.2, SKOTNICZNY, K.2, KOSTRZEWA, M.1, GAWELCZYK, M.1,2, FILIP-STACHNIK, A.1,2

1INSTITUTE OF SPORT SCIENCES, THE JERZY KUKUCZKA ACADEMY OF PHYSICAL EDUCATION IN KATOWICE, KATOWICE, POLAND 2NUTRITION AND SPORTS PERFORMANCE RESEARCH GROUP, THE JERZY KUKUCZKA ACADEMY OF PHYSICAL ED

INTRODUCTION: There is a strong evidence base for the effectiveness of caffeine and nitrate supplementation on sports performance. Although performance-enhancing benefits have been observed with both caffeine and nitrates used separately, it is unclear whether their combined use has an additive effect. Therefore, the aim of this study was to investigate the effect of individual and combined caffeine and nitrate intake on the anaerobic performance of highly trained judo athletes in both upper and lower body, replicating the combat conditions of the athletes.

METHODS: Twenty-five highly trained judo athletes (age: 20 ± 2 years, body mass: 75.9 ± 8.9 kg) habituated to caffeine (2.2 mg/kg/day) participated in a randomized, double-blind, placebo-controlled, parallel-group experiment. Each participant was randomly assigned to one of the following groups: (a) a caffeine placebo (PLAC-CAF) + a beetroot juice placebo (PLAC-BJ) [n=6]; or (b) 6 mg/kg body mass (BM) of caffeine (CAF) + PLAC-BJ [n=4]; or (c) beetroot juice (BJ) + PLAC-CAF [n=7]; or (d) CAF + BJ [n=8]. In each condition athletes ingested 2 x 70 ml of concentrated beetroot juice containing either 400 mg of nitrate or no nitrate for 2 days and 2 × 70 ml 2.5 h prior to each test session. Caffeine or placebo tablets were administered 45 min before the test session. Each session consisted of four 30-s Wingate tests performed with a constant load equivalent to 4.5% and 7.5% of BM for the upper and lower body, respectively. The subjects first performed the upper body test and then, after 1 minute of passive rest, started the lower body test. This protocol was repeated after 3 minutes of passive rest.

RESULTS: The two-way repeated measures ANOVA (4 substance 2 Wingate tests) did not show any significant interactions for Relative Peak Power Output (for upper body Wingate test (UBW): p=0.342 and lower body Wingate test (LBW): p=0.143), Fatigue Slope (for UBW: p=0.723 and LBW: p=0.188), Total Work (for UBW: p=0.131 and LBW: p=0.131), nor main effects of group on Relative Peak Power Output (for UBW: p=0.445 and LBW: p=0.532), Fatigue Slope (for UBW: p=0.366 and LBW: p=0.604) and Total Work (for UBW: p=0.131 and LBW: p=0.69). However, it showed significant main effects of the time on Relative Peak Power Output (for UBW: p<0.001 and LBW: p<0.001), Fatigue Slope (for UBW: p<0.001 and LBW: p<0.001) and Total Work (for UBW: p=0.022 and LBW: p<0.001).

CONCLUSION: The present study suggests that neither single nor combined dose of 6 mg/kg BM of caffeine, along with chronic nitrate supplementation, is effective in improving anaerobic performance, as assessed by a repeated 30-s Wingate test for both the upper and lower body in highly trained judo athletes habituated to caffeine.

DOSE-INDEPENDENT ERGOGENIC EFFECT OF CAFFEINE SUPPLEMENTATION ON JUMP PERFORMANCE IN ATHLETES: A SYSTEMATIC REVIEW AND META-ANALYSIS

MATSUMURA, T., TOMOO, K.1,2, TERADA, M.1, HASHIMOTO, T.1

1> RITSUMEIKAN UNIVERSITY, 2> PURDUE UNIVERSITY

INTRODUCTION: Caffeine at doses ranging from 3 to 6 mg/kg (i.e., ~moderate doses) has been shown to acutely enhance jump performance (1,2) that is an important component of many sports. Conversely, there is growing interest in the impact of low doses of caffeine (i.e., ≤3 mg/kg) as not only an effective but also a safe and feasible ergogenic strategy (3,4), considering the widespread use of caffeine in competitive sports. However, the potential concern of "whether caffeine exhibits dose-dependent ergogenic effects" arises when considering the use of lower doses of caffeine. Our recent work demonstrated that within the range of 1–6 mg/kg, a very low dose (1 mg/kg) of caffeine increased countermovement jump (CMJ) height in a dose-independent manner, although its effect on squat jump (SJ) height was not significant (4). Despite this, the effect size was nearly equivalent to previous meta-analyses (1,2). This study aimed to examine the acute effect of caffeine on jump performance in athletes and its dose-response relationship, with the intention of exploring the potential use of lower caffeine doses.

METHODS: A literature search was conducted on PubMed, the Cochrane Library, and Web of Science to identify studies that investigated the acute effect of caffeine on single vertical jump performance in athletic populations. Studies with level 2 evidence or higher were included if vertical jump height were assessed in caffeine and placebo conditions with CMJ, CMJ with arm swing (CMJA), as well as SJ. Data pertaining to study methodology and vertical jump height were systematically extracted. Separate random effects meta-analyses were performed for vertical jump height. Meta-regression was employed to examine the relationships between caffeine dose and vertical jump height.

RESULTS: Twenty-four studies were included. Meta-analysis showed that caffeine doses ranging from 1 to 6 mg/kg caffeine exhibited significantly higher pooled jump height in CMJ (P < 0.001, g = 0.31 [95%CI: 0.16 to 0.46]) and SJ (P = 0.005,

g = 0.22 [95%CI: 0.08 to 0.36]) compared to the placebo. However, no significant difference was observed in CMJA (P = 0.101, g = 0.13 [95%CI: -0.03 to 0.29]). Meta-regression revealed no significant linear relationships between caffeine dose and the ergogenic effect of caffeine on jump height in any testing forms of jump performance (CMJ: P = 0.440, CMJA: P = 0.642, SJ: P = 0.793).

CONCLUSION: Caffeine has an ergogenic effect on jump performance in athletes, but this effect does not exhibit a dose-response relationship within the range of very low to moderate doses. These findings indicate the applicability of even lower doses (i.e., 1–3 mg/kg) of caffeine as an ergogenic aid for jump performance. Increasing the acute dose of caffeine may not guarantee a proportional increase in ergogenic effects on jump performance.

REFERENCES:

1. Grgic et al. J Int Soc Sports Nutr. 2018

2. Salinero et al. Res Sports Med. 2019

3. Grgic. Nutr Food Sci. 2023

4. Matsumura et al. Int J Sport Nutr Exerc Metab. 2023

PERCEIVED SIDE EFFECTS DERIVED FROM THE INDUCED BELIEF OF CAFFEINE INGESTION.

GONZÁLEZ-MOHÍNO, F., VALERO, F., LARA, B., GALLO-SALAZAR, C., ARECES, F., SALINERO, J.J.

UNIVERSITY OF CASTILLA-LA MANCHA

INTRODUCTION: According to previous research, believing ingested caffeine can improve sports performance to a similar extent to receiving caffeine (1, 2), so, the use of placebos can be an alternative to the use of caffeine. The perceived ergogenicity of caffeine (3, 4) could lead to these positive effects. However, the expectancy induced by caffeine can propitiate suffering the typical caffeine side effects too. Previous research found that caffeine ingestion increased diverse side effects, such as insomnia, activeness, and nervousness (3, 4). This study aimed to analyse the prevalence of perceived side effects after the ingestion of a placebo informed as caffeine.

METHODS: Thirty-five individuals (28 men, 7 women; 28±11 years, 71±8 kg, 176±7 cm) volunteered to participate. Participants were provided with informed consent forms before participating in the investigation in which they were informed of the experimental procedures and risks. The study was approved by the local Research Ethics Committee and was performed under the latest version of the Declaration of Helsinki. On the day of testing, participants ingested a placebo informed as caffeine and completed a specific sports session. The morning after, participants were provided with a side-effects survey to determine if they had perceived any caffeine-associated side effects the hours after ingestion. This survey included questions about participants' activeness, nervousness, gastrointestinal problems, irritability, diuresis, headache, and insomnia using a yes/no scale. This methodology has been previously used to assess the prevalence of side effects after the intake of caffeine in the sports context (4).

RESULTS: The ingestion of a placebo informed as caffeine resulted in almost 4 out of 10 participants (37.1%) perceiving greater activeness. In addition, 17.1% reported nervousness, 14.3% increased diuresis, 11.4% headache, 5.7% gastrointestinal discomfort, and 5.7% insomnia. No one reported being irritable.

CONCLUSION: The placebo effect can improve sports performance, but the use of a placebo reported as caffeine can produce adverse side effects in some individuals. Coaches/nutritionists employing placebos may wish to consider other options (i.e. other fictive substances) with known ergogenic effects but without adverse side effects.

EFFECT OF CAFFEINE ON EXERCISE BEHAVIOUR AFTER SUSTAINED COGNITIVE ACTIVITY

WEIPPERT, M., BEHRENS, M., GUBE, M., MORITZ, J., STRÜBEN, M., MAU-MÖLLER, A., BRUHN, S.

UNIVERSITY OF ROSTOCK

INTRODUCTION: Sustained cognitive activities (SCA) can lead to perceived fatigue and impair subsequent exercise motivation and endurance performance. Elite athletes as well as habitual exercisers regularly consume caffeinated beverages before exercise to boost mood, motivation and performance during states of perceived fatigue. However, it is not clear whether the potential positive outcomes are caused by positive "side-effects" (conditioned or expected increase in affect, mood motivation etc.) or the pharmacological effect of caffeine itself. Also, the performance enhancing effects seem to be larger in trained athletes. Here, we tested, whether caffeine has an effect on exercise behaviour (i. e., running/ walking distance during 30 min of self-paced exercise) after SCA in a placebo-controlled randomized cross-over trial in untrained subjects.

METHODS: Therefore, 20 untrained male and female participants (10/10) completed two 60 min Stroop-tests (SCA) after reading the current physical activity guidelines of the American College of Sports Medicine in a weekly interval. After 30 min of SCA they ingested a pill with either 6 mg/kg bodyweight caffeine or a placebo (maize flour) and proceeded for another 30 min. Following the SCA, the participants completed a treadmill run or walk at self-selected speed. Covered distance was compared between conditions, while controlling for habitual caffeine consumption (HCC) as well as for a potential placebo effect (i. e., participant´s expectation of the content of the ingested pill, PE) using an analysis of covariance (ANCOVA, IBM SPSS Statistics 29.0).

RESULTS: The ANCOVA revealed significant and large interaction effects of condition × HCC ($F(1,17) = 9.330$, $p = 0.007$, $\eta p^2 = 0.354$) and condition × PE ($F(1,17) = 6.698$, $p = 0.019$, $\eta p^2 = 0.282$). Only after controlling for these covariates, condition

had a significant and large effect on covered distance ($F(1,17) = 6.089$, $p = 0.025$, $\eta p^2 = 0.264$), with higher values in the caffeine condition.

CONCLUSION: HCC and the individual expectation may bias potential effects of caffeine on endurance performance after SCA. Both aspects have to be considered when evaluating a potential performance enhancing effect of caffeine after SCA, also in placebo-controlled experiments. Incorporating experimental designs that consider placebo-/nocebo-effects may better elucidate the performance enhancing effects of caffeine and potential mechanisms affecting exercise behaviour after SCA (Beedie et al. 2020).

TITLE: THE ROLE OF ASTAXANTHIN ON EXERCISE PERFORMANCE AND MUSCLE RECOVERY: THE AXTION STUDY (CONCEPTUAL DESIGN)

CULLINANE, G., GREEN-GOMEZ, M., PRADO-CABRERO, A., COLLINS, K., NOLAN, J.
SOUTH EAST TECHNOLOGICAL UNIVERSITY

INTRODUCTION: During periods of sustained intensive exercise training and competition, protein, lipid, and nucleic molecules in exercising athletes can be damaged by an overproduction of reactive oxygen and nitrogen species (RONS). RONS produced during exercise are known to be fundamental stressors which can promote improvements in overall health and athletic performance, however, in instances of sustained vigorous exercise an excessive overproduction of RONS can overwhelm the bodies antioxidant defence system, leading to a state of oxidative stress. Dietary carotenoids delay and prevent oxidative damage caused to body cells and organelles by quenching and preventing the formation of RONS. Current data on supplemented astaxanthin (AX) in relation to exercise performance and muscle recovery in human athlete populations is inconclusive. The aim of this project is to examine the effects of AX on exercise performance and muscle recovery in Irish hurling athletes.

METHODS: The development of a standardised methodology for measuring and reporting AX in carotenoid formulations and human samples using high-performance liquid chromatography (HPLC) is currently in progress. Furthermore, a systematic review of literature examining the influence of AX supplementation on health, exercise performance, and muscle recovery is presently ongoing. The body of work collated during these initial two steps will be used to provide evidence and guidance for the development of an AX randomised interventional placebo-controlled trial in Irish hurling athletes.

RESULTS: The establishment of an analytical methodology for quantifying AX in carotenoid formulations and human samples using HPLC has been established. A significant body of evidence supporting the hypothesis relating to the role of AX supplementation on markers of health, exercise performance, and muscle recovery in human populations has been collected. A randomised placebo-controlled intervention trial among Irish hurling players evaluating the role of AX supplementation in exercise performance and recovery will be completed.

CONCLUSION: It is perceived that this study will provide a novel and significant impact within the Gaelic sports community via the development of an evidence-based carotenoid complex which may improve exercise performance and muscle recovery. Due to the currently existing heterogeneous data surrounding AX supplementation in human populations, further research to support the development of a safe and reliable AX dietary intervention is warranted.

GENDER DIFFERENCES IN APPETITE AND FOOD PREFERENCE FOLLOWING ACUTE RESISTANCE EXERCISE.

HSIEH, C.H., CHENG, H., YU, P., KUO, Y., CHIANG, Y., LIU, H.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The impact of resistance exercise (RE) on appetite and food preference has been extensively investigated, yet studies addressing gender differences in this area remains relatively sparse. This study aimed to examine gender differences in subjective appetite and food preference subsequent to RE.

METHODS: Eighteen healthy male participants (age = 22.9 ± 1.9 years, body mass = 22.8 ± 2.0 kg/m2) and eleven healthy female participants (age = 22.6 ± 1.3 years, body mass = 22.8 ± 2.1 kg/m2) were recruited in this study. Participants completed a RE trial (3 sets with 70% 1RM) and a control trial (no exercise) in a randomized crossover design. Subjective appetite ratings (hunger, fullness, satisfaction, prospective food consumption, and nausea) were evaluated before exercise and 90 minutes after exercise (post 0, post 30, post 60, post 90). Leeds Food Preference Questionnaire was measured at post 30 and 90 and after ad libitum meal (about 120 minutes after exercise).

RESULTS: Subjective prospective food consumption and overall appetite at post 0 were significantly lower than before exercise ($p < .05$), but no differences were found between males and females ($p > .05$). For food preference, explicit liking of low-fat sweet food (LFSW) and explicit wanting of high-fat sweet food (HFSW) at post 30 were significantly higher in males than in females ($p < .05$). Females showed a significantly higher preference of explicit liking and wanting of LFSW at post 120 than males. There were no significant differences in explicit wanting and implicit wanting for fat and taste bias ($p > .05$).

CONCLUSION: No gender differences were found in terms of RE-induced appetite suppression. Changes in food preferences were found between males and females after RE and meal.

EFFECT OF PLAIN SUGAR AND POLYPHENOL CONSUMPTION ON THE REGENERATION OF THE INTESTINAL BARRIER IN AFTER MODERATE ENDURANCE EXERCISE AND IN ULTRA-MARATHON RUNNERS.

DIEL, P., VALDER, S., STALTNER, S., KÖPSEL, T., ESATBEYOGLY, T., KOSTOV, T., BERGHEIM, I.
DEUTSCHE SPORTHOCHSCHULE KÖLN

INTRODUCTION: Exercise and the consumption of sugars have been demonstrated to result in a dysfunction of the intestinal barrier (IB). The purpose of this study was to determine the effect of polyphenols and plain sugars on the regeneration of the intestinal barrier after moderate (Study A) and highly intensive endurance exercise (Study B)

METHODS: In all participants the function of the intestinal barrier (IB) was determined before running (pre) and directly after finishing (post) by measuring serum endotoxin concentrations (LPS) as marker of intestinal barrier function. Immediately after finishing the runners consumed either 500 ml of water, diluted apple juice (test drink) containing 550 mg/l polyphenols and 57,5g/l sugar (glucose, fructose and sucrose) or a drink only containing an identical sugar mix (57,5g/l sugar) but no polyphenols (placebo). Over a period of 180 min blood samples were taken and LPS was determined.

RESULTS: In Study A: 1 h exercise at 80% IAT resulted in all participants in a moderate but significant increase of serum endotoxin. After exercise serum endotoxin levels decreased in all groups with a comparable rate. No positive but also no negative impact of the different drinks could be observed. In Study B in the 20 participants there was a strong increased of serum LPS ($p<0.05$) between pre (5 UE/ml) and post (12 UE/ml) ultramarathon. In the water group serum LPS decreased about 90 % in the first 120 min after finishing. The LPS area under the curve (AUC) in the first 180 min after exercise in the placebo group (15.000 UE) was significantly higher ($p<0.05$) than the AUC in the water (7.000UE) and the test drink group (10.000 UE).

CONCLUSION: Even a moderate endurance exercise is resulting in a moderate but significant increase of serum LPs, indicating a leakiness of the IB. The IB is regenerating fast after moderate exercise. The consumed drinks did not affect the kinetics regenerating. An ultramarathon resulted in a very strong increase of serum LPS indicating an IB dysfunction. Also here IB function regenerates very fast after the consumption of water whereas the intake of plain sugar (placebo) seems to have a negative impact on the IB regeneration which was diminished by the presence of polyphenols in the drink (test drink). Because uptake of sugars is necessary for recovery after intensive exercise, the results of this study provide evidence that the negative impact of plain sugars on the IB may be compensated by polyphenols

FUNCTIONAL NEUROMUSCULAR PERFORMANCE IN YOUNG ATHLETES RECOVERING FROM RELATIVE ENERGY DEFICIENCY IN SPORT SYNDROME: PRELIMINARY DATA: PRELIMINARY DATA

STENNETT, R., PLATEAU, C.R., NAHMAN, C., BLAGROVE, R.C.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: The Relative Energy Deficiency in Sport (REDs) syndrome is a serious medical condition associated with a myriad of impairments to physiological systems and performance [1], including neuromuscular function [2]. For young athletes who are returning to sport following severe REDs, impairments in strength may be detrimental to performance and increase the likelihood of injury. No previous studies have compared the differences in sport-relevant measures of neuromuscular performance between athletes recovering from REDs and healthy controls, thus this study aimed to address this dearth in literature.

METHODS: Using a cross-sectional design, this study compared a group of participants (age 14-25 years) medically diagnosed with severe REDs recently (<3 months) cleared to resume exercise, and a group of age-, sex-, and sport-matched controls. Following a familiarisation visit 3-10 days prior, participants performed a standardised warm up before completing the following tests on fixed dual force plates sampling at 2000Hz; counter-movement jump (CMJ), 0.3m drop rebound jump (DJ) and an isometric mid-thigh-pull (IMTP). Participants were permitted three attempts at each test interspersed with a 60 sec recovery. Data were analysed to quantify CMJ height, DJ reactive strength index, and IMTP maximal force. Independent samples T-tests were used for between-group comparisons and effect size was quantified using Cohens d. Statistical significance was set at $p<0.05$.

RESULTS: To date, data has been collected on fourteen participants (8 REDs and 6 controls; 7 and 5 females respectively). Height, body mass, body mass index and age were all similar between groups ($p>0.05$). CMJ height was found to be greater in the control group (0.29 ± 0.03m) compared to the REDs group (0.25 ± 0.03m; $p=0.034$, $d=0.55$). DJ rebound height was also greater in the control group (0.27 ± 0.03m) compared to the REDs group (0.22 ± 0.05m; $p=0.029$, $d=0.62$). All other measures (DJ reactive strength index, DJ ground contact time and IMTP maximal force) were not different between groups.

CONCLUSION: Preliminary data indicates that young athletes recovering from severe REDs have significant deficits in jump performance metrics compared to healthy counterparts. Thus, REDs appears to have a negative impact on reactive and explosive strength producing capabilities that may impair performance and leave an athlete vulnerable to injury upon their return to sport.

REFERENCES:

1. Mountjoy, M., Ackerman, K., Bailey, D., Burke, L., Constantini, N., Hackney, A., Heikura, I., Melin, A., Pensgaard, A., & Stellingwerff, T. (2023). 2023 International Olympic Committee's (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs). British Journal of Sports Medicine, 57(17).

2. Tornberg, Å. B., Melin, A., Koivula, F. M., Johansson, A., Skouby, S., Faber, J., & Sjödin, A. (2017). Reduced neuromuscular performance in amenorrheic elite endurance athletes. Medicine & Science in Sports & Exercise, 49(12), 2478–2485.

Conventional Print Poster Presentations

CP-MH17 Sports Medicine III

CONTRIBUTIONS OF LOWER LIMB SYMMETRY AND STIFFNESS IN ACL RECONSTRUCTION ATHLETES DURING SINGLE-LEG DROP JUMPS

HSIAO, H.W., TZENG, Y.T., CHU, N., CHEN, Y.J., LEE, H.J.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Athletes are found to have altered landing mechanics in the reconstructed leg after anterior cruciate ligament reconstruction (ACLR) and returning to sports, potentially increasing injury risk due to lower limb asymmetry. Stiffness plays a crucial role during jump-landing performances and injuries. This study investigated whether ACLR affects vertical and joint stiffness, and lower extremity joint contributions during single-leg drop jumps (SLDJ), compared to healthy controls. Additionally, limb asymmetries in ACLR athletes were analyzed by comparing reconstructed and non-reconstructed sides. The results will elucidate the effects of ACLR on stiffness, limb symmetry, and injury risk during sports-related movements.

METHODS: This study included 10 ACLR athletes and 11 healthy athletes and performed three SLDJ per leg from a 30 cm platform. Lower extremity kinematic and kinetic data were collected using a 10-camera Vicon motion capture system synchronized with one Kistler force plate. The first ground contact and jump phase of each SLDJ were analyzed. Joint angles, moments, and stiffness were calculated using Visual 3D. The dominant leg was identified as the preferred kick leg. Independent t-tests compared SLDJ performance and symmetry indices between ACLR and healthy groups. Paired t-tests compared biomechanical variables between reconstructed and non-reconstructed legs within the ACLR group.

RESULTS: The limb symmetry index of hip joint stiffness was significantly lower in the ACLR group compared to the healthy group (88 vs 112). The ACLR group also showed significant asymmetry in knee range of motion, peak knee moment, and peak knee power during landing. No differences were found between legs in the ACLR group for vertical stiffness or joint stiffness. However, the reconstructed leg had a significantly lower knee flexion range of motion and knee extension moment than the non-reconstructed leg. Besides, the reconstructed leg had lower peak knee extension power during landing and propulsion. Regarding performance, the reconstructed leg in the ACLR group showed significantly lower jump height and reactive strength index compared to the non-reconstructed leg and the healthy group.

CONCLUSION: Despite returning to play post-rehabilitation, ACLR athletes showed no side-to-side differences in stiffness index, suggesting stiffness may not reliably indicate ACL reconstruction function. However, knee joint contribution was asymmetric, although ACLR joint stiffness and limb symmetry resembled healthy controls during landing. Reduced knee power generation likely impaired landing and propulsion, influencing SLDJ movement and jump performance. In ACLR athletes, knee angle and moment differences between both legs indicate potentially higher injury risk and burden on the reconstructed side. Our results demonstrate persistent knee joint asymmetries in ACLR athletes after rehabilitation, highlighting the need to monitor knee biomechanics to mitigate injury risk when returning to sports.

BALANCE IMPROVEMENT FOLLOWING TRUNK MUSCLE TRAINING IN PEOPLE WITH CHRONIC LOW BACK PAIN

SUTANTO, D., HO, C.Y., YANG, Y.Y., SO, B., KWOK, M.Y., WONG, S.H.S.
THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: People with Chronic Low Back Pain (CLBP) experience decrease in balance and lower limb mobility that could be measured by postural sway and leg reach during Y-Balance Test (YBT) with limited data if these measures would improve upon recovery. Isometric trunk training in the form of Isolated Trunk Exercise (ITE) and Structural Exercise (SE) can reduce disability in people with CLBP. This study investigated the effect of different trunk muscle training on changes in postural sway and reach during YBT in people with CLBP.

METHODS: 33 male participants are randomly allocated to either control, SE or ITE training and did YBT on a force plate pre and post intervention with second round randomization on those in control group. Both training interventions includes once per week in person training and two times per week at home training with regular adjustment on participant's training intensity based on their pain free capacity and exercise rate of perceived exertion.

RESULTS: There were within subjects time effect in postero-medial direction ($p = 0.005$, $\eta p2 = 0.622$) and postero-lateral direction ($p = 0.001$, $\eta p2 = 0.684$). Within subjects' time*group effect only significant for postero-medial direction. Univariate test showed time interaction on normalized reach in all direction and time*group interaction on normalized reach, MVEL and nMVEL in postero-medial direction. Estimated marginal means group allocation * time pairwise comparison resulted in ITE group increasing their normalized reach in posterior related direction while those in SE group increased their normalized reach and nMVEL in posterior related directions.

CONCLUSION: Both training group significantly increases their lower limb reach in posterior related direction while only the SE group experience reduction in postural sway. This showed that both postural sway and lower limb reach can be im-

proved with training and postural sway requires more specific training stimuli. Practitioners should consider the performance deficit experienced by specific person with CLBP during YBT and develop a training program to address that particular deficit.

THE DETERMINISTIC CONDITION FOR THE GROUND REACTION FORCE ACTING POINT ON THE COMBINED KNEE VALGUS AND TIBIAL INTERNAL ROTATION MOMENTS IN EARLY PHASE OF CUTTING MANEUVERS

OGASAWARA, I., OHTA, K., REVANKAR, G., KONDA, S., NAKATA, K.

OSAKA UNIVERSITY

INTRODUCTION: Anterior cruciate ligament (ACL) injury frequently occurs during the early deceleration phase of landing or cutting with the rapid increase of ground reaction force (GRF). The combined knee valgus and tibial internal rotation (VL+IR) moments was shown to stress ACL and regarded as a mechanism of non-contact ACL injury. To utilize this knowledge for non-contact ACL injury prevention in sports, it is required to elucidate how the GRF acting point (center of pressure: CoP) at the stance foot produces combined knee VL+IR moment in risky maneuvers, such as cuttings. However, the effects of GRF acting point at foot on the development of the combined knee VL+IR moment in cutting are still unknown.

METHODS: In this study, we first introduced the deterministic mechanical condition that the CoP position relative to the tibial rotation axis differentiates the GRF vector directional probability for the combined knee VL+IR moment development. Then, we tested a stochastic aspect of our theory in that when the CoP is posterior to the tibial rotation axis, the GRF vector is more likely to produce the combined knee VL+IR moment than when the CoP is anterior to the tibial rotation axis in lab-controlled in-vivo experiment. Fourteen females performed 60° cutting under forefoot/rearfoot strike conditions (10 trials each). The positions of lower limb markers and GRF data were measured, and the knee moment due to the GRF vector was calculated. The trials were divided into anterior- and posterior-CoP groups depending on the CoP position relative to the tibial rotation axis at each 10 ms interval from 0 to 100 ms after foot strike, and the occurrence rate of the combined knee VL+IR moment was compared between trial groups.

RESULTS: As a result of theoretical consideration, the deterministic condition suggested that when the CoP is posterior to the tibial rotation axis (e.g., GRF acted at the heel side), the spatial probability of the combined knee VL+IR moment was maximized. In addition, we theoretically expected that the posterior-CoP group showed significantly higher occurrence rates of combined knee VL+IR moment (maximum of 82.8%) at every time point than those of the anterior-CoP trials.

CONCLUSION: This study first identified deterministic condition for GRF acting point that could generate risky knee biomechanics. This theoretical finding universally explains the injury mechanism of non-contact ACL injury in several sorts of sports. The results experimentally supported the validity of the deterministic mechanical condition. They may suggest the foot strikes inducing the posterior CoP should be avoided to reduce the risk of combined VL+IR knee stress.

EXPLORING THE DIFFERENCES IN LUMBOPELVIC MOTOR CONTROL TESTS BETWEEN COLLEGIATE ATHLETES WITH AND WITHOUT A HISTORY OF LOW BACK PAIN

WANG, C.Y., WANG, T.

NATIONAL YANG MING CHIAO TUNG UNIVERSITY

INTRODUCTION: Low back pain (LBP) is recognized as a significant health issue worldwide, particularly among athletes. A history of LBP is considered the most consistent risk factor, possibly attributed to changes in motor control. The previous study has identified altered lumbopelvic control in athletes with a history of LBP through movement testing. However, the abilities of lumbopelvic control in collegiate athletes remain unknown, and there is no existing research exploring the outcome differences in high and low-threshold tests. The study aims to examine lumbopelvic control in collegiate athletes and assess potential differences between those with and without LBP experiences through a series of motor control tests.

METHODS: This was a case-control study performing a series of motor control tests on twenty participants with and without a history of LBP. The assessments encompass single-joint tests and multi-joint control tests in high and low thresholds. Each test is taught and practiced 3-8 times, with recordings from frontal and lateral views utilizing cameras for subsequent analysis of the tests. Blinded to participants LBP history, a physiotherapist scored the subject's performance on each test. The significance differences between the groups were calculated with the Mann-Whitney U test and the p-value was set at 0.05.

RESULTS: Subjects with a history of LBP exhibited poorer lumbopelvic control compared to the control group. The significant differences between groups with and without a history of LBP were particularly marked for the bent knee fall out (p=0.017), double knee swing (p=0.036), single leg 1/4 squat + hip turn (p=0.005), short Lunge + front knee swing, lean & rear leg lift (p=0.004), pelvic bridge + arms overhead + heel Lift + 1 leg extension & lower (p=0.036), and lateral stair hop + rotational landing control (p=0.047). The remaining tests, including single-joint and multi-joint high-threshold tests, didn't show significant differences between groups.

CONCLUSION: This study indicates that the multi-joint low-threshold lumbopelvic control tests are more effective in discriminating between collegiate athletes with and without a history of LBP. Our results provide an aspect of screening on the potential risk of LBP. In the future, clinical practitioners can refer to research findings to tailor training programs targeting weaknesses in collegiate athletes, and even predict the occurrence of LBP to achieve prevention goals.

EPIDEMIOLOGY OF INJURIES AMONG JAPANESE MALE UNIVERSITY FOOTBALL PLAYERS

HIRAMATSU, Y., MASHIMO, S., HOGAN, T., OTA, A.
OSAKA ELECTRO-COMMUNICATION UNIVERSITY

INTRODUCTION: Injury surveillance using a common method is necessary for sports injury prevention. The Fédération Internationale de Football Association (FIFA) has established common methods for injury surveillance [1], and many injury surveillance programs have been conducted [2,3]. In Japan, adequate injury surveillance targeting male university football players has not been performed and the actual injury situation remains unclear. Hence, this study was aimed at investigating the injury profile of male university football players by using a common method [1].

METHODS: This descriptive epidemiological study included 208 players from one university men's football team of the Student's Soccer Federation of Kansai from 2019 to 2023. The study followed the consensus on definitions and data collection procedures in studies of football injuries outlined by FIFA [1]. The assessment categories were exposure time, number of injuries, injury incidence, location, type, mechanism, and burden. Injury incidence was calculated by dividing the number of injuries by exposure duration in hours × 1000 (1000 player hours: 1000 PH). Injury burden was calculated as the product of injury incidence and mean injury severity. Injury incidence and burden were checked for overlap at 95% confidence intervals (95% CIs) to determine significant differences [4]. Ethical considerations included verbal explanations to the participants that participation was voluntary and that there would be no disadvantages related to refusal and protection of personal information. Consent for study participation was obtained.

RESULTS: The total exposure duration, in hours, during the 5-year study period was 46835.9 hours for training and 6863.0 hours for matches, resulting in a total of 53698.9 hours. The total number of injuries was 204, with an incidence of 3.80/1000 PH (95% CI: 3.28-4.32); 130 (63.7%) and 74 (36.3%) injuries occurred during training and matches, respectively. Injury incidence was significantly higher during matches (10.78/1000 PH; 95% CI: 8.33-13.24) than during training (2.78/1000 PH; 95% CI: 2.30-3.25). The most common injury locations were the thigh (n = 51, 25.0%), ankle (n = 49, 24.0%), and knee (n = 32, 15.7%), and the injury types were muscle injury (n = 62, 30.39%), ligament injury (n = 58, 28.4%), and contusion (n = 27, 13.24%). Regarding the injury mechanism, 80 (39.2%) and 124 (60.8%) were contact and non-contact injuries, respectively. The injury location and type associated with a high burden were the knee (46.59/1000PH) and ligament injury (59.11/1000PH), respectively.

CONCLUSION: The results of this study showed that over 60% of injuries occurred during matches and were caused by non-contact situations. Furthermore, the knee and ligament injury were associated with the greatest burdens; therefore, prevention of these injuries is important.

1. Fuller CW et al. (2006), 2. Hägglund M et al. (2009) 3. Eirale C et al. (2012) 4. Knowles SB et al. (2006)

SYNCHRONOUS VIRTUAL MOTIVATIONAL INTERVIEWING AND MENTOR TRAINING FOR PHYSICAL MEDICINE AND REHABILITATION CLINICAL EDUCATORS

SCALES, R., PETERS, C., BUCKNER-PETTY, S.A., AYOUB, J., IVY, C.C.
MAYO CLINIC

Background: Motivational interviewing (MI) has gained empirical support as a method of communication to effectively counsel patients that are not ready to follow a healthful treatment plan, including rehabilitation after injury. Physical Medicine & Rehabilitation (PM&R) clinical educators are not typically trained to model effective communication with MI and code/mentor students during clinical rotations. Purpose: This investigation evaluated the effect of a brief synchronous virtual interactive workshop in MI and mentor training on self-perceived MI proficiency in PM&R academic faculty and clinical/field educators. Methods: A member of the MI Network of Trainers conducted the training with Qualtrics data collection and technical support from a research assistant. Zoom video sharing technology was used to deliver a 2-hour synchronous virtual workshop. Confidential pre-post surveys (0-10 Likert scale) evaluated self-perceived MI proficiency. Subjects received a brief didactic group presentation on MI content with two pre-recorded MI video demonstrations, trainer guided questions and discussion plus two 20-minute Zoom breakout group real/role playing exercises conducted in triads (speaker, listener, coder/mentor) to practice and mentor others in MI with the option of brief supervision from the MI trainer. Pre to post differences in survey responses were assessed with the Wilcoxon signed rank test. All analyses were conducted using R version 4.2. Results: Thirty-eight subjects (87% female; 68% Occupational Therapist/Assistant) with little to no prior MI training self-selected to participate in one of three workshops (groups=6-14 subjects). Pre-post survey scores were significantly improved ($p<0.001$) in self-perceived understanding of MI principles (pre vs post median=3.0 vs 8.5), MI proficiency (pre vs post median=2.0 vs 7.0), skillful listening (pre vs post median=7.0 vs 8.0) and ability to increase a patient's motivation (pre vs post median=5.0 vs 7.0). A post training survey identified all subjects would recommend a MI workshop to colleagues and 92% were interested in using a multimedia product to learn MI. Conclusion: It appears feasible to adapt standard in-person group MI training methods to conduct a brief introduction to MI and mentor training by using video sharing technology. A rigorous evaluation of MI proficiency is needed for future research associated with virtual MI training in PM&R.

Conventional Print Poster Presentations

CP-AP03 Power and Strength I

THE TIME OF DAY CAUSES NO EFFECT ON MUSCULAR STRENGTH AND POWER PERFORMANCE

DEL VAL MANZANO, M., MONTALVO-ALONSO, J.J., LÓPEZ-SAMANES, A., MARTÍN-LÓPEZ, J., VALADÉS, D., FERRAGUT, C., PÉREZ-LÓPEZ, A.

UNIVERSIDAD DE ALCALÁ

INTRODUCTION: Neuromuscular performance variations have been reported at different times of day in different sports modalities. The morning reductions in performance can be observed in complex and continuous motor control tasks (e.g., tennis serve or swimming), but the changes in motor performance associated with circadian rhythm have been mostly described for long- and medium-term effects, mainly depending on endurance performance. However, how the circadian rhythm affects short-term events that rely on muscle strength and power output remained poorly studied. Therefore, this study aimed to examine the effect of the time of day on muscular strength, power and endurance in resistance-trained individuals.

METHODS: Thirteen resistance-trained males (age: 26.3±6.7 years; resistance training experience: 4.3±3.1 years; 1RM/kg bench press: 1.22±0.21; 1RM/kg back squat: 1.82±0.32) participated in a randomized cross-over and counterbalanced trial, performing in the morning (9:00h) and the evening (18:00h) a muscular strength and power assessment for bench press and back squat exercises at 25%, 50%, 75%, 90% and 100% of 1RM, performing 3, 2, 1, 1 and 1 repetitions, respectively. Muscular endurance was then assessed for both exercises at 65% 1RM, performing one set until task failure.

RESULTS: In muscular strength and power, no statistically significant differences between groups (morning vs evening) or interaction (group by load) were found in the bench press or back squat exercise for mean, peak and time to reach peak velocity and power output (ANOVA, P>0.05). Only, in the back squat exercise, higher performance was found in the evening compared to the morning at 25%1RM in mean (13%, 1084+/-259 vs 956+/-163 W/kg, P=0.031, g=1.91) and peak power output (11%, 2417+/-450 vs 2183+/-262 W, P=0.018, g=2.2). Similarly, in muscular endurance, no statistically significant differences were found between morning and evening trials for the number of repetitions, mean, peak, time to reach peak velocity, and power output (P>0.05).

CONCLUSION: Some evidence suggests a performance reduction in complex motor control tasks involving muscular power (e.g., tennis or volleyball) in the morning compared to the evening. However, in this study, no differences in muscular strength, power, or endurance were found in the bench press or back squat exercises performed from 25% to 100% of 1RM. Therefore, if circadian rhythm affects short-term tasks, this effect may occur in action performed with light loads (<25%1RM).

A NEW ERA OF ECCENTRIC TRAINING: A DELPHI STUDY

HANDFORD, M., MUNDY, P.2, THEIS, N.3, SUCHOMEL, T.4, LAKE, J.5, HUGHES, J.1

1. CARDIFF METROPOLITAN UNIVERSITY, 2. HAWKIN DYNAMICS, USA, 3. UNIVERSITY OF GLOUCESTERSHIRE, UK, 4. CARROLL UNIVERSITY, USA, 5. UNIVERSITY OF CHICHESTER, UK.

INTRODUCTION: Eccentric (ECC) training is gaining recognition in strength and conditioning for improving athletic performance and rehabilitation. Yet, the academic community lacks standard definitions and terminology for eccentric training methods (ETM), complicating the translation of research into practice. Establishing a consensus on ETM principles is essential to guide researchers and practitioners alike.

METHODS: A two-round Delphi study was undertaking including 12 academics and strength and conditioning coaches with extensive background in ETM. For round one, participants were given statements regarding ETM and asked to agree, disagree or suggest amendments. Based on the feedback, the statements were revised. All 12 participants completed round one and 11 completed round two. The questions addressed were: (Q1) the definition of ECC training; (Q2) the definition and appropriateness of the term ECC overload; (Q3) the necessity for a new construct of ECC muscle action; and (Q4) the importance of creating a measure for time under tension. Consensus was defined as achieving 73% agreement on each question.

RESULTS: Consensus was achieved for Q1, with 73% participants agreeing on the definition of ECC training. While 64% supported avoiding the term "ECC overload" (Q2), this did not constitute a consensus. For Q3, concerning the creation of a new ECC muscle lengthening construct, 73% of participants concurred, reaching a consensus; however, it was noted that further research is necessary integrating new terminology. 100% agreement was found for adopting the term "time in action".

CONCLUSION: ECC training is defines as methods that focus exclusively on the eccentric (ECC) phase or integrate it during multi-phase resistance or plyometric exercises. While a definitive consensus on ECC overload was not reached, it is advised that specific ETM be detailed in lieu of the term; authors opting to use "ECC overload" should provide a precise definition. Regarding muscle lengthening classifications, consensus was achieved for three distinct actions: passive, active, and forced ECC actions. However, further research with a broader participant base is recommended before adopting these terms. Additionally, "time in action" was unanimously approved to describe the overall duration of an exercise, distinguishing it from "time under tension," which refers to the periods a muscle can actively create or decelerate force.

SEX DOES NOT INFLUENCE CPK LEVEL KINETIC AFTER ECCENTRIC EXERCISE?

DELFORGE, E., BOISSIÈRE, J., IMBERT, S., DUPONT, A., DINE, G., DAUSSIN, F.
UNIVERSITÉ DE LILLE

INTRODUCTION: In humans, exercise-induced muscle damage often arise following eccentric contractions. While existing animal literature consistently demonstrates that females tend to experience less damage than males, findings from human studies present a contrasting picture. Some studies suggest no discernible difference between men and women, while others propose that men may be more susceptible to exercise-induced muscle damage than women. This study aimed to investigate whether muscle mass and strength could potentially account for any observed differences between men and women in the context of exercise-induced muscle damage.

METHODS: Seventy-one men (mean ± SD; age: 24.5±4.8 years; height: 180.5±7.1 cm; body mass: 79.9±13.7 kg) and forty-eight women (mean ± SD; age: 23.5±3.9 years; height: 165.1±6.0 m; body mass: 63.3±9.8 kg) were recruited. After a force—velocity profile assessment (one leg press exercise), individual maximal isometric strength (F0) was determined. Subjects performed on a separate day 8 sets of ten 5-second eccentric repetitions at 85% of their individual F0. Before and after exercise (+0h, +24h, +48h, and +72h), the maximal isometric strength, muscle soreness, and creatine phosphokinase (CPK) levels of each participant were assessed.

RESULTS: Maximal isometric strength significantly decreases after exercise and 24h after for men and women. Muscle soreness was affected by the time but not by the sex. Significant time effect was found in all the group between resting CPK levels and CPK levels at +0h (x1.22, $p<0.01$), +24h (x1.84, $p<0.001$), and +48h (x1.39, $p<0.001$). An effect of sex was observed on absolute CPK levels at all time point ($p<0.001$): men have greater CPK levels values compared to women. When CPK levels were normalized to the participant's maximal strength and mass, no significant difference was observed between the sexes.

CONCLUSION: Our results showed that the muscle damage differences observed between men and women after an eccentric exercise (absolute CPK values) were not significant when data were normalized to both mass and maximal strength. Differences in CPK level seem explained by the higher muscle mass and muscle strength engaged by the men during the exercise and not by the sex. However, the sex appears to impact the recovery of the initial strength level.

A NEW STRATEGY FOR PLYOMETRIC TRAINING ON NATIONAL-LEVEL JUMPERS AND SPRINTERS. A CROSS-SECTIONAL RANDOMIZED CROSSOVER STUDY

MONTORO, R., SOUSA, P., COSTA, A., PINHEIRO, V., SARMENTO, H., RAMA, L.
UC: UNIVERSIDADE DE COIMBRA; ISCE - POLYTECHNIC UNIVERSITY OF LISBON AND TAGUS VALEY

INTRODUCTION: The integral reactive strength index (IRSI) has recently been described in the literature as a marker that could allow better control of plyometric training programs. This study aimed to compare the effects of a plyometric training program based on the IRSI versus a traditional jump training program on spatiotemporal variables associated with the performance of national-level jumpers and sprinters.

METHODS: A cross-sectional, randomized, repeated measures crossover study was conducted. Twenty-seven male track and field athletes were divided in three groups. Group 1 (G-RT1 = 9) began the experiment with IRSI-based plyometric training, group 2 (G-PT2 = 10) began the experiment with traditional plyometric training, and (a control) group 3 (G-CT3 = 8) continued its usual training without any specific plyometric intervention.

RESULTS: After 19 weeks of the experiment, a two-way mixed analysis of variance for the G-RT1 group found a significant interaction and large effect sizes (ES) in the group-time relationship in the 60m dash ($p \leq 0.001$; $f = 101.2$; $\eta 2 = 0.089$), and the standing triple jump (STJ) ($p \leq 0.001$; $f = 119.8$; $\eta 2 = 0.031$). The G-PT2 also showed better results, but the ES was lower for the standing long jump ($p \leq 0.001$; $f = 52.7$; $\eta 2 = 0.045$), and the STJ ($p \leq 0.001$; $f = 22.7$; $\eta p2 = 0.011$). Meanwhile, the G-CT3 did not show significant improvement at the end of the program.

CONCLUSION: It has been demonstrated that the use of ISRI-based plyometric training programs produces better results than traditional ones. The use of ISRI-based practice improves individualization, emphasizes high-intensity maintenance, and induces better results with less cumulative work.

THE EFFECT OF RESISTANCE TRAINING VOLUME PRIOR TO ENDURANCE TRAINING ON ENDURANCE PERFORMANCE: A SYSTEMATIC REVIEW AND META-ANALYSIS

KIKUCHI, S., SAITO, M., HOMMA, H., KIKUCHI, N.
NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: Concurrent high-intensity resistance training and endurance training are effective for endurance performance (Eihara et al., 2022). However, the effects of resistance training volume on endurance performance in concurrent training is unknown. The purpose of present study was to examine the effects of resistance training volume prior to endurance training on endurance performance in concurrent training, using a meta-analysis and systematic review.

METHODS: Relevant studies published before February 7th, 2024 were identified from PubMed database using the following keywords and Boolean operators: ("concurrent training" or "combined training" or "complex training") AND ("strength training" OR "resistance training " OR "velocity based training ") AND ("endurance training" OR "aerobic training" OR "endurance performance" OR "endurance capacity"). Studies that met the following criteria were included: (1) published in

English, (2) athlete subjects, (3) had a target group, and (4) measured endurance performance. Collected endurance performance measures were running speed at maximal oxygen uptake, power at maximal oxygen uptake, oxygen uptake at the specified load, and time trial. All analyses were conducted using the Review Manager software program (version 5.4) with a significance level of $p<0.05$.

RESULTS: The initial search strategy retrieved 362 articles. After completion of the exclusion process, 4 articles remained. A total of 73 participants from 4 studies were included in the meta-analysis. Training intervention period in these studies were 8 to 12 weeks. Low volume resistance training was shown to significantly improve endurance performance compared to high volume resistance training (ES=0.39, 95%CI – 0.05 to 0.73; p=0.03).

CONCLUSION: The combination of low-volume resistance training and endurance training was observed to improve endurance performance compared to the combination of high-volume resistance training and endurance training.

THE REPEATED BOUT EFFECT DOES NOT INFLUENCE POST-ACTIVATION PERFORMANCE ENHANCEMENT BUT MAY IMPROVE JUMP CAPACITY IN RECREATIONAL RUNNERS

PROTZEN, G., MATOSO, B., DOMA, K., DE OLIVEIRA JR, S., BOULLOSA, D.

UNIVERSITY OF LEÓN

INTRODUCTION: High-intensity eccentric exercises may cause exercise-induced muscle damage (EIMD). However, a prior session of a similar exercise can alleviate EIMD symptoms in the next sessions, a phenomenon called repeated bout effect (RBE) (1). Athletes typically improve jump performance through post-activation performance enhancement (PAPE) after a high-intensity running exercise (2). Meanwhile, it is not known if the attenuation of EIMD may enhance the magnitude of the PAPE (3). Therefore, we hypothesized that the execution of two bouts of an eccentric-oriented exercise could promote RBE, thus providing protection against EIMD, and subsequently enhancing jump potentiation after a high-intensity running exercise in recreational runners.

METHODS: Twenty male recreational runners (32.1 ± 2.8 years; 173.4 ± 6.1 cm; 73.3 ± 11.5 kg; 57.8 ± 7.2 ml.kg.min-1) were randomly assigned to either experimental (EXP; N = 10) or control (CON; N = 10) groups. Both groups underwent evaluations of jump capacity before and after a shuttle-run test until exhaustion in the first and fourth weeks. The EXP group, in addition to their regular training, performed one low-volume (3 × 10 reps.) session of an eccentric-oriented lunge exercise (i.e., Kudashov lunge) in the second and third weeks to induce RBE. The CON group maintained their regular training without any intervention. Muscle damage markers were assessed 48 hours after the tests and exercise sessions.

RESULTS: The first training session effectively induced muscle damage, which was reduced following the second session ($p<0.05$), thus confirming the RBE. However, no PAPE in jump capacity was observed following the shuttle-run test, regardless of the presence of RBE. In addition, there was an increase in countermovement jump height after the intervention in the experimental group when compared to the control group (p=0.008).

CONCLUSION: The results suggest that the completion of two low-dose bouts of an eccentric-oriented exercise may induce an RBE, leading to reduced muscle damage, and possibly increasing jumping capacity in recreational runners. However, the RBE may not directly influence PAPE after high-intensity running exercises.

1. Doma et al. (2023); 2. Boullosa et al. (2018); 3. Souza et al. (2022).

A COMPARISON OF THE ISOMETRIC MID-THIGH PULL AND ISOKINETIC STRENGTH TESTS

FREITAG, N., PEITZ, M., EKIZOS, A., SCHUMANN, M., LEGERLOTZ, K., BOEHLKE, N.

OLYMPIC TRAINING CENTRE BERLIN

INTRODUCTION: Strength testing provides insights into muscular capabilities, performance potential and areas of injury risk and has therefore been a fundamental component of academic research and applied sport science. Two widely employed methods for assessing strength are isokinetic tests and isometric tests. Isokinetic tests measure forces through a predetermined range of motion at a constant velocity, mainly using single-joint movements and performed with specialized equipment. Isometric tests evaluate force generation while maintaining a fixed joint position. A typical example of a whole-body, multi-joint isometric test is the isometric mid-thigh pull (IMTP) test. The aim of this study was to compare the multi-joint IMTP measurements with data collected from mainly single-joint isokinetic tests.

METHODS: Eighty-five elite level athletes (age 19.9 ± 4.3 years; 30 females) from different sports (canoe, judo, handball, olympic weightlifting, water polo and volleyball) performed IsoK for leg press (100 mm/s, 700 mm/s), knee flexion and extension, trunk flexion and extension (60°/s) as well as the IMTP. After a standardized warm-up the athletes performed the isokinetic strength tests before the IMTP.

RESULTS: Strong, statistically significant correlations between IMTP and isokinetic tests were found for leg press ($r = 0.746$ - 0.811; $p < 0.01$), knee flexion ($r = 0.831$-0.847, $p < 0.01$), knee extension ($r = 0.846$ - 0.864, $p < 0.01$), trunk flexion ($r = 0.739$, $p < 0.01$) and trunk extension ($r = 0.733$, $p < 0.01$). The relationships remained significant when subjects were divided by sex for leg press (females: $r = 0.616$ - 0.732, $p < 0.01$; males: $r = 0.454$ - 0.608, $p < 0.01$), knee flexion (females: $r = 0.438$ - 0.443, $p < 0.05$; males: $r = 0.655$ - 0.696, $p < 0.01$), knee extension (females: $r = 0.663$ - 0.665, $p < 0.01$; males: $r = 0.652$ - 0.681, $p < 0.01$) and trunk extension (females: $r = 0.478$, $p < 0.01$; males: $r = 0.406$, $p < 0.01$). Trunk flexion showed a weak but still statistically significant correlation only for males ($r = 0.419$, $p < 0.01$; females: $r = 0.162$, $p > 0.05$).

CONCLUSION: While isokinetic strength tests provide rich data, their lab-based nature prohibits frequent diagnostic events. In contrast, the mobile IMTP can be carried out quickly both in lab and field settings, allowing for more frequent testing,

but only providing somewhat gross performance insights. The strong correlations we have shown between the two approaches provide a rationale for implementing the IMTP in the current strength diagnostic routines within the elite sports setting. This is not with the aim of replacing one with the other, but rather to consider them as two elements in a diagnostic chain - from the laboratory to the field.

COMPARING RATE AND FORCE DEVELOPMENT IN COUNTERMOVEMENT JUMP, SQUAT JUMP, AND ISOMETRIC MID-THIGH PULL: A PILOT STUDY

WU, C.Y., LEE, H.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Rate of force development (RFD) is crucial for explosive movements in sports and daily living. The countermovement jump (CMJ), squat jump (SJ), and isometric mid-thigh pull (IMTP) are commonly used to evaluate lower limb explosive strength. The CMJ assesses stretch-shortening capabilities while the SJ isolates concentric action. Isometric RFD assessments also provide valuable insight into an individuals capacity to generate force rapidly. Comparing isometric RFD from these tasks can provide insight into differences in maximal strength and explosive performance. This study aimed to investigate differences in isometric rate and force development during the CMJ, SJ, and IMTP.

METHODS: Three healthy men aged 22-24 years with sports experience participated in the study. Isometric mid-thigh pull, countermovement jump, and squat jump tests were conducted using Bioware force plates. Each participant performed three maximal trials of each test. Body weight standardization scaling was applied. From the force-time curves, peak force, peak rate of force development, and force development rates at different time intervals (0-50, 50-100, 100-150, 150-200 ms) were calculated. Jump height and center of mass displacement were also obtained from the countermovement and squat jumps.

RESULTS: The results showed jump heights were the greatest in the countermovement jump with arm swing (0.38 ± 0.02 m), followed by the countermovement jump (0.33 ± 0.05 m) and the squat jump (0.30 ± 0.02 m). Force peaks were the greatest in the isometric mid-thigh pull (1910 ± 77.2 N), followed by the countermovement jump (1510 ± 209.9 N), the countermovement jump with arm swing (1408 ± 114.1 N), and the squat jump (1135 ± 105.8 N). Rate of force development (RFD) peaks were the greatest in the countermovement jump (7765 ± 2225 N/s), followed by the countermovement jump with arm swing (7485 ± 1016 N/s), the isometric mid-thigh pull (6016 ± 4172 N/s), and the squat jump (4728 ± 1001 N/s).

CONCLUSION: Overall, the results showed that the countermovement jump, especially with an arm swing, produced the greatest rate of force development compared to the other exercises tested. This indicates that dynamic stretch-shortening cycle movements like the countermovement jump are more effective at enhancing rapid force production than concentric-only exercises such as the squat jump or isometric exercises like the mid-thigh pull. These findings can inform training program design for athletes and sports requiring explosive force generation. However, the small sample size in this study means the accuracy and generalizability of these results need to be confirmed through additional research. Future studies should aim to replicate these findings using larger sample sizes.

VALIDATION OF FREE-WEIGHT BACK SQUAT LOAD ADJUSTMENTS BASED ON THE THEORETICAL LOAD AT ZERO VELOCITY

FITAS, A., GIGGLINGER, S., PEZARAT-CORREIA, P., MENDONCA, G.V.

UNIVERSITY OF LISBON FACULTY OF HUMAN KINETICS

INTRODUCTION: The autoregulation of resistance training load is highly relevant for the field of strength and conditioning. Of all the regulation strategies presented in the literature, monitoring movement velocity and accessing the load-velocity relationship seems to be among the most reliable and objective [1,2]. Additionally, the individual load-velocity relationship can be attained through the two-point method, without the necessity of directly determining the one-repetition maximum (1RM) [3]. However, whether adjustments of load solely based on daily fluctuations of the load at zero velocity (LD0: y-intercept of the relationship) allow for a similar training stimulus - similar number of repetitions performed after the load adjustment, is unknown.

METHODS: 15 participants were evaluated on 3 distinct sessions. On all sessions, submaximal load-velocity relationships were obtained using the two-point method and participants performed a set of the free-weight back squat to failure. Training load was set at 80%1RM on one session, and on the subsequent sessions load was adjusted according to the magnitude of LD0 change. This training intensity was selected as it translates to a load compatible with hypertrophy, strength and power training. The validity of this methodology was examined via repeated measures ANOVAs, absolute mean differences, absolute-percent errors and Bland-Altman plots addressing the load adjustments (kg) and the number of repetitions performed on each session [4].

RESULTS: Similar load adjustments and repetitions were performed on both subsequent sessions (mean absolute differences of ~1.5 kg and 1 repetition, respectively). The absolute mean differences in the number of repetitions performed was significantly inferior to 2. The Bland-Altman analysis revealed homoscedasticity for the load adjustments but not for the difference in number of repetitions performed for one of the testing sessions, revealing a lack of validation when a larger number of repetitions was performed.

CONCLUSION: Overall, this methodology accommodates daily changes in maximal neuromuscular capacities and allows for resistance training practitioners to undergo a similar training stimulus. Regardless, some between subject variability was identified and, on some individual cases, the load adjustments may lead to an excessively different number of repetitions to be performed.

1. Suchomel et al. (2021) 2. Guppy et al. (2022) 3. García-Ramos (2023) 4. Bland & Altman (1999)

ASSESSING ISOMETRIC HAMSTRING STRENGTH AND ASYMMETRY IN ELITE MALE SOCCER PLAYERS: THE INFLUENCE OF KNEE ANGLE ON PERFORMANCE

SMITH, P., PALLOTTA, H.2, TAYLOR, M.J.1

1 TEESSIDE UNIVERSITY. 2 MIDDLESBROUGH FOOTBALL CLUB.

INTRODUCTION: Hamstring strain injuries (HSI) are one of the most prevalent musculoskeletal injuries in footballers Following a rise over the last 20 years HSI now make up 24% of all injuries [1]. HSI typically occur during maximal intensity running, during the late swing and early ground contact phase where the hamstring tendon is elongated and the muscle transitions from eccentric to concentric contraction [2]. Isometric testing is often used to measure hamstring strength and imbalances between legs, and to allow practitioners to identify athletes at risk of injury. As average knee joint angle during sprinting ground contact was 27.7 ± 5.6 degrees [3] the aim of this study was to compare testing at 0 to 30 degree knee angles to determine if 30 degrees is a more appropriate position for assessing strength.

METHODS: 42 professional and semi-professional male soccer players performed isometric hamstring strength testing at a 0 (straight leg, ISOProne) and 30 degrees knee angles (ISO30) using the NordBord device (Vald Performance, Brisbane, QLD, Australia. Tests were performed in a randomised, counterbalanced order, 7 days apart,). Following a standardised warm up, 3, 5 second maximal isometric efforts, separated by 30 seconds recovery were performed. Per leg, peak and average force, and peak and average asymmetry was recorded. Statistical analysis was carried out using a paired t-test and a Pearson correlation coefficient (PCC). Statistical significance was set at $p<.05$ and correlations were categorised as <.1 negligible, .1-.39 weak, .4-.69 moderate and >.7 strong [4].

RESULTS: Peak force production was 293 ± 56 N left, 311 ± 60N right in ISOProne, while ISO30 was 351 ±73N left, and 368 ±79N right, $p<.001$, PCC.54 left, .66 right, $p<.001$ for both. Average force production was 266 ± 51 N left, and 282 ± 58 N right in ISOProne, while ISO30 was 321 ± 68N left, and 338 ± 73N right, $p<.001$, PCC.524 left, .645 right, $p<.001$ for both. Tests in the ISOProne and ISO30 positions show a statistically significant difference with a bias of 55-58N in favour of the ISO30. However, the left-right imbalance was not statistically significant with peak ISOProne 5.6%, ISO30 4.2% $p=.420$, PCC .5, $p<.001$, and average ISOProne 5.4%, ISO30 4.5% $p=.589$, PCC .56, $p<.001$.

CONCLUSION: Both ISOProne and ISO30 display a moderate correlation with left and right peak, average, and imbalance with a statistically significant difference between angles, with players stronger in the 30 degree knee position. This is closer to the typical knee angle during ground contact when sprinting and given the prevalence of HSI practitioners should consider assessing strength and asymmetry with the ISO30 test.

Conventional Print Poster Presentations

CP-PN06 Molecular Biology and Biochemistry

ACUTE EFFECTS OF DIFFERENT EXERCISE INTENSITIES AND DURATIONS ON SALIVARY LL-37 SECRETION

ITO, R., UCHINO, T.1, UCHIDA, M.1, FUJIE, S.1, IEMITSU, K.1, KOJIMA, C.1, NAKAMURA, M.2, SHIMIZU, K.2, TANIMURA, Y.2, SHINOHARA, Y.1, HASHIMOTO, T.1, ISAKA, T.1, IEMITSU, M.1

1. RITSUMEIKAN UNIVERSITY, 2. JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Antimicrobial peptides LL-37, present in the saliva, has an important role in oral immune function. LL-37 exerts antimicrobial activity by disrupting the membranes of bacterial and viral cells. A few studies indicated an increase in salivary LL-37 secretion after high-intensity and long-duration acute exercise [1, 2]. However, it remains unclear whether the acute effects of different exercise intensities or durations on salivary LL-37 secretion. This study aimed to clarify the acute effects of different exercise intensities and durations on the secretion of LL-37 in saliva.

METHODS: Fourteen healthy young men (age: 21.6 ± 1.6 years, height: 173.8 ± 3.8 cm, weight: 63.8 ± 6.0 kg, VO2max: 42.0 ± 4.7 ml/kg/min) with no exercise habits participated in this study. Maximal oxygen uptake (VO2max) was measured approximately 1 week before the main trials. All participants randomly performed [Intensity study] cycling exercise for 30 minutes at 35% (Low), 55% (Moderate), and 75%VO2max (High) and [Duration study] cycling exercise for 30 (Short), 60 (Middle), and 90-minutes (Long) at 55%VO2max. Saliva samples were collected before (baseline), immediately after (post), and 60 minutes after exercise (post-60 min) each trial. The salivary LL-37 concentrations were measured by enzyme-linked immunoassay. The effects of different exercise intensities (Low, Moderate, High) or durations (Short, Middle, Long) were determined using three trials × three time points (baseline, post, and post-60 min each exercise) of two-way repeated-measures ANOVA. A $p<0.05$ was considered statistically significant.

RESULTS: In the intensity study, no significant differences in the percentage change from baseline were observed in salivary LL-37 concentration at post as well as post-60 min among the Low, Moderate, and High trials.

In the duration study, the percentage change from baseline in salivary LL-37 concentration at post significantly increased by 40.7% in the Middle trial and 58.6% in the Long trial compared to the Short trial (each $p<0.05$). However, no significant differences were observed in the percentage change in salivary LL-37 concentration at post-60 min compared to baseline among the three different exercise durations trials.

CONCLUSION: These results suggest that salivary LL-37 secretion may be independent of exercise intensity and may be stimulated depending on exercise duration.

WHOLE-BODY CRYOSTIMULATION ALTERS THE EXPRESSION OF GENES RELATED TO ANTIOXIDANT DEFENSE AND INFLAMMATION IN YOUNG TRAINED AND UNTRAINED MEN

LIPOWSKA, M., WOJCIAK, G., KUSMIERCZYK, J., SZYMURA, J., SZYGULA, Z., WIECEK, M.

UNIVERSITY OF PHYSICAL EDUCATION IN KRAKOW, POLAND; UNIVERSITY OF PHYSICAL EDUCATION IN KRAKÓW, POLAND

INTRODUCTION: Whole-body cryostimulation (WBC) offers preventive and therapeutic benefits, including enhanced metabolism, anti-inflammatory effects, and increased antioxidant defense, but the mechanism of these effects is unknown. This study aims to evaluate the impact of repeated WBC sessions on the expression of key genes involved in these responses, particularly in young, trained, and untrained males.

METHODS: The study involved 28 young healthy Caucasian males, comprising 10 non-training individuals (NTR), 10 non-training men undergoing WBC (NTR-WBC), and 8 long-distance runners undergoing WBC (TR-WBC). Over an 8-week period, NTR-WBC and TR-WBC groups underwent 24 WBC treatments lasting 3 minutes at -130°C, three times weekly (Monday, Wednesday, Friday). Blood samples were collected before starting WBC and after the 1st, 12th, and 24th session. mRNA expressions of glutathione synthetase (GSS), superoxide dismutase 2 (SOD2), sirtuin 1 (SIRT1), sirtuin 3 (SIRT3), and intercellular adhesion molecule 1 (ICAM-1) in mononuclear blood cells were determined.

RESULTS: Following the first WBC session, the TR-WBC group exhibited increased mRNA levels of SIRT1 ($p = 0.01$), SIRT3 ($p = 0.05$), and SOD ($p = 0.04$), GSS mRNA expression rose in both groups, with statistical significance in the NTR-WBC group ($p = 0.05$).

After 12 WBC sessions, significant elevation in SIRT1 mRNA levels was observed in the TR-WBC group ($p = 0.02$), while the NTR-WBC group showed a statistically significant rise in SOD and ICAM-1 mRNA levels ($p = 0.05$ for both).

By the 24th WBC session, the TR-WBC group showed marked increases in SIRT1 ($p < 0.01$) and SOD2 ($p = 0.02$), along with a decrease in ICAM-1 mRNA levels ($p = 0.03$). In the NTR-WBC group, changes in mRNA expressions of these genes were also noted (SIRT1: $p = 0.05$, SOD: $p = 0.04$, ICAM-1: $p = 0.05$).

CONCLUSION: WBC treatments enhances sirtuins expression, important for antioxidant defense systems and inflammatory responses in young men, dependent on physical activity level and number of treatments.

EXPLORING CIRCADIAN REGULATION OF ACE2 AND ANTIOXIDANT REGULATOR NRF2: IMPLICATIONS FOR SKELETAL MUSCLE BIOPSY PROCEDURES.

GALLEGO-SELLES, A.1, MARTINEZ-CANTON, M.1, GALVAN-ALVAREZ, V.1, GARCIA-GONZALEZ, E.1, GARCIA-PEREZ, G.1, MORALES-ALAMO, D., MARTIN-RINCON, M.1, CALBET, J.A.L.1,2

1 IUIBS AND ULPGC, SPAIN; 2 DEP. PHYSICAL PERFORMANCE, NIH, NORWAY.

INTRODUCTION: After the COVID-19 pandemic, ACE2 has garnered substantial attention due to its pivotal role as the primary entry receptor for SARS-CoV-2 into host cells. Our recent study highlights the abundant presence of ACE2 protein in human skeletal muscle, which varies between sexes [1]. Elevated ACE2 protein levels may enhance infection, while diminished levels have been linked to age-related muscle mass decline, potentially exacerbating inflammation and influencing disease severity. As a key antioxidant and anti-inflammatory defence mechanism, NRF2 may exhibit a complex interaction with ACE2, suggesting a role in modulating oxidative stress responses and maintaining cellular homeostasis [2]. Moreover, ACE2 protein expression has been linked to brain and muscle Arnt-like protein 1 (BMAL1), a circadian rhythm signal, indicating temporal fluctuations influenced by circadian and environmental factors [3]. Understanding protein expression dynamics across different time points in skeletal muscle could provide crucial insights and refine biopsy extraction methodologies.

METHODS: Twelve volunteers (6 males and 6 females) participated in our study. Following a 12-hour fasting period, biopsies of the vastus lateralis muscle were taken from randomly selected legs at five time points (baseline, 4h, 8h, 12h, and 24h), totalling 60 biopsies. Leg allocation for biopsy was randomized but consistent for each participant. We ensured strict adherence to biopsy time intervals. Protein expression levels were analysed using Western Blot. Temporal changes were assessed via ANOVA in SPSS, while correlations were explored using mixed linear models in JAMOVI.

RESULTS: Compared to baseline levels, ACE2 protein expression increased by 1.9 and 1.7-fold after 4 and 8 hours, respectively ($p<0.05$). Similarly, significant increases were observed in BMAL (1.6-fold and 1.4-fold) and Nrf2 (2 and 1.5-fold) expression at the same time points ($p<0.05$). Strong linear associations were found between ACE2 and NRF2 (R^2 marginal=0.71, R^2 conditional=0.94, $p<0.01$) and between ACE2 and BMAL (R^2 marginal=0.73, R^2 conditional=0.84, $p<0.01$). Both genders showed similar responses.

CONCLUSION: Our study highlights the temporal modulation of ACE2 and Nrf2 protein expression in skeletal muscle, possibly influenced by circadian rhythms. This regulatory mechanism may significantly contribute to maintaining cellular homeostasis and responding to hormonal signals. Moreover, understanding the dynamic interplay of these signals reveals intricate mechanisms governing oxidative stress responses and circadian regulation within skeletal muscle. Considering biopsy timing in skeletal muscle signalling research is crucial for accurately capturing intervention-related changes and properly interpreting results.

GRANT: PID2021-125354OB-C21 and PID2021-125354OB-C22.

1. Perez-Valera M, et al. Scand J Med Sci Sports. 2021; 31(12):2249-2258

2. Wang, Y. et al. Cell Stress Chaperones. 2023; 28(1):11-20.

3. Zlacká J, et al. Physiol Res. 2021; 70: S177-S194.

INFLUENCE OF EXERCISE, SEX AND OBESITY ON THE EXPRESSION OF HOUSEKEEPING PROTEINS IN HUMAN SKELETAL MUSCLE

GALVÁN ÁLVAREZ, V., MARTINEZ, M.1,2, GARCIA, E.1,2, GALLEGO, A.1,2, MORALES, D.1,2, MARTIN, M.1,2, CALBET, J.A.1,2,3,4

1,2 UNIVERSITY OF LAS PALMAS DE GRAN CANARIA; 3 THE UNIVERSITY OF BRITISH COLUMBIA, CANADA; 4 THE NORWEGIAN SCHOOL OF SPORT SCIENCES, NORWAY

INTRODUCTION: A main procedure applied to determine protein expression and translational modifications in skeletal muscle is western blotting. Nevertheless, this technique may be imprecise due to differences in protein loading. Therefore, an accurate quantification of protein concentration in lysates is necessary and the amount of protein loaded must be checked, which is usually achieved by staining methods. Another extended practice is to measure in the same gel another protein which is not varying with the intervention, generically called housekeeping (Hk) protein. The results are usually reported in arbitrary units, representing the ratio between band density of the protein and band density of the Hk (or a total protein loading control, e.g., stain free or Memcode).

METHODS: This study examines the impact of strength training (S1), HIIT (S2), SIT (S3), SIT with post-ischaemia (S4), and acute exhaustive exercise (S5) on the commonly used Hk proteins: GAPDH, B-tubulin and Vinculin.

RESULTS: For this purpose, we used muscle biopsies from several previous studies including a total of 44M/31W (31 obese). Basal expression of all Hk proteins was similar in both sexes ($p>0.21$). After normalization by total protein with Memcode, vinculin was 78% lower in males ($p<0.001$) and 61% lower in obese than lean participants ($p<0.001$). S1: 10 males underwent 8 wk strength training program eliciting a 9% hypertrophy of the v. lateralis, GAPDH was reduced by 10% ($p=0.045$) and B-tubulin increased by 23% ($p=0.003$). S2: 6M/6W underwent 6 wks of HIIT followed by a 3wk detraining, B-tubulin levels decreased non-significantly ($p=0.08$), mainly due to a 18% reduction after detraining. S3: 12 males performed SIT arm cranking and leg pedaling (30s sprints, 6 sessions in 2 wks). B-tubulin expression was higher in arms than legs ($p=0.q004$) and training reduced (11%) and augmented (25%) the levels in arms and legs, respectively (time*extremity, $p=0.02$). GAPDH had higher expression levels in arms ($p=0.002$) and was reduced by training ($p=0.04$) regardless of extremity. S4: 3M/7W performed SIT training (30s sprints, 6 sessions in 2 wks) with post-exercise ischaemia in one leg. GAPDH was reduced (8%) by SIT ($p=0.02$), similarly in both legs. B-tubulin was increased only by SIT+ischaemia (46%, $p=0.05$). S5: 7M/5W underwent a session of acute exhaustive exercise accompanied by ischemia in one leg: B-tubulin expression was reduced by 18% ($p=0.05$), only in the leg with ischaemia. GAPDH was reduced when both legs were analysed conjointly ($p=0.049$).

CONCLUSION: This study shows variation in classical Hk proteins used to normalize western blot analysis, depending in the extremity analysed, sex and body composition. Exercise training changes the basal expression of GAPDH and B-tubulin. These findings have crucial relevance for the proper interpretation of studies using the western blot technique, whose results may distorted if normalized by proteins that not behave as actual Hk.

Grants: PID 2021-25354OB-C21 & CSD (EXP_75097).

EFFECTS OF RESISTANCE TRAINING AT LOW- AND HIGH-INTENSITY ON MUSCLE FIBROSIS IN SENESCENT MICE

YASUNAGA, S., FUJIE, S.1, HORII, N.2, INOUE, K.1, IEMITSU, M.1

1. RITSUMEIKAN UNIVERSITY, 2. RESEARCH FELLOW OF JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE

INTRODUCTION: Muscle mass and muscle function decline with advance of age, and muscle fibrosis is involved in this muscle loss. Our studies showed that high-intensity resistance training improves muscle fibrosis via down-regulation of muscle component 1q (C1q)-Wnt signaling pathway in older adults and senescent mice. Low-intensity resistance training is effective in improving muscle mass and muscle function in older adults, but it is not clear whether low-intensity resistance training improves muscle fibrosis with advance of age. This study aimed to clarify the effects of resistance training at low- and high-intensity on muscle fibrosis in senescent mice.

METHODS: In this study, 38-week-old male senescence-accelerated mouse prone 1 (SAMP1) mice were divided into three groups: sedentary control (CON, N=7), low-intensity resistance training (LRT, N=8) and high-intensity resistance training (HRT, N=8) groups. LRT was performed 3 days a week, 6 to 8 sets per day with rest between sets for 1 minute for 12 weeks using a climbing ladder with attachment 40% lead weight of body weight to the mouses tail. HRT was performed using the same protocol with 70~100% loads of body weight. The frozen tibialis muscle (TA) samples were sliced, subjected to Masson trichrome staining, and then measured the cross-sectional area (CSA) of muscle fibers and fibrotic area. Serum C1q levels were detected using a sandwich ELISA kit. The one-way ANOVA was used to compare among the three groups. A $p<0.05$ was considered statistically significant.

RESULTS: After 12 weeks of each intervention, the TA muscle mass in the HRT group was significantly higher than the CON and LRT groups (each $p<0.05$). Maximal carrying capacity of lead weight and CSA of TA muscle in the HRT group were significantly higher than those in the CON and LRT groups, and the LRT group was significantly higher to compared with the CON group (each $p<0.05$). In addition, muscle fibrosis and circulating C1q levels in the HRT and LRT groups were sig-

nificantly lower than those in the CON group (each $p<0.05$). No significant differences in muscle fibrosis and circulating C1q levels between the HRT and LRT groups were observed.

CONCLUSION: These findings suggest that low-intensity resistance training in senescent mice may suppress muscle fibrosis and promote muscle hypertrophy with a decrease in C1q secretion, similar to high-intensity resistance training.

THE EFFECT OF VALINE INTERMEDIATE 3-HYDROXYISOBUTYRIC ACID DERIVED FROM THE SKELETAL MUSCLES ON THE ELEVATION OF BLOOD GLUCOSE LEVEL

MIYAZAKI, T., HONDA, A.

TOKYO MEDICAL UNIVERSITY IBARAKI MEDICAL CENTER

INTRODUCTION: Branched-chain amino acids (BCAAs) are catabolized for energy substrates in the skeletal muscles to fulfill high energy demands, instead of decreased glucose supply, during endurance exercise and in metabolic diseases. We have presented in ECSS that a small molecule 3-hydroxyisobutyric acid (3HIB) was produced as an intermediate of valine in the mitochondrial catabolic pathway, and some of which was released from the skeletal muscles to blood circulation, dependently on the amount of endurance exercises in humans and animals. We hypothesized that 3HIB has any physiological role in energy metabolism in response to decreased glucose supply. The present study evaluated the effect of 3HIB on blood glucose concentration in rats.

METHODS: Male Wister rats (8 weeks of age) were intraperitoneally injected with PBS or 6% 3HIB solution as 60 mg/kg BW (N=3/groups), and glucose and 3HIB levels were measured in blood samples collected through a silicone catheter inserted into the jugular vein every 5 min for 60 min. In addition, blood and liver were collected from the rats at 0, 15, and 60 min (N=7/groups) after the i.p. injections of PBS or 3HIB. Furthermore, an alpha blocker prazosin was also injected as 5 mg/kg BW i.p. before the 3HIB injection (N=7/groups). Energy metabolites, mRNA expression, and glucose-regulation hormones were measured in the samples.

RESULTS: In over time observation, blood glucose level was significantly increased after 5 min of the 3HIB injection accompanied with the significant increase of 3HIB, and then, glucose level was decreased but kept at higher levels until 60 min. After 15 min when significantly higher levels of glucose and 3HIB were kept, serum adrenaline and corticosterone concentrations were significantly increased and decreased, respectively, while noradrenaline, glucagon, insulin, and thyroid hormones were unchanged. The effects of 3HIB injection on blood glucose and hormones were canceled by prazosin. In the liver, glucose 6-phosphatase mRNA expression and fumarate and malate concentrations were significantly increased after 15 min of 3HIB injection.

CONCLUSION: The increased 3HIB concentration in serum significantly enhanced blood glucose levels with the increased adrenaline concentration in serum and gluconeogenesis-related genes and metabolites. A BCAA catabolic metabolite 3HIB derived from the skeletal muscles in endurance exercises might have a feedback effect to improve the metabolic shift by enhancing blood glucose levels through the sympathetic nervous system.

THE INFLUENCE OF SLEEP DURATION ON GUT MICROBIOTA COMPOSITION AND FUNCTIONALITY IN JAPANESE ELITE ATHLETES

TANIMURA, Y., AKAZAWA, N., NAKAMURA, M., EDA, N., SHIMIZU, K., MURAKAMI, H., NAKAGATA, T., NANRI, H., KAWASHIMA, H., PARK, J., HOSOMI, K., MIZUGUCHI, K., KUNISAWA, J., MIYACHI, M., HOSHIKAWA, M.

JAPAN INSUTITUTE OF SPORTS SCIENCES

INTRODUCTION: Athletes need to ensure adequate sleep, which is essential for effective recovery [1]. Recent studies have reported an association between insufficient sleep and a reduction in the production of short-chain fatty acids by the gut microbiota [2]. Another study observed a higher relative abundance of two genes involved in butyric acid synthesis via the lysine pathway in participants with shorter sleep duration [3].

The aim of this study is to investigate elite Japanese athletes to elucidate the distinctive features, which are the composition and functionality of their gut microbiota, associated with their sleep duration.

METHODS: A total of 90 elite athletes (24.2 ± 4.4 years old; male/female=51/39; sleep duration, 454.2 ± 51.6 min) competing internationally or representing their respective national teams in various sports participated in this study. Sleep duration was self-reported through a questionnaire. Shotgun analysis was used to obtain data on the microbial composition and KEGG ortholog groups (KOs) present in their fecal samples. Participants were categorized into two sleep groups: short sleep (SS), defined as less than 7 hours on more than 5 nights per week, and normal sleep (NS), defined as 7 hours or more on more than 5 nights per week. Approximately 16% of participants (n=14; 22.9 ± 5.0 years old; male/female=7/7; sleep duration, 368.5 ± 21.7 min) were identified as short sleepers, whereas approximately 84% (n=76; 24.5 ± 4.3 years old; male/female=44/32; sleep duration, 470 ± 38.2 min) fell into the normal sleep category.

RESULTS: Shotgun analysis of microbial communities revealed no significant differences in β-diversity (Bray-Curtis distance) and α-diversity between groups. Among the strains with an average relative abundance of 0.1% or more in the whole population, Bacteroides fragilis showed a significantly higher relative abundance in the SS group compared to the NS, while Faecalibacterium duncaniae, Blautia massiliensis and Butyricimonas virosa showed a significantly lower relative abundance in the SS group compared to the NS (Wilcoxon rank sum test, adjusted for FDR, $q<0.05$).

The functional profile exhibited a trend of significant differences in β-diversity between the two groups based on the identified KOs (Adonis2 PERMANOVA, p=0.057). Regarding the α-diversity indices, the SS group had a significantly lower value in the Shannon index, while the SS group had a significantly higher value in the Simpson index.

CONCLUSION: Differences in sleep duration were suggested to have the impact on the composition and functionality of the microbiota.

REFERENCES:

1. N. P. Walsh, et al. Br J Sports Med 2021; 55: 356-368.

2. Y. Shimizu, et al. Gut Microbes 2023, 15 (1): 2190306. 3. N. Fei, et al. PLoS One 2021, 16(9): e0255323.

3. N. Fei, et al. PLoS One 2021, 16(9): e0255323.

THE IMPACT OF COMPETITIVE CATEGORY ON CHARACTERISTICS OF GUT MICROBIOME IN JAPANESE ELITE PARA-ATHLETE

AKAZAWA, N., NAKAMURA, M., TANIMURA, Y., KOJIMA, C., MOTONAGA, K., HAKAMADA, N., SHIMIZU, K.
NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: Deterioration of physical condition causes not only decreased physical fitness but also immunodeficiency, digestive dysfunction, and gastrointestinal complaints (abdominal pain, diarrhea, constipation, etc.). Some individuals with lower limb dysfunction have been often in trouble about defecation and gut dysbiosis, which are related to some symptoms such as fatigability, mood disturbance, and metabolic disorder. However, it is not understood the gastrointestinal condition and gut microbiome in sitting category para-athletes. The aim of the present study was to investigate the impact of competitive category on gut microbiome in para-athletes.

METHODS: Eighteen Japanese elite para-athletes were participated in the study and were divided to the sitting category and the standing category. We analyzed their gut microbiome using 16S rRNA sequencing and evaluated the abundance at genus level and the alpha diversity evenness.

RESULTS: The abundance of Bacteroides genus was significantly higher and Prevotella genus was significantly lower in the sitting category group than that of the standing category group (21.7 ± 9.5 vs. 8.0 ± 6.4 % and 0.2 ± 0.4 vs. 10.7 ± 11.4 % respectively, $p < 0.05$). The diversity of gut microbiome was significantly lower in the sitting category group than in the standing category group (0.79 ± 0.03 vs. 0.81 ± 0.02 U, $p < 0.05$).

CONCLUSION: These findings suggested that para-athletes have a different gut microbiome profile between competitive categories. Gut microbiota dysbiosis is associated with neurological dysfunction and deterioration of host homeostasis. Therefore, gastrointestinal status may be an important factor for maintaining condition in sitting category para-athletes.

ACUTE AND CHRONIC CHANGES IN ANDROGEN RECEPTORS ARE NOT ASSOCIATED WITH MUSCLE HYPERTROPHY IN WOMEN AND MEN

LIBARDI, C., BERGAMASCO, J.1, SCARPELLI, M.1, GODWIN, J.2, MESQUITA, P.2, CHAVES, T.1, SILVA, D.1, BITTENCOURT, D.1, DIAS, N.1, UGRINOWITSCH, C.3,4, ROBERTS, M.2
1: FEDERAL UNIVERSITY OF SÃO CARLOS, BRAZIL; 2: AUBURN UNIVERSITY, USA; 3: UNIVERSITY OF SÃO PAULO, BRAZIL; 4: UNIVERSITY OF TAMPA, USA.

INTRODUCTION: The expression of androgen receptors (AR) has emerged as a potential mechanism for muscle hypertrophy. While studies establish a connection between AR and skeletal muscle hypertrophy, how AR under physiological circumstances affects this process in humans remains unclear (1). The purpose of this study was to investigate the acute and chronic effects of resistance training (RT) on total AR contents in women and men. Additionally, we investigated whether these acute and chronic changes are associated with the hypertrophy of type I and II fibers in women and men.

METHODS: Thirty-eight young women (n = 19) and men (n = 19) underwent 10 weeks of RT. Muscle biopsies were performed at baseline, 24 h after the first RT session (acute effect), and 96-120 h after the last session (chronic effect). AR were analyzed using Western blotting and muscle fiber cross-sectional area (fCSA) were analyzed through immunohistochemistry.

RESULTS: Acutely, only a main time effect was demonstrated for AR ($F = 57.52$; $p < 0.0001$), in which the 24 h values were smaller than the Pre values. Acute AR responses did not significantly correlate with hypertrophy of type I and II fibers in women ($r = -0.154$, $p = 0.553$ and $r = -0.082$, $p = 0.754$, respectively) or men ($r = -0.089$, $p = 0.717$ and $r = 0.159$, $p = 0.516$, respectively). Chronically, no main or interaction effect was shown for AR ($P > 0.05$). Additionally, chronic AR responses did not significantly correlate with hypertrophy of type I and II fibers in women ($r = -0.071$; $p = 0.787$ and $r = -0.077$; $p = 0.769$, respectively) or men ($r = 0.066$; $p = 0.787$ and $r = 0.190$; $p = 0.436$, respectively).

CONCLUSION: While animal studies suggest a link between AR content and muscle hypertrophy, the results in humans are controversial. Therefore, the precise role of AR in human muscle hypertrophy under physiological conditions remains unclear and warrants further investigation. In summary, acute and chronic changes in androgen receptors are not associated with muscle hypertrophy in women and men.

REFERENCE:

1. Roberts et al. Physiol Rev. 103(4):2679-757, 2023.

Conventional Print Poster Presentations

CP-BM03 Muscle Function

SEVEN WEEKS OF PECTORALIS MUSCLE STRETCHING DOES NOT INDUCE NON-LOCAL EFFECTS IN DORSIFLEXION ANKLE RANGE OF MOTION

SEGUEL, J.M., REINER, M., FISCHER, J., SCHÖPFLIN, A., TILP, M., BEHN, D.G., KONRAD, A.
UNIVERSITY OF GRAZ

INTRODUCTION: Static stretching (SS) techniques have been shown to improve a joint's range of motion (ROM), both acutely after one bout of stretching and chronically after stretch training for several weeks. Furthermore, acute static stretching can also improve the flexibility of non-adjacent joints, for example, the contralateral joint, or on a heterologous region (i.e. increase in ROM in lower body ROM when stretching upper body). However, to our best knowledge, there is no evidence of an increase in ROM in heterologous regions after a chronic intervention of static stretching. This study aimed to investigate the effects of 7 weeks of static stretching of the Pectoralis Major muscle on ankle dorsiflexion range of motion

METHODS: Thirty-three participants were divided into two groups (intervention n=18; control n=15), and their ankle dorsiflexion ROM was assessed before and after a 7-week intervention program. Ankle dorsiflexion ROM was passively assessed with a dynamometer device (Con Trex Mj, CMV AG, Dübendorf, Switzerland) in both groups. The intervention consisted of three static stretching exercises for the Pectoralis Major performed three times a week for 5 minutes each (total stretching time = 15 minutes) with an intensity at the point of discomfort. The control group did not perform any additional stretching exercises besides their normal exercise routine.

RESULTS: Analysis of Variance revealed no significant changes between groups as well as between pre-and post-intervention.

CONCLUSION: There is vast evidence that a single bout of SS can increase ROM of non-stretched body regions, either due to strain transfer along myofascial chains, or to an increase in global pain perception. However, our data did not show significant long-term changes in this regard. This suggests that, if the objective is to improve the range of motion in a particular joint, the advisable would be to intervene in the involved muscle with exercises targeting the enhancement of ROM, such as stretching or resistance training.

EFFECT OF DYNAMIC STRETCHING ON THE SHEAR MODULUS OF THE BICEPS FEMORIS LONG HEAD

SAKAMOTO, R., NAKAMURA, M., ITAYA, S., SUGANO, J., YANASE, K.
DOSHISHA UNIVERSITY

INTRODUCTION: In sports settings, dynamic stretching (DS) is used to prevent injury and enhance sports performance. Many previous studies reported that the joint range of motion (ROM) increases immediately after DS (1, 2). Muscle stiffness is one of the elements constituting the ROM; however, as far as we know, it is unclear whether DS affects muscle stiffness. The purpose of this study was to determine the changes in muscle shear modulus following DS.

METHODS: The participants comprised 13 healthy young men (20.9 ± 1.8 years, 172.3 ± 4.8 cm, 65.9 ± 8.9 kg). They performed DS of right hip flexors in the supine position, completing 8 sets of 30-second with 60 seconds rest interval. The shear moduli of the biceps femoris long head (BFlh) were measured before DS, after 4 sets of DS (4DS), and after 8 sets of DS (8DS) using ultrasonic shear wave elastography. In addition, ROMs were measured before DS and after 8DS using Biodex, and the initial position was the hip flexed at 120° and knee flexed at 90° in a supine position. The ROM was defined as the maximum angle achieved by movement of only knee extension. A one-way repeated measures analysis of variance (ANOVA) and Bonferroni's post hoc test were used to determine the effects of DS on the shear modulus of the BFlh, and a paired t-test was used to determine the effect of DS on ROM.

RESULTS: The ANOVA showed the main effect of time and Bonferroni's post hoc tests showed that the shear moduli after 4DS (36.9 ± 16.6 kPa) and 8DS (36.1 ± 11.6 kPa) were significantly higher than before DS (31.2 ± 15.2 kPa) (both $p < 0.01$). On the other hand, there was no significant difference in shear modulus after 4DS and after 8DS ($p = 1.00$). The ROM was significantly higher after 8DS than before DS ($p = 0.02$).

CONCLUSION: Our results suggest the DS of hip flexors increases the shear modulus of the BFlh. On the other hand, the DS of that increased ROM. Further research is needed to examine the mechanism by that DS increases muscle stiffness while simultaneously increasing ROM.

References

(1) Iwata et al., J Sports Sci Med, 2019

(2) Matsuo et al, J Sports Sci Med. 2023

Contact

cgtg0146@mail4.doshisha.ac.jp

STUDY ON THE DEGREE OF GLUTEUS MAXIMUS ACTIVATION IN COMMON EXERCISES

JI, X., SUN, K.
BEIJING INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: The function of the gluteus maximus(GM) is very important in sports and daily activities. The GM has complex functions and many exercise methods, if it is not practiced properly, it may cause fatigue and injury in the lower limbs and waist, while the GM is not exercised enough. In order to improve the exercise efficiency of the GM, this paper aims to find the exercise that activatie the GM more while activating the waist and lower limbs less.

METHODS: Thirteen healthy subjects performed 24 types of no load GM exercises: static gluteal bridge (twice, pre and post the test), dynamic gluteal bridge, shoulder raise gluteal bridge, frog gluteal bridge, one-leg gluteal bridge, side bridge, single-leg side bridge, side-lying hip abduction, kneeling hip abduction (leg up and bend the knee), prone hip extension (legs lift),prone hip extension (frog pose), mid-back extension, kneeling hip extension (leg lift and bent knee), Kneeling hip extension (leg lift straightly), squat, sumo squat, bulgarian squat, lunge squat, front lunge, back lunge, side lunge, knee bend deadlift, straight-leg deadlifts,single-leg deadlifts. Repeat each exercise 5 times for 2s each time; Take a 3min break between exercise. Surface EMG of GM, erector spinae (lumbar,ES), biceps femoris(BF), and vastus lateralis(VL) were acquired. The root mean square (RMS) of each subjects dynamic gluteal bridge was defined as the benchmark, and the RMS of each exercise was divided by the benchmark, which was called normalized RMS of the exercise. Reliability was estimated by the intraclass correlation coefficient (ICC)from RMS of the two static gluteal bridges pre and post the experiment to exclude the influence of fatigue. One-way ANOVAs was used to test the differences between the normalized RMS and activation ratios of each exercise and the gluteal bridge.

RESULTS: The ICC of RMS values of the two static gluteal bridges pre and post the experiment is 0.83, which indicate that the GM had no fatigue during the test, and the results were reliable. The normalized RMS of GM of each exercise ranged form 0.70 to 2.83, and the prone hip extension (frog pose) was maximal (2.83±1.48, P=0.000). The GM/ES activation ratio ranged from 0.29 to 1.93, the kneeling hip abduction (leg up and bend the knee) was maximal (1.93±1.87, P=0.000), and the prone hip extension (frog pose) was the third (1.16±1.00, P=0.212). The activation ratio of GM/VL was 0.33 to 6.63, and the prone hip extension (frog pose) was maximal (6.63±4.42, P=0.000). The activation ratio of GM/BF was 0.54 to 1.63, the hip abduction was maximal in all the lying exercise (1.63±1.70, P=0.173), and the fifth in the prone hip extension (frog pose) (1.26±0.63, P=0.910).

CONCLUSION: Among the 24 common GM exercises, the prone hip extension (frog pose) has the maximal activation degree for GM, and lower activation degree of erector spinae, vastus lateralis and biceps femoris.It will develop the GM More specialized, and cause less fatigue on nearby muscles.

EXPLORING HOW ARM MOVEMENT MODERATES THE EFFECT OF LOWER LIMB MUSCLE FATIGUE ON DYNAMIC BALANCE IN HEALTHY CHILDREN AND ADOLESCENTS

BORGMANN, K., MÜHLBAUER, T.
UNIVERSITY OF DUISBURG-ESSEN

INTRODUCTION: In young adults, there is evidence that free arm movements do not help to compensate muscle fatigue-induced deteriorations in dynamic balance performance. However, the postural control system in children and adolescents is immature, and as a result, the use of arm movements may provide a compensatory 'upper body strategy' to correct fatigue-related balance impairments. Thus, the purpose of the present study was to compare the effects of free versus restricted arm movements on dynamic balance performance prior and following exercise-induced muscle fatigue.

METHODS: Twenty-one healthy children (9 females; mean age: 11.1 ± 0.7 years) and 22 adolescents (10 females; mean age: 14.6 ± 0.8 years) performed the Y Balance Test – Lower Quarter before and immediately after a fatiguing exercise (i.e., repetitive vertical bipedal box jumps until failure) using two different arm positions: free (move the arms freely) and restricted (keep the arms akimbo) arm movement. The fatigue protocol involved metronome-paced box jumps, with participants instructed to jump until failure. Perceived exertion was recorded using the Borg scale.

RESULTS: Muscle fatigue and restriction of arm movement resulted in significantly deteriorated dynamic balance performance. However, the interaction between the two did not reach the level of significance.

CONCLUSION: Our findings indicate that the use of an 'upper body strategy' (i.e., free arm position) has no compensatory effect on muscle fatigue-induced dynamic balance deteriorations in children and adolescents.

THE EFFECTS OF DYNAMIC TAPING WITH EXERCISE ON NEUROMUSCULAR CONTROL IN INDIVIDUALS WITH SUBACROMIAL IMPINGEMET SYNDROME

WANG, K.L., LIN, Y.
NATIONAL YANG MING CHIAO TUNG UNIVERSITY

INTRODUCTION: Subacromial Impingement Syndrome (SIS) is the commonest disorder of the shoulder, accounting for 44%–65% of all complaints of shoulder pain. Previous studies have found changes in scapular kinematics and muscle activation patterns. To restore altered scapular kinematics and muscle activation in individuals with SIS, treatments for SIS commonly include scapula-focused exercises or/and taping. Recently, a newly developed biomechanical taping technique, dynamic tape, has been used in clinical practice to provide load absorption, force contribution and modify movement. However, only few studies have investigated the effect of dynamic tape in individuals with musculoskeletal injuries

and no research has investigated the effect of dynamic tape in combination with exercises, in individuals with SIS. The purpose of this study was to investigate the immediate effects of dynamic taping in combination with scapula-focused exercise, compared to exercise alone on scapular kinematic and muscle activity in individuals with subacromial impingement syndrome.

METHODS: This was a randomized control trial. We plan to recruit 30 individuals with SIS and randomly assign them into either an exercise group (Control group) or a dynamic taping with exercise group (Taping group). Both groups received one 30-minute treatment protocol of scapula-focused exercise. The taping group performed exercise with dynamic taping, which was applied to increase scapular upward rotation, posterior tilt and external rotation. Outcome measures were collected at baseline and right after the treatment protocol. Outcome measures included scapular kinematics and scapular muscle activation (upper trapezius, lower trapezius and serratus anterior) during arm elevation with an electromagnetic device (Viper, Polhemus, Colchester, VT, USA) and surface electromyography (myoMotion, Noraxon, Scottdale, Ariz , USA). Scapular kinematics and muscle activation were calculated at 30° 60° 90° and 120° of the humerothoracic elevation. Changes from baseline to post-treatment were calculated to compare between groups.

RESULTS: This is an ongoing study. Ten individuals have been recruited (four individuals (4M/0F) in the taping group with average age of 28y, height of 1.8m, and weight of 79kg and six (5M/1F) in the control group individuals with average age of 29y, height of 1.7m, and weight of 75kg). The individuals in the taping group demonstrated significant increases in scapular external rotation at all elevation angles ($p = 0.01 – 0.02$), compared to control group.

CONCLUSION: Compared to those receiving only scapular motor control exercise, subjects having scapular motor control exercise with dynamic taping demonstrated increased scapular external rotation. These findings suggest that scapular exercise protocols for patients with SIS could include dynamic tape to improve scapular kinematics.

IMPROVED VASTUS LATERALIS OXYGENATION IN ATHLETES FOLLOWING FLOTATION-REST.

ROBERTS, M., BERGDAHL, A., COMTOIS, A.S.

CONCORDIA UNIVERSITY

INTRODUCTION: Reduced environmental stimulation through isolation tanks (flotation-REST) induces rapid relaxation by eliminating sensory inputs. This is facilitated by the buoyancy provided by the high saline content of the water, allowing individuals to effortlessly float, without exposure to somatosensory, visual, and vestibulocochlear stimuli. Consequently, the vagus nerve can promptly initiate feelings of tranquility and calmness. Athletes employ flotation-REST as a method to rest and recover. While previous studies have emphasized its effectiveness in promoting relaxation, there is still a need to comprehensively understand how this technique influences the pathways of athlete recuperation. Hence, this study aimed to investigate the impact of flotation-REST on muscle oxygenation of the vastus lateralis (VL) in university athletes.

METHODS: Twelve university athletes (5 males and 7 females; 23.9 ± 3.9 years old) participated in weekly one-hour flotation-REST sessions over 10 weeks. Muscle oxygenation of the VL was evaluated before and after each trial using near-infrared spectroscopy, with a Moxy monitor positioned over the muscle belly- 5 minutes supine followed by 5 minutes standing. With significance set to $p<0.05$, a repeated measures ANOVA (with Bonferroni correction) assessed within-subject effects over the 10 weeks, paired t-tests compared pre-to-post measures in both supine and standing, and a multivariate analysis of variance was carried out between male and female athletes.

RESULTS: No significant effects were observed over the 10-week period. However, a consistent increase in VL oxygenation was observed immediately after each weekly flotation-REST session in both positions (Supine pre-post: $t(93) = -10.433$, $p < 0.001$; Standing pre-post: $t(93) = -10.433$, $p < 0.001$). Notably, no significant differences were detected between male and female participants.

CONCLUSION: The relaxation induced by flotation-REST manifests in improved VL muscle oxygenation in both male and female athletes, though this effect appears transient in nature. While flotation-REST seems to be an efficient relaxation and recovery technique for athletes, akin to other recuperative methods, its benefits may necessitate consistent practice. Future research should investigate additional parameters, such as postural stability and heart rate variability, to comprehensively understand the multifaceted advantages of flotation-REST.

MUSCLE MECHANICAL RESPONSE DURING PASSIVE CALF STRETCHING USING A LABORATORY PROTOCOL VERSUS A FIELD PROTOCOL

MARIANI, A.1, DALLEAU, G.1, CADERBY, T.1, BEGON, M.2, PORTERO, P.3

1. UNIVERSITÉ DE LA RÉUNION, IRISSE , FRANCE; 2. UNIVERSITÉ DE MONTRÉAL, CANADA. 3. UNIVERSITÉ PARIS-EST CRÉTEIL, BIOTN , FRANCE.

INTRODUCTION: Stretching exercises are used in training and rehabilitation. Many studies have focused on measuring muscle mechanical stress during static stretching in controlled laboratory settings involving isokinetic dynamometers and slow-speed movements, notably without neuromuscular activation [1]. During stretching exercises performed under field conditions, in contrast, significant neuromuscular activity is typically observed [2]. Understanding muscular dynamics is crucial for accurately assessing the impact of stretching techniques in sports and rehabilitation. Shear wave elastography (SWE) is a technique that enables the study of muscle mechanical behaviour, with the elasticity modulus linearly correlated to both active and passive muscular tensions [3]. The objective of this study was to compare muscle tensions using SWE during passive calf stretching conducted using a laboratory versus a field protocol.

METHODS: Six healthy participants (age: 22.5±1.2 years, height: 1.72±0.06 m, mass: 71.6±11.8 kg) randomly performed two calf stretching protocols each separated by 30 min rest: 1) on an isokinetic dynamometer (Dyn); 2) based on an exercise commonly used in field conditions, namely "wall calf stretching" (Wall). Each stretching lasted 80 s and was performed at 80% of maximum dorsiflexion range of motion. Subjects were asked to avoid any muscle contraction. We measured and compared the gastrocnemius medialis shear elastic modulus (SEM) and electromyography (EMG) between protocols.

RESULTS: Mean SEM and EMG activity were significantly higher in Wall (SEM: Wall: 403±56.5 kPa, Dyn: 267±93.9 kPa, $p<0.01$; EMG: Wall: 2.84±2.09%, Dyn: 0.63±0.41% of EMG max, $p=0.03$). Furthermore, a significant decrease in the elasticity modulus between the beginning and the end of the stretching was observed in Dyn condition ($p=0.02$), but not in Wall condition ($p=0.24$).

CONCLUSION: During field stretching protocol, the muscle mechanical response differs from laboratory stretching protocol. Muscular structure experiences more tension and does not exhibit the typical stress relaxation observed in the literature. Research conducted on animals has shown that exposing muscles to higher tension leads to an increase in markers of mechanotransduction and hypertrophy [4], [5]. These findings suggest that muscle adaptations to stretching could differ between laboratory protocols and field protocols.

REFERENCES:

[1] Freitas et al. (2015) Eur J Appl Physiol, vol. 115, no. 6, pp. 1263–1272.

[2] Portero et al. (2020) Front. Neurol., vol. 11, p. 584304.

[3] Hug et al. (2015) Exercise and Sport Sciences Reviews, vol. 43, no. 3, pp. 125–133.

[4] Kjær. (2004) Physiological Reviews, vol. 84, no. 2, pp. 649–698.

[5] Martineau et al. (2001) Journal of Applied Physiology, vol. 91, no. 2, pp. 693–702.

THE CHARACTERISTICS OF TENDON SLACK LENGTH ON TRICEPS BRACHII

OZAWA, Y., SHIMIZU, M., MIYAZAKI, S., UCHIYAMA, S., YAMADA, H.

TOKAI UNIVERSITY

INTRODUCTION: The Electromechanical Delay (EMD) is caused by 1) the propagation of action potential on muscle membrane, 2) the excitation-contraction coupling processes, and 3) the stretching of the series elastic component (SEC) by the contractile element (Norman RW and Komi PV, 1979, Alexander RM and Bennet-Clark HC, 1977). The time for the last factor is considered a major portion of EMD time (Cavanagh PR and Komi PV, 1979).

The effect of SEC stretching on EMD had been examined in tendons of the lower limb however it had not been examined in that of the upper limb. The tendon slack length would be more affected for motor control on the upper limb because its joints especially require more precise control than the lower limb joints. Therefore, there is the possibility that the upper limb tendons have different behavior. In addition, a tendon on the lower limb is too long to be captured by one prove of ultrasonogram. The tendon length on the triceps brachii (TB) is 10-15 mm (Keener JD et al., 2010) and it could be captured by one probe. In the present study, we focus on the changing behavior during the stretching slack length of the tendon on TB.

METHODS: Six healthy subjects were recruited. The trials were elbow concentric contraction for 30, 60, and 90% of maximal voluntary contraction (MVC) with a seated position. The distal tendon of TB was captured by using B-mode ultrasonography. Each trial was tested three times, and before the test trials, the MVC trials were tested for two times. The electromyography was recorded from biceps brachii (BB) and TB. The percentage of tendon stretching length was calculated by dividing the tendon length during muscle contracting by relaxing. The mean ± standard deviation of all data was calculated. The effect of contraction levels on tendon length changes was examined by using paired one-way ANOVA. Statistical significant level was set at a level of $p < 0.05$.

RESULTS: There was no significant difference in the tendon length in 30% MVC between relaxation and contraction ($p = 0.052$). In the 60 %MVC and 90% MVC trials, the tendon length at the contraction condition was significantly longer than that of the relaxation condition (60% MVC: $p = 0.002$, 90% MVC: $p = 0.002$). The percentage of tendon stretching length in 30% MVC was shorter than that of 60% MVC ($p = 0.010$) and 90% MVC ($p = 0.013$).

CONCLUSION: When the tendon loads the tension, during the weak load the tendon stress increases non-linearly, however, the load tension through the transition point, the tendon stress increases linearly (Connizzo et al., 2013). In the previous study, the Achilles tendons transition point was around 60% MVC (Muraoka T, et al., 2004). In the present study, the percentage tendon stretching length change was significantly different between 30% to 60% MVC and 60% to 90% MVC. From these results, the upper limb muscle tendon has the slack length as well as lower limb tendons, and the behavior has a similar pattern with the lower limb tendon.

MUSCLE ACTIVATION DURING DIFFERENT ARM SWING TECHNIQUES DURING THE SPIKE ATTACK IN ELITE VOLLEYBALL

SCHRAPF, N., KINZER, C., TILP, M.

INSTITUTE OF HUMAN MOVEMENT SCIENCE, SPORT AND HEALTH

INTRODUCTION: The spike attack is the most commonly performed movement in volleyball. The analysis of various elements of this movement was therefore in the focus of previous studies. Seminati et al. (2015) and Giatsis et al. (2019) examined the use of various arm swing techniques during spike attacks. They focused on biomechanical aspects of the

movement regarding performance and injury prevention. For a better understanding of the various techniques, it would be helpful to examine the activation of the muscles involved during the movement, which has not yet been investigated. Therefore, the aim of the present study is to analyze the muscle activation patterns during spike attacks using different arm swing techniques.

METHODS: The muscle activation from spike attacks using different arm swing techniques of seven professional male volleyball players were examined by means of electromyography (EMG). Based on the classification of Seminati et al. (2015), the players performed both the traditional and the alternative technique. The start of the movement was defined at the beginning of the cocking phase at 45° shoulder flexion and the end was defined at a shoulder flexion of 135° in the acceleration phase. The activation of the muscles was recorded using a Noraxon Ultium EMG system for the following muscles: M. pectoralis major, M deltoideus (pars clavicularis, acromialis and spinalis), M. infraspinatus, M. trapezius (upper and middle part), M. latissimus dorsi. To compare the EMG signals of the subjects, they were normalized based on the maximum voluntary contraction of the muscles. Differences in the muscle activation were examined using a paired t-test of an statistical parametric mapping (SPM) analysis.

RESULTS: SPM analysis revealed different activation patterns for the M. deltoideus (pars clavicularis) and the M. infraspinatus. In the first part of the cocking phase (about 10% of the movement), EMG amplitude of the infraspinatus muscle was higher in the traditional technique compared to the alternative technique ($p<0.004$). In contrast, the M. deltoideus (pars clavicularis) showed higher EMG amplitudes in the alternative technique compared to the traditional technique in the acceleration phase ($p<0.001$). For the other muscles no significant differences were observed.

CONCLUSION: The higher activation of the M. infraspinatus could be due to greater external rotation of the shoulder in the cocking phase of the movement. The higher activation of the M. deltoideus is surprising, as the acceleration phase is similar in both techniques. To understand whether this higher activation is a result of the different chocking phase, further research needs to be done.

REFERENCES:

Giatsis et al. (2019). Analysis of the arm swing technique during the spike attack in elite beach volleyball, Int. J. Perform. Anal. Sport, 19:3, 370-380.

Seminati et al. (2015). Shoulder 3D range of motion and humerus rotation in two volleyball spike techniques: injury prevention and performance. Sports Biomech, 14:2, 216-231.

EXAMINATION OF MECHANICAL PROPERTY IN ANTAGONIST MUSCLES FOLLOWING FOAM ROLLING INTERVENTION

HIBIKI, T., NAKAMURA, M., SUGANO, J., YANASE, K.

DOSHISHA UNIVERSITY

INTRODUCTION: Foam rollers are widely used in sports settings. Previous studies have reported the changes in mechanical muscle properties, such as range of motion (ROM), and maximal voluntary isometric contraction (MVC) torque, immediately after foam rolling (1). A recent study reported that contralateral joint ROM is increased immediately after foam rolling (2). However, it is unclear whether the foam rolling to one muscle (e.g. quadriceps muscle) affects the mechanical muscle property of the antagonist muscle (e.g. hamstrings muscle). The purpose of this study was to examine the changes in mechanical muscle properties in antagonist muscles following foam rolling intervention.

METHODS: Sixteen male athletes belonging to the track and field club participated in this study (20.7 ± 0.7 years, 176.1 ± 6.1 cm, 75.0 ± 25.4 kg). All participants randomly conducted two interventions for 2 days (cross-over design). The foam roller group (FR group) performed foam roller to the right anterior thigh (anterior superior iliac spine to patella) for 60 seconds. The control group (CON group) rested in the prone position for 3 minutes. The following measurements were taken before and after each intervention for the right hamstrings, i.e., knee extension ROM, passive stiffness and knee flexion MVC using Biodex, and root mean square (RMS) of each hamstrings using electromyography system. The Visual Analog Scale (VAS) was also measured participant's perceptive changes in hamstrings flexibility and muscle strength after foam rolling. Repeated measures analysis of variance (ANOVA) was performed for two factors: time and group. In addition, correlation analysis was used to examine the relationship between the amount of change of all values (ROM, stiffness, knee flexion MVC, and RMS) and the VAS (hamstrings flexibility and muscle strength) .

RESULTS: The ANOVAs showed no significant interaction effects in all variables. Correlation analysis revealed a significant positive correlation between the amount of change in ROM and VAS of flexibility ($r= 0.713$, $p<0.01$), as well as a significant negative correlation between the amount of change in stiffness and the VAS of flexibility ($r=0.575$, $p=0.03$). On the other hand, there was no correlation between the muscle strengths (MVC and RMS) and the VAS of muscle strength.

CONCLUSION: The results of this study suggest that mechanical properties (ROM, stiffness, MVC, and RMS) of antagonist muscles (hamstrings muscle) do not change immediately after foam rolling intervention for quadriceps muscle. However, those who feel that hamstrings flexibility (VAS) correlates with ROM and stiffness following foam rolling for quadriceps muscle.

Conventional Print Poster Presentations

CP-BM04 Applied Biomechanics

RELATIONSHIP BETWEEN SHOULDER JOINT FUNCTION AND COUNTER MOVEMENT JUMP HEIGHT UTILIZING ARM SWING MOTION

ITAYA, S., SAKAMOTO, R., WAKITA, M., FUJITA, K., YANASE, K.
DOSHISHA UNIVERSITY

INTRODUCTION: The arm-swing motion has a significant impact on the jumping height. Previous study reported Performing the arm-swing motion obtain floor reaction force and generate jumping power (1). Shoulder joint functions, such as muscle strength and flexibility, influence the arm-swing movement, however, this has not been examined yet. The purpose of this study was to clarify the relationship between shoulder joint function and jumping height. The hypothesis was that greater muscle strength and flexibility of the shoulder joints correlates with jumping height utilizing arm-swing motion.

METHODS: Participants were 30 healthy young men (20.9 ± 1.3 years, 173.4 ± 5.1 cm, 64.2 ± 9.9 kg). Using the Multi Jump Tester II (Qsfix, Inc., Japan), counter movement jump (CMJ) heights were measured under two conditions: with arm-swing and without arm-swing .Voluntary isometric maximal contractions (MVC) of the shoulder joint were measured in four directions; flexion, extension, abduction, and horizontal adduction using a hand-held dynamometer (Moby, Sakai Medical Co., Ltd., Japan). Shoulder joint range of motion (ROM) were taken in four directions; flexion, extension, abduction, and horizontal abduction using a goniometer. Muscle shear moduli were measured using the ultrasound shear wave elastography (Aixplorer, SuperSonic Imagine, France). The measurements were taken at the pectoralis major, pectoralis minor, trapezius, and latissimus dorsi muscle. Pearson correlation coefficient or Spearmans rank correlation coefficient were used to determine the association between the CMJ heights and these shoulder joint functions (MVCs, ROMs, and muscle shear moduli).

RESULTS: The CMJ heights with arm-swing were correlated with all MVCs (flexion; $r = 0.625$, $p < 0.01$, extension; $r = 0.466$, $p < 0.01$, abduction; $r = 0.479$, $p < 0.01$, horizontal adduction; $r = 0.444$, $p < 0.05$). On the other hand, the CMJ height without arm-swing was correlated with flexion MVC only ($r = 0.445$, $p < 0.05$). No significant correlations were found between the CMJ height with/without arm-swing and the other measurements.

CONCLUSION: Our results suggest that shoulder MVCs are correlated with CMJ height utilizing arm-swing.

However, jumping ability is influenced not only by the upper limbs, but also by the lower limbs and trunk. Therefore, it is necessary to examine the jumping ability involving both the lower limbs and the trunk.

References:

1)Mackay H,Br J Sports Med.2003

Contact:

cgtg0044@mail4.doshisha.ac.jp

ELASTIC ENERGY AT MULTI-JOINTS AFFECTS JUMPS ACCOMPANIED BY SSC.

CHO, Y.H., JO, I., YOON, J., LEE, H.
YONSEI UNIVERSITY

INTRODUCTION: Performance and efficiency enhancement during stretch-shortening cycle (SSC) exercises, such as jumping, are related to the utilization of elastic energy stored in the muscle-tendon complex. A recent study (Kosaka et al., Journal of Sports Sciences, 2023) quantified the elastic energy of the Achilles tendon and found its relationship with the SSC effect in a single joint. However, in daily locomotion or exercise, multi-joint movements are more common than single-joint movements. In this study, we aim to investigate the correlation between jumping in multi-joint situations and Achilles tendon (AT) elastic energy.

METHODS: Fourteen healthy adult males participated in this study and were divided based on their maximal countermovement jump (CMJ) height into a high jump group (HJG: age: 26.4 ± 0.1 yr, height: 179.4 ± 4.3 cm, weight: 80.7 ± 9.3 kg) and a low jump group (LJG: age: 25.6 ± 1.5 yr, height: 176.9 ± 6.5 cm, weight: 77.4 ± 8.1 kg). Subjects performed maximum plantar flexion (PF) on a custom-built dynamometer, and maximum PF torque was measured. The elongation of the Achilles tendon (AT) was measured using B-mode real-time ultrasound imaging to assess elastic energy and stiffness. Countermovement jump (CMJ) and drop jump (DJ) were performed to measure jumping ability. In the muscle force-elongation curve, the section from 50% to 100% of the force was defined as stiffness (Kubo, Keitaro et al., British journal of sports medicine, 2004), and the section below the curve was defined as elastic energy (Kubo, Keitaro et al., Physiological, 2017).

RESULTS: The HJG showed greater elastic energy storage than the LJG (HJG: 3.7 ± 1.4, LJG: 2.2 ± 0.9), and higher jump height for CMJ (HJG: 46.9 ± 4.55, LJG: 36.5 ± 4.5), DJ20 (HJG: 42.1 ± 6.1, LJG: 32.3 ± 6.6), and DJ30 (HJG: 42.9 ± 4.6, LJG: 34.2 ±5.5). However, there was no statistically significant difference in stiffness. Elastic energy and jump height showed significant correlation (CMJ: .46, DJ20: .45, DJ30: .31).

CONCLUSION: Elastic energy has been shown to be associated with jump height involving SSC in both single-joint and multi-joint movements. The HJG exhibited higher Achilles tendon elastic energy at the ankle, supporting a positive correlation tendency with jump height, which suggests a relationship between elastic energy and SSC effect. Additionally, as a measure of tendon properties closely related to SSC, tendon elastic energy has been shown to be more useful than tendon stiffness, which has been used in many previous studies.

LOWER LIMB MUSCLE ACTIVATION ASYMMETRY DURING SINGLE-LEG DROP JUMP IN ATHLETES AFTER ACL RECONSTRUCTION RETURN TO SPORTS

CHU, N., CHEN, Y.J., TZENG, Y.T., LEE, H.J.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Secondary ACL injuries are common, with twice as many occurring on the non-injured side. Lower extremity asymmetry after ACL reconstruction (ACLR) may increase reinjury risk. The single-leg drop jump (SLDJ) assesses functional recovery after ACLR. Muscle activation asymmetry during SLDJ landing could indicate injury risk. This study evaluated lower limb muscle activation asymmetry during SLDJ in athletes after ACLR return to sports.

METHODS: Participants: Ten ACLR and eleven healthy athletes were recruited to this study. The conditions of ACLR acceptance were: unilateral and one ACL reconstructed surgery; all athletes have completed the rehabilitation and returned to sports. All participants were without lower limbs musculoskeletal injury within six months.

Procedures: Subjects performed SLDJ from 30cm while electromyography (EMG) recorded muscle activation of the vastus lateralis (VL), vastus medialis (VM), and biceps femoris (BF) on both lower limbs. The EMG data were collected at 2000 Hz. Vertical ground reaction force(vGRF) data during landing were simultaneously collected using a Kistler force plate at a sampling frequency of 2000 Hz. The raw EMG data underwent band-pass filtering (10-500 Hz), and Root Mean Square calculations were performed with a time window of 20 ms. Maximum voluntary isometric contractions were used to normalize muscle activation. Muscle activation levels were calculated using a 100 ms window before and after the landing instant, defined as when vertical ground reaction force exceeded 20 N.

Statistics: Muscle activation variables were compared between ACLR and healthy groups using independent t-tests. Symmetry indices were calculated as injury side/non-injury side x 100% for the ACLR group and as non-dominant side/dominant side x 100% for the healthy group. Significance was set at $\alpha<.05$.

RESULTS: The ideal symmetry value is 100%. Before the first landing, we found that the ACLR group had significantly higher asymmetry in BF activation compared to the healthy group. The ACLR group had higher BF activation on the injured side than the non-injured side. The healthy group had larger vGRF asymmetry than the ACLR group. There was significant asymmetry in VM and BF activation between groups. In the ACLR group, VM activation was lower on the injured side while BF activation was higher. In the healthy group, the opposite pattern was seen.

Before the second landing, we found both groups had asymmetric VM activation, but the ACLR group had greater asymmetry. On the second landing, a similar pattern of asymmetric VM and BF activation was seen as on the first landing for both groups. The ACLR group had lower VM and higher BF activation on the injured side compared to the non-injured side. The opposite was seen for the healthy group when comparing dominant and non-dominant sides.

CONCLUSION: The asymmetrical muscle activation patterns seen in the ACLR group when landing could shift load to the non-injured leg and increase injury risk. The healthy group also showed asymmetry but in the opposite direction, which may elevate injury risk in the non-dominant leg. Addressing these asymmetries through targeted training may help reduce second injury risk when returning to sports after ACLR.

PHYSIOMECHANICAL ASPECTS OF NORDIC AND FREE WALKING ON RECOVERY IN PARKINSON'S DISEASE: A RANDOMIZED CLINICAL TRIAL

MONTEIRO, E., RODRIGUES, J., FRANZONI, L., GOMEÑUKA, N., ARCILA, D., PEYRÉ-TARTARUGA, L.
GRADUATE PROGRAM IN HUMAN MOVEMENT SCIENCES, FEDERAL UNIVERSITY OF PARÁ

INTRODUCTION: Gait disturbance is a relevant component of motor disability in people with Parkinson's disease (PwP). Recovery, a mechanism for exchanging energy of Center of Mass (CoM), is less effective in PwP than in healthy age-matched people. Rehabilitation with Nordic walking (NW) can promote changes in the CoM movement parameters, increasing energy reconversion. Therefore, the study aimed to evaluate the effects of NW compared to free walking (FW) on recovery in PwP.

METHODS: This study is a randomized controlled clinical trial (Number: NCT03355521) composed of two groups, NW and FW, with the following eligibility criteria: Parkinson's disease diagnosis, both sexes, age over 50 years, with stages between 1 to 4 on the Hoehn & Yahr (H&Y) scale. The recovery assessment took place before and after the intervention program, using the VICON® kinematics system (100Hz), 36 reflective markers, a sphere shape 14mm in diameter, and both sides of the body at anatomical points. For data treatment, we used a mathematical routine in Matlab® software. The training program was conducted for nine weeks, with two alternating weekly sessions ranging from 35 to 50 minutes daily in the last training cycle, totaling 18 sessions. Generalized Estimating Equations were used to compare groups. We used H&Y and Froud number values as covariates (appearing are fixed values – H&Y: 1.69; Froude number: 0.07). We used Bonferroni post-hoc to identify differences between means for all outcomes. Data were analyzed using SPSS® software (v.20.0) with an $\alpha = 0.05$.

RESULTS: The final sample consisted of 20 PwP (NW: 13 and FW: 7), age (NW: 64.23±10.52 and FW: 69.71±6.82 years), body mass (NW: 80.07±14.79 and FW: 65.42±9.05 kg), height (NW: 1,68 ± 0,07 and FW: 1,68 ± 0,06 m), H&Y (Median: 1.5) and time since diagnosis (NW: 5.54±3.75 and FW: 3.29±1.97 years). For Recovery, significant differences were found for Group and Time (both P<0.01), with increased value for the NW group (NW pre: 51.12±7.95 to NW post: 66.07±7.63). In addition, we found significant differences in Time and interaction between Time*Group (P=0.0014 and P=0.010, respectively) for horizontal mechanical work. Internal mechanical work from arms showed significance for Time and Time*Group (P=0.02 and P<0.01, respectively), and the trunk showed Time*Group interaction (P=0.01). Vertical external work also presented significance for Time (P<0.01). Rint also showed significance for Time, Group, and Time*Group (P<0.01, P<0.01, and P=0.02, respectively). For maximum trunk flexion, we found significance for Time and Group (both P=0.001). Finally, we found significant differences for Time (P=0.006).

CONCLUSION: We conclude that the NW group carried out the reconversion process more effectively. Thus, aged PwP, who walked with poles, had a more optimized pendular mechanism and, therefore, a more efficient gait than the FW group. This finding concludes that the reconversion process was carried out more effectively by the NW group.

REMOTE AND NON-LOCAL EFFECTS OF A 7-WEEK COMBINED STRETCHING AND FOAM ROLLING TRAINING INTERVENTION OF THE PLANTAR SURFACE

KONRAD, A., REINER, M., GABRIEL, A., WARNEKE, K., NAKAMURA, M., MANIEU, J., FISCHER, J., SCHÖPIN, A., BEHM, D.G., TILP, M.

UNIVERSITY OF GRAZ

INTRODUCTION: It is established that a single session of foam rolling (FR) or stretching can bring about changes in range of motion (ROM) in distant areas of the posterior chain (remote effects) and regions beyond the stretched tissue (non-local effects) (1–3). However, it remains unknown whether such effects persist after prolonged training interventions. This study aimed to explore the remote and non-local effects of a seven-week combined stretching and FR training intervention on the plantar surface.

METHODS: Fifty-two recreational athletes were divided into an intervention group (n=20), a control group for remote effects (n=18), and a control group for non-local effects (n=14). Participants visited the lab three times—for a familiarization session, a pre-session before the seven-week intervention, and a post-session at the interventions end. In the pre-session, participants were assigned to the intervention or control groups. Each session started with a five-minute warm-up on a stationary bike (Monark, Ergomedic 874 E, Sweden). Measurements were conducted on the dominant limb, assessing ankle dorsiflexion ROM (remote effects) with an isokinetic dynamometer and shoulder extension ROM (non-local effects) with a three-dimensional motion capture system (Qualisys, Gothenburg, Sweden). While control groups refrained from additional flexibility training on the plantar surface, the intervention group performed three five-minute exercises three times a week for seven weeks, totaling 15 minutes per session and 45 minutes per week, including a plantar surface stretch, a rolling exercise with a wooden cylinder, and another with a foam roller ball.

RESULTS: According to the Analysis of Variance, there were no interaction or time effects for ankle dorsiflexion ROM or shoulder extension ROM. The 95% confidence intervals for ankle ROM indicated a trend of a 2.0° increase (–0.03 to 4.0) in the intervention group compared to the control group (–0.5°, –2.6 to 1.6).

CONCLUSION: Recent reviews have noted acute non-local effects of single stretching or foam rolling exercises, attributing them to increased global pain tolerance or warm-up effects (1,4). However, our study showed no such changes following a seven-week combined stretch and foam rolling training. Consequently, if the goal is to improve the ROM of a specific joint, frequent treatment of the associated tissue is recommended.

1. Behm DG et al. Sport Med 2021;51:945–959.

2. Williams W and Selkow NM. J Sport Rehabil 2020;29:400–404.

3. Wilke J et al. J Sport Rehabil 2018;28(7):758-763

4. Konrad A et al. Eur J Appl Physiol 2023;123:1167–1178

Contact: andreas.konrad@uni-graz.at

MINIMAL POWER REQUIRED TO ASCEND A FLIGHT OF STAIRS VERSUS ACTUAL POWER MEASURED WITH BODY-FIXED SENSORS IN ADULTS AGED 19-85 YEARS

VAN ROIE, E., MEULEMANS, L., SEGHERS, J., DELECLUSE, C.

KU LEUVEN

INTRODUCTION: A good stair-climbing (SC) ability is crucial for independent living in older adults. A simple formula that estimates the mean power needed to ascend a flight of stairs in a predetermined time (i.e., total ascent duration) is easy to implement in practice, but lacks information on the actual utilized power per step. One might thus expect that sensor-derived SC power (i.e., actual utilized power) differs from SC power estimated through a simple duration-based equation (i.e., minimal power required for a given duration), questioning whether both methodologies actually measure a similar construct and whether both are equally sensitive for age-related changes. Therefore, the objectives of this study were (1) to compare equation-derived and sensor-derived SC power data; and (2) to explore the potential of both methods to detect age-related differences across the full adult lifespan.

METHODS: Three-hundred eighteen participants (men: N = 156, women: N = 162; age 19-85 years) performed a 6-step SC test and two methodologies were used to estimate mean SC power: (1) a body-fixed sensor with automated detection of power production per step (Psensor), and (2) a mathematic equation based on timed ascent duration, body mass and stair height (Pformula). Linear mixed models were used to investigate the differences on SC power between both methods and their possible interaction with age and sex. Intraclass correlation coefficients (ICC 2,1) and Bland-Altman plot were used to better understand the relationship between Psensor and Pformula.

RESULTS: Pformula was 210.4W lower than Psensor, lower in women versus men and in older versus young adults ($p<0.001$). The difference between Pformula and Psensor was greater in individuals with better performance (i.e., men and young adults) ($p<0.001$), indicating a ceiling effect of the formula in well-functioning and younger individuals. Likewise, ICC's between both methodologies showed poor reliability in people aged <65 years (0.087-0.363) and moderate to good reliability in people aged ≥65 years (0.453-0.780).

CONCLUSION: Participants with better SC performance are able to largely overshoot the minimal power required to ascend the stairs in a certain duration. This makes the sensor more sensitive to identify early age-related differences compared to the formula. However, further optimization of the methodology is necessary for large-scale implementation, e.g. by developing automated detection of SC events outside of the laboratory. It is also important to realize that a simpler approach to measure SC power, i.e. by only measuring time, can be just as valuable compared to the more complex sensor-based methodology in older individuals with limited performance. Future research should investigate whether higher values of SC power can postpone the development of future negative health outcomes. In addition, research should focus on identifying the threshold value of SC power below which functional impairments are likely to occur.

BETWEEN TRIAL RELIABILITY OF TOTAL TRAVEL DISTANCE OF THE COP IN SINGLE LEG BALANCE DURING EYES OPEN, EYES CLOSED, AND EYES OPEN ON FOAM

HAN, K.

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

INTRODUCTION: Total travel distance (TTD) of the center of pressure (CoP) during single-leg stance has been shown to be a valid measure of postural balance [1]. TTD in cm was calculated by summing the displacement of the x and y components of the CoP as a function of time by applying the Pythagorean Theorem. The reliability of a single trial or averaged trials and the number of trials to average must be considered when using TTD. The purpose of the study was to determine a single trial and averaged trials reliability of TTD of the CoP in a single leg balance with eyes open, eyes closed, and eyes open on a foam surface.

METHODS: A total of 12 (6 males, 6 females) healthy subjects (age = 23.8 ± 2.6 yrs, height = 157.5 ± 7.3 cm, mass = 51.3 ± 8.1 kg) participated in this study. Each subject completed 8 trials of single leg balance in each condition on a force platform with the order counterbalanced. The force data were sampled for 15 seconds at 60 Hz. TTD (cm) was measured in single leg stance and calculated according to the balance condition of each trial. Reliability was analyzed using SPSS to compute the intraclass correlation coefficient (ICC) with a 2-factor mixed-effects model and type consistency.

RESULTS: For eyes open condition, there were significant differences in TTD between trials 1-8 (49.3 ± 13.7, 49.2 ± 12.7, 45.5 ± 11.1, 45.6 ± 11.0, 48.4 ± 17.1, 42.2 ± 9.9, 43.6 ± 11.8, 39.7 ± 9.0 cm), $p = 0.026$, respectively. Mean (SD) TTD in eyes open was 45.5 ± 10.0 cm with a single trial ICC of 0.609 and an averaged trials ICC of 0.926. In the eyes closed condition, there were significant differences in TTD between trials 1-8 (91.1 ± 35.8, 87.3 ± 27.7, 75.9 ± 21.5, 79.0 ± 16.4, 75.6 ± 15.6, 67.8 ± 21.0, 75.0 ± 20.7, 75.3 ± 22.9 cm), $p = 0.027$, respectively. Mean TTD in eyes closed was 78.4 ± 17.7 cm with a single trial ICC of 0.502 and an averaged trials ICC of 0.890. In the eyes open on foam condition, there were no differences in TTD between trials 1-8 (60.5 ± 20.6, 64.4 ± 16.7, 60.0 ± 23.1, 61.5 ± 18.9, 58.1 ± 16.3, 58.2 ± 18.8, 58.8 ± 15.0, 51.3 ± 13.8 cm), $p = 0.161$, respectively. Mean TTD in eyes open on foam was 58.9 ± 15.1 cm with a single trial ICC of 0.650 and an averaged trials ICC of 0.937.

CONCLUSION: Averaging multiple trials of single leg balance improves the reliability of TTD (cm) measurement of the CoP. Further research is needed to identify possible interactions between trial-specific learning effect and fatigue when recording multiple trials in postural balance measurements.

REFERENCE:

1. Han et al (2009). Journal of Orthopaedic & Sports Physical Therapy, 39(4), 246-255, doi:10.2519/jospt.2009.2958

RELIABILITY OF THE 30-SECOND CHAIR RISE TEST ON THE LEONARDO MECHANOGRAPH GROUND REACTION FORCE PLATE – IMPACT OF FAMILIARIZATION AND FATIGUE ON TIME- AND FORCE-BASED OUTCOME PARAMETERS

SLUNECKO, M., CSAPO, R., WESSNER, B.

UNIVERSITY OF VIENNA

INTRODUCTION: The 30s chair rise test (30CRT) is a commonly used measure for lower limb muscle function. However, the traditional version, which quantitates the number of chair stands within 30s, has limited reliability and can be influenced by familiarization [1]. An instrumented form of the test that relies on the Leonardo Mechanograph ground reaction force plate (LM) to directly assess force, power, and velocity during the 30s-CRT might improve measurement reproducibility [2]. This study is the first to evaluate the reliability and the presence of learning effects (LE) and fatigue effects (FE) over multiple 30CRTs performed on the LM.

METHODS: The reliability of the 30CRT on the LM was evaluated in young healthy participants throughout four test sessions organized in two blocks. The first block consisted of 3 test sessions with one trial of the 30CRT each taking place with one rest day in between. The 2nd block consisted of one longer test session on one day, 2-3 weeks after block one. It encompassed four trials of the 30CRT separated by 15 min rest periods. Time- (repetitions [reps] and time per repetition [t_rep]) and force-based (force [F_max], power [P_max], velocity [v_avg]) parameters were recorded and evaluated with the LM software. The three trials of block one and the first trial of block two were analyzed with a repeated measures ANOVA to evaluate the LE. The four consecutive trials of block two were analyzed using a separate repeated measures ANOVA to evaluate the FE. Reliability was assessed by intraclass correlation coefficient (ICC(1)).

RESULTS: Thirty-four participants (16M/18F, age: 26.0±4.4; BMI: 23.2±4.0 kg/m2) performed 20.6±3.8 reps at baseline. The time-based parameters showed a significant LE (reps: $p<0.001$, $\eta p2=0.54$; t_rep: $p<0.001$, $\eta p2=0.52$) with a mean improvement of 20.5% for reps and 16.6% for t_rep from the first to the fourth trial. Apart from a slight improvement of 3.2% for vavg, the force-based parameters did not change significantly over the first four trials (F_max: $p=0.16$, $\eta p2=0.05$; P_max: $p=0.13$, $\eta p2=0.06$; v_avg: $p=0.03$, $\eta p2=0.10$). In the four consecutive trials of block two, further improvements of reps ($p<0.001$, $\eta p2=0.60$) and t_rep ($p<0.001$, $\eta p2=0.55$) were observed, as well as a minor drop in vavg ($p=0.01$, $\eta p2=0.13$). F_max ($p=0.13$) and P_max ($p=0.08$) did not change significantly. ICC(1) values over the third and fourth trial, which did not significantly differ in post hoc analyses, ranged between 0.89-0.91 for time- and between 0.91-0.96 for force-based parameters.

CONCLUSION: Two familiarization trials are recommended for good measurement reproducibility of time-based parameters during the 30CRT in young adults. Force, power, and velocity can be assessed with the LM in a reliable way without familiarization, even while the time-based parameters initially change considerably due to LE.

[1] Rittweger, J., et. al (2004), J Am Geriatr Soc,

[2] Taani, M.H., et. al (2017), Res Gerontol Nurs,

GEAR FITTING FOR DOWNWIND STAND-UP PADDLE FOIL PERFORMANCE

OSTRE, B., ALGOURDIN, P., CHARLES, P.E., JOLIFF, Y., NUNEZ, M., RANGHEARD, L., SERRALHEIRO, A.

LABORATOIRE MAPIEM

INTRODUCTION: DownWind (DW) Stand-Up Paddle (SUP) Foil is a brain new watersport activity. It consists to fly above the surface of the sea in the same direction as the wind thanks to the propulsion of the waves created at the surface of the water. The rider has meanly 3 gears to achieve his goal: a paddle in the hands giving propulsion for take-off, a board flying in the air under his feet and an hydrofoil under water keeping the board over the surface. Due to early birth of this sport, many brands offer a huge amount of new gear every week. Currently, the foil/board/paddle association is not based on any scientific fact demonstrating suitability for the practitioner. The aim of this work is to optimise this association from muscular energy measurements.

METHODS: This project is design to set a multi factorial experiment. A first demonstrator was design to set the process on land. A specific board has been modified (embedded strain gauges) in order to measure the force applied by the rider and his center of gravity (CG) position during the ride. Datas are collected through ARDUINO board and it gives a structural analysis of how exactly the rider act on the board. In addition the rider's body has been monitored thank's to wireless Emgs (Cometa MiniWave Infinity) at a sample rate of 2000Hz. Electrodes were placed according to SENIAM recommendations after skin preparation. The leg muscles activity (Tibialis Anterior, Gastrocnemius Medialis) were recorded because these muscle are known to be the most expensive during riding sport [5]. Finally the full body position was analyzed with inertial measurement units (IMU) (Cometa WaveTrack) [1]. IMUs were calibrated using standing T-pose acquisition. Heart Rate (HR) was also recorded throughout the trials. Datas collected by EMGs were then filtered using a 4th order Butterworth filter with a cut-off frequency between 20 and 400Hz, rectified with low pass frequency of 15Hz and then normalized using Matlab [3]. IMUs' signals were filtered using a Kalman filter until the Euler angles were obtained [4]. A professional rider performed the same 2km path through 40 knots wind ride the same day in ecological conditions. The trace was tracked by Garmin GPS. After 10 min warm-up, 8 trials were performed following the order of an experimental design with adjustable factors of the hydrofoil: Mast longer, fuselage length, hydrofoil Rake and Wing-set. Each test was repeated 3 times and a separated by a 10 min break to avoid fatigue [2].

RESULTS: The study proved that gear parameters affect energy consumption and body position for riding sport. Indeed it has been showed that a 15% HR and a 10% reduction in Gastrocnemius Medialis activation of the back leg could be achieve by setting the gear properly. In addition, body position is modified.

CONCLUSION: The power of gear fitting method has been confirmed by reducing energy consumption by at least a 10 % in muscles activity and 12 Bpm HR for the right gear setting.[1]Cordillet [2]Jobson [3]Munera Ramirez [4]Nez [5]Ruess

Conventional Print Poster Presentations

CP-BM05 Technology based methods

TECHNOLOGY-BASED METHODS FOR THE ASSESSMENT AND APPLICATION OF SARCOPENIA RISK FACTORS IN OLDER ADULT

HO, T.H., LIN, L., LI, C., CHUANG, C.
NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: The 5-time chair stand test is the best option to reflect lower muscle strength, physical performance, and function. This is the trend to focus on Inertial Measurement Units (IMUs) and surface Electromyography(sEMG) in wearable devices to assess Sarcopenia in primary prevention. Therefore, this study aimed to explore the trend and application of the kinematic performance of the lower extremity in the 5-time chair stand test using wearable IMU and sEMG-based devices for different risks of Sarcopenia in community-dwelling older adults.

METHODS: 53 adults (71.26 ±7.34 years) participated in this study were divided into two groups depending on those whose standing seconds in 5-rep were less than 10 seconds and Skeletal Muscle Index(SMI) did not meet the risk factors for Sarcopenia were classified into the low-risk group (n=27, LRG), the others were classified into the high-risk group(n=26, HRG). The 5-time chair stand test collected the surface electromyographic signals of each vastus lateralis and vastus medialis muscle and collected the hip and knee's angular signals using 3 nine-axis inertial measurement units. The gender was used as a covariate for multivariate analysis of variance, MANOVA. Pearson's correlation analysis was used to analyze the correlation between SMI, the seconds of 5-rep chair stand, sEMG and IMU signals. Furthermore, the multiple stepwise regression analysis predicted the key factors of the seconds of 5-rep chair stand.

RESULTS: The LRG was better at SMI (+12.68%), the 5-rep seconds (-30.91%)(p<.001), and the left EMG signals, which were mean potential difference and potential difference area of vastus lateralis(+40.83%, p=.046) and vastus medialis muscle(+32.39%, p=.028), etc. The mean angular velocity of hip(+37.3%) and knee joint (+37.5%)were significantly different(p<.001). The mean potential difference of vastus medialis muscle in both right(r=-0.356, p=.007) and left(r=-0.341, p=.01), the mean peak potential difference of the vastus medialis muscle in both right(r=-0.350, p =.008) and left(r=-0.323, p=.015), the mean angular velocity of hip (r=-0.829, p<.001) and knee joint (r=-0.820, p<.001) were all significant correlated with the seconds of 5-time chair stand. Furthermore, it could be predicted by hip joint's mean angular velocity and total angular changes. The formula is y= (-0.86) *mean angular velocity of hip joint+(0.157) *total angular changes of hip joint+4.705(R2=0.701, p<.001).

CONCLUSION: This study recommended that the EMG signal be given priority on the vastus medialis muscle. In the application of IMU, the angular velocity (muscle strength) and changes (activity/ROM) of the hip joint were the key factors that affected the performance. In the future, there can be measured 5-time chair stand test with EMG and IMU, not only be used to analyze the data simultaneously but also to help determine Sarcopenia risk factors and movement performance factors more accurately to refer the prevention and improvement suggestions.

INVESTIGATION OF THE INFLUENCE OF DIFFERENT MIDSOLE MATERIALS IN SAFETY SHOES ON THE BIOMECHANICS OF THE LOWER EXTREMITIES DURING WALKING USING MUSCULOSKELETAL MODELING

OSTERLOH, J., KNAACK, F., BLENKE, D., BEHRENS, M., KEBBACH, M., SOODMAND, I., BADER, R.
ROSTOCK UNIVERSITY MEDICAL CENTER

INTRODUCTION: In certain occupational environments, wearing safety shoes is essential for mitigating the likelihood of sustaining foot, leg, or knee injuries. For workers who wear safety shoes for long periods of time, ergonomics play a key role in maintaining health and work performance. This pilot study aimed to investigate the effect of different midsole materials in safety shoes on biomechanical parameters of the lower extremities during walking. In this context, musculoskeletal modeling can be an innovative method for investigating internal forces in the human body based on external measurements [1].

METHODS: A randomized crossover pilot study was conducted with 24 healthy males who regularly wear safety shoes in their daily work environment. Two safety shoes (safety class S2 according to EN ISO 20345) of similar construction but with midsoles fashioned of different polyurethane (PU) foams were compared while walking on a treadmill. Resilience tests of the manufacturer showed that the innovative midsole material (M1) is characterized by greater maximal deformation and higher energy return compared to other materials such as conventional PU (M2). Outcome variables of the pilot study included joint angles, joint moments and muscle forces of the lower extremities analyzed by means of musculoskeletal modeling using the Twente Lower Extremity Model 2.0 [2]. Dependent t-tests and Statistical Parameter Mapping 1D (SPM) were carried out for the one-dimensional continuous time series. Significance was set at p<0.05.

RESULTS: The musculoskeletal modeling and SPM approach indicated small midsole-related differences with respect to the angle of the talocrural joint during walking (p<0.01), but no differences were observed regarding the joint moments. However, lower muscle forces of the plantar flexors were detected when wearing the safety shoe with the M1 midsole compared to the M2 midsole. Particularly, a significant reduction in muscle force of the gastrocnemius medialis muscle was observed between midstance and terminal stance (p<0.001).

CONCLUSION: Musculoskeletal modeling proved to be a helpful tool to investigate the influence of different midsole materials in safety shoes. The midsole material had only minor effects on lower extremity joint angles and moments. Nevertheless, the M1 midsoles appear to support the plantar flexors during stance and may therefore reduce the risk of Achilles tendinopathy.

REFERENCES:

[1] Andersen, Introduction to musculoskeletal modelling. In: Computational Modelling of Biomechanics and Biotribology in the Musculoskeletal System: Elsevier. 2021.

[2] Carbone et al., TLEM 2.0 - a comprehensive musculoskeletal geometry dataset for subject-specific modeling of lower extremity. J Biomech. 2015.

INFLUENCE OF WEARING HIGH HEELS ON LOWER LIMB AND LUMBAR SPINE POSTURE IN STATIC STANDING

MATSUSHITA, K., NAKAYAMA, T.2, ISHIGURO, K.2, SAITO, H.2, ENDO, N.2, SUZUKI, N.2, SYAKU, F.1

1NIHON UNIVERSITY;2TOKYO UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Many women wear high heels for fashion or occupational reasons. However, studies have reported that wearing high heels can alter the posture of the lower limbs and pelvis, leading to the occurrence of lower back pain. Among these, there is a variety of debates regarding the effects on the lumbar spine, with reports suggesting that wearing high heels can both increase and decrease lumbar lordosis, resulting in a lack of consensus. Therefore, this study aimed to estimate the posture of the lower limbs and lumbar spine in static standing posture while wearing high heels using VICON and OpenSim, and to examine their effects.

METHODS: Static standing posture was captured using a three-dimensional motion analysis system when participants were barefoot and wearing four different heights of high heels. Four healthy female participants aged 20.75 (SD±0.43) years, weighing 51.25 (SD±9.03) kg, and with a height of 156.7 (SD±6.9) cm took part in the study. Heel heights of 1.5 cm, 3.0 cm, 6.0 cm, and 9.0 cm were used, and measurements were taken using VICON and four floor force plates (manufactured by AMTI). A marker set based on Plug-in Gait consisting of 39 markers was used, with an additional 34 markers attached to the thoracic and lumbar vertebrae for posture evaluation. Participants held a static standing posture for three seconds, with one second analyzed as the evaluation period. After static standing posture recording, missing markers were corrected using VICON, then adapted to the OpenSim model (FeMaleFullBodyModel_v2.0_OS4.osim) developed by Bruno et al., and Inverse Kinematics and Residual Reduction Algorithm were executed to calculate the angles of the lower limbs and lumbar spine.

RESULTS: As heel height increased, there was a tendency for ankle plantarflexion angle to increase. Similarly, knee flexion angle tended to increase with higher heel heights, while hip angle showed minimal changes regardless of heel height. Pelvic posterior tilt angle showed an increasing trend with higher heel heights. However, lumbar lordosis angle showed minimal variation regardless of heel height.

CONCLUSION: Wearing high heels forces ankle plantarflexion, leading to a kinematic chain of knee flexion and pelvic posterior tilt. Considering the minimal change in lumbar lordosis angle and the increased pelvic posterior tilt angle, it is suggested that the stability of unstable postures like high heels is controlled by the pelvis rather than the lumbar spine. Due to the limited number of participants in this study, further experiments and validation are necessary in the future.

ESTIMATE OF INTERNAL AND EXTERNAL LOAD IN HYPOGRAVITY LOCOMOTION WITH MUSCULOSKELETAL MODELING: A FIRST STEP FOR EVALUATING A COUNTERMEASURE

NATALUCCI, V., COWBURN, J.2, LUCIANO, F.1, HERSSENS, N.3, ALBRACHT, K.4,5, BRAUNSTEIN, B.4, SCHUNGEL, V.5, COLYER, S.2, RITTWEGER, J.6, WEBER, T.3, GREEN, D.A.3,7, PAVEI, G.1, MINETTI, A.E.1, CAZZOLA, D.2

1 UNIVERSITY OF MILAN, 2 UNIVERSITY OF BATH, 3 EUROPEAN SPACE AGENCY, 4 GERMAN SPORT UNIVERSITY, 5 UNIVERSITY OF APPLIED SCIENCES AACHEN, 6 INSTITUTE OF AEROSPACE MEDICINE DLR, 7 KINGS COLLEGE LONDON

INTRODUCTION: Microgravity is known to have a detrimental effect on the human musculoskeletal (MSK) system. Although various countermeasures have been tested during missions, most astronauts still suffer from muscle wasting and bone loss on their return to Earth (e.g. Demontis et al. 2017). In the future, astronauts will locomote once settled on Moon or Mars, but little is known about the load of daily locomotion in such environments and the potential effect on the MSK system. The aim of this study was to calculate external and internal load during different gaits in emulated Moon and Mars gravity levels.

METHODS: Hypogravity levels were emulated with a body weight suspension system in the L.O.O.P. facility (Herssens et al. 2022). Three participants were asked to walk at 1.39 m/s, and run and skip at 1.39, 1.94 and 2.50 m/s on an instrumented treadmill at Earth, Mars and Moon gravity levels while motion capture system recorded the position of 66 markers. Joint angles and net joint moments were calculated using inverse kinematics and dynamics, respectively, in OpenSim.

RESULTS: Ground reaction forces peaks were speed and gravity dependent in all gaits. Running showed the highest vertical average peak at 1.39 and 1.94 m/s in hypogravity (~1.5 BW). At 2.50 m/s, running showed highest peaks on Mars (~1.6 BW), whereas skipping and running shared the same peaks on Moon (~1.2 BW). Joint moments were gait, speed and gravity dependent at the hip and knee. Peak joint moments increased with speed and decreased with hypogravity for all gaits but showed higher values in the trailing leg during skipping compared to walking and running at all gravities and speeds. At the ankle, skipping and running showed similar values at both hypogravity levels (1-1.4 N*m*kg-1), which were

lower than Earth, with highest values observed for running on Earth compared to the other two gaits. Ground reaction force and joint moment values are higher in locomotion compared with submaximal single leg hopping (Cowburn et al. 2024), a promising countermeasure.

CONCLUSION: We have estimated, for the first time, the external and internal load during locomotion at different hypogravity levels. Such information is key to devise exercise programmes in the future to be used by astronauts as countermeasures. External and internal load showed different trends when gait-speed-gravity level were compared, with running generating the highest external load and skipping the highest internal one.

REFERENCES:

Demontis et al. (2017). Human pathophysiological adaptations to the space environment. Front Physiol 8:547.

Herssens et al. (2022). Movement in low gravity environments (MoLo) programme-The MoLo-L.O.O.P. study protocol. PLoS One 17(11):e0278051.

Cowburn et al. (2024). A novel computational framework for the estimation of internal musculoskeletal loading and muscle adaptation in hypogravity. Front Physiol 15:1329765.

THE EFFECT OF SINGLE-TOOTH WOODEN CLOGS (GETA) ON THE WHOLE BODY DURING WALKING

ISHIGURO, K., SAKAI, H., MATSUSHITA, K., NAKAYAMA, T., SHE, J.

TOKYO UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Geta, often referred to as Japanese wooden clogs, are a uniquely Japanese type of footwear that have no parallel in the world. Geta are basically a wooden board called a 'tooth' that stands vertically to the ground with another wooden board placed horizontally over it with a toe strap attached. Typical geta have two-teeth but there are also single-tooth geta. Although geta are rarely used in modern day-to-day life, they are worn when dressing in kimono (traditional Japanese clothing) on special occasions. There are very few examples of kinematic studies using single-tooth geta, and there is little kinematic knowledge about how geta affect humans and whether they are useful in physical exercise.

METHODS: Nine healthy males participated in this study. Their mean (standard deviation) age, height, and weight were 23.2 (2.3) years, 166.4 (7.2) cm, and 58.2 (6.6) kg, respectively. Prior to measurements, the purpose and procedure of this study were explained in detail, and informed written consent was obtained from all subjects. The subjects went barefoot and wore single-tooth and two-teeth geta. Before measurements were taken, subjects were allowed to practice walking with each pair of geta to achieve a comfortable gait. A VICON system and synchronized electromyography were used to capture three-dimensional movements. VICON data were recorded while subjects walked, from the time of heel contact to the completion of the walking cycle. Data were recorded throughout the right stance phase of the walking cycle. We defined the stance phase of the walking cycle, before and after the partial pressure of foot floor reaction, as the 'braking phase'. The latter phase was defined as the 'acceleration phase'. Statistical analyses were conducted using one-factor ANOVA and the Tukey-Kramer correction test.

RESULTS: There were significant differences in the peak values of the floor reaction forces for vertical forces. The vertical component was significantly higher for barefoot and two-teeth geta than for single-tooth geta. In terms of the peak values of joint moments, the plantar flexion moment of the ankle joint increased significantly more in single-tooth geta than in barefoot and two-teeth geta. The dorsiflexion moment increased significantly more in barefoot and two-teeth geta than in the one-tooth geta. Muscle activity of the erector spinae muscles in single-tooth geta was significantly higher than in bare feet ($p<0.05$).

CONCLUSION: When wearing single-tooth geta, the heel rocker function advocated by Jacquelin Perry could not be performed due to the shape of the footwear, so impact was absorbed by the plantar dorsiflexion movement of the ankle joint and the exertion of the plantar flexion moment while shortening the braking period. Based on these findings, single-tooth geta are considered to be relatively high-load footwear because they require a flexible ankle joint strategy.

KINEMATIC AND KINETIC ANALYSIS OF GAIT DURING LEVEL, UPHILL, AND DOWNHILL TREADMILL-BASED WALKING USING TOBLERS HIKING FUNCTION

MANDALIDIS, D., KAFETZAKIS, I.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Hiking is a recreational and physically challenging activity that requires individuals to overcome gravitational resistance during uphill walking and to control excessive impact forces during downhill walking. Considering the impact of increased propulsive forces necessary for uphill walking and the need for effective deceleration strategies during downhill walking, successful and efficient participation in hiking relies on adapting ones speed to the slope of the terrain. This study aimed to investigate the velocity/slope interplay, as determined by Toblers Hiking Function (1), on specific gait kinematic and kinetic parameters.

METHODS: Thirty-two healthy male and female physically active collegiate students were instructed to walk barefoot at 0% slope (level) with a velocity of 5 km/h, uphill slopes at +10% and +20% with velocities of 3.5 km/h and 2.5 km/h, respectively, and downhill slopes at –10% and –20% with velocities of 5.0 km/h and 3.5 km/h, respectively, on an instrumented treadmill. The walking conditions were conducted in a random order, with each condition lasting 4 minutes, followed by a 2-minute break to prevent fatigue. Gait was analysed in terms of spatial (e.g., step length, step width, foot rotation) and

temporal gait parameters (e.g., step time, duration of gait phases) as well as ground reaction forces (GRFs) exerted on the rearfoot, midfoot and forefoot plantar areas.

RESULTS: Statistical analysis revealed a decrease in step length as the slope/velocity interplay progressively became more challenging during both uphill and downhill walking compared to level walking ($p \leq 0.001$). Uphill walking necessitated a progressive increase in outward foot rotation, while downhill walking required an increase in step width. Step and phases of gait cycle durations increased ($p \leq 0.001$), while cadence decreased ($p \leq 0.001$) during uphill walking conditions. Conversely, step time and the duration of gait phases were shorter, and cadence was higher during downhill walking ($p \leq 0.001$). GRFs exerted on the rearfoot, and forefoot were lower when walking on inclined surfaces compared to level walking ($p \leq 0.001$), but they remained unchanged on the midfoot. GRFs were also greater on the forefoot and lower on the rearfoot during uphill walking compared to downhill walking.

CONCLUSION: Walking uphill and downhill at velocities such as those recommended for hiking modifies both spatiotemporal gait characteristics and GRFs. These changes were manifested with shorter and slower steps during uphill walking, ultimately resulting in a slower pace. Conversely, during downhill walking, steps became shorter, wider, and faster, leading to a faster pace. This information may offer insights to various sectors within the hiking industry, as well as to individuals seeking to harness the benefits of outdoor walking by adapting and optimizing specific aspects of it indoors (2).

REFERENCES:

1) Tobler, W. Technical Report, 1993.

2) Niedermeier, M. et al. PLoS One 2017.

KINEMATICS ANALYSIS OF TECHNIQUES IN ARTISTIC GYMNASTICS USING THE AI SCORING SYSTEM -SWITCH LEAP TO RING POSITION ON BALANCE BEAM-

ISHIKAWA, M., NORO, H., HATA, K., YAMAZAKI, Y., LEE, R.Y., YANAGIYA, T.

JUNTENDO UNIVERSITY

INTRODUCTION: The scoring in artistic gymnastics is based on the sum of the Difficulty Score (D-Score), reflecting the difficulty of the skills, and the Execution Score (E-Score), which evaluates the aesthetic quality of the performance. Traditional scoring relied on visual human judgment, leading to concerns about subjectivity and discrepancies in the location of judgment. Recently, AI scoring systems (Judging Support System, Fujitsu, Japan) have been used in international competitions for judging. An AI scoring system makes it possible to estimate 3D skeletal coordinates, without using reflective markers. Therefore, this system not only improves the accuracy of gymnastic motion evaluation but also provides insights into the technical corrections that can enhance athletic performance and reduce injury prevention. This study aimed to clarify the technical factors in the successful execution of "switch leap to ring position" using three-dimensional kinematic analysis with the AI scoring system.

METHODS: Four female college gymnasts performed a total of 120 trials of "Switch to leap to ring position" leap on the balance beam over a 5-day practice period. The AI scoring system was used to identify successful and unsuccessful trials by tracking 18 body points to analyze the kinematic and kinetic of the movement. Specific criteria for success comprised three points: leg split over 180° in both forward and backward direction (Criteria 1), front foot positioned above the horizontal (Criteria 2), and back foot toe pointed above the head (Criteria 3).

RESULTS: Of the 120 "Switch leap to ring position" trials, 82 were successful and 38 were unsuccessful. Out of 120 trials, 45 met Criteria 1 (leg split over 180°), 102 met Criteria 2 (front foot positioned above horizontal) and 68 met Criteria 3 (back foot toes pointed above toes). The 68 trials that cleared Criteria 3 were all successful performances. In contrast, only 41 attempts met all three requirements. Multiple regression analysis showed a significant correlation between Criteria 2 and 3 with skill certification. Successful trials had significantly greater splitting the leg angle in Criteria 1 and significantly higher back foot tiptop position in Criteria 2. Comparing the success and failure of the techniques, a significant difference in Criteria 1 and 3 was found. Successful trials showed a significantly higher average angular velocity (4.4rad/s) compared to unsuccessful trials.

CONCLUSION: The most important factor to be recognized in the "Switch leap to ring position" on a balance beam about the toe of the back foot reaches above the top of the head (Criteria 3). Moreover, increasing the angular velocity of the swinging-up leg is more likely to be certified as a technique.

STRENGTH AND MUSCLE SIZE CORRELATIONS ACROSS BENCH PRESS RANGE OF MOTIONS IN RESISTANCE TRAINED PARTICIPANTS. A PILOT STUDY

FISCHER, J., BURGER, C., SCHÖPFLIN, A., RODOPLU, C., KONRAD, A.

UNIVERSITY OF GRAZ

INTRODUCTION: The range of motion (ROM) during a resistance training exercise has been shown to influence the hypertrophic outcome whereby partial ROM training at longer muscle lengths seem to show a benefit when compared to ROMs at different muscle lengths 1. Given these findings, it would be of interest to assess whether the specific emphasis within individuals resistance training routines correlates with differences in muscle mass. Thus, the aim of this research was to correlate the strength levels, measured by the 10-repetition maximum (10RM), across different ROMs in the barbell bench press exercise (BP) to the cross-sectional area (CSA) of the muscles primarily engaged in the exercise.

METHODS: Ten resistance trained participants (average age 27.2 ± 4.0 years,) volunteered in this study and visited the laboratory on two separate days. The first day was used to record the CSA with ultrasound imaging using the Aixplorer V12.3 ultrasound system (Supersonic Imaging, Aix-en-Provence, France) and to familiarize the participants with the BP and its different ROMs. Ultrasound images were captured in a longitudinal panoramic view for the pectoralis major at two sites, medial and lateral 2 and in a transversal panoramic view for the triceps brachii long head at two sites, proximal and distal to the acromial process 3. On the second day, participants were assessed for their 10RM of the three types of BP variations, a full ROM and two partial ROMs (lower half and upper half of the full ROM). Pearsons correlation was applied to examine relationships between 10RM strength assessments and muscle CSAs.

RESULTS: Pilot data analyses revealed significant correlations between the full ROM BP variation and the medial CSA of the pectoralis major ($r = 0.674$, $p = 0.023$). Furthermore, significant correlations were found between the lower ROM BP variation with the medial ($r = 0.821$, $p = 0.002$) and lateral ($r = 0.742$, $p = 0.009$) CSA of the pectoralis major. Additionally, neither upper ROM BP or triceps brachii showed any significant correlations.

CONCLUSION: Correlations between 10RM strength levels and CSA of the pectoralis muscles were only found for the full ROM and lower ROM BP variations. For the upper ROM BP variation, no correlation was found for any of the investigated muscle locations. These findings add to the expanding body of evidence highlighting the importance of the stretched position in resistance training 4 as individuals who demonstrated greater strength in the lower bench press variation also showed larger cross-sectional area of the pectoralis major. Future training studies will have to investigate potential causalities between higher CSA of the pectoralis major muscle and different ROM settings of the BP exercise.

1.Pedrosa et al., European Journal of Sport Science, 2022.

2.Hernández-Belmonte et al., Ultrasound in Medicine & Biology, 2022.

3.Matta et al., Journal of Strength and Conditioning Research, 2011.

4.Wolf et al., International Journal of Strength and Conditioning, 2023.

PREDICTING THE RUNNING INJURIES WITH KINEMATICS AND KINETICS DATA OF MOTIONMETRIX USING MACHINE LEARNING ALGORITHMS

LI, M.H., LUK, J.T.C., LAM, S.S., LAW, V.K.H., LEE, G., HO, I.M.K.
TECHNOLOGICAL AND HIGHER EDUCATION INSTITUTE OF HONG KONG

INTRODUCTION: Running-related injuries are a significant concern among runners, particularly overuse injuries, impacting their performance and recovery time. Despite efforts to prevent these injuries, current research and programs have shown limited success in reducing injury rates and recurrence. Traditional measures such as solely relying on running volume may provide an oversimplified view of training stress and other factors like ground reaction force and foot-strike pattern are often overlooked. Instead of the linear and unidirectional causality view of sports injury etiology, the complex system perspective proposed a multifactorial unknown interaction among the web of determinants with different weights. The current study combined both clinical tests, survey data, and the joint kinematics and kinetics results generated by the novel markerless running assessment system, MotionMetrix for performing predictive analytics on running injury risk.

METHODS: A total of 30 trained long-distance runners participated in the running assessment. Participants completed the 1-minute MotionMetrix test on a motorized treadmill using 11 km/h speed and 0% inclination. Meanwhile, the clinical tests including the knee-to-wall ankle dorsiflexion mobility test, hip abduction strength test, single-leg squat test, and the foot posture index, as well as the short survey regarding the training and running injury history were recorded. The occurrence of any running injury was the outcome variable while others were treated as the predictors. One-hot-encoding was used to pre-process the nominal categorical data such as gender while the redundant or irrelevant variables were eliminated or filtered out to reduce the dimensionality. Machine learning models were produced using the library Scikit Learn in Python including random forest (RF), support vector machine (SVM), lightGBM (LGBM), and Neural Network (NN). Training and testing data were obtained by 80% and 20% of the original dataset respectively while the k-fold cross-validations were used to reduce the overfitting issues.

RESULTS: The model accuracy and F1 scores were compared to select the best-performed model. Furthermore, the feature importance or SHAP values were calculated to identify the most influential predictors.

CONCLUSION: The combined use of the markerless 3D running gait analysis tool, MotionMetrix system, survey data of training volume, and clinical tests were able to predict the running injuries using the selected machine learning algorithms. It offers a feasible, efficient, and cost-effective alternative overcoming the limitations of traditional laboratory-based evaluation methods. Running coaches can make a better decision and training programs with data analytics using machine learning on a larger dataset.

VALIDATING KINOVEA FOR POSTURAL STABILITY ASSESSMENTS AMONG OLDER ADULTS DURING ONLINE CLINICAL EXERCISE TRIALS

CHEN, E., BERGDAHL, A., ROBERTS, M.
CONCORDIA UNIVERSITY, MONTREAL

INTRODUCTION: While online exercise programs for older adults have been an increasingly popular form of balance training [1], there are no quantitative methods to remotely assess postural stability. The aim of this study was to investigate the validity and reliability of Kinovea, a free video sports analysis software, for tracking shoulder and hip sway. The

assessment involved a comparison with the gold-standard center of pressure (CoP) analyses conducted using force plates [2].

METHODS: 10 women (73.9 ± 5.7 years old) completed three 30-second quiet standing trials on force plates in three staggered conditions: eyes open (EO), eyes closed (EC) and foam with eyes open (FOAM). Trials were filmed from a sagittal view and frame-by-frame analysis of anteroposterior shoulder and hip sway was completed by two blinded raters. Pearson's Correlation Coefficient (r) was used to determine the validity of shoulder and hip sway to CoP displacement. Intraclass Correlation Coefficients (ICC2,1) assessed inter-rater reliability (α=.05).

RESULTS: As conditions increased in difficulty from EO to EC to FOAM, anteroposterior CoP increased (mEO=2.27 ± 0.70 cm; mEC=3.17 ± 1.34 cm; mFOAM=3.46 ± 1.07 cm). Raters demonstrated excellent inter-rater reliability across all conditions for the shoulder (ICC2,1=0.96-.98, p≤.001), and ranged from moderate-good for hip sway (ICC2,1=0.37-0.64, p≤.001). Both raters showed significant moderate correlations between shoulder sway and CoP in all conditions (r=0.54-0.69, p=.002-.001). Raters found diverging relationships between hip sway and CoP ranging from weak-moderate during EO (r2=.39, p2=.032; r1=0.58, p1=.008), moderate-strong for EC (r1=.70, p1≤.001; r2=.60, p2≤.001). Both raters showed moderate correlation during FOAM (r1=.67, p1≤.001; r2=.67, p2≤.001).

CONCLUSION: As CoP displacements became larger, Kinovea showed greater validity and reliability. Shoulder sway is a valid and highly reliable method for remote postural stability assessment. While acceptable, hip sway was greatly influenced by artefacts such as hand movement. Kinovea provides a free and accessible method for online researchers and clinicians to assess the fall risk and effectiveness of balance training among older participants. Future studies should explore the use of AI video tracking to speed-up analyses.

Conventional Print Poster Presentations

CP-AP06 Monitoring II

RELIABILITY OF INERTIAL MEASUREMENT UNIT(IMU) AS A FUNCTION OF RUNNING SPEED

KANG, J.H., KANG, J., PARK, S., YOON, S.

KOREA NATIONAL SPORT UNIVERSITY

INTRODUCTION: Since running is a fundamental and core movement in all sports, there is a lot of research on motion analysis to quantify the lower limb movements during running to improve performance, prevent injuries, and develop shoes for runners(1). However, the equipment used for motion analysis is expensive, requires time-consuming data processing, is not portable, and is limited to laboratories. To solve this problem, wearable devices are being used to analyze movements in real-world situations, such as sports(2). Previous studies using wearables have analyzed movement at slow speeds or at a single, fixed high speed, so it was deemed necessary to verify the reliability of IMUs as speed increases. Therefore, the purpose of this study was to check the reliability of IMUs at various speeds in real sports situations(3).

METHODS: Twelve healthy adult males (age: 27.3±3.8 years, height: 173.1±4.3 cm, weight: 75.3±9.3 kg) with no history of musculoskeletal injury or surgery within the last 6 months participated in this study. Participants were asked to perform running on a treadmill at three different speeds (2.7 m/s, 3.3 m/s, and 4.0 m/s). A 3 dimensional motion analysis was performed using eight infrared cameras (sampling rate: 100 Hz) and four IMUs (sampling rate: 100 Hz) to determine kinematic differences in the lower extremity joints measured by infrared cameras and IMUs with increasing speed. A two-way ANOVA with repeated measures with the statistical significance level set at α=.05.

RESULTS: In RoM of ankle joint, equipment, and an interaction effects between running speed and equipment showed significant differences. Post hoc tests showed that the RoM of the ankle joint was larger for motion capture than IMU at all speeds.

The RoM of the knee and hip joints showed a main effect of speed, equipment, and an interaction effect between speed and equipment. Post hoc tests showed that the RoM of the knee and hip joints increased as running speed increased for both Motion Capture and IMU. Finally like ankle joint, Motion Capture had a larger RoM than IMU for both the knee and hip joints.

CONCLUSION: The results of this study showed that the RoM of the lower extremity joints differed between motion capture and IMU with increasing speed, and larger in Motion Capture. Therefore, when analyzing IMU equipment in the field, it is necessary to apply it with the knowledge that there is an error from the Motion Capture. However, since this study compared the overall RoM in the running section, it was not possible to compare within the entire running cycle. Therefore, in future studies, it is necessary to determine the reliability of the entire section through SPM analysis.

REFERENCES:

1) Perry, J., & Burnfield, J. M. Gait analysis. Normal and pathological function 2nd ed. California: Slack. 2010

2) Park, S., Yoon, S, Sensors, 2021

3) Jeon, T., Lee. J. Journal of the Korean Society for Precision Engineering. 2018

PROCESSING ACCELERATION DATA FROM A SACRUM MOUNTED INERTIAL MEASUREMENT UNIT TO DETERMINE GROUND CONTACT TIME DURING SPRINT ACCELERATION

FESER, E., LINDLEY, K., PERRY, L., STUCKER, R., GILLARD, C.
BELMONT UNIVERSITY

INTRODUCTION: Researchers have determined that a single, sacrum-placed inertial measurement unit (IMU) sensor can be used to record pelvis motion during sprinting [1]. This approach is convenient but lacks reference to other valuable metrics needed to track pelvis motion during sprinting (e.g. contact detection). Signal processing techniques can be used to find step kinematic metrics [2,3] but have not been evaluated for short, accelerated sprints. The purpose of this study was to establish the magnitude of systematic bias and random error in determining ground contact time (CT) obtained from a sport market ready IMU to those obtained from a high-speed camera recording during a 20 m sprint run.

METHODS: Seventeen competitive collegiate athletes completed a 20 m sprint with an IMU and two high-speed video cameras (iPhone 11, Apple Inc., USA; frame rate = 240 Hz) simultaneously recording. The IMU (Blue Trident, Vicon Motion Systems, UK) was placed on the posterior sacrum. To process the IMU data, acceleration vectors were rotated into the global reference frame using the on-board global orientation estimates in quaternion format. This resulted in a vertical acceleration value represented by the third element of the rotated acceleration vector, which was filtered by a fourth order low-pass butterworth filter with a 10 Hz cutoff frequency. CT for steps 1, 2, 4, 7, and 10 were identified as the time between the maximum and minimum vertical acceleration peaks following methods described in [4]. The video recordings were manually analyzed (Kinovea, vers. 0.9.5). To compare CT derived from the IMU to the cameras the following, bias (mean measurement difference between the two devices, IMU – Camera) and random error (1.96 × standard deviation of the differences between the devices) were determined [5].

RESULTS: An average negative bias, indicating a lower measurement for the IMU, was found for all steps (1: -67 ms; 2: -45 ms; 4: -33 ms; 7: -28 ms; 10: -3 ms). Bias measures reported as a percent of the CT identified by video are -35%, -28%, -25%, -22%, and -2.5% for steps 1, 2, 4, 7, and 10, respectively. Random error was largest for step 1 (±95 ms). For steps 2, 4, 7, and 10 random error was ±90 ms, ±76 ms, ±68 ms, and ±78 ms respectively.

CONCLUSION: This study evaluated the use of a sacrum mounted IMU to determine CT for individual steps during a 20 m accelerated sprint. An average negative bias was found for all steps, indicating a lower CT time for the IMU method. The bias values lessened as the sprint progressed, reaching -3 ms at step 10. However, random error at step 10 (±78 ms) represented ±35% of the reference video mean CT. Although bias was relatively low by step 10, practitioners should consider if the potential for error is acceptable with respect to their specific application context.

1. Wada et al. (2020) 2. Day et al. (2021) 3. Lee et al. (2010) 4. Miranda-Oliveira et al. (2023) 5. Bland & Altman (1999)

TIME OF FLIGHT MEASURED USING SMARTPHONE ACCELEROMETER: VALIDITY, RELIABILITY AND SENSITIVITY TO ACUTE CHANGES IN MOTOR PERFORMANCE

GALLINA, A., HUANG, M., MEREDITH, E.
UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Jump height is often considered a key outcome measure in sport performance and rehabilitation, but its measurement in practice relies on the availability of specialized equipment [1]. Smartphone sensors may be a low-cost, widely-available alternative to characterize motor performance in clinics and remotely [2]. We sought to determine whether time of flight estimated using smartphone accelerometer is valid when compared with force platform, reliable between laboratory and home sessions, and whether it can detect changes in performance due to acute pain and fatigue.

METHODS: Twenty healthy participants (20.6 years old, 6 males) participated in one laboratory session and two remote, unsupervised session. In the laboratory participants performed: 1) five maximal countermovement jumps; 2) five maximal countermovement jumps while experiencing during acute knee pain, induced by means of electrical stimulation at an intensity that induced a perceived pain of 5 out of 10 [3]; 3) a 30s continuous jump test. Participants then performed five countermovement jumps at home, 3-5 and 10-12 days after the laboratory session. Two force platforms were used to collect ground reaction forces in the laboratory. Participants held their own smartphone on their chest and collected acceleration data using the Phyphox application [4]. The time of flight during the jumps was calculated as the time when the ground reaction forces were less than 50N, and when the vertical acceleration was higher than -1 m/s2. Validity and reliability between force plate and smartphone estimates were estimated using Intraclass Correlation Coefficient and T-tests, whereas the effect of acute pain and fatigue was estimated using paired T-tests.

RESULTS: Validity of time of flight estimates obtained from force plates and smartphone accelerometer was excellent (ICC=0.96) despite 25ms larger estimates for smartphones ($p<0.001$). Between-day reliability was good (ICC=0.87) between the laboratory and the first home session, and excellent between the two home sessions (ICC=0.93), with no bias in either case ($p>0.08$). Time of flight decreased during experimental pain (force platform: -3.2%, $p=0.001$; smartphone: -2.5%, $p=0.029$) and when comparing the first and last five jumps during the 30s continuous jump test (force platform: -16.8%, $p<0.001$; smartphone: -13.7%, $p<0.001$).

CONCLUSION: Time of flight estimated using smartphone accelerometer is valid compared to force plates, reliable between days and in different environments, and sensitive to changes in performance due to fatigue and pain. The use of the participants' own smartphones, the performance of the task at home unsupervised, and the fact that participants held

the smartphone instead of needing a harness, demonstrates the ecological validity of the proposed approach. Future work should assess the usefulness of this technology in practice.

1. Dutaillis, MSSE 2024;56:181-92

2. Devecchi, PLoS ONE 2023;18:11

3. Gallina, J Physiol 2021;599:2401-17

4. Staacks, Phys Educ 2018;045009

SENSOR FUSION OF HIGH-FREQUENCY RTK GNSS AND IMU IMPROVES THE DETECTION PERFORMANCE OF RUNNING CHARACTERISTICS OF EACH STEP IN 400 M RUN

KEISUKE, O., KIYOSHI, H., NAOTO, M., AKIKO, K., WAKO, K., HIROSHI, N., SHUNYA, U., MASAKI, T.

GRADUATE SCHOOL OF DOSHISHA UNIVERSITY

INTRODUCTION: Analyzing the kinematic characteristics of running performance, such as initial contact (IC) and toe-off (TO) timing, step length (SL), and frequency (SF), is a common practice among scientists and practitioners [1, 2]. Outdoor running is commonly measured by setting markers at intervals (e.g., every 50 m) and calculating section averages of these characteristics using a video camera [3]. This study aims to refine the analysis of running characteristics during 400 m runs, focusing on capturing the changes in running characteristics with each step using sensor fusion of GNSS and IMU.

METHODS: The subject was a male runner specializing in 400 m running. GNSS (Sampling frequency: 100 Hz) and an IMU (1,000 Hz) were attached to the head. The subject completed a 400 m run at maximum effort. Running velocity was measured with differential and real time kinematic (RTK) modes of GNSS. Initial contact and TO timing were detected using IMU acceleration (Y and Z axis) in a global coordinate system estimated by the extended Kalman filter, filtering out centrifugal and tangential accelerations. This process allowed us to identify the exact timestamps for IC and TO. Step length was calculated by synchronizing these timestamps with GNSS (latitude and longitude), defined as the 2D distance between successive IC points. However, the subject's head tilt at IC, which varied between left and right ICs, affected head position and SL accuracy. To address this, head tilt data from the IMU was incorporated, adjusting for discrepancies due to head movements, ensuring a more precise determination of SL. We employed video analysis to validate SL, IC, and TO timings. The imaging of the subject running was recorded by two cameras (PYTHON 1300) at the curved and straight segments of the track, each over 8 m, with footage analyzed using the software WINanalyze for detailed 3D motion insights. Moreover, the subject running was recorded with another Go pro camera to count the number of steps over 400 m.

RESULTS: The GNSS data allowed us to monitor 2D velocity changes at 0.01-second intervals over 400 m. Average root mean square error (RMSE) between 3D analysis and RTK GNSS velocities were 0.31 ± 0.29 m/s on the straight segment and 0.19 ± 0.17 m/s on the curved segment. Initial contact and TO timings were measured by IMU with the accuracy within 0.01 seconds (minimal resolution capability of camera measurement) when compared with camera data. The number of steps over the 400 m measured by IMU was identified as 200, which was the same steps measured by Go pro camera. The difference in SL were 0.082 ± 0.037 m in differential GNSS, 0.032 ± 0.016 m in RTK GNSS, and 0.016 ± 0.011 m in the sensor fusion of RTK GNSS and IMU after correcting for head tilt.

CONCLUSION: It was found that the sensor fusion of GNSS and IMU enables precise and accurate measurements of velocity, IC, and TO timing in each running step with minor errors.

1. Hunter et al. (2004) 2. van Oeveren et al. (2017) 3. Hanon & Gajer (2009)

ACCURACY OF RUN DISTANCE MEASURED VIA CONSUMER SMART WATCHES

LEPLEY, A., MELVIN, A., AUDET, A., WASSERMAN, M., SOLDES, K., DEJONG LEMPKE, A., KOZLOFF, K.

UNIVERSITY OF MICHIGAN

INTRODUCTION: Smart watch technology is widely used by athletes to obtain metrics on fitness and enhance the overall exercise experience. The capability to accurately measure and report on running distance, both indoor and outdoor, is pivotal for providing users with valuable feedback during and post-activity, and can influce pace metrics and workout trends. As individuals increasingly rely on devices to track and monitor workouts, it becomes imperative to evaluate the precision of distance measurements so consumers can make informed decisions. The purpose of this study was to evaluate the accuracy of consumer smart watches in measuring run distance in indoor and outdoor environments.

METHODS: 102 participants (age: 39.7±13.9yrs; BMI: 23.8±4.0kg/m2) completed 2 running sessions on separate days at self-selected pace: 1. outdoor 5km run on the same predetermined GPS measured route, and 2. an indoor 5km run on a treadmill (4Front, Woodway). A subset of participants performed a 3rd trial of either a standardized GPS measured outdoor (n=13) or indoor (n=12) 20km run. During all runs, participants wore a Garmin Forerunner 945 on their right wrist, and an Apple Watch Series 7 (proximal) and Samsung Galaxy Watch 5 (distal) on their left wrist. Distance was recorded from each device after the run and mean absolute error (MAE) and mean absolute percent error (MAPE) were calculated from the known distance from the measured route/treadmill reading. Intraclass correlation coefficients (ICC) with absolute agreement were used to assess agreement between devices.

RESULTS: Samsung (MAE: 0.10±0.18km; MAPE: 3.2±10.5%), Garmin (MAE: 0.07±0.11km; MAPE: 1.4±2.3%) and Apple (MAE: 0.07±0.19km; MAPE: 1.5±3.8%) watches demonstrated good agreement with each other (ICC(3,3): 0.84, $p<0.001$) during the outdoor 5km trial and demonstrated less error compared to the indoor 5km trial (Samsung MAE: 0.77±0.46km; MAPE: 15.4±9.3%; Garmin MAE: 0.69±0.71km; MAPE: 13.9±14.2%; Apple MAE: 0.49±0.51km; MAPE: 9.9±10.2%). The devices

demonstrated moderate agreement during the indoor 5km run (ICC(3,3): 0.59, p<0.001). Similarly, Samsung (MAE: 0.18±0.18km; MAPE: 0.9±0.9%), Garmin (MAE: 0.05±0.04km; MAPE: 0.2±0.2%), and Apple (MAE: 0.19±0.81km; MAPE: 0.9±0.4%) watches demonstrated moderate agreement (ICC (3,3): 0.52, p=0.04) and less error during the outdoor 20km trial compared to the indoor 20km trial (Samsung MAE: 3.51±1.89km; MAPE: 17.5±9.4%; Garmin MAE: 2.12±1.37km; MAPE: 10.6±6.8%; Apple MAE: 0.93±0.74km; MAPE: 4.6±3.7%). The devices demonstrated poor agreement during the indoor 20km run (ICC (3,3): 0.33, p=0.05).

CONCLUSION: Consumer smart watches demonstrate less error on distance metrics during outdoor compared to indoor runs. The three watches tested demonstrate moderate-to-good agreement on outdoor distance, and poor-to-moderate agreement on indoor distance measurements. Consumers can use this information when understanding the accuracy of distance metrics measured by smart watch technology in varying environments.

RUNNING DEMANDS AND PHYSICAL PERFORMANCE CHARACTERISTICS OF COLLEGIATE RUGBY SEVENS PLAYERS

HSU, J.T., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The purpose of this study was to analyze the movement patterns in college Rugby Sevens matches to determine the physiological requirements of the athletes. The data obtained can provide coaches with useful insights to develop effective substitution strategies, design training regimens for the next season, and ultimately enhance the competitive level of play.

METHODS: A study assessed running loads and high-intensity actions in 11 university rugby players (age: 19 ± 1.85 years, height: 1.75 ± 0.05 m, weight: 76 ± 8.38 kg) during a halftime game. The players wore validated GPS devices (APEX, STATSport, Northern Ireland) sampling at 10 Hz, along with accelerometers and gyroscopes sampling at 100 Hz. Running loads were quantified by total distance (TD, m), high-intensity running distance (HIRD, > 14.1 km/h, m), maximum speed (MS, km/h) and average speed (AVGS, km/h). High-intensity actions included sprints (> 20 km/h, n), accelerations (> 2.5 m/s2, n) and decelerations (< -2.5 m/s2, n). A repeated measures one-way ANOVA was conducted for each minute of the game to analyze the running loads and high-intensity actions.

RESULTS: The findings show that total distance (TD) covered in the first minute was markedly higher than subsequent minutes. In the first half, high-intensity running distance (HIRD) declined significantly after the first minute. Similarly, in the second half, HIRD was substantially lower in several minutes compared to the first minute. Maximum speed (MS) and average speed (AVGS) peaked in the opening minute, being markedly faster than other minutes. However, MS slightly rose again in the fifth minute. For high-intensity actions, sprinting and acceleration patterns showed no differences during the match. Yet, there were more decelerations in the first and final minutes of the second half. In summary, TD, HIRD, MS and AVGS declined after the intense first minute, while decelerations increased at the start and end of the second half.

CONCLUSION: This study analyzed movement patterns per minute during collegiate Rugby Sevens matches. Activity levels were highest in the opening minute, implying fatigue increasingly hindered physical performance as time progressed. However, by the fifth minute, speed and movement appeared to recover to an improved range before declining again due to fatigue. The high-intensity running distance (HIRD) revealed that fatigue escalated at a faster rate in the second half versus the first. Overall, these findings offer useful insights for substitutions tactics and fitness training by highlighting the intense early demands and accelerating fatigue over the duration of a Rugby Sevens match. The peak physical outputs in the initial minute followed by declining intensity underscores the importance of pacing and planned rotations. Furthermore, the more rapid onset of fatigue in the second half emphasizes the need for targeted conditioning to mimic match demands.

HIGH INTENSITY MOVEMENT DEMANDS ON COLLEGIATE DIVISION II WOMEN'S BASKETBALL PLAYERS: DESCRIPTIVE ANALYSIS FROM A SINGLE SEASON

FRINKS, C., BEST, S., WELCH, E., MENDONCA, J., ANDERSEN, J.

THE UNIVERSITY OF TAMPA

INTRODUCTION: Basketball is a physically demanding sport that requires high intensity movements in all directions. Therefore, understanding high intensity movement is integral to optimizing training, performance, and injury prevention (3). Investigating high intensity movements (e.g., accelerations, decelerations and changes of direction) in games has been done in other sports, namely football (1-3), however we are unaware of literature addressing these variables in women's collegiate basketball. Our purposes were to identify the high intensity movement demands and movement patterns by position in women's collegiate basketball.

METHODS: Fourteen games from the 2023-2024 season were monitored. Data were collected from 9 players (age 21.8±1.6 years [range 18-24]; height 174.7±8.8cm) from the university womens team. Of the 9 players, 6 were guards (G) and 3 were forwards/centers (F/C). A threshold of 10 minutes played per game was used to include individual performance measures. Catapult S7 sensors in indoor mode and OpenField Console 3.10.1 were used to capture movement counts for the following variables: change of direction left high (CoD-LH), change of direction right high (CoD-RH), acceleration high (ACC-H) and deceleration high (DEC-H). The data were visualized using OpenField Cloud 4.7 and exported to excel to assess data quality. We obtained 46 observations for each variable from the G and 36 observations for each variable from the F/C for a total of 328 observations. Jamovi 2.3.28 was used to calculate descriptive statistics. In addition, the proportion of high intensity movements in each direction were expressed as a percent of the total.

RESULTS: Average minutes played per game was 34±20.4 for G and 25.6±5.6 for F/C. The median CoD-LH was 5.5 (IQR=2.75) for G and 7.5 (IQR 5.25) for F/C. For CoD-RH the median was 8 (IQR=6) for G and 9.5 (IQR=6) for F/C. For ACC-H the median was 13 (IQR=11) for G and 14.5 (IQR=9.5) for F/C. For DEC-H the median was 6 (IQR=4.75) for G and 4 (IQR=9.5) for F/C. Relative to the total, CoD-LH accounted for 16.6% and 19.5% of high intensity movements for G and F/C, respectively. CoD-RH was 28.6% for G and 27.2% for F/C. ACC-H accounted for 37.1% for G and 41.2% of the total for F/C. DEC-H was 17.6% for G and 12% for F/C.

CONCLUSION: Our results indicate that the high intensity demands and patterns of movement are similar for G and F/C. ACC-H was the largest portion of the total demand and had the greatest variability for both positions. Both groups had greater CoD-RH than CoD-LH, which may be explained by team and individual factors. Further investigation is needed to better profile the high intensity demands of women's collegiate basketball. In practice, understanding these demands and patterns can be used to tailor training to better reflect game demands.

1.Galé-Ansodi, C et. al. (2019). Annals of Reviews and Research, 5(2), 60-3

2.Harper, DJ et. al. (2019). Sports Medicine, 49, 1923-1947

3.Szigeti, G et. al. (2021). Sport Perform Sci Rep, 1(Nov), 145

THE INFLUENCE OF THE VIDEO ASSISTANT REFEREE (VAR) ON THE UEFA EUROPEAN FOOTBALL CHAMPIONSHIP

BAO, R.1, LI, Y.2

1. UNIVERSITY OF EDINBURGH 2. UNIVERSITY OF GLASGOW

INTRODUCTION: With the rapid development and enhancement of sport technology, a variety of high-tech auxiliary devices have gradually been introduced into football. The Video Assistant Referee (VAR) was officially introduced at the 2020 UEFA European Football Championship in order to assist referees in officiating the match. The aim of this study is to explore the influence of the introduction of VAR on the UEFA European Football Championship.

METHODS: The match sample includes all 51 matches played in the 2016 UEFA European Football Championship without VAR and all 51 matches played in the 2020 UEFA European Football Championship with VAR. The following nine match performance variables were recorded for each match: the first-half match time, the second-half match time, total match time, offsides, fouls, yellow cards, red cards, goals and penalties. All the match statistics were retrieved from the UEFA official website (www.uefa.com). The statistical significance was set at $p < 0.05$. An independent sample T-test was first conducted to compare the difference between the variables with and without VAR. Subsequently, a mixed linear model (MLM) was used to clarify intra-tournament variations and control the random effects.

RESULTS: The results demonstrated that after the introduction of VAR, there were significant increases in the 1st match time [$p < 0.001$, Cohen's d = −0.335, 95%CI (−0.498, −0.272)], the 2st match time [$p < 0.001$, Cohen's d = −0.233, 95%CI (−0.506, −0.107)], total match time [$p < 0.001$, Cohen's d = −0.366, 95%CI (−0.689, −0.61)] and the number of penalties [$p < 0.001$, Cohen's d = −0.282, 95%CI (−0.395, −0.06)]. In comparison, a significant decrease was observed in the number of offsides [$p < 0.001$, Cohen's d = −0.456, 95%CI (0.211, 0.369)] after the introduction of VAR. In addition, the result of MLM found that the first-half match time ($p < 0.01$), the second-half match time ($p < 0.01$), total match time ($p < 0.01$), offsides ($p < 0.01$) and penalties ($p < 0.01$) were still significant after control for the random effects of the tournament period.

CONCLUSION: The findings demonstrated significant increases in the first-half match time, second-half match time, total match time and the number of penalties. Furthermore, there was a significant reduction in the number of offsides after the introduction of VAR. In summary, this research may help football practitioners and fans better understand the influence of VAR on the worlds top professional football tournament., especially on the UEFA European Football Championship and also help to optimise referees' officiating strategies.

AN EVALUATION OF THE USE OF IMMERSIVE 360° VIDEO AS A REFLECTION TOOL FOR COACH EDUCATION IN FOOTBALL

ANDRONIKOS, G., CUNNIGHAM, I.

EDINBURGH NAPIER UNIVERSITY

INTRODUCTION: Recent research has identified the benefits of 3D video immersion in sport coaching situations for strengthening coach observation (Lombard et al., 2022) and assessing expertise differences (Nishihara et al., 2022). 360° video captures an omnidirectional view of the natural environment that can be later used in reflection and education of professional practices, as evidenced teacher education and other work analysis fields. The aim of this case study was to investigate the bi-modal use of 2D video and 360° video images by developing football coaches to explore its acceptability and usability as a reflective practice tool as part of their UEFA B Licence.

METHODS: Micro-coaching sessions were captured through a head-mounted, mobile 360° video recording approach (from the student coaches moving perspective). Video was later synchronised with a VEVO gantry perspective video recording of the same session. Later, collective allo-confrontation interviews as outlined by Mollo and Falzon (2004) were conducted with student-coach dyads to elicit their perceptions and attitudes about the observed novice coach. This involved 3 independent focus groups which included 6 student-coaches, a coach educator, and the researcher. The interview guide consisted of open-ended questions and students had the autonomy to alter between the 360° video (freely rotating and searching the image) and the fixed video, pause and discuss points of interest.

RESULTS: Student-coaches outlined that the immersive angle allowed them to grasp the interactions between coach and players through an enhanced emotional immersion in the coaching situation. This was highlighted by increased noticing

behaviour demonstrated by the student coaches through the bi-modal use of the video provided to detect and more deeply interpret social cues of the observed coaching situation. This facilitated a better understanding in relation to the manner of coaching which is a key criterion for the UEFA B Licence requirements but also an essential element of effective coaching in general.

CONCLUSION: Limitations associated with recording and other pragmatic factors are discussed concerning 360° video capture and use. Implications of this case study suggest that 360° video has strong potential within the coach education process of developing coaches (for example, as a pedagogical tool through an Extend Reality (XR) curriculum) or could also be a valuable tool for evaluation purposes within elite academies.

References

Lombard, G., Dejong, B., Mouton, A., & Cloes, M. (2022). Evaluation of the volleyball coaches' experience in a 3-dimensions environment. Movement & Sport Sciences, (1), 33-42.

Nishihara, Y., & Uchiyama, W. (2022). Characteristics and Differences in the Verbal Responses of Expert and Novice Basketball Coaches Elicited by Cognition of Fixed Camera Images and VR Images. International Journal of Sport and Health Science, 20, 181-192.

BODY OXYGEN LEVEL TEST IS NOT ASSOCIATED WITH ATHLETIC PERFORMANCE IN HIGHLY-TRAINED INDIVIDUALS

KOWALSKI, T., WILK, A., REBIS, K., KLUSIEWICZ, A., WIECHA, S., PALECZNY, B.

INSTITUTE OF SPORT - NATIONAL RESEARCH INSTITUTE

INTRODUCTION: The analysis of chemoreflex and baroreflex sensitivity in clinical and sports settings provides valuable information regarding respiratory and cardiovascular function. Therefore, it may contribute to optimizing patient care and athletic performance. Due to the limited feasibility of golden standard clinical tests, breath-holding tests have gained popularity as an alternative evaluation of reflex control over the cardiorespiratory system.

Body Oxygen Level Test (BOLT) is one of the most popular subjective breath-holding tests in sports settings. According to its proponents, the BOLT score reflects the body's sensitivity to carbon dioxide and homeostasis disturbances, providing feedback on exercise tolerance. Popularized by Patrick McKeown and "The Oxygen Advantage®" method, it is frequently mentioned in literature, podcasts, videos, and workshops worldwide.

Despite its popularity, BOLT has never been scientifically validated or linked with athletic performance in highly-trained individuals. Therefore, we investigated the association of BOLT scores with the results of well-established performance tests in elite speedskaters.

METHODS: A group of 49 elite speedskaters (n=33 males, age 19.16 ± 2.33 years, VO2max 59.51 ± 5.14 mL/kg/min; n=16 females, age 19.53 ± 4.06 years, VO2max 49.53 ± 4.80 mL/kg/min) representing national teams from 3 countries performed BOLT, Wingate Anaerobic Test (WAnT), and cardiopulmonary exercise test (CPET) on a cycloergometer. Peak power, total work, and power drop were measured during WAnT. Time to exhaustion and VO2max were measured during CPET. Spearman's rank correlation and multiple linear regression were performed to analyze the association of BOLT scores with parameters obtained during the tests, age, somatic indices, and years of training.

RESULTS: No significant correlations between BOLT scores and parameters obtained during WAnT and CPET were found, $r(47) = -.17$ to $.01$, $p = .25$ to $.98$. The parameters obtained during the tests, age, somatic indices, and years of training were not significant in multiple linear regression ($p = .38$ to $.85$). The top-performing regression model showed an $R2$ of only 0.08 and RMSE of 9.78.

CONCLUSION: Numerous narrations and services related to breathing are now promoted with claims of therapeutic or performance benefits. However, our findings do not confirm a significant relationship between BOLT scores and athletic performance. Age, somatic indices, and years of training were not significant in our analysis. The source of the lack of relationship between BOLT and investigated variables remains to be established. Speculatively, it may be associated with BOLT's limitations, narrow variability of reflex sensitivity in elite athletes, both, or other factors. It is recommended not to interpret BOLT concerning athletic performance in the elite population.

Conventional Print Poster Presentations

CP-AP08 Fatigue recovery and intervals

ELITE YOUTH FOOTBALL GOALKEEPERS OUTPERFORM AMATEUR ADULTS IN REACTIVE AGILITY TASK WITHOUT A SIGNIFICANT CONTRIBUTION OF FATIGUE

SKALA, F., KOVÁC, K., ZEMKOVÁ, E.

COMENIUS UNIVERSITY IN BRATISLAVA

INTRODUCTION: The performance of football goalkeepers (GKs) includes rapid changes in movement direction in response to visual stimuli. The available reactive agility tests, used to assess this ability, are sensitive enough to distinguish between field players of different performance levels [1,2]. However, there is a missing link in the reactive agility testing of football GKs. Furthermore, increasing repetitions of reactive tasks could produce fatigue, which is often neglected in the

evaluation of reactive agility. Applying the novel "Football reactive agility for goalkeepers task" (FRAG), this study compares the reactive agility performance of elite youth and amateur adult GKs and analyses their changes in reaction speed with an increasing number of stimuli.

METHODS: Eight elite youth (EY; 14.3±0.9 y) and eight amateur adult goalkeepers (AA; 21.6±1.3 y) underwent the reactive agility task, consisting of reaction to 8 light-based stimuli randomly displayed on 4 LED sensors (WittySEM, Microgate, Bolzano, Italy). These sensors were 2 m apart from the starting point and located at 30° and 60° angles. Participants ran and reacted to stimuli separated by 2 seconds with their hands. They performed 3 trials of the task with a 3-min rest interval. The best average reaction time of trials from the 2nd to the 7th stimulus was considered as a result of the FRAG task. Intraclass correlation (ICC) of the task with 95% CI was calculated. The Mann-Whitney U test with Cohen's r effect size was used to compare the groups. These data are presented as median±SEM. The changes in reaction speed with an increasing number of stimuli were analysed using repeated measures ANOVA and Tukeys post hoc test.

RESULTS: The ICC of the trials showed moderate to good reliability of the FRAG task (0.74-0.89). The average reaction time in the reactive agility task was shorter in the EY than in the AA group (Δ–0.04±0.014 s; –1.62%; p=.028; ES = .503, large effect). Repeated measures ANOVA showed non-significant differences between reaction times to consecutive stimuli in both the EY (F [7, 159] = 1.751, p = 0.10), and the AA group (F [7, 159] = 0.98, p = 0.45).

CONCLUSION: The EY GKs outperformed the AA GKs in the FRAG task. Both groups were able to maintain their level of reaction speed when responding to an increasing number of stimuli. The influence of fatigue occurred as the "U-effect" with the lowest reaction times from the 2nd to the 5th response and further increases until the last 8th response. These changes were comparable in EY and AA groups. The FRAG task provides a potential evaluation method for the reactive agility assessment of football goalkeepers.

1. Pojskic et al. (2018). Frontiers in Physiology 9(506)

2. Trajković et al. (2020). Int. J. of Env. Res. and Pub. Health 17(11)

This work was supported by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences (No. 1/0725/23).

INDUCEMENT AND PERCEPTIONS OF MENTAL FATIGUE IN NATIONAL-LEVEL FENCING

BIAN, C., RUSSELL, S.2, ROELANDS, B.1

1 VRIJE UNIVERSITEIT BRUSSEL; 2 AUSTRALIAN CATHOLIC UNIVERSITY

INTRODUCTION: Growing evidence identifies the presence, fluctuation, and persistence of mental fatigue (MF) in training and competition settings. Fencing is a sport that has seen a recent increase in scientific research. It is a typical skill-based combat sport with intermittent intensive mental demands. Exploring the nature and presence of MF in fencing provides insights to inform the practice and strategic approach of athletes and coaching staff.

METHODS: A mixed-methods survey obtained 92 national-level adult practitioners perceptions of MF and understanding of its potential inducement in fencing. Thematic analysis interpreted open-text responses to specific definitions of MF. Frequency counts representing fencing-specific factors perceived to be associated with mental fatigue were reported. Perceptions of MF following fencing competition and training, and analysis of specific moments and processes were obtained using a 100mm visual analog scale. Results were displayed as mean ± SD and paired t-tests were performed to determine potential differences between perceptions of MF between moments and processes to elucidate fencing-specific MF inducement.

RESULTS: Most respondents (88%) were active fencers or coaches representing all three fencing disciplines (Epee/Foil/Sabre). Participants indicated MF was more prominent after a game than training. Participants perceived MF to be associated with negative emotions (n=27), uncomfortable brain and whole-body feelings (n=24), worsened psychomotor response (n=20), disengaged thought (n=13), and sleep disturbance (n=9). In official competitions, respondents evaluated higher MF after an elimination stage game than after the pool stage (57.59±21.02 vs. 49.21±21.73; p<0.001). Sleep quality (78.26%), match environment (50.0%), and preparation duration (43.48%) were considered the most influential external inducers of MF. Higher tactical (t=6.22, p<0.001), technical (t=3.92, p<0.001), and psychological (t=3.81, p<0.001) contributions to MF were reported in relation to post-match vs. post-training. Respondents rated the cumulative execution of decision-making (57.36±23.27) and attack (51.93±25.92) as most effortful moments that induced MF during the match. The survey indicated that within a single competition bout, attention maintenance (61.80±27.11), anticipation of the opponent (53.15±24.85), and emotional regulation (52.87±25.74) contributed predominantly to perceived MF inducement.

CONCLUSION: National-level fencers indicate elevated MF following competition and associate this with emotional, behavioral, and physical sensation changes. The inducement of MF in fencing combat was primarily attributed to the accumulative decision-making, attention, anticipation, and emotion regulation processes. The present findings emphasize the importance and impact of MF in fencing and highlight potential factors and interrelationships that require further applied investigation.

THE RELATIONSHIP BETWEEN EXTERNAL AND INTERNAL LOAD IN RESISTANCE TRAINING WITH DIFFERENT INTER-SET REST INTERVALS AND TRAINING TO FAILURE

YEH, K.T., CHENG, H., TSAI, S., LIU, H.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The correlation between external load, such as exercise work rate (WR) and exercise density (ED), which incorporate exercise duration into calculation, with internal load, such as lactate levels and session rating of perceived exertion (sRPE), is evident. Existed studies in the relationship between external and internal load are still a lack of different inter-set rest intervals and training to failure. Therefore, this study aimed to assess the relationship between external and internal load in resistance training with different inter-set rest intervals and training to failure.

METHODS: Healthy young males (n = 18; age = 22.9 ± 1.9 years; weights = 69.7 ± 5.9 kg) completed four trials, namely resistance exercise with short (60 seconds), medium (120 seconds), and long rest (180 seconds) interval and training to failure (120 seconds rest interval). The prescription consisted of squat, bench press, and deadlift, performed for 3 sets of 7 repetitions (70% of 1RM). Blood lactates were measured before and after exercise. sRPE was assessed 30 minutes post-exercise. External load calculations included WR(VL) = (load × repetitions × sets) ÷ exercise time (kg/min), WR(J) = (load × repetitions × sets × distance) ÷ exercise time (joules/min), and Exercise density (ED) = (load × repetitions × sets) ÷ total rest interval time (kg/min).

RESULTS: sRPE and changes in blood lactate concentration were higher in short rest interval compared to long rest interval, and in failure trial compared to non-failure trial ($p < 0.05$). WR (VL), WR (J), and ED decreased with inter-set rest intervals. WR (VL), WR (J), and ED in the failure trial were higher than medium and long rest intervals, whereas ED in the failure trial was significantly lower than short rest interval ($p < 0.05$). Moderate correlations were found between external load and sRPE ($p < 0.05$, $r = 0.303$-0.406) and changes in blood lactate concentration ($p < 0.05$, $r = 0.416$-0.498).

CONCLUSION: The relationship between external and internal load in resistance training with different inter-set rest intervals and training to failure further ensured the reliability of external load to monitor the training dose.

THE USE OF THE SELF-SELECTED REST INTERVAL METHOD IS AS EFFECTIVE FOR OPTIMIZING POST-ACTIVATION PERFORMANCE ENHANCEMENT IN ELITE ATHLETES AS EMPLOYING THE BEST FIXED REST INTERVAL

LIMA, L., BARRETO, R., JUNIOR, R., FONTANETTI, G.
UNIVERSITY OF SÃO PAULO

INTRODUCTION: Responsiveness to post-activation performance enhancement (PAPE) has been extensively investigated and shown to be modulated by factors relating to an individuals inherent characteristics (e.g., fiber type distribution, biological sex or age) and previous history with exercise (e.g., training status or the manifestation of exercise-induced muscle damage) or to pre-activation (PA) protocol-related factors (e.g., load, number of sets and repetitions or the rest interval between PA and performance assessment). Addressing the former, recent research indicated that trained individuals exhibit greater PAPE responsiveness using a self-selected recovery interval (SSI) compared to a fixed four-minute recovery interval (FRI), which negatively affected performance. However, comparing PAPE responsiveness using a single FRI and SSI might be misleading, as optimal recovery intervals can vary among individuals. This study aimed to investigate whether adopting SSI is more effective in inducing PAPE than utilizing five different fixed recovery intervals (FRI) and the individual's best recovery interval.

METHODS: After familiarization with countermovement jump (CMJ) exercises and determining the load for five-repetition maximum (5RM: 146 ± 27 kg) squat exercise, ten male professional volleyball athletes (20.6 ± 1.5 years; 92.8 ± 4.9 kg; 195 ± 8 cm) from Brazil's national youth league participated in three randomly order experimental sessions: 1) control session (CON), with measurement of CMJ height 4 minutes before and 2, 4, 6, 8, and 10 minutes after participants rested without PA; 2) session with FRI, with measurement of CMJ height at 2, 4, 6, 8 and 10 minutes after performing a PA exercise consisting of five squats with 5RM load (the best recovery interval during this session was also considered by identifying the time-point at which each participant achieved the greatest CMJ height); and 3) session with SSI, with measurement of CMJ height once after performing the PA with a SSI based on a readiness scale. CMJ height values recorded at all time-points were compared to values recorded at baseline in the CON session using one-way ANOVA followed by Bonferronis post hoc tests.

RESULTS: No significant differences were observed between CMJ heights registered in the CON session. CMJ height was higher ($p < 0.05$) than the baseline measurement at minutes 4, 6, and 8 post-PA in the FRI session, for the best individual recovery interval during the FRI session, and after the PA in the SSI session. No significant differences were found between the CMJ heights of the best individual recovery interval in the FRI session (49.2 ± 6.8 cm at 315 ± 89 seconds post-PA) and post-PA in the SSI session (49.6 ± 6.6 cm at 213 ± 63).

CONCLUSION: Adopting FRI and SSI are equally effective in inducing PAPE in elite athletes. Despite being as effective as adopting FRI to induce PAPE, SSI is more intuitively applicable in contexts where PAPE is implemented.

THE RELATIONSHIP BETWEEN METABOLIC AND MECHANICAL ENERGY COSTS AND LONG SPRINT PERFORMANCE: FOCUS ON INTRA-INDIVIDUAL VARIATION

MURATOMI, K., FURUHASHI, Y., USHIROOKA, N., TANIGAWA, S., MAEMURA, H.
UNIVERSITY OF TSUKUBA

INTRODUCTION: Unlike the short sprint, in the 400 m race it is well known that the body cannot complete the event at maximum effort. This compels even the elite athlete to compromise in the areas of speed and energy expenditure. Reis and Miguel [1] found that the 400 m performance improvement was matched by significant decreases in the oxygen uptake during the run. Mann and Murphy [2] reported that the most successful long sprinter is the one who is able to produce the most economical mechanics performance. However, few studies have examined in detail changes in metabolic and mechanical variables within individuals. Therefore, the aim of this study was to assess metabolic and mechanical energy costs during a supramaximal running test and to comprehensively examine the components that determine to improved performance in long sprinters.

METHODS: Five trained 400 m or 400 m hurdles runners performed a supramaximal constant load test for 50 seconds on a treadmill (ORK-7000, Ohtake Root Kogyo, Japan). During the constant load were determined the metabolic responses (i.e., gas exchange and blood lactate) to estimate the energetic contribution. The mechanical variables were calculated by the kinematic responses. The test was conducted two times for all participants, and the two tests were classified into high-performance condition (HPC) and low-performance condition (LPC) according to the result in most recent competition. The velocity was chosen based on mean velocity during 400 m run so that the participants could run for 50 seconds, and the same velocity was used in the two tests for each participant. A paired samples t-test was used to detect differences between the variable values in the two moments of assessment.

RESULTS: The oxidative, glycolytic, and phosphagen metabolisms were no significant differences between HPC and LPC respectively. Additionally, there were no significant differences in stride parameters. However, whole body mechanical work per unit distance was significantly lower in HPC than in LPC.

CONCLUSION: The findings suggest that the running technique of lower mechanical work per unit distance is an important component of long sprint performance.

1. Reis, V. M. and Miguel, P. P. (2007) Changes in the accumulated oxygen deficit and energy cost of running 400 metres. New Studies in Athletics, 22(2): 49-56.

2. Mann, R. V. and Murphy, A. (2022) The mechanics of sprinting and hurdling. CreateSpace Independent Publishing Platform.

IMPACT OF A RESISTED OR ASSISTED SPRINT TRAINING IN INDIVIDUALS WITH CONTRASTING FORCE-VELOCITY PROFILES - A PILOT STUDY

VOLK, N.R., FERRAUTI, A.
RUHR UNIVERSITY BOCHUM

INTRODUCTION: Optimizing sprint performance is crucial in many sports (e.g., football) (1). In this regard, resisted and assisted sprints are commonly used training methods (2). There is still insufficient evidence regarding the efficiency of interventions for individuals with different preconditions and their adaptation to training (1). Therefore, the study aims to evaluate the effects of resisted and assisted sprint training on two groups of subjects with contrasting force-velocity profiles.

METHODS: After initial pre-testing (PRE), 15 male students volunteered for a 6-week training intervention (two sessions per week) followed by two post-tests (POST) separated by one week. The intervention included either heavy-resisted sprints (HRS; n=7) or assisted sprints (ASS; n=8). PRE and POST included two all-out 30m outdoor sprints and a load-velocity profile (LVP) using three resisted sprint conditions (10, 20, 30% body weight). Subjects were categorized into a force-dominant (FD) or a velocity-dominant (VD) type based on their force-velocity profile (F-v) according to the median of an unpublished male reference sample (n=47). Subjects were then randomly advised to either HRS or ASS. Prior to each training session, a free 30m sprint was conducted to set the subsequent training intensity under consideration of LVP. The HRS group targeted a 40-60% velocity loss over 10-20m. The ASS group aimed for a 5-10% velocity increase over 25-35m. All measurements and training loadings were conducted using a motorized device (333 Hz). Descriptive and individual analyses were used to evaluate the changes in split times (5m, 30m) and F-v measurements (F0, v0).

RESULTS: Small improvements between PRE and POST were shown in HRS (5m: -0.08±0.15s, d: -0.54±1.00; 30m: -0.07±0.16s, d: -0.39±0.87; F0: 0.28±0.64 N/kg), while small changes in ASS were only found for v0 (0.20±0.22m/s, d: 0.50±0.59). Overall, beneficial adaptations were less in the ASS for short-distance measurements at POST but more profound for longer-distance measurements. Regarding the FD and VD typology, subgroups demonstrated inconsistent changes independent of the training group.

CONCLUSION: Individual effects after a 6-week training intervention of heavy resisted or assisted sprint training are not straightforward. The HRS intervention tends to lead to more beneficial adaptations towards acceleration-dominant measurements, while over-speed training seems to improve only speed-dominant measurements. However, this dataset does not provide a definitive conclusion depending on the initial slope and training group. There are small indications that the acceleration of subjects with a flatter F-v slope (VD) might benefit from HRS. An extension of the dataset is in process.

(1) Lahti et al. 2020, Sports, 8(5), 74. doi: 10.3390/sports8050074

(2) Cahill et al. 2019, Sports, 7(5), doi: 119. 10.3390/sports7050119

EFFECT OF HOT WATER IMMERSION OF HAND AND FOREARM DURING HALF-TIME ON PHYSIOLOGICAL RESPONSE AND SUBSEQUENT EXERCISE PERFORMANCE IN A COLD ENVIRONMENT

YAMASHITA, Y., UMEMURA, Y.
CHUKYO UNIVERSITY

INTRODUCTION: Half-time (HT) strategies are important for preventing a decrease in high-intensity exercise performance in the early 2nd half during intermittent team sports [1]. Decreased body temperature during HT is reported to be associated with a decrease in high-intensity exercise performance in the early 2nd half [2]. Methods of passive heat maintenance such as wearing heated jackets and hot water immersion are considered to be effective for attenuating the reduction in body temperature and exercise performance [3]. The hands have a high surface area-to-mass ratio and arteriovenous anastomoses, which, together with superficial veins up to the elbow, constitute a specialized heat exchange organ [4], that which may be the large potential area for heat transfer. Therefore, the aim of current study was to investigate the effects of hot water immersion of the hand and forearm during HT on physiological response and exercise performance in a cold environment.

METHODS: Ten healthy men (age 22 ± 2 years, height 170.6 ± 2.1 cm, body mass 63.1 ± 4.5 kg) participated in this study. Participants performed experimental sessions that consisted of 40 min of intermittent cycling in the 1st half, a 15-min HT, and an intermittent cycling sprint test as the 2nd half. During the 15-min HT, participants underwent two different interventions: seated rest (CON), and immersion of the hand and forearm in hot water (43°C) up to the elbow (HEAT). The intermittent cycling sprint test comprised 10 sets of 5 s maximal pedaling (weight × 0.075 kp) and 25 s recovery to evaluate their cycling sprint performance. Additionally, participants performed maximal voluntary isometric contraction (MVC) in knee extension at HT pre and post. The experimental sessions were conducted in a climate chamber set at a temperature of 5°C and 50% relative humidity.

RESULTS: Although the cycling sprint performance in the simulated 2nd half was not significantly different between the CON condition and the HEAT condition (CON: 682 ± 72 W, HEAT: 696 ± 64 W, $p > 0.05$), rectal temperature (Tre) at post HT, pre, and post sprint test in the HEAT condition were significantly higher than that in the CON condition. Moreover, the change of Tre during HT in the HEAT condition was significantly lower than that in the CON condition (CON: –0.50 ± 0.08°C, HEAT: –0.27 ± 0.14°C, $p < 0.05$). The MVC force at HT post was significantly increased compared with HT pre in the HEAT condition (105.0 ± 6.1 %, $p < 0.05$) and was significantly higher than that in the CON condition (CON: 96.2 ± 6.9 %, HEAT: 105.0 ± 6.1 %, $p < 0.05$).

CONCLUSION: Our results suggested that the hot water immersion of the hand and forearm during HT may provide a new HT strategy to prevent the reduction of Tre during HT and improve lower muscle strength in a cold environment.

References:

[1] Russell et al. (2015) Sports Med.

[2] Mohr et al. (2004) Scand J Med Sci Sports.

[3] Bishop. (2003) Sports Med.

[4] Vanggaard. (2012) Clin. Physiol. Funct. Image.

SKELETAL MUSCLE ADAPTATION TO MODERATE-INTENSITY CONTINUOUS TRAINING AND HIGH-INTENSITY INTERVAL TRAINING IN HORSES

MUKAI, K., TAKAHASHI, Y., EBISUDA, Y., SUGIYAMA, F., YOSHIDA, T., MIYATA, H.
EQUINE RESEARCH INSTITUTE, JAPAN RACING ASSOCIATION

INTRODUCTION: High-intensity interval training (HIIT) improves the exercise performance and aerobic and glycolytic metabolism of humans, but there have been few studies of HIIT in horses. The purpose of this study was to test the hypothesis that 6 weeks of HIIT would elicit greater skeletal muscle adaptation than moderate-intensity continuous training (MICT) in Thoroughbred horses.

METHODS: We performed a randomized crossover trial using seven untrained Thoroughbred horses comprising 6-week (3 sessions/week) distance-matched training protocols on a treadmill, consisting of MICT (6 min at 70% VO2max) or HIIT (6 × 30 s at 100% VO2max, with 30 s recovery at 30% VO2max) with a 3-month washout period. Incremental exercise tests (IETs) were conducted before and after training, and biopsy samples were collected from the middle gluteal muscle before each IET. The muscle cross-sectional area, muscle fiber composition, capillary density, glycogen content, and succinate dehydrogenase (SDH) and phosphofructokinase (PFK) activities were measured. The effects of time and protocol were analyzed using mixed models and Tukey's multiple comparisons test, and the relationships between the change in run distance and variables related to skeletal muscle were analyzed using Pearson's correlation coefficient. Significant level was set at $P < 0.05$.

RESULTS: After 6 weeks of training, the run distance to exhaustion at IET increased to a greater extent in HIIT (+29%) than in MICT (+5%). The cross-sectional areas of type IIA and IIX fibers increased significantly more following HIIT (+26% and +44%, respectively) than following MICT, whereas that of type I fibers increased following MICT (+59%) without a significant inter-protocol difference. There were no significant changes in muscle fiber composition or capillary density in either pro-

tocol, but the muscle glycogen content increased in both protocols (MICT, +32%; HIIT, +24%). The SDH activity increased only in HIIT (+61%), and the PFK activity did not change in either protocol. The change in run distance positively correlated with the change in the cross-sectional area of type IIX fibers following HIIT (r = 0.88), but there were no significant correlations associated with MICT.

CONCLUSION: Despite the same training distance, 6 weeks of HIIT improved exercise performance and muscle hypertrophy, particularly in fast-twitch muscle, compared with MICT. These results indicate that high training intensity is essential for skeletal muscle adaptation and HIIT represents a promising training strategy for Thoroughbred horses.

Conventional Print Poster Presentations

CP-AP09 Running and cycling

PROGRESSION OF THEORETICAL RESEARCH ON WORLD SPRINTING TECHNIQUES

WU, Y.

GUANGZHOU SPORTS UNIVERSITY

INTRODUCTION: This paper will delve into the state of short sprint techniques and research throughout the past 30 years whilst discussing the popular topics, looking into the techniques developed by different countries on a global scale, to achieve the goal of finding the most efficient and effective methods of analyzing, training, coaching and developing future and existing track and field athletes.

METHODS: Journals recorded in SCI-E, SSCI that relate to track and field sprint research will be checked through targeting keywords such as "Sprint", "Sprinting", "Sprinters" etc. Journals will then be analyzed, screened and read to retrieve the relevant literature whilst eliminating irrelevant literature. Bibliometric analysis method will be used to analyze the articles, this is done by using Cite Space visualization software to analyze literature within the articles as well as conducting mathematical statistical analyzation on data involved such as publication volumes; Presenting the author's collaborative relationships, keyword co-occurrence; Analyze and process publications according to nation publication volumes and author publication volume.

RESULTS: The field of short sprint for track and field in foreign counties show that the development of short sprint in track and field has gone through 3 major stages in the past 30 years, the dull period (1993-2004), the slow upward period (2005-2011), and the fluctuation period (2012-2022).

Research in the Field of Sprinting according to Countries. The top 3 countries which have the most advanced research are, The United Kingdom, 16.96% of the total publication volume, Australia, 16.40% of the total publication volume, The United States, 14.34% of the total publication.

Keywords in Relation to the Field of Sprinting Research Publications. Most frequent track and field research publication keywords are performance (421 times), exercise training (302 times), strength (271 times), and explosive power (252 times).

Overview of Analysis Result. Research topics in track and field sprint events in foreign countries mainly focus on four aspects: sprint performance, sprint training monitoring, sprint training, and sprint injuries.

CONCLUSION: In the past 30 years, the entire transformation process of sprint projects from being underdeveloped into becoming increasingly valued by researchers has proven that sprint projects are one of the representative projects in todays track and field sports. The main research achievements are concentrated in Europe and America, especially in sports developed countries. These achievements also provide certain theoretical support and guarantee for other countries and disciplines, contributing to many new theories developed through interdisciplinary integration.

Foreign sprint research mainly revolves around four aspects, how many novel viewpoints have been proposed in the sports training and sports injury sections, providing new ideas for scholars in the concept of track and field sports and new methods for training.

EVALUATION OF OXYGEN UPTAKE KINETICS IN EARLY STAGE OF SUPRA MAXIMAL RUNNING FOR MIDDLE DISTANCE RUNNER

YASUSHI, E., HONDA, S., SUGAWARA, H.

UNIVERSITY OF TSUKUBA

INTRODUCTION: The contribution of aerobic energy supply during middle distance race is estimated more than 50% for 800 m and 70% for 1500m (Hill, 1998). However, physiological determinants related to aerobic and anaerobic capacities has not been clarified compared to long distance running (Brandon, 1995). Theoretically and practically to enhance performance of middle-distance running, it would be important to increase in aerobic energy supply during the race to save anaerobic capacity until the final stage of the race. Jones et al. (2008) showed the possibility of saving oxygen deficit in the first stage by rapid rise of oxygen uptake. The purpose was to examine rapid rise of oxygen uptake kinetics in early stage of supra maximal running and to propose the index of the evaluation of oxygen uptake kinetics for middle-distance runner.

METHODS: 15 male middle-distance runners are recruited as a subject for the study. They had two set of treadmill tests to estimate vVO2max and maximal accumulated oxygen deficit (MAOD) in July and November. At first VO2max for each subject was measured on a treadmill by means of all-out running test for about 4~5 min after 5 successive sets of incremental sub-maximal 3 min run about 14 to 18 km/h. MAOD test was conducted on a treadmill setting at 110 - 120 % of vVO2max until voluntary exhausted. Oxygen uptake was measured by bless-by-bless before 2 min start of running until all out. Time constant τ (VO2τ) and peak of VO2 were estimated to be fit exponential regression model. VO2A was calculated VO2peak divided by VO2τ.

RESULTS: The average (SD) of 800 m and 1500 m velocities for the subjects were 24.6 (1.0) km/h and 21.8 (0.8) km/h in July and 24.6 (1.0) km/h and 22.4 (0.5) km/h in Nov, respectively. The average (SD) of VO2peak, VO2τ, and VO2A for the subjects were 60.6 (4.2) ml/kg/min, 16.7 (2.1) sec, 3.88 (0.45) ml/kg/min/sec in July and 61.6 (3.5) ml/kg/min, 16.8 (3.0) sec, 3.85 (0.70) ml/kg/min/sec in Nov. VO2τ and VO2A of the subjects were positive and negative correlated to their MAOD in July ($r=0.75$, $p<0.01$ and $r=-0.83$, $p<0.01$) and Nov ($r=0.58$, $p<0.01$ and $r=-0.66$, $p<0.01$). There are no significant relationships between the velocities of 800 m and 1500 m and VO2A. But we can find a tendency between changes in these velocities and change in VO2A ($r=0.50$ for 800 m and $r=0.57$ for 1500 m) from July to Nov.

CONCLUSION: VO2τ is an index of oxygen uptake kinetics but influenced by VO2peak. The results showed that VO2A can evaluate not only for rapid rise of oxygen uptake but also for peak of oxygen uptake. There is negative relationship between change in VO2A and change in MAOD, which suggests that VO2A may be more appropriate index of aerobic ability for middle distance runner against anaerobic capacity evaluated by MAOD. It could be also shown that rapid rise of oxygen uptake kinetics is one of important aerobic capacity for middle distance runner.

RESERVE OF RUNNING SPEED, STEP FREQUENCY, AND STEP LENGTH DURING THE FIRST PART OF 800 M RACE: A CASE STUDY.

SUGAWARA, H., ENOMOTO, Y.

UNIVERSITY OF TSUKUBA

INTRODUCTION: 800m races are known to be difficult for runners to run keeping their maximal sprint speed (MSS) during the race, and then pacing strategy is a crucial issue for improving their performance. However, runners can control their running speed in the first part of the race, and they can reserve running speed. The running speed is determined by the product of step frequency (SF) and step length (SL). It has not been revealed how the reserve of running speed, maximal SF (MSF), and maximal SL (MSL) contribute to running speed in the race. The purpose of this study was to assess running speed, SF, and SL during the first part of the 800 m race reserved from MSS, MSF, and MSL for a male runner.

METHODS: A male 800m runner (age: 21 years, height: 1.80 m, weight: 74.0 kg) participated in the 60 m running speed increase test (RSIT) on a straight track in this study. The running speed, SF, and SL for each 10 m were calculated from the video, and MSS, MFS, and MSL for the participant were detected. The running speed, SF, and SL for each 100 m (120 m for the first section) were also calculated from the videos of the 800 m races. The relative of running speed (RRS), SF (RSF), and SL (RSL) for each section were then estimated to divide by MSS, MSF, and MSL. In this study, a successful race and a failed race were defined as 99 % and less than 99 % of the seasons best record (SB) in 2023.

RESULTS: The participant's SB was 1:48.17, MSS was 9.68 m/s, MSF was 4.29 steps/s, and MSL was 2.39 m. The RRS for the successful races was 79.6% in the 0-120 m section and decreased to 71.2% in the 700-800 m section. The RRS for the failed races was 77.2% at the 120-200 m section and decreased to 69.3% at the 700-800 m section. The large difference in RS between the successful and failed races for each section was in the 0-120 m section, followed by the 120-200 m section. In three out of eight failed races' the average speed of 400-800m was faster than the successful races. The RSF and RSL were changed from 77.6 to 82.6% and 80.7 to 94.2% during the successful races. RSF in the successful and failed races were 82.6% and 81.1% for 0-120m, 79.8% and 79.1% for 120-200m. RSL in the successful and failed races were 91.0% and 89.1% for 0-120m, 94.2%, and 92.5% for 120-200m.

CONCLUSION: The 800m runner reserved about 20% running speed, 20% SF and 10% SL from his maximal values in his successful races. But in the failed races, the reserve of the running speed in the first section was large, even if the running speed in the second lap of the race was faster than. Running with a reserve of about 20% of his MSS for participants during the first part of a race is effective in improving his best record. Further research needs to be conducted with more 800m runners to identify a proper reserve of speed during the first part of 800m race.

PREDICTING RUNNING ENDURANCE PERFORMANCE BY POOLING RUNNING KINEMATICS AND KINETICS USING THE MOTIONMETRIX SYSTEM, PHYSIOLOGICAL AND ANTHROPOMETRIC DATA: MACHINE LEARNING AND DEEP LEARNING APPROACHES

RUDOMETKIN, E.1, PERHAM, M.1, POON, E.T.3, HO, I.M.K.4, LAM, S.S.2, LAW, V.K.H.2, LEE, G.2, NGAN, C.K.1

1:DATA SCIENCE PROGRAM, WORCESTER POLYTECHNIC INSTITUTE, WORCESTER, MA, USA 2:RUNLAP, HONG KONG, CHINA. 3:DEPARTMENT OF SPORTS SCIENCE AND PHYSICAL EDUCATION, THE CHINESE UNIVERSITY OF HONG KONG, CHIN

INTRODUCTION: MotionMetrix is a novel markerless system estimating running joint kinematics and kinetics. Due to the efficient assessment processes, predictive analytics using machine learning (ML) is feasible. This study aimed to use the data-driven analytical framework to predict and potentially improve the endurance performance of runners.

METHODS: A total of 131 trained runners have completed the MotionMetrix test on a motorized treadmill using their race pace for 1 minute. Meanwhile, all of them completed an incremental VO2 max test, and the final running speed was

obtained. Features selection was performed that the best set of predictors including the running gait kinematics (e.g. hip flexion), kinetics (predicted ground contact time), physiological parameters (e.g. VO2 max), and anthropometric factors (e.g. body fat), gender and age were pooled to predict the final running speed of the incremental test. The ensemble-and-ranking-based technique was obtained by the average rank of 3 different approaches including the filter method (Maximum Relevance Minimum Redundancy), the wrapper method (Recursive Feature Elimination with Random Forest), and the embedded method (Ridge Regression) were applied to select the best set of relevant and non-redundant features for producing the subsequent ML algorithms. ML regressors including single-based (SVM and ANN), ensemble-based (AdaBoost and XGBoost), and deep learning-based (Feedforward Neural Networks) models (DL) were conducted.

RESULTS: The DL model outperformed the ML methods by 25% on average in terms of Mean Squared Error, Root Mean Squared Error, and Mean Absolute Error. Based on the calculated average rank, the top 5 important features in predicting running endurance (i.e. maximum speed) are VO2 max, ground contact time, age, right hip sagittal moment (or maximum propulsive torque), and step separation.

CONCLUSION: Using the MotionMetrix system to collect running kinematics and kinetics data efficiently can facilitate the use of ML for big data and predictive analytics. The novel feature selection method using the ensemble-and-ranking-based technique and the DL model provided decent predictive performance. Coaches can take reference from our feature importance to identify the training focuses to improve the endurance performance of runners. Future studies on predicting other running-related outcomes such as the actual competition results or risk of injuries using this approach are recommended.

COMPARISON OF EXPERIMENTAL AND CALCULATED ANAEROBIC THRESHOLD CONCEPTS IN RECREATIONAL TRIATHLETES AND CYCLISTS

SCHAFFARCZYK, M., SIEMERS, P., GRONWALD, T.
MSH MEDICAL SCHOOL HAMBURG

INTRODUCTION: The purpose of this study was to compare anaerobic threshold (AnT) concepts like the second ventilatory threshold (VT2) with less utilized ones like the reverse lactate test (RLT) and the calculated maximal lactate steady-state (MLSSc) as correlates for the experimentally determined MLSS, though with just one testing session needed, in cycling.

METHODS: 15 triathletes and cyclists performed an isokinetic sprint of 15s to determine maximal glycolytic rate (VLaMAX) followed by an incremental test with continuous assessment of gas exchange to determine maximal oxygen uptake (VO2MAX) and VT2. MLSSc was calculated using VO2MAX and VLaMAX. RLT was conducted on a separate day and consisted of three to four priming stages, followed by one stage at estimated 105% of MLSS and reverse segments, accompanied by blood lactate samples taken every stage. The wattage corresponding to the apex of the reverse lactate plot corresponds to the RTL's AnT estimate. Power at experimental (VT2, RLT) and calculated (MLSSc) AnTs were compared using statistical methods for assessing agreement.

RESULTS: Cycling power for VT2, RLT and MLSSc was assessed at 250±36W, 236±34W, 229±38W. Correlations were high (RLT vs. MLSSc: ICC3,1 = 0.806; VT2 vs. RLT: ICC3,1 = 0.890) and moderate (VT2 vs. MLSSc: ICC3,1 = 0.699). However, there were significant differences between VT2 and MLSSc (p = 0.012) and VT2 and RLT (p = 0.009), but not for RLT and MLSSc (p = 0.268). RLT vs. MLSSc also showed the smallest mean difference (7.1±22.4W), though with wide limits of agreement (LoA: 50.9 to -36.7W). For VT2 vs. MLSSc, and VT2 vs. RLT mean difference was 21.3±28.7W (LoA: 77.6 to -35.1W) and 14.1±16.5W (LoA: 46.5 to -18.2W).

CONCLUSION: The results accord to published comparisons of AnT concepts, also showing large individual differences. The observed deviations could originate from the methodological procedure, but are most likely attributable to divergent underlying physiological mechanisms with each concept representing a different entity. The MLSSc includes more information about the interaction of endurance performance determinants (VO2MAX, VLaMAX) and could give more goal-oriented training recommendations with minimal additional effort in just one testing session. The next step should involve the validation of the calculation with actual determined MLSS. However, decision for a concept depends on practicability, knowledge background, and experience in ecological valid application settings.

TRAINING LOAD AND INTENSITY IN PROFESSIONAL FEMALE CYCLISTS DURING HIGHLY SUCCESSFUL SEASONS

ROETE, A., VAN ERP, T., ELFERINK-GEMSER, M.T., KEMPE, M., LAMBERTS, R.P.
UNIVERSITY OF GRONINGEN

INTRODUCTION: Training plays an essential role to be successful in professional cycling. However, insights into training and racing load in professional female cyclists are limited. Therefore, this study aims to describe and determine the differences in training or race load in female professional cyclists during highly successful versus less successful seasons.

METHODS: Training and race data of professional female cyclists during 43 seasons, over a 7-year period were analyzed. Each season of a cyclist was classified as either highly successful or less successful, based on the mean number of ProCyclingStats points per race (≥5: highly successful; <5: less successful). Mean external (duration, distance, power output (PO), kilojoules (kJ), training stress score (TSS)), as well as mean internal (heart rate (HR), rating of perceived exertion (RPE) and Edwards Training Impuls (eTRIMP)) load was determined per session. In addition, PO distribution, as a percentage of time spend in each power zone, were calculated. A multilevel random intercept model followed by pairwise comparison was used to determine if differences existed between highly successful and less successful seasons, while significance was set at $p<0.05$.

RESULTS: In total, 14 professional female cyclists were included in this study, resulting in 18 highly successful and 25 less successful seasons. Mean duration (2.6±0.2 vs 2.3±0.2, p<0.001, and 3.2±0.2 vs 3.0±0.2 h, p<0.01), distance (75±6 vs 66±5, p<0.001, and 116±7 vs 104±9 km, p<0.001) and relative kJ burnt (23.6±1.5 vs 20.4±2.3, p<0.001, and 31.9±2.0 vs 29.4±3.4 kJ·kg^-1, p<0.001) during training and race sessions, respectively, were higher during highly successful seasons, while no differences were found for mean PO or TSS. In line with this, no differences were found for internal load markers (HR, RPE, eTRIMP) during less and highly successful seasons, while session RPE (2022±191 vs 1725±198, p<0.01, 3076±288 vs 2718±322, p<0.01) were higher during the highly successful seasons. Intensity distribution analysis showed that cyclists, during highly successful seasons, spend relatively more time riding in PO zone 2 and less in PO zone 4 and 5 during training sessions (p<0.05), while they spend relatively less time in PO zone 5 and more in Zone 1 during races (p<0.01).

CONCLUSION: Female professional cyclists, during highly successful seasons train longer and burn more kJ per session than cyclists during less successful seasons. In addition, when training they spent more time in PO zone 2 and less in zone 4 and 5. This finding likely highlights the importance of building up endurance capacity and fatigue resistance, which has shown to be an important factor for success in professional cycling(1,2). In line with training longer, cyclists during highly successful seasons were selected for longer, and generally more prestigious, cycling races than cyclists during less successful seasons.

References

1. van Erp T et al. IJSPP 2022;17:1070-1076

2. van Erp T et al. MSSE 2021;53:1903-1910

A COMPARATIVE STUDY ON THREE INDIRECT ENERGY EXPENDITURE PREDICTION METHODS FOR THE GRADED CYCLE ERGOMETER TEST

MA, G., QIU, J., LU, J.J., WANG, J.H.

SHANGHAI RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: Cycling is a periodic physical event that is associated with high exercise intensity and high-energy expenditure. Accurate measurement of energy expenditure in the course of daily training and competition is crucial in evaluating the amount of training and rational supply of energy for cyclists. Calculation of energy expenditure in exercise using gas metabolic parameters is generally considered accurate [1]. However, the test has a high demand for equipment, facilities and skills. Accelerometry is a well accepted method for measuring physical activity in population-based studies of free-living individuals [2]. It can provide valid and reliable estimates of physical activity [3]. The aim of this study was to investigate the relationship of heart rate (HR), accelerometer counts, and energy expenditure in cyclists during a graded exercise stress test (GXT) on the cycle ergometer.

METHODS: Twenty male cyclists (mean age 15.7 ± 2.4 years) were selected from the Shanghai Cycling Team. Gas metabolic parameters were determined by cardiopulmonary analysis. Heart rate was telemetered by HR monitoring. After a 10 min warm-up, a GXT on Wattbike was started from 60 rpm with 5 rpm increments every 2 min for a nine-level cycling test. Kinematic parameters included power and cadence. Two energy expenditure indicators were calculated, and acceleration test indicators included triaxial accelerometer counts on the coronal (x), sagittal (y), and vertical axes (z) of the left knee and ankle. Two integrated triaxial accelerometer counts were also calculated. Pearson correlation analysis evaluated the relationship among ACx, ACy, ACz, VM, power and cadence, and EEHR and EES of the knee and ankle in GXT. Relationship was considered statistically significant by $r > 0.7$.

RESULTS: We found that cadence and power were correlated with EES ($r > 0.9$). Since most energy of the cyclist is used for mechanical work during GXT, work directly reflects levels of energy expenditure in the cyclist. Incremental cadence GXT directly reflected the level of energy expenditure in the cyclist. We showed that power in the range of 100–300 W was correlated with EES. The level of correlation between EES and cadence declined as cadence increased, possibly due to small sample size and individual athletic ability.

CONCLUSION: In the cycle ergometer GXT of an incremental cadence cycling mode, an integrated count from the ankle-worn triaxial accelerometer might be more effective than the knee-worn triaxial accelerometer for predicting cycling activity energy expenditures.

VALIDITY OF LOW FREQUENCY FATIGUE (LFF) AS A MARKER OF MUSCLE FUNCTION AFTER A STRENGTH, ENDURANCE OR SPRINT TRAINING UNDER FIELD CONDITIONS

REIMANN, M., ROSENTHAL, T., FERRAUTI, A.

RUHR-UNIVERSITY BOCHUM

INTRODUCTION: Optimizing the recovery management of athletes is a crucial topic in sports because of steadily increasing training loads and competition frequency [1]. A sensitive monitoring of fatigue and recovery could reduce the risk of injury and counteract a non-functional overreaching and overtraining [2]. Therefore, the aim of this study was to validate a new field-based portable measurement based on electrostimulations of the m. quadriceps as a marker of fatigue introduced by high-intensive strength, endurance, and sprint protocols.

METHODS: Twelve healthy sport students (age 22.5 ± 2.5 yrs., n=6f, 6m) participated in this cross-over study. Subjects completed three different training interventions followed by 1 week recovery. The training protocols consisted of either

strength training (ST: eccentric overload squat 4x6 reps), endurance training (EN: 4x10 min running at 4mmol lactate threshold) or sprint training (SP: 4x6x5 sec all-out sprints) and were applied in a randomized counter balanced order. Low frequency fatigue (LFF) was assessed at baseline, pre- and post-exercise and after 24h and 48h using a device that measures evoked force of low- and high-frequency stimulation at the m. quadriceps (Myocene, Liège, Belgium). Changes of the low- and high-frequency force ratio (Powerdex (PD)) were compared between the different trainings and related to changes in countermovement jump height (CMJ), serum creatine kinase (CK) and delayed-onset muscle soreness (DOMS). Repeated measures ANOVA was used to detect changes of PD, CMJ and CK between interventions, measurements and gender. Reliability of PD was calculated by ICC between baseline measures. Significance level was set at $p<0.05$.

RESULTS: PD baseline reliability was high [r=0.854]. PD changed significantly between measurements ($p<0.001$), while no differences between interventions ($p=0.217$) and gender ($p=0.653$) was found. PD decreased from pre to post training and ST had the strongest effect (ST: -20.2, $p<0.001$; SP: -10.6, $p<0.001$; EN: -8.0; $p=0.1$). Similar changes were found for CMJ (ST: -5.4 cm, $p=0.029$; SP: -2.7cm; EN: -0.2cm) while for CK the highest increase was found in SP (SP: +305 U/L, $p=0.098$; EN: +150 U/L, $p=0.037$; ST: 103 U/L, $p=0.931$).

CONCLUSION: PD seems to be a reliable tool to measure the acute muscle fatigue induced by intensive training as well as the follow-up recovery, both under practical field conditions. It has to be considered that strength, endurance and repeated sprint training lead to different effects on PD which can be attributed to different mechanisms of fatigue. The highest sensitivity was shown for neuromuscular fatigue (ST) while sensitivity for muscle damage and CK activity (SP) was lower. Metabolic and cardiorespiratory fatigue (EN) seems to be less relevant for PD changes. In conclusion, PD seems to be most valid for strength and sprint training including intensive quadriceps work.

1. Hecksteden et al. (2016) 2. Thorpe et al. (2017)

BIOMECHANICAL DIFFERENCES OF CYCLE PEDALING ACCORDING TO UPHILL SLOPE

KIM, D., YOON, S., LIM, H.S.

KOREA NATIONAL SPORT UNIVERSTY

INTRODUCTION: Road cycling is one of the most popular sports not only for professional athletes but also for recreational players around the world(1). Uphill slope riding must be included in this event and the winners of road cycle races are inevitably the better in uphill riding(2). Uphill slope riding which is the resistance of gravity dominates, most riders use a variety of postural strategies to overcome higher loads and the resulting fatigue and the riders cycling position is a criterion that can determine how well the riding performance can be performed(3). However, to date, quantitative data on differences in rider biomechanics according to changing uphill slopes are lacking. Therefore, the purpose of this study is to provide athletes and recreational riders with more effective information when riding uphill by analyzing differences in biomechanics according to changing slopes.

METHODS: Ten healthy adult males (age: 30.18 ± 4.2 yrs., height: 173.75 ± 2.99 cm, weight: 66.9 ± 2.64 kg). and who have a weekly exercise distance of more than 100km and participated in amateur competitions with no lower extremity musculoskeletal injury within the past six months participated in this study. The experiment was conducted at three uphill slopes of 8%, 14%, and 20%, and the intensity of the experiment was 5.5 to 6 watts per kg of body weight for each slope for 4 minutes.

A 3-Dimensional motion analysis with eight infrared cameras(sampling rate: 200 Hz) and five-channel of EMG(sampling rate: 2000Hz) was performed. In this study event 1, 2, 3, and 4 were set at angular position of pedal at 330°, 30°, 150° and 210°, respectively. Also connections of events were set as phases (P1~P4). A one-way ANOVA with repeated measures was conducted to verify the intervention effect and the statistical significance was set at $\alpha=.05$.

RESULTS: As the uphill slope increased, the position of COM moved further back from the center of the cycle, and the changes in ROM and angular velocity were different for each phase. In the knee joint, P1 and P3 showed greater ROM and higher angular velocity as the slope increased, while P2 and P4 showed opposite results to P1 and P3 as the slope increased. As a result of analyzing the peak muscle activation timing of each muscles according to the incline during cycle pedaling, as the slope increased the peak activation timing was found to be faster for the vastus lateralis and biceps femoris, while the peak activation timing for the medial gastrocnemius muscle was delayed.

CONCLUSION: The results of this study are expected to help athletes and recreational groups achieve more effective pedaling and efficient riding when riding uphill and will be helpful in follow-up research in the future.

REFERENCE:

1)Chun-Kai, T. ISBS Proceedings Archive, 2018

2)Bini, International Journal of Sports Science & Coaching, 2020

3)Caldwell et al., Journal of applied biomechanics, 1998

EXAMINING THE KNOWLEDGE, ATTITUDES, AND REPORTING INTENTIONS OF ELITE CYCLISTS AND STAKEHOLDERS TOWARDS SPORTS-RELATED CONCUSSION

BUNCH, L., OXFORD, S.

COVENTRY UNIVERSITY

INTRODUCTION: Research suggests potential gaps in concussion knowledge within elite cycling (Thornton et al., 2023). Consequently, a thorough review is needed to examine current knowledge and attitudes among riders and stakeholders.

The aim is to determine the current knowledge, attitudes, and reporting behaviours of elite cyclists and stakeholders towards sports-related concussion (SRC), which has received little acknowledgement compared to contact sports (OReilly et al., 2020).

METHODS: The RoCKAS (Rosenbaum & Arnett, 2010) knowledge and attitudes survey was adapted for cycling and distributed online (JISC) to national-level riders and stakeholders. The study respondents consisted of 68 riders and stakeholders. The survey instrument measured knowledge, attitudes and reporting intentions towards SRC. Data management was performed using Excel and SPSS for statistical analysis to determine the prevalence of these factors amongst this cohort.

RESULTS: Knowledge (CKI) was high (Median=22/25, IRQ=21,23), with 100% indicating that vision, balance and dizziness were prominent signs and symptoms. Similarly, all respondents had positive attitudes (Median=58/75, IRQ=54,61). Additionally, our Reporting Preparedness Index (RPI) demonstrated a strong readiness to report a concussive event, with a mean score of 36.06 (SD=3.8) or a median percentage of 66% (SD=7%). The Team doctor was the preferred choice for reporting, with a mean preference of 73.63% (SD=7.61% across all participants. Notably, most participants (93.88%, SD=6.92%) strongly opposed riders continuing to ride or train with an SRC. Equally, participants strongly agreed (87.22%, SD=7.53%) that increased knowledge would improve safety for themselves and fellow team members.

CONCLUSION: The findings provide important insights into the level of knowledge, attitudes and reporting intentions of these riders and stakeholders. This information can be used to develop targeted educational content for prevention strategies and improved SRC management within this cycling organisation.

Conventional Print Poster Presentations

CP-MH05 Health and Fitness/Lifestyle factors

EFFECTS OF ACUTE EXPOSURE TO PROLONGED SITTING, WITH AND WITHOUT INTERRUPTION, ON ARTERIAL STIFFNESS: A SYSTEMATIC REVIEW AND META-ANALYSIS

MOINUDDIN, A., PATERSON, C., TURNER, L., STONE, K., LUCAS, S., GRIFFITHS, T., FRYER, S.
UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Sedentary behaviour is associated with heightened cardiovascular disease (CVD) risk 1, with increased arterial stiffness (AS) being implicated as a principal pathophysiological mechanism. Numerous studies have demonstrated that AS, determined using pulse wave velocity (PWV), can increase (worsens) during prolonged uninterrupted sitting, but this effect can be attenuated when sitting is interrupted with short bouts of activity. However, to date, there has been no consolidation of the literature to determine the effect of sitting with and without interruptions on PWV. Objectives: The current systematic review, with meta-analysis, aimed to consolidate and quantify the AS response to: (1) prolonged uninterrupted- and (2) interrupted-sitting, as assessed by central- and peripheral-PWV

METHODS: Data Sources: Electronic databases (PubMed, Web of Science and, SPORTDiscus) were searched from inception to August 2023. Study Selection: The inclusion criteria for objective (1) were: randomised experimental trials pre- versus post-test trials; adult participants (≥18 years) who were free of any known chronic illness; prolonged sitting period of at least 1-h; assessment of any segmental measure of PWV; PWV was assessed pre- and post-sitting in the same posture. Additional inclusion criteria for objective (2) were: if a strategy was employed to disrupt the effects of sitting, the strategy must have been during the sitting period; there must have been a control (uninterrupted sitting) group or condition, and the interruption strategy must have involved the participants actively moving their limbs. Appraisal and Synthesis Methods: In total, 326 articles were identified, of which 10 and 6 met inclusion criteria for objectives: (1) and (2), respectively. Mean differences (MD) and 95% confidence intervals (CI) were calculated for all trials using a three-level random-effects model, with restricted maximum likelihood (REML) estimation. The amount of heterogeneity was estimated using Cochran's Q, and Higgins I2 tests.

RESULTS: (1) Prolonged uninterrupted sitting resulted in a significant increase in cf-PWV (MD = 0.211 m•s, 95% CI = 0.136 to 0.285, $p < 0.0001$). (2) Interrupting bouts of prolonged sitting resulted in a significant increase in cf-PWV (MD = 0.145 m•s, 95% CI = 0.056 to 0.235, $p < 0.0014$), that was lower compared to the uninterrupted sitting.

CONCLUSION: This is the first known study to assess the pooled effect of prolonged sitting (with and without interruption) on arterial stiffness (PWV). Uninterrupted sitting appears to significantly increase (worsen) arterial stiffness (cf-PWV), and interrupting sitting with bouts activity may confer some protective effect, but it does not remove it entirely. Our conclusions are strengthened by our robust meta-analytic model, 3-hours (median) sitting period, and prominent female representation (~50%).

Ref: 1. Matthews CE, et al. Amount of time spent in sedentary behaviors and cause-specific mortality in US adults. Am J Clin Nutr. (2012) 95:437–45

EFFECTS OF REDUCING SEDENTARY BEHAVIOUR ON BACK PAIN, PARASPINAL MUSCLE INSULIN SENSITIVITY, AND MUSCLE FAT FRACTION: A SIX-MONTH RANDOMIZED CONTROLLED TRIAL

NORHA, J., SJÖROS, T., GARTHWAITE, T., LAINE, S., VERHO, T., LAITINEN, K., HOUTTU, N., VÄHÄ-YPYÄ, H., SIEVÄNEN, H., LÖYTTYNIEMI, E., VASANKARI, T., KALLIOKOSKI, K.K., HEINONEN, I.H.A.

UNIVERSITY OF TURKU

INTRODUCTION: Reducing sedentary behaviour (SB) could potentially be beneficial for back pain mitigation but the current evidence is conflicting. Moreover, the mechanisms by which SB reduction could affect back pain are poorly understood. Impaired insulin sensitivity (IS) and increased paraspinal muscle fat fraction (FF) are related to both back pain and high SB, or conversely low physical activity (PA), and therefore they may mediate the effects of SB on back pain. Thus, we aimed to investigate the effects of a six-month SB reduction intervention on back pain, disability, and paraspinal muscle IS and FF.

METHODS: Sixty-four physically inactive adults with overweight or obesity and metabolic syndrome were randomized into intervention (n=33) and control (n=31) groups. Participants in the intervention group aimed at reducing accelerometer-measured SB by 1 h/day for six months. SB was replaced by everyday non-exercise activities based on individual preferences. The control group was advised to maintain usual SB and PA habits. All participants wore accelerometers, which were connected to a smartphone application for self-monitoring of the individually set daily SB and PA goals. Back pain and disability were assessed using 10 cm visual analogue scales and the Oswestry disability index. In a subsample of n=44, paraspinal muscle IS and FF were measured using FDG-PET imaging during hyperinsulinemic-eugclycemic clamp and magnetic resonance imaging, respectively.

RESULTS: The intervention group reduced SB by 40 min/day and increased moderate-to-vigorous PA by 20 min/day whereas no statistically significant changes in the control group were observed. A significant group x time interaction on back pain intensity was observed in favour of the intervention group (intervention group pre 1.3 [95% CI 0.5, 2.4] cm, post 1.3 [0.5, 2.4] cm; control group pre 1.3 [0.5, 2.3] cm, post 2.6 [1.4, 4.0] cm; group x time p=0.030). No statistically significant changes in disability or paraspinal muscle IS or FF were observed.

CONCLUSION: A six-month intervention aimed at reducing SB 1 h/day may be feasible for preventing back pain intensity increase regardless of paraspinal muscle IS or FF.

PREVALENCE OF ALCOHOL, RECREATIONAL AND PERFORMANCE-ENHANCING DRUG USE IN IRISH INTERVARSITY COLLEGIATE ATHLETES

TIERNAN, C., KASHMER, F., GRIFFIN, A.

UNIVERSITY OF LIMERICK; ATLANTIC TECHNOLOGICAL UNIVERSITY

INTRODUCTION: Intervarsity athletes fulfil dual roles both as a student and athlete, which can increase the stress and pressure athletes may experience [1]. Research has found a higher prevalence of alcohol consumption in collegiate athletes compared to non-athletes [2]. Rates of illicit recreational drug (IRD) use have been shown to be lower in athletes than non-athletes [2;3], and the prevalence of banned performance-enhancing drugs (PED) in collegiate athletes ranges from 0.8-9.8% [3;4]. Alcohol, IRD and PEDs can have negative effects on physical and mental health and performance [5]. This study was the first to investigate the prevalence of alcohol, IRD and PED use in Irish collegiate sport.

METHODS: One hundred eighty-six (n=98 male, n=88 female) Irish collegiate intervarsity athletes, competing in either team (n=125; 67.2%), individual (n=58; 31.2%), or both team and individual (n=3; 1.6%) participated in the study. Participants completed an online self-reported questionnaire adapted from Yusko [3]. This investigated alcohol, IRD and PED lifetime use and prevalence. Data were analysed using SPSS (Kruskal-Wallis and Chi-squared) to explore significant differences between sports, genders, and frequency of use.

RESULTS: Results found no reported use of PED by any respondent. The highest reported heavy drinking episodes over 12-months was 'once per month' (n=66; 35.5%); the highest frequency over the past month was '2-3 times per month' (n=55; 29.6%). Team sport athletes reported significantly higher heavy drinking frequencies than individual sport athletes ($p<0.05$). Prevalence of lifetime IRD use was found to be 33.3% (n=62) and was significantly higher in males (p=0.002). Past month IRD use was shown to be significantly higher than the past 12-months ($p<0.05$).

CONCLUSION: A main finding of this research was the absence of PED use in this sample and significantly higher IRD use in males. The frequency of heavy drinking episodes was lower than similar cohorts in previous studies and was less than the recommend allowance. However, the study supports the prevalence of alcohol consumption is greater within team sports, and practitioners need to be aware of its sports related adverse effects.

1. Madrigal, L. and Robbins, J. (2020). Student-athlete stress: An examination in United States Collegiate Athletics, J Stud Sports Athl Educ, 14(2), 123-139

2. Charest, J, et al. (2021). Substance use among collegiate athletes versus non-athletes. Athl. Train. Sports Health Care, 13(6), e443-e452

3. Yusko, D, et al. (2008). Alcohol, tobacco, illicit drugs, and performance enhancers: a comparison of use by college student athletes and nonathletes, J Am Coll Health, 57(3), 281-90

4. Moore, M. and Abbe, A. (2021). The National Association of Intercollegiate Athletics Substance Use and Abuse Survey, J Iss Intercoll Athl, 95-114

5. McDUff, D, et al. (2019). Recreational and ergogenic substance use and substance use disorders in elite athletes: a narrative review, Br J Sports Med, 53(12), 754

A STUDY ON THE BIOLOGICAL MECHANISMS UNDERLYING THE PROMOTION OF STUDENTS PSYCHOLOGICAL WELL-BEING THROUGH PHYSICAL EXERCISE: THE MEDIATING ROLE OF GUT MICROBIOTA COMPOSITION

LIN, H., LI, Z., SU, Q., WU, J.
HARBIN ENGINEERING UNIVERSITY

Abstract: Introduction: Although numerous studies have shown that regular physical exercise can promote individual mental well-being and effectively treat emotional dysregulation symptoms comparable to psychotherapy and antidepressant medication, our understanding of how physical exercise influences students mental health through physiological mechanisms, particularly involving the gut-brain axis and gut microbiota, is still insufficient. The purpose of this paper is to systematically review the literature and explore how physical exercise affects students mental health pathways via the physiological mechanisms of the gut-brain axis. Through a comprehensive analysis of existing research, this review aims to deepen our understanding of the approaches to improving students mental health, provide a theoretical basis for physical exercise to foster students mental well-being, assist in the formulation of more effective health policies and interventions, and offer insights into future research directions.

Methods: The literature review method and CiteSpace 6.2.R6 keyword burst mapping analysis were employed. This narrative review followed a narrative review checklist and selected 415 Web of Science articles for CiteSpace 6.2.R6 keyword burst mapping analysis based on inclusion and exclusion criteria, with 58 research articles chosen for review.

Results: We integrated and summarized the main findings and conclusions of the 58 selected research articles to gain a comprehensive understanding of the impact of physical exercise on the gut-brain axis and gut microbiota and to explore their relationship with mental health. On the other hand, we used CiteSpace 6.2.R6 analysis tools to conduct data extraction and visualization analysis on the 415 Web of Science articles, deeply understanding the time span of important keywords and their emergence, prosperity, and decline in specific research fields, providing a comprehensive overview of the latest research in the field. Additionally, we evaluated the quality of the studies, methodological limitations, and future research directions.

Conclusion: Gut microbiota are closely associated with mental health, with a negative correlation between microbial diversity and abundance and the incidence of psychological issues. The gut-brain axis and gut microbiota act as intermediaries in this relationship, with their abnormal functioning linked to psychological issues. Physical exercise has a bidirectional and reversible impact on the gut-brain axis and gut microbiota, which gradually diminishes and disappears completely following the cessation of exercise. Moderate aerobic exercise can enhance the diversity and stability of the gut microbiota in individual students, potentially contributing to improved mental health, including reduced symptoms of anxiety and depression, increased self-esteem, and enhanced psychological well-being. In contrast, intense exercise may have the opposite effect.

PHYSICAL FITNESS IS POORER IN YOUNG MEN LIVING IN RURAL AREAS COMPARED TO URBAN AREAS - RETROSPECTIVE REGIONAL COMPARATIVE STUDY AMONG 200 000 CONSCRIPTS BETWEEN THE YEARS 2012–2016 AND 2017–2021

PIHLAINEN, K., RAITANEN, J., VAARA, J., OJANEN, T., KYRÖLÄINEN, H., SANTTILA, M., VASANKARI, T.
FINNISH DEFENCE FORCES

INTRODUCTION: Cardiorespiratory and muscular fitness level of young adults has decreased and mean body mass increased throughout the last few decades in the western countries. More detailed information on geographical variation in these health indicators might be useful for regional health promotion. Thus, the aim of our study was to compare regional differences in cardiorespiratory and muscle fitness as well as body mass index (BMI) of young Finnish men between the years 2012–2016 and 2017–2021.

METHODS: All available data of conscript register consisting of physical fitness test (12-min running test, standing long jump, 1-min push-up, 1-min sit-up) and body anthropometry (body mass, stature) variables from 214 063 healthy young men, including their place of residence at the time of conscription, were analysed retrospectively. Places of residences were divided into three area types, Urban, Peri-urban and Rural, based on classification system provided by the Finnish Environment Institute. Standard statistical methods, including one-way ANOVA with Bonferroni post-hoc tests were performed to compare the effect of area types on cardiorespiratory and muscular fitness, and Pearson correlations were calculated to study relationships between population density of the place of residence and physical performance.

RESULTS: Significant regional differences, favouring individuals living in urban areas of Finland, were observed in mean values during and between the follow-up years. Comparing the years 2012–2016 and 2017–2021, significantly higher proportions of individuals with low maximal oxygen uptake (11.9% vs. 17.8%, $p<0.001$) and muscular fitness level (12.2% vs. 14.7%, $p<0.001$) were observed during 2017–2021 in the rural areas, while respective differences were not observed between urban and semi-urban areas. In addition, higher prevalence both for overweight (36.3% vs. 33.7%, $p<0.001$) and obesity (10.6% vs. 8.4%, $p<0.001$) were observed among rural compared to urban areas. However, the correlations between municipal population density and BMI as well as the physical performance variables were lower than $r=0.08$ during both time periods (2012–2016 and 2017–2021).

CONCLUSION: The present study confirmed that regional variation exists both in cardiorespiratory and muscular fitness, as well as in BMI among young Finnish men, indicating poorer results among rural areas. In addition, the prevalences of poor cardiorespiratory and muscular fitness and excess body weight of young men have increased between the follow-up years, especially in the rural regions of Finland. Tailored physical activity promotions are required to enhance fitness

level in young men living in rural areas which are characterized with poorer training facilities and longer distances to sports services.

SURVIVAL OF THE FITTEST: MORTALITY AND LONGEVITY IN MALE AUSTRALIAN ELITE RUGBY UNION PLAYERS

LYSTAD, R.
MACQUARIE UNIVERSITY

INTRODUCTION: Previous studies have reported that elite athletes from a wide range of sports live longer than the general population. The survival benefit of participation in elite sports is generally attributed to decreased risk of mortality caused by cardiovascular disease and cancer. However, there may be considerable variation in athlete survival and longevity between and within sports. For instance, in contact sports with high risk of repetitive head trauma there are concerns that the survival benefit may be offset by increased risk of mortality from other causes such as neurodegenerative disease. This study quantified survival and longevity among male Australian elite rugby union players compared to sex- and age-matched referents from the general population.

METHODS: This retrospective cohort study included male rugby union players who had their Australian national team debut from 1 January 1921 to 31 December 2023. The cohort was identified by cross-referencing rugby statistics from open online sources (i.e. classicwallabies.com.au, ESPNscrum.com, and www.wikipedia.com). Cohort data included athlete name, date of birth, date of national team debut, player position, and date of death. Data on sex- and age-specific all-cause mortality in the Australian general population were obtained from life tables available from the Human Mortality Database (www. mortality. org). Survival time was calculated from the date of national team debut until the date of death or end of the follow-up period (i.e. 31 December 2023). To avoid issues with high variability due to data sparsity at very old ages, athletes were censored at age 90 years. Survival analysis was performed using the Kaplan-Meier estimator and longevity gains or losses were quantified using the life years difference method and presented with 95% confidence intervals. Differences between forwards and backs were examined using a log-rank type test comparing net survival curves.

RESULTS: The cohort comprised 801 athletes with a median age at national team debut of 23.3 (IQR 21.8 to 25.6) years. By the end of the study follow-up period, 310 (38.7%) athletes were deceased, with a median age at death of 74.6 (IQR 64.0 to 82.1) years. Maximum net survival was observed at 47.6 years post-debut, at which point the average life years gained was 0.33 (-0.29 to 0.96) years. After this peak, there was a steady decline in net survival, with minimum net survival observed at 70.4 years post-debut, at which point the average life years lost was 0.82 (-0.39 to 2.03) years. There was no significant difference in net survival between backs and forwards (p=0.597).

CONCLUSION: Unlike elite athletes in many other sports, there was no observable survival benefit among male Australian elite rugby union players compared to the general population. Further research examining disease-specific mortality is needed to elucidate the underlying reasons for the absence of longevity gains among male Australian elite rugby players.

EFFECTS OF DEDICATED PHYSIOTHERAPEUTIC TRAINING ON MUSCLE STIFFNESS AND FATIGUE IN ADMINISTRATIVE STAFF

WINIARSKI, S.1, MOLEK-WINIARSKA, D.2
<1> WROCLAW UNIVERSITY OF HEALTH AND SPORT SCIENCES, POLAND; <2> WROCLAW UNIVERSITY OF ECONOMICS AND BUSINESS, POLAND

INTRODUCTION: The purpose of the study was to assess the changes in muscle fatigue and stiffness of the muscles stabilizing the body in the sitting position in administrative workers of a corporation.

METHODS: 45 participants were divided into intervention (N=22) and comparison (N=23) groups and tested before and after PT training. The exclusion criteria were serious health problems or a certified degree of disability.

Muscle fatigue and stiffness were assessed for the muscles crucial for maintaining upright posture and spinal stability: upper and lower Trapezius Descendens (Trap.Up, Trap.Lw), Erector Spinae in the lumbar (ESpin.Lumb) and thoracic region (ESpin.Thor). Calculations of the EMG signal using Noraxon Ultium EMG included the use of an FIR filter, smoothing, reduction of artefacts, and calculation of the slope of the median frequency curve (in Hz/s) for each muscle on the right and left side.

Participants performed an endurance test in a sitting position with a 30° trunk forward inclination, holding 2kG weights in their hands. This forced position lasted until the moment of the participant's refusal.

Muscle elastic stiffness (in N/m) of the damped oscillation was tested by the MyotonPro device.

The PT training covered physical exercises to reduce tension and fatigue of muscles used during a long-term sitting position.

RESULTS: In summary, the intervention group showed a significant decrease in stiffness in the upper trapezius (from 417.6 to 344.0 N/m, p=0.02) and erector spinae (from 573.1 to 494.9, p=0.01) central on both sides. A slight insignificant decrease was also observed in the erector spinae inferior (from 284.7 to 243.6 N/m, p>0.05) on the left side, with a small increase on the right side (from 292.5 to 287.4 N/m, p>0.05).

The intervention group showed a general trend of reduced muscle fatigue rates across all measured muscles (on average from -0.075 to -0.022 Hz/s on the left and right side) post-intervention, as indicated by the less negative slope of the median frequency.

CONCLUSION: The median frequency of the EMG signal reflects the frequency spectrums central point. It is influenced by both the muscle fiber conduction velocity and the recruitment of different types of muscle fibers. As muscle fatigue pro-

gresses, there is a noticeable shift in the median frequency towards lower values. The stiffness measurements revealed a general decrease in muscle stiffness in the intervention group post-treatment, suggesting the potential effectiveness of the intervention in alleviating muscle tension due to prolonged sitting.

Fatigue assessment through median frequency slope analysis indicated that the intervention group experienced a reduction in the rate of muscle fatigue, as evidenced by the less negative slope post-intervention.

These findings support the application of dedicated physical therapy interventions tailored for individuals who experience the effects of long sitting positions, which may include strategies to reduce stiffness and slow down the onset of fatigue.

THE EFFECTS OF EXERCISE ALONE OR COMBINED EXERCISE + DIETARY INTERVENTIONS ON INSULIN RESISTANCE AND METABOLIC HEALTH IN POSTMENOPAUSAL WOMEN WITH BREAST CANCER: A SYSTEMATIC REVIEW AND META-ANALYSIS

SHANLEY, H., DULAI-PIPER, A., MAWN, R., THORP, S., OMAR, H., WARR, T., TURNER, J., MORISSY, H., LAHART, I.
UNIVERSITY OF WOLVERHAMPTON

INTRODUCTION: Postmenopausal women with breast cancer represent a challenging population due to their increased risk for breast cancer development and progression. The beneficial effects of exercise has been demonstrated for women with breast cancer in previous reviews; however, to date, research findings regarding the effects of exercise in postmenopausal breast cancer patients have not been systematically appraised or synthesised. Therefore, we have conducted a systematic review and meta-analysis to examine the insulin- and health-related effects of exercise training in this population.

METHODS: Cochrane central register of controlled trials (CENTRAL; 2023), PubMed (via MEDLINE), CINHL (via EBSCOhost.com), SPORTDiscus (Via EBSCOhost.com), Scopus (via Elsevier.com) and the OpenGrey database were searched. An English language restriction was applied. Randomised controlled trials (RCTs) which: (1) compared exercise versus no exercise/control in postmenopausal women with a diagnosis of breast cancer (stage I-III), and (2) assessed at least one of our chose outcomes, primary or secondary (circulating levels or markers of insulin resistance, glucose, leptin, adiponectin, oestrogen, body composition, markers of metabolic syndrome, circulating cytokine levels, chemotherapy-related outcomes, and quality of life). Outcomes and measure effects were expressed as either mean differences (MDs) or standardised mean differences (SMDs) with 95% confidence intervals (CIs). A random effects model meta-analysis was conducted. Heterogeneity and publication bias of studies was also assessed.

RESULTS: Our search revealed a total of 25 articles, reported from 17 RCTs. A meta-analysis of 6 studies showed exercise to elicit no statistically significant effects on circulating levels of insulin (SMD -0.59, 95% CI -1.45 to 0.26). A meta-analysis of 10 studies showed exercise interventions to statistically improve body mass (MD -0.89, 95% CI -2.59 to -1.37). A subgroup analysis of BMI status revealed those who were classed as 'overweight' at baseline experienced significant reductions in body mass with exercise (5 studies; MD -1.95, 95% CI -2.93 to -0.97) compared to those who were classed as 'obese' (3 studies; MD -2.14 95% CI -7.39 to 3.12) or 'healthy weight' (2 studies; MD -2.54 95% CI -11.42 to 6.33).

CONCLUSION: Based on limited number of studies, our results do not support an insulin lowering effect of exercise-based interventions in postmenopausal women with breast cancer. However, exercise may be an effective intervention for reducing bodyweight. Findings indicate that more research is required to investigate the effects of exercise on insulin resistance in this population.

Conventional Print Poster Presentations

CP-MH10 Disabilities

DEMOGRAPHIC INFLUENCES ON FREQUENCY OF STRENGTH TRAINING AMONG INDIVIDUALS WITH DISABILITIES: INSIGHTS FROM FREE-LIVING DATA

TAMULEVICIUS, N., HOUSTON, F., MCKNABB, R., ANDERSEN, J.C., LEUNG, W.
THE UNIVERSITY OF TAMPA

INTRODUCTION: There are multiple benefits associated with engagement in strength training, including maintaining a healthy musculoskeletal system, improving functional abilities, and promoting independence are associated with resistance training [1]. The current recommendation is to engage in strength training twice per week [2]. Among people with disabilities, their demographic factors, such as age, sex, and race, could influence their frequency of strength training engagement. Currently, little is known about how demographic factors influence the frequency of strength training among people with disability. Therefore, this study aims to examine the association between demographic factors and the frequency of strength training using free-living data.

METHODS: Using the free-living data of 2015-2019 Behavioral Risk Factors Surveillance System, 251062 individuals with disabilities were included in this cross-sectional secondary data analysis. Respondents self-reported the frequency of engagement of strength training per week. Demographic factors such as older adults, sex, race and ethnicity, and normal weight status were examined on their association with the frequency of strength training per week. Due to the frequency

of strength training being counts data, multiple Poisson regressions were performed for each of the demographic variables. Sampling weights were accounted for during the analysis due to the data being complex survey data.

RESULTS: The average frequency of strength training among the participants was 1.02 (95% CI [1.00, 1.04]) times per week. Among the participants, 70.98% [95% CI 70.65, 71.32]) were ≥65 years old, 44.68% (95% CI [44.26, 45.10]) were males, 63.52% (95% CI [63.11, 63.94]) were white, and 25.12% (95% CI [24.76, 25.49]) had normal weight status. The Poisson regressions found that participants who were older than 65 years old (RR=1.20, p<.01), male (RR=1.36, p<.01), and having normal weight (RR=1.39, p<.01) were more likely to have a higher frequency of strength training per week. Being white had a lower RR of having a higher frequency of strength training per week (RR=0.98, p=.35), but the association was not statistically significant.

CONCLUSION: The reported strength training frequency was below the recommended guidelines of two times per week among the participants. Demographic factors impact the frequency of strength training among individuals with disabilities. All included demographic variables in the study were statistically associated with the strength training frequency per week. Investigating potential barriers and facilitators associated with these variables may guide the development of more effective strength training interventions targeting people with disabilities.

References:

1. Seguin, R. & Nelson, M., The benefits of strength training for older adults. AJPM, 2003. 25(3): p. 141-149.

2. Piercy, K.L., et al., The physical activity guidelines for Americans. JAMA, 2018. 320(19): p. 2020-2028.

TEST RE-TEST RELIABILITY OF CMJ TEST FOR ELITE PARA-KARATE ATHLETES WITH INTELLECTUAL IMPAIRMENT

AUGUSTOVICOVA, D., HADZA, R., HRUBY, M.

COMENIUS UNIVERSITY

INTRODUCTION: Countermovement jumps (CMJs) are a widely used tool in athlete training, performance monitoring, and research for measuring power output. Athletes with intellectual impairments (II) typically rely on gross motor batteries or specialized test batteries. Strength diagnostics are often conducted through long jump or hand grip tests. While there has been extensive scientific research on physical fitness for individuals with II, there is limited data available on elite athletes using CMJ, particularly for female athletes with II and those with Down syndrome.

METHODS: The aim of the study was to evaluate the reliability of the CMJ in elite para-karate athletes who have II (with an IQ below 75 "K21") and Down Syndrome (DS) "K22" by utilizing Kistler Force plates. During the classification session of the WKF World Para-karate championships 2023, a group of 20 (K21) and 24 (K22) para-karate athletes (age 27.2±7.0 and 27.4±6.2 years) performed the CMJ twice within a 1-minute interval.

RESULTS: The difference between the test and re-test in jump height calculated from flight time was not significant (-1.45± 4.50 cm, t(42)=-1.88, p= 0.07, for K21 -0.71± 5.42 cm, t(19)=-0.58, p=0.57 and for K22 sport class -0.32±3.92 cm, t(19)=-0.365, p=0.719 respectively.

The difference between the test and re-test in jump height calculated from take-off velocity was not significant (-0.94± 7.10 cm, t(41)=-0.86, p=0.39, for K21 -2.45± 5.70 cm, t(21)=-0.64, p=0.53 and for K22 sport class -0.32±3.92 cm, t(21)-2,04, p=0,06 respectively.

The ICC correlation coefficient for jump height calculated from flight time indicate good reliability to excellent reliability ICC=0.79 (95%CI 0.64-0.88), K21 ICC=0.9 (95%CI 0.77-0.96), K22 ICC= 0.90 (95%CI 0.77-0.96), and for jump height calculated from take-off velocity moderate to good reliability ICC=0.70 (95%CI 0.51-0.83), K21 ICC= 0.82 (95%CI 0.61-0.92), K22 ICC=0.61 (95%CI 0.26-0.82), (p≤0.01 for all ICC coefficients).

CONCLUSION: To ensure that the test is easily understood, it is essential to communicate and explain it using simple language while providing visual demonstrations. Our analysis has shown that the CMJ test is a suitable option for assessing explosive power in II para-karate athletes, for both sport classes (K21 and K22). The parameters obtained from the CMJ test, such as jump height determined by take-off velocity and flight time, can be relied upon as reliable indicators for evaluating explosive power, with higher reliability for jump height calculated by take-off velocity.

Acknowledgement: This article is a partial work of the VEGA project (number 1/0611/23).

EXPLORING THE IMPACT OF EXERCISE ON CARDIOVASCULAR HEALTH IN OLDER ADULTS WITH INTELLECTUAL DISABILITIES: PRELIMINARY RESULTS OF THE IDEA PROJECT

OVIEDO, G.R., SIMÓN-SILES, S.2, FONT-FARRÉ, M.2, GUERRA-BALIC, M.2, VILARÓ-CASAMITJANA, J.3, JAVIERRE, C.4

1. INTERNATIONAL UNIVERSITY OF CATALUNA FACULTY OF MEDICINE AND HEALTH SCIENCES; 2. FPCEE BLANQUERNA UNIVERSITAT RAMON LLULL; 3. FCS BLANQUERNA, UNIVERSITAT RAMON LLULL; 4. UNIVERSITAT DE BARCELONA

INTRODUCTION: The prevalence of cardiovascular diseases in older adults with intellectual disability (ID) is high, and this population often experiences deteriorated physical condition compared to those without ID. Therefore, the implementation of exercise programs to improve the cardiovascular health and physical fitness is of fundamental importance.

Objectivs: This study aimed to compare the results of two exercise programs (continuous aerobic training (CAT) and sprint interval taining (SIT)) on carotid intima-media thickness (cIMT) and aerobic capacity in older adults with ID.

METHODS: Fifty-six older adults (49.5±7.71 Y.O.) with mild-moderate ID of both sexes were recruited and randomly allocated to the CAT (n=16), SIT (n=20) and control (CG; n=20) groups. The intervention groups performed a multicomponent

exercise program of 72 sessions (3 sessions per week) of 90 each. Different anthropometric variables (height, weight, body mass index, fat mass) were analyzed by bioimpedance; oxygen consumption (VO2) and peak power (watts) through a direct stress test on a cycle ergometer; systolic blood pressure (SBP) and diastolic blood pressure (DBP); and carotid intima-media thickness (cIMT) was obtained using specific software and ultrasound measurements (Cardiovascular Suite, Quipu).

Descriptive data were obtained for all variables. A one-way ANOVA was used to compare the groups baseline characteristics, and a repeated-measures ANOVA was used to assess the interventions effect (α=0.05)

RESULTS: Fat mass was reduced in the CAT (22.7±9.6 vs 21.3±8.7 kg; p=0.010) and SIT (21.8±9.8 vs 20.7±9.7 kg; p=0.047) groups after the intervention.

There were improvements in the VO2 ml/kg/min in the CAT (19.4±4.8 vs 23.28±7.0 ml/kg/min; p<0.001) and SIT (19.2±3.4 vs 25.8±4.5 ml/kg/min; p<0.001). At the end of the intervention, there were significant differences between the two groups and the CG (pre=17.2±4.8 ml/kg/min; post=16.9±3.9 ml/kg/min) (CAT, p=0.001; SIT, p<0.001).

The peak power reached in the stress test increased significantly in both active groups (CAT=117.5±23 vs 135.8±36.3 watts, p=0.002; SIT=112.5±40.2 vs 149±40.1 watts; p<0.001). The peak power achieved by both active groups at the end of the intervention was significantly higher than the results obtained by the CG (CAT, p=0.009; SIT, p<0.001).

The CAT group significantly improved the SBP after the intervention (122.8±15.6 vs 115.7 mmHg; p=0.009). Post-intervention differences in the SBP were observed between the SIT and CG groups (125.2±17.6 vs 129.27 mmHg; p=0.013).

Distensibility of the carotid artery in both active groups improved (p<0.05) . Significant differences were observed in cIMT pre/post values for the SIT group (p=0.046)

CONCLUSION: The results showed that the different programs (SIT and CAT) promote better health and physical fitness in older adults with ID. The results obtained are very favorable since both intervention groups improve anthropometric, vascular and aerobic measures.

TEST-RETEST RELIABILITY OF BALANCE TEST IN INTELLECTUALLY IMPAIRED PARA-KARATE ATHLETES

HADŽA, R., AUGUSTOVICOVÁ, D.

COMENIUS UNIVERSITY, FACULTY OF PHYSICAL EDUCATION AND SPORT

INTRODUCTION: World Karate Federation (WKF) based on the International Paralympic Committee Classification code (IPC) recognizes and offers opportunities to compete in individual sport class (K20) categorised for para-karate athletes with intellectual impairment (II) (K21) and Down Syndrome (II2) (K22). Classification guidelines for intellectually impaired athletes in para-karate are coordinated in cooperation with Virtus [1]. Performances of athletes are evaluated based on the specific criteria including balance. Balance is one of the crucial physical parameters of sport performance in karate kata competitions, during transitions and stances throughout performing kata, for able bodied or the para-karate athletes [2]. Athletes are having to not only stabilize and maintain balance but also to precise and efficiently regulate positioning of the centre of mass [3]. Therefore, for the purpose of further physical part of the classifications it is important to find out, whether the thirty second static balance test is reliable test for intellectually impaired para-karate athletes?

METHODS: Forty-four top-level para-karate intellectually impaired athletes (K21, n=20, aged 27.2 ± 7.0) and (K22, n=24, aged 27.4 ± 6.2 years) took part in the study. The work is aimed at the assessment of the test-retest reliability of the 30 second static balance test in II athletes. We used parallel stance with opened eyes, hands on the hips and no manipulation during the test. All athletes were instructed to step on the force plates (each leg on one plate), standing still for 30 seconds and maintaining eye contact with the picture on the wall in front of them during the test. The test was carried out twice with 1 minute rest interval between attempts using device Kistler Force plates (9260AA6). The parameters obtained were total path [mm] and velocity [mm.s-1] of centre of pressure (COP). The athletes performed the test as a part of classification session of the WKF World Para-karate championship 2023. To perform statistical analysis of the data, we used correct form of intraclass correlation coefficient [4, 5] and Pearson correlation.

RESULTS: We demonstrated correlations between test and retest measurements for total path K20: r(42)=.95, p<0.001 (ICC=0.945), K21: r(18)=.96, p<0.001 (ICC=0.959) and K22: r(22)=.94, p<0.001 (ICC=0.923) and total velocity K20: r(42)=.95, p<0.001 (ICC=0.943), K21: r(18)=.96, p<0.001 (ICC=0.959) and K22: r(22)=.94, p<0.001 (ICC=0.923) of the thirty second static balance test suggesting excellent reliability of the obtained data.

CONCLUSION: Total path and velocity are highly reliable parameters of the thirty-second static balance test. Therefore, from the point of view of reliability, we recommend including this test for the purpose of physical classification in intellectually impaired top-level para-karate athletes.

Funding:

VEGA project of The Ministry of Education, Research, Development and Youth of the Slovak Republic (number 1/0611/23).

EFFECTS OF A FORCED SEDENTARY BEHAVIOUR ON THE PHYSICAL FITNESS OF TOP LEVEL WHEELCHAIR BASKETBALL PLAYERS.

BERNARDI, M., CICCARELLI, A., PELUSO, I., CAVEDON, V., CASTELLUCCI, F., BELLITO, S., MILANESE, C., TOTI, E., RAGUZZINI, A., CAVARRETTA, E.

SAPIENZA UNIVERSITY OF ROME

INTRODUCTION: To examine the effects of a relative sedentary behaviour (SB) due to the CoViD-19 related lockdown (LD) on all components of physical fitness (PF) in wheelchair basketball players (WBP) with different locomotor impairments (impaired muscle strength, limb deficiency and impaired passive range of motion).

METHODS: A comprehensive PF evaluation (1) was performed on twelve male WBP recruited from the Italian national team at the peak of their PF (June 2019, PRE) and after the LD (June 2020, POST), in both cases after the end of the national major league championship. PF evaluation included anthropometry (body mass and skinfold measurements) to assess fat mass, cardiopulmonary incremental maximal arm cranking exercise (ACE) test (CPET) to measure oxygen uptake peak (VO2peak), supramaximal (130% of the power peak reached in the CPET) up to exhaustion ACE test to estimate maximal glycolytic anaerobic capacity, 10-second-long "Wingate" all out ACE Test to estimate anaerobic peak power and handgrip measurements (HG) to assess maximal strength. Similarly to the typical training modality previously carried out in the gym, strength training was prescribed at the beginning of the LD period (for a minimum of three times per week, bench press, triceps extension, dumbbell row, biceps curl, lateral raises, dumbbell shrugs, abdominal crunch carried out 12 repetitions for 4 sets at 50% of the one repetition maximum). WBP were asked to fill in a questionnaire regarding their home and possible out-door training. Dietary advice was provided to WBP during the LD.

RESULTS: The self-reported aerobic training performed during the LD by our WBP was very law compared to the typical aerobic training (9.6±4.96 to 2.4±3.67 hours per week) which included typically wheelchair basketball training in field. An higher strength training volume was obtained during the LD period. Comparing PRE vs POST LD significant results ($p<0.05$), we found a decrease in fat mass (19.6±3.9 vs 15.7±3.9 %) and aerobic fitness (VO2peak decreased from 37±6.3 ml·Kg-1·min-1 to 34±5.2 ml·Kg-1·min-1 and power peak at CPET from 168±36.9 watt to 158±34.6 watt) and an increase in explosive power and strength. Peak power in Wingate test increased from 12±3.32 watt·Kg-1 to 13.8±3.79 watt·Kg-1). HG measurements (sum of both upper limb) increased from 896±156.2 Newton to 973.4±205.8 Newton. No significant PRE vs POST differences were found in the total work load of the supramaximal up to exhaustion ACE test (19.6±6.70 kJ vs 20.7±7.42 kJ; $p=0.2$).

CONCLUSION: The present study suggests that strength and explosive power can be adequately trained at home. Possibly this training and dietary advice and strength training contributed to the reduction of FM% and increased PEP and HGS. The negative impact of a forced relative LD on the dangerous reduced aerobic fitness of Paralympians suggests that home aerobic exercises should be included in the periods out of Championship.

References:

1) Bernardi et al. Clin J Sport Med 2012 22(1):26-30

DEVELOPMENT OF A SIMPLE STICK-TYPE UPPER LIMB FUNCTIONAL TRAINING DEVICE

SAKAI, H., MURAKI, D., ISHIGURO, K.

TOKYO UNIVERSITY OF TECHNOLOGY

INTRODUCTION: In recent years, upper limb training robots have been used in rehabilitation for upper limb dysfunction due to stroke, and their usefulness has been reported. However, robot devices used for rehabilitation intervention are often large and expensive, and availability is limited. Therefore, there is a need for equipment that can be used in day care facilities and homes. In this study, we developed an inexpensive, compact and easy-to-operate upper limb training device, and tested it on several patients with chronic hemiplegia.

METHODS: Five people with chronic hemiplegia (3 men, 2 women) participated in this study. Their age ranged from 42 to 67 years (average 58.2 years, 7 to 93 months after onset), and there were 3 cases of right hemiplegia and 2 cases of left hemiplegia. Training was carried out, using our unique system, in an outpatient setting for 40 minutes a day, 2 to 3 times a week for 4 weeks after the study was explained in full and subjects gave their informed consent. The system we have developed consists of an operating stick (similar to a joy stick) and a stick-type computer (similar to a television streaming dongle). The lower part of the operating stick uses a special ball joint technology to reduce the weight of the upper limbs while allowing smooth movement in space. A sensor is embedded under the ball joint at the bottom of the operating stick allowing for movements in any direction (360 degrees) to be displayed on a monitor. Evaluation consisted of the Fugl-Meyer Assessment (FMA) for upper limbs (total 66 points) before and after training, Motor Activity Log (MAL), and a questionnaire after training. The Wilcoxon signed rank test was used for before and after comparisons.

RESULTS: FMA-U score was 45.2±10.3 before training and 57.2±12.7 after training, a statistically significant improvement, ($p<0.05$). Furthermore, FMA was divided into four categories: shoulder, elbow, and forearm (total 36 points), wrist joint (total 10 points), hand finger (total 14 points), and speed/coordination (total 6 points). Elbow and forearm scores increased significantly from 22.8±7.2 before training to 28.3±4.1 after training, ($p<0.05$). There was a tendency for improvement in speed/coordination. MAL-A showed a significant improvement in AOU from an average of 1.4 ± 2.6 points to 2.3 ± 2.8 points after completion, ($p<0.05$). In the usability questionnaire, there was a lot of positive feedback.

CONCLUSION: We have developed a unique portable stick-type training device for upper limb dysfunction and when it was tested on patients with chronic hemiplegia, significant results were obtained. This system enables exercise in space

as a training method for upper limb dysfunction, and can provide a certain volume of training while receiving visual feedback. This system is inexpensive, compact and portable, making it possible for it to be widely used in general hospitals, rehabilitation facilities, and in homes.

A CASE STUDY OF HR MEASUREMENT IN WHEELCHAIR RACING ATHLETES

MOMMA, R., TANIMURA, Y., GOTO, H., KAGEYUKI, T., YAMAGISHI, T., HAKAMADA, N., MATSUBAYASHI, T.
JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: In para-athletes, heart rate (HR) measurement during exercise is essential to monitor exercise intensity and ensure safety of the athletes. Traditionally, chest band HR sensors, which can measure HR accurately using electrocardiography (ECG), are utilized in many sports fields. Furthermore, optical heart rate (OHR) sensors, which measure pulse rate on forearm or upper arm, have been widely used in recent years and are expected to replace the chest band HR sensors. While armband sensors measure pulse rate using changes in the intensity of light reflected from the skin, body movement and muscle contractions can interfere with the intensity of the light, making it difficult to accurately capture the pulse in such cases [1]. However, few studies have examined the accuracy of armband sensors during exercise in wheelchair racing athletes where strong upper body motions repeatedly occur. Therefore, this study sought to investigate the accuracy of armband sensors during exercise in wheelchair racing athletes by comparing with chest band sensors.

METHODS: Subjects were 6 middle- and/or long-distance track and/or marathon athletes with cervical and thoracic spinal cord injuries. We analyzed 8 trials of measurement data performed in 2023 (2 of them were measured once on different days). The athletes performed a progressive incremental speed test on a wheelchair roller ergometer (ESSEDA). During the test, HR was simultaneously measured using a chest band sensor (Polar H10) and armband sensor (Polar verity sense). Armband sensors were measured on the forearm for 4 of the 8 trials and on the upper arm for the other 4 trials. HR data were averaged over the last minute of each stage, and a single regression analysis was performed for each athlete to examine changes of HR as a function of speed increment with the two sensors. Moreover, all data derived from the 8 trials were pooled, and then the same analysis was performed. The coefficient of determination was interpreted as $R2>0.9$ (good), $R2>0.6$-0.89 (moderate), and $R2<0.59$ (poor), respectively.

RESULTS: Armband sensor could measure the changes of HR with exercise speed in most of 8 trials, with good in 5, moderate in 1, and poor in 2 trials, respectively. In 1 trial with moderate, HR did not rise with exercise speed only in the last stage, whereas it showed linear increase with speed in the preceding 4 stages. In 3 trials with good and 1 with moderate, the measurement site was the forearm; in 2 poor trials, on the upper arm. Chest band sensor could capture changes in HR with exercise speed in 4 of 8 trials ($R2>0.9$), while it did not increase linearly with exercise speed in the other 4 trials ($R2<0.59$). When pooled all data, $R2=0.78$ for armband and $R2 =0.26$ for chest band sensors.

CONCLUSION: Armband sensors more accurately captured the changes of HR during the incremental tests in wheelchair athletes, especially when it was measured on the forearm.

Reference: [1] Horton et al., 2017

UNRAVELING THE INTERPLAY OF SOCIOECONOMIC STATUS AND WEIGHT TRAINING ADHERENCE AMONG INDIVIDUALS WITH DISABILITIES

KACKER, P., HIRSCH, A., FARRELL, C., FIORE, G., TIRALLA, G., TAMULEVICIUS, N., LEUNG, W.
THE UNIVERSITY OF TAMPA

INTRODUCTION: Current physical activity guidelines recommend that adults aged 18 and above engage in weight training at least twice a week [1]. Despite these recommendations, people with disabilities are less likely to meet these guidelines [2]. Currently, there is a paucity of literature exploring weight training behaviors in this population and how socioeconomic status (SES) influences adherence to the guidelines. The purpose of this analysis is to examine the impact of SES on meeting weight training recommendations among people with disabilities.

METHODS: A total of 251,062 participants reporting a disability, based on the Washington Group on Disability Statistics Question Set from the 2015-2019 Behavioral Risk Factor Surveillance System, were included in the analysis. Participants were considered having met the weight training guidelines if self-reporting weight training at least twice a week, otherwise classified as non-compliant. SES variables, such as college education (received and not received), employment status (employed and unemployed), income level (≤ $25,000 and > $25,000), and home ownership (homeowner and not homeowner), were separately examined in logistic regression for their association with meeting the weight training guidelines using survey analysis.

RESULTS: Among participants, 78% (95% CI [77.82, 78.53]) did not meet the weight training guideline, while only 21.82% (95% CI [21.47, 22.18]) complied. Chi-squared analyses indicated an association between meeting the weight training guideline and each SES variable ($p<.05$). According to individual logistic regressions, participants with a college education (OR=1.64, 95% CI [1.57, 1.71]), employment (OR=1.40, 95% CI [1.34, 1.46]), and income exceeding $25,000 (OR=1.41, 95% CI [1.35, 1.47]) were more likely to comply. Conversely, homeowners were less likely to meet the weight training guidelines (OR=0.88, 95% CI [0.85, 0.92]).

CONCLUSION: Unsurprisingly, the majority of participants with disabilities did not meet the recommended weight training guidelines. SES significantly influences adherence, with higher SES individuals with disabilities, as indicated by factors such as education, employment, and income, appearing to positively impact guideline adherence. Addressing these dispari-

ties may require targeted interventions and tailored strategies, such as improving accessibility of weight training programs for individuals with disabilities with lower SES and raising awareness of weight training benefits within the disability community. The development of inclusive weight training programs and policies addressing socioeconomic factors may help bridge the gap in adherence among people with disabilities.

References:

1. Piercy, K.L., et al., The physical activity guidelines for Americans. JAMA, 2018. 320(19): p. 2020-2028.

2. Martin Ginis, K.A., et al., Participation of people living with disabilities in physical activity: A global perspective. Lancet, 2021. 398(10298): p. 443-455

Friday, 5 July 2024

08:00 - 09:15

Invited Symposium

IS-AP03 Sustainable implementation of position tracking systems in sports: its power to connect sport science and sport practice

SUSTAINABLE IMPLEMENTATION OF POSITION TRACKING SYSTEMS IN SPORTS

DE MEY, K.
GHENT UNIVERSITY

During the last decade the sport technology industry has provided sports with many new digital sport analytics technologies that are used from grassroot to elite level. GNSS and LPS are among the most used wearable tracking technology in sport and is applied to measure performance, health and activity related aspects. Tracking technologies are used in 1) coaching to enhance coach support, educate and guide skill acquisition processes, 2) recreational sport to facilitate and promote physical activity and for monitoring of lifelong physical activity, 3) increase engagement in major sporting events (broadcasting), and 4) facilitate remote sport activities during the Covid-19 pandemic. The widespread use of tracking technologies in the sport society has created a new labor market of societal relevance for sport students. This new opportunity however is not well exploited, and implementations of tracking technologies as coaching support systems are too often not sustainable. The reasons for that are twofold: 1) lack of education in the use, analysis and implementation of tracking technologies in sport science and coaching education and 2) lack of comprehensive information regarding the appropriate choice of tracking systems for a given sport analysis. This leads typically to lack of validity in analysis, suboptimal communication and role understanding between coach, athlete and sport scientist in sports, causing confusion and distrust between athlete, coach and performance analyst and harms the sustainability in the implementation of in sports. This is unfortunate, since tracking technologies have great potential for direct transfer and collaboration between academia and the active sport on all levels from grassroot to elite and holds great potential for employment through sport. This lecture aims at improving the understanding of validity of tracking technology for scientists, coaches, athletes and other users of that type of technology in sports

METHODS TO ASSESS VALIDITY OF POSITIONING SYSTEMS IN TEAM SPORTS. CAN WE DO BETTER?

LUTEBERGET, L.
NORWEGIAN SCHOOL OF SPORT SCIENCES

The sport industry provides new technological solutions to sport science offering the opportunity to conduct academic research in sport practice with high external validity. Sport science should make use of this new possibility, but also be aware of their role and responsibility in the symbioses between sport scientists, stakeholders in sports and the industry. One key responsibility is to approach the use of tracking systems with a critical eye. This will be exemplified through validation methods in this talk: Since wearable tracking devices applied in sports should be small, light and user-friendly, the manufacturers of such devices must optimise the trade-off between system performance, handling simplicity and cost, thus compromises are unavoidable. Due to this, and the continuous system improvements in hardware, firmware, and software, the validity of different systems needs to be investigated before use. To date, there are several validity studies published on GNSS and LPS in team sports. However, there is a large variety in the validation methods applied to assess the accuracy of position tracking systems, including a large range of reference systems and criterion measures. In this talk we will assess how the choice of reference systems and methods affect the outcome of validation studies. By mapping out the consequences of these methodological choices we aim to raise awareness for the 1) consequences of these methodological choices, 2) for the responsibility sport scientists have when conducting tracking device validation studies, 3) and the impact on credibility and trust between sport practice, sport science and the sport technology industry. Hence, this lecture highlights how sport scientists should validate tracking devices, be aware of their responsibility to apply and share their knowledge to advance the field of position tracking systems in sports.

PRACTICAL RECOMMENDATIONS FOR THE USE OF TRACKING TECHNOLOGY IN SPORTS AND FUTURE DIRECTIONS

GILGIEN, M.
ENGADIN HEALTH AND INNOVATION FOUNDATION

Today position tracking technology is applied in many different sports to enhance performance, monitor athlete training and health and mitigate injury risk. Each of these sport applications has different requirements to accuracy. To achieve valid results, the accuracy of the tracking devices needs to match the accuracy demands and hence sport scientists need take into account the sensor validations that are conducted to choose appropriate sensors. But sport scientists also need

to have a good understanding of the practical application and processing of tracking data. This is particularly important, since the dynamics of sports motion increase the challenges to tracking devices compared to other GNSS and LPS applications substantially and hence sport tracking is particular. This lecture illustrates the factors that influence accuracy such as hardware and software, measurement surrounding, etc. and shows how the different types of error can be mitigated by the choice of suitable receivers for a given purpose, by proper practical application if the device in the field measurement, by suitable position processing and by suitable parameter derivation strategy. Hence, this lecture offers explicit information and a guideline for the practical use of tracking technology in sports and also shows good examples of proper applications of tracking devices in sports.

Invited Symposium

IS-PN08 Variability of individual responses to exercise: from statistical considerations to practical recommendations

AN OVERVIEW OF QUANTIFYING TRAINABILITY IN SPORT AND EXERCISE SCIENCE

SWINTON, P.
ROBERT GORDON UNIVERSITY

It has long been presumed that individuals respond differently to chronic exercise and maximising improvements requires an individualised approach. Whilst most exercise prescription adheres to some aspects of scaling (e.g., % 1 repetition maximum or % of maximum heart rate), individualised approaches call for additional and tailored specification in terms of the exercise content and/or dosing. It is in this context that researchers are increasingly exploring if systematic and meaningful differences occur both within and between individuals (e.g., trainability), and as a result, whether individualised approaches are indeed required. To address these questions researchers must employ statistical analyses distinct from those typically used to quantify mean differences. Importantly, researchers must account for variability in measured outcomes caused by measurement error and biological processes independent of the intervention. So far, research findings have been contradictory, with many studies reporting no convincing evidence of trainability, and others reporting clear evidence of meaningful differences between individuals that can be linked to genetic background. The statistical approach used to explore trainability is likely to account for some of the divergent findings reported in the literature. In this talk, I will summarise the terminology and important concepts associated with this emerging area of research. The talk will identify the evolution of terms such as response, responder, and trainability; common sources of variability in measurements made throughout an intervention; and different research designs that can be considered. The talk will then discuss some of the methodological limitations with responder analyses including the use of arbitrary criteria, and that these analyses do not capture true individual treatment effects. Following a discussion of statistical approaches to avoid, the talk will then summarise recommended practices. Firstly, a distinction will be made between heterogeneity of a treatment effect and effect modelling, with the former an important first step to assess whether trainability exists and is likely to be meaningful. A focus will be placed on the standard deviation of individual response statistic and its calculation from individual studies and meta-analyses. Assumptions that influence the validity of the statistic will be discussed. The talk will conclude with a discussion of the need for research to progress to assessment of effect modelling and the requirements for reliable calculation. The sample size required for individual studies to quantify effect modelling will be demonstrated based on reasonable assumptions, and an argument made for the need for individual participant data meta-analyses to ultimately address the question of trainability.

INFLUENCE OF GENETIC AND ENVIRONMENTAL FACTORS ON EXERCISE RESPONSE VARIABILITY

THOMAS, H.
DEAKIN UNIVERSITY

Physical inactivity is responsible for 6–10% of annual global mortality. Exercise interventions have been shown to improve traditional risk factors for lifestyle-related diseases and premature death. However, it is also suggested that up to 20–30% of individuals may fail to exhibit beneficial physiological responses to exercise interventions that accord with guideline recommendations for health. These individuals are often termed exercise 'non-responders' for particular health parameters. Recent literature has explored individual response variability and how we can improve exercise prescription to achieve optimal adaptations for every individual. It is generally acknowledged that distinct modalities of exercise induce different physiological adaptations, for example, aerobic exercise typically modifies cardiovascular capacity and oxygen uptake (VO2max), whereas resistance training principally modifies skeletal muscle function and strength. However, few studies have been designed to directly address inter-individual variation in responsiveness to different exercise modalities. This has practical implications for exercise prescription; when an individual is a non-responder for one modality of training, perhaps they may be 'rescued' by converting to an alternate mode. Furthermore, response variability in different health variables or multiple health variables to the same exercise intervention is an equally important question. Although an individual may not see improvements in fitness with aerobic training, it is possible that they have improved several other variables that may improve overall health (e.g., blood pressure, weight, and cholesterol). Another important question is whether changes in health variables with exercise training are dictated by heredity, that is, whether individuals are

genetically pre-disposed to respond. A classical twin study design, utilizing both monozygotic and dizygotic twin pairs, has advantages over other heritability estimation methods as extensive variance (i.e., difference between twins) and co-variance (i.e., common characteristics between twins) information are deduced. From this, we can determine what amount and proportion of the variation is a result of genes and environmental factors. In this talk, I will discuss the findings and implications of the STRUETH study on improving individualised exercise prescription for health. The STRUETH study employed a randomized cross-over design, where each participant completed two forms of training, to investigate whether responses to training are modality-dependent. Furthermore, monozygotic and dizygotic twins were used to understand exercise trainability. This design can be used to analyse concordance/discordance of responses, to determine whether individuals are universal responders or recalcitrant non-responders and the heritability of this response.

EXERCISE PRESCRIPTION AS A NOVEL APPROACH TO INCREASE RESPONSE RATES TO V̇O2MAX

MUNIZ PUMARES, D.
UNIVERSITY OF HERTFORDSHIRE

The most effective means to increase cardiorespiratory fitness, which is quantified as the maximum oxygen uptake (V̇O2max), is endurance training. However, response rates to endurance training are heterogenous, and typically 20-30% of those entering an endurance training programme may not realise an increase in V̇O2max. This is important because relatively small increases in V̇O2max (e.g., 3.5 mL·kg-1·min-1) translate to an 8-35% reduction in premature mortality. This talk will discuss strategies to increase response rates to endurance training, which can be attained by reducing response variability, increasing mean response, or both. Several factors affect response rates to V̇O2max, including non-modifiable (e.g., genetics, sex, age), and modifiable factors (e.g. those related to training characteristics). Among modifiable factors, the method of exercise intensity prescription has been identified as an under-investigated and underexploited, yet promising avenue to improve V̇O2max response rates. The intensity of exercise is normally prescribed relative to a maximal physiological capacity during endurance training programmes, such as relative to V̇O2max or maximum heart rate. Such approaches, however, do not account for the relative positioning of boundaries demarcating exercise domains. This is remarkable, because exercise domains represent a range of intensities where similar homeostatic perturbations are elicited. Indeed, more homogeneous responses to a single bout of exercise are elicited by prescribing the intensity of exercise relative to physiological thresholds, such as the gas exchange threshold as the boundary between moderate and heavy domain and, particularly, critical power as the boundary between the heavy and severe domain. Moreover, data from an individual participant data meta-analysis containing 42 studies and 1587 participants suggests that prescribing the intensity of exercise endurance training programmes relative to physiological thresholds results in greater response rates in V̇O2max, compared to that observed when the intensity of exercise is prescribed relative to traditional anchors of intensity. The greater response rates in V̇O2max appear to derive from higher mean response, without reducing response variability. Overall, this talk will present evidence from a range of studies (responses to an acute bout of exercise, chronic adaptations to training, and meta-analysis of individual participant data) demonstrating that prescribing the intensity of exercise relative to physiological thresholds can reduce response variability to an acute bout exercise, and increase the likelihood of an individual realising a meaningful increase in V̇O2max with endurance training.

Oral Presentations

OP-AP11 Training and Testing/Power and Strength III

KEEPING VELOCITY-BASED STRENGTH TRAINING SIMPLE: PERCEPTION OF VELOCITY LOSS DURING THE BARBELL BENCH PRESS

WIEDENMANN, T., RAPPELT, L., HELD, S., WAGNER, L., DONATH, L.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Velocity based (strength) training (VBT) has been recognized as an effective method for controlling training volume and quality [1]. Studies have demonstrated that a training with velocity loss thresholds (VLT) results in increased maximal strength as well as improved sprinting and jumping performance compared to traditional resistance training [2]. Unfortunately, available velocity and acceleration sensors are expensive and can impose practicability issues. Hence, the objectives of this study were to evaluate (I) the accuracy of velocity perception for strength trained participants during the barbell bench press and (II) whether a single habituation session with VLT feedback can beneficially affect the perceived 20% VLT's agreement with the true values.

METHODS: Eighteen strength trained participants (n (female, male) = 10, 8; age: 26 ± 5 years; 177 ± 10 cm; 79,3 ± 27,6 kg; ≥ 2 years of bench press experience), without prior VBT experience, completed 4 individual sessions, separated by 48 h. Session 1 served as an instruction session and one repetition maximum (1RM) assessment. In session 2 and 4, the participants completed 3 sets at 80 % 1RM. For each set, the participants were instructed to give a verbal cue when they estimated a relative loss of velocity ≥ 20% (20%VLT) and continued their set until failure (≤ 1 repetitions (reps) in reserve). In session 3 the participants were familiarized with a VLT training and completed 3 sets of bench press at 70% 1RM until the 20%VLT was reached. Bench press velocity and reps were monitored, analysed for agreement and presented as bias with limits of agreement (LoA).

RESULTS: The participants performed an average of 9.9 ± 2.1 reps to failure across all sets in session 2. The mean number of reps completed at the 20%VLT was 4.5 ± 1.3 and the mean velocity at 20%VLT was 0.33 ± 0.07 m/s across sets. The participants slightly underestimated the repetitions until 20%VLT by -0.3 reps (LoA [-1.7, 1.2]) which resulted in a slight overestimation of velocity at 20%VLT by 0.02 m/s (LoA [-0.05, 0.08]). There was no change after the familiarization in session 3 for the reps (bias = -0.24, LoA [-1.60, 1.12]; Cohen's d = 0.015, p = 0.93), or velocity (bias = 0.01 m/s, LoA [-0.05, 0.07]; Cohen's d = -0.107, p = 0.48).

CONCLUSION: The analysis of agreement between the perceived and true repetitions and velocity at the 20%VLT reveals a small bias for the bench press with high load. A single habituation session does not meaningfully affect this bias. Our findings indicate that a VLT training can alternatively be applied without velocity measurement, if the athletes are moderately strength trained. Future studies should expand on the current findings with respect to different exercises and load ranges.

1. Weakley J, Mann B, Banyard H, McLaren S, Scott T, Garcia-Ramos A. Strength & Conditioning Journal. 2021;43:31–49.

2. Held S, Speer K, Rappelt L, Wicker P, Donath L. Front Physiol. 2022;13:926972.

THE AUTOREGULATION REST REDISTRIBUTION TRAINING METHOD MITIGATES SEX DIFFERENCES IN NEUROMUSCULAR AND PERCEIVED FATIGUE DURING RESISTANCE TRAINING

DELLO IACONO, A., WATSON, K., JUKIC, I.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: In the realm of strength and conditioning, practitioners continually strive to refine training methodologies that effectively manage fatigue levels and optimize the outcomes of resistance training. Autoregulation, a notable paradigm, involves tailoring resistance training to individual needs and capabilities through the manipulation of training variables. While existing evidence predominantly focuses on autoregulation practices within the male population, there remains a paucity of knowledge concerning the impact of autoregulation resistance training on sex-specific differences in fatiguability and resistance training performance. The aim of this study was to examine the sex differences in motor performance, neuromuscular and perceived fatigue during resistance training prescribed using traditional (TRA) and autoregulation rest redistribution training (ARRT) approaches.

METHODS: Twelve resistance-trained males and twelve females completed two sessions including the bench press exercise matched for load (75% of 1-repetition maximum), volume (24 repetitions), and total rest (240 s). Sessions were performed in a randomized order with TRA consisting of 3 sets of 8 repetitions with 120 s interest rest and ARRT employing a personalized combination of clusters, repetitions per cluster, and between-cluster rest regulated with a 20% velocity loss threshold. The effects of TRA and ARRT on velocity loss, unilateral isometric peak force and rating of fatigue (ROF) were compared between males and females.

RESULTS: The velocity loss was generally lower during ARRT compared to TRA (-0.47 ± 0.11%) with velocity loss being mitigated by ARRT to a greater extent among males compared to females (-0.37 ± 0.15%). Unilateral isometric peak force was greater after ARRT than TRA among males compared to females (38.4 ± 8.4N). Lower ROF after ARRT than TRA were found among males compared to females (-1.97 ± 0.55AU). Additionally, males reported greater ROF than females across both conditions (1.92 ± 0.53AU), and ARRT resulted in lower ROF than ARRT overall (-0.83 ± 0.39 AU).

CONCLUSION: The ARRT approach resulted in decreased velocity loss, peak force impairment, and ROF compared to TRA in both sexes. The flexible, dynamic, and personalized nature of ARRT accounts for between-subject variability in resistance training performance and seems to accommodate individual neuromuscular capabilities and training patterns. However, male subjects exhibited more pronounced acute within-session benefits from the ARRT method compared to females. Morphological, physiological, and training-related factors underlying the sex differences in fatiguability are likely the main reasons explaining these effects. These findings emphasize the effectiveness of the ARRT paradigm in improving neuromuscular outcomes and mitigating perceived fatigue during resistance training. Additionally, a differential response to the ARRT method between sexes underscores the importance of personalized training approaches.

EXPECTATIONS ABOUT SHAM-ISCHEMIC PRECONDITIONING CUFF INTERVENTION ARE LINKED TO CHANGES IN THE MAXIMUM NUMBER OF LEG-EXTENSION REPETITIONS

MAROCOLO, M., FERRAUTI, A., MONTEIRO, L.O.S., OLIVEIRA, G.T., MEIRELES, A., ARRIEL, R.A., HOHL, R., HURST, P., SOUZA, H.L.R.

FEDERAL UNIVERSITY OF JUIZ DE FORA, RUHR UNIVERSITY, CANTERBURY CHRIST CHURCH UNIVERSITY

INTRODUCTION: The placebo effect refers to positive changes in outcomes following the administration of a placebo, while the nocebo effect pertains to negative changes. Ischemic preconditioning (IPC) involves intermittent blood occlusion followed by reperfusion of skeletal muscle, performed either before or after exercise or test. The mechanism for its purported benefit is questioned, with many have reporting that changes in performance are the result of placebo effects (1-2). Given that one major factor mediating placebo and nocebo effects is the expectation evoked after receiving an intervention (3), we investigated the placebo effect associated with IPC. This was accomplished by manipulating subjects expectations following the application of a sham-IPC intervention.

METHODS: Thirty-five healthy men, experienced in resistance exercise (RE), were randomly assigned to one of the following conditions: positive (POS), negative (NEG), or no verbal manipulation (CON). No participants reported prior pneumatic

cuff experience. In the 1st and 2nd visit a familiarization with maximal voluntary isometric contraction (MVIC), lower limb muscle power output, and 10RM test and retest were performed. On the 3rd visit, three maximum sets with a 10RM load were performed, representing the baseline moment. Finally, on the 4th visit, sham-IPC with either POS, NEG or CON manipulations preceded performance tests. All tests were performed unilaterally, on the subjects dominant limb. The sham-IPC intervention consisted of 3 cycles of 5-minute cuff administration (positioned on the proximal region of thigh) set at 20 mmHg of the subjects, followed by 5 minutes of "pseudo-reperfusion" at 0 mmHg, totaling 30 minutes of intervention. The CON intervention involved no cuff application, while subjects remained in a supine rest position for 30 minutes.

RESULTS: Differences were observed for the number of repetitions (POS: 29.6±4.0; NEG: 24.9±4.4; CON: 26.9±2.7; p=0.019), whereby those who received positive information about IPC, significantly improved than those who received negative-information (p=0.01; ES: 1.11). No changes in MVIC peak force were found between groups (POS: 646.6±81.9; NEG: 642.3±90.9; CON: 599.5±56.5 N; p=0.06), and peak muscle power was similar across all groups (POS: 531.4±99.0; NEG: 632.7±111.1; CON: 538.5±69.4 W; p=0.11).

CONCLUSION: The use of sham-IPC cuff intervention linked to positive or negative manipulation, influenced the maximum number of repetitions during a leg-extension task. Our results have important implications for researchers measuring participant expectations about their intervention, which can significantly influence performance outcomes.

REFERENCES:

(1) Souza, et al. 10.1371/journal.pone.0250572;

(2) Marocolo, et al. 10.1007/s00421-022-05109-9;

(3) Brietzke, et al. DOI:10.1007/s00421-022-05029-8

*Contact: isamjf@gmail.com

QUANTIFICATION OF INTER-LIMB ASYMMETRIES IN MALE PROFESSIONAL VOLLEYBALL PLAYERS BY RATE OF FORCE DEVELOPMENT, MAXIMAL VOLUNTARY FORCE AND FORCE STEADINESS

DEMANUELE, S., BOCCIA, G., ZARDO, V., DURIGON, V., SCHENA, F., TARPERI, C.

UNIVERSITY OF VERONA

INTRODUCTION: Inter-limb asymmetries have been identified as a potential factor that may contribute to impaired sports performance and possibly increase injury risk, especially in sports that involve many asymmetrical actions, such as volleyball. We had a dual aim: to investigate if muscle function asymmetries are muscle-specific or if one side is overall more performative independently of the muscle group; and to investigate if, within each muscle group, asymmetry direction is consistent among various muscle performance and motor control metrics.

METHODS: 13 professional male volleyball players (24±3 yrs; 87±7 kg; 194±7 cm; 12±4 yrs of practice; 19±2h training/week) took part in our study. The subjects were seated on a bench with the arm flexed at 90°. The wrist was aligned and fixed with custom-built telescopic support connected to a strain gauge load cell to record compression/extension forces. After familiarisation, participants performed two maximal voluntary contractions (MVC) and 40 submaximal and maximal ballistic contractions to assess the Rate of Force Development Scaling Factor (RFD-SF) and RFD at peak (RFDpeak), and in time-locked intervals (RFD50,100,150). Furthermore, participants performed two contractions lasting 8s to assess force steadiness as Approximate Entropy (ApEn), Coefficient of Variations (CoV), and Detrended Fluctuation Analysis (DFAα). These evaluations were repeated randomly for both limbs elbow extensors (EE) and flexors (EF).

Repeated measure ANOVA assessed each metrics differences between muscle groups and limbs. Kappa coefficients (K) were calculated to determine the levels of agreement for the direction of asymmetry among muscle groups and performance metrics at the individual level.

RESULTS: MVC of EF was greater in the dominant vs non-dominant side (MVC = 12%, p=.007, d=.68), while no differences were achieved for the other metrics.

The asymmetry direction agreement between muscle performance metrics was null for all parameters except for CoV, which resulted in slight (K=0.153) and fair (K=0.234) for ApEn. The agreement between RFDpeak and MVC (K=0.211) was appropriate, slight between RFDpeak and RFD-SF (K=0.178), and null when comparing RFDpeak with CoV, ApEn and DFAα.

CONCLUSION: Although volleyball is considered a sport with an asymmetrical nature, the overall muscle symmetries observed in this study did support this hypothesis. Our results demonstrate that asymmetries are muscle-specific and rarely favour the same side across different muscle performance metrics, regardless of dominance. Generally, at the individual level, no side proves more performant than the other, not even at the level of variability and complexity of the force output: each limb is favoured depending on the muscle group and performance metric. Strength and conditioning coaches who wish to address asymmetry levels can use the current findings, as they should prescribe specific training for each goal.

FORCE-TIME CHARACTERISTICS DURING COUNTERMOVEMENT JUMPS WITH DUMBBELL ACCENTUATED ECCENTRIC LOADING IN YOUTH SOCCER PLAYERS

BRIGHT, T., LAKE, J., MUNDY, P., THEIS, N., HUGHES, J.
CARDIFF METROPOLITAN UNIVERSITY

INTRODUCTION: Young athletes participating in regular strength and conditioning programmes inclusive of resistance and plyometric training have enhanced strength and power capabilities [1]. Considering the natural development and trainability of the stretch-shortening cycle during childhood [2], training methods that target this mechanism are of interest. While dumbbell accentuated eccentric loading (AEL) has shown promise in improving vertical jump heights during drop jumps in adolescent athletes [3], its acute effects during a countermovement vertical jump (CMVJ) remain unexplored. Therefore, the aim of this study was to explore the differences between force-time characteristics during a body weight CMVJ (CMVJBW) and a CMVJ with dumbbell AEL (CMVJAEL).

METHODS: Eight male youth soccer players (age: 15.57 ± 1.53y; height: 173.76 ± 4.87cm; mass: 58.66 ± 7.26kg) volunteered to participate in the study. After familiarisation, participants completed 3 trials of CMVJBW and CMVJAEL using dumbbells at 20% of body mass using two parallel force platforms (Kistler type 9286AA, Kistler Instruments Inc., Amherst, NY, USA; 1000 Hz). Both the CMVJBW and CMVJAEL force-time data were filtered [4] and processed using published guidelines [5] to obtain the following variables: jump height, reactive strength index modified, time to take-off, countermovement depth, force at zero velocity and time, force and velocity characteristics for the unweighting, yielding, braking and propulsion phases. To account for the change in body mass as a result of the dumbbell release during CMVJAEL, backward integration was also undertaken[6]. A series of paired sample t-tests were conducted to determine the differences between CMVJBW and CMVJAEL. Hedge's g effect sizes were used to examine the magnitude of the differences between conditions.

RESULTS: Significantly greater jump height, velocity at take-off, unweighting peak velocity, yielding mean velocity, braking mean velocity and propulsion peak velocity were observed in the CMVJAEL condition ($p < 0.05$; $g = 0.79$-2.35). Yielding time was reduced during the CMVJAEL condition ($p < 0.05$; $g = 0.79$), while unweighting time and minimum force were moderately higher in the CMVJAEL condition ($g = 0.66$). All other effect sizes were trivial to small.

CONCLUSION: This sample of youth soccer players were able to realise a greater jump height during the CMVJAEL condition. Furthermore, the CMVJAEL facilitated greater velocities during the unweighting, yielding, braking and propulsion phases without a significant change in countermovement depth. Collectively, these results suggest that practitioners can utilise CMVJAEL through dumbbells to target the stretch-shortening cycle in youth soccer players. Future research should investigate the acute effects of CMVJAEL at 30 and 40% of body mass to identify the changes in force-time characteristics at greater loads.

Oral Presentations

OP-PN09 Nutrition V

MAXIMAL FAT OXIDATION DOES NOT DIFFER BETWEEN FEMALES AND MALES WHO ARE MATCHED FOR MAXIMAL OXYGEN UPTAKE

QUITTMANN, O.J., VAN EIK, S., ABEL, T.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Maximal fat oxidation (MFO) has implications for metabolic health [1] and explains between 12-14% of the variance in ultra-endurance events [2,3]. MFO seems to be influenced by training status, exercise intensity/duration, nutrition and sex [4]. Regarding the latter, there are still inconclusive findings on the influence of sex, that are biased by the expressed units and performance differences between groups [5,6]. This study aimed to compare MFO and the corresponding intensity (Fatmax) between females and males who are matched for maximal oxygen uptake (VO2max).

METHODS: A sub-sample was taken from a previous study in N = 44 well-trained runners/triathletes [7]. Ultimately, n = 10 females and n = 10 males met the inclusion criterion of a VO2max between 55 and 63 ml/min/kg. Substrate oxidation rates were calculated from a graded exercise test by using equations of stoichiometry [8]. Fat oxidation was calculated for every intensity level and interpolated by a quadratic polynomial to determine MFO and Fatmax (expressed in %VO2max). Normality was checked by the Kolomogorov-Smirnov test (α=10%). Based on this criterion, comparisons between groups were performed by an independent t-test or the Mann-Whitney-U-test (α=5%). Effect-sizes were calculated as Cohen's d.

RESULTS: There was no significant difference between females and males in terms of VO2max (d=-0.331, p=0.533), MFO (d=-0.500, p=0.269), Fatmax (d=0.030, p=0.948), onset of blood lactate accumulation (d=-0.775, p=0.108) and maximal lactate accumulation rate (d=-0.919, p=0.600). MFO was 0.38±0.14 and 0.45±0.14 g/min in females and males, respectively. Even if MFO was normalised to fat free mass, there was no difference between sexes (d=0.330, p=0.432). However, females needed significantly more time to cover a 5-km time trial (d=1.383, p=0.006).

CONCLUSION: MFO and Fatmax were similar in females and males who are matched for VO2max. This indicates that the influence of training status is higher than the influence of sex per se. However, these results are specific for the applied protocol, equipment and equations, that seem to influence outcomes of fat oxidation [9]. Limitations worth mentioning are

that no concrete standardizations were applied in terms of nutrition, daytime and menstrual cycle between participants, which increases the secondary variance of this study. Future studies should validate these findings in a larger and more standardized sample as well as in elite (endurance) athletes.

References

1) Chavéz-Guevara et al. Eur J Appl Physiol

2) Fradsen et al. (2017) Int J Sports Med

3) Martinez-Navarro et al. (2020) Int J Sports Med

4) Purdom et al. (2018) J Int Soc Sports Nutr

5) Randell et al. (2017) Med Sci Sports Exerc

6) Maunder et al. (2018) Front Physiol

7) Quittmann et al. (2022) Int J Sports Med

8) Péronnet & Massicotte (1991) Can J Sport Sci

9) Amaro-Gahete et al. (2019) Scand J Med Sci Sports

A 10-WEEK LOW-CARB DIET OFFSETS THE BENEFICIAL EFFECTS OF ENDURANCE EXERCISE ON BLOOD LIPID LEVELS COMPARED TO A CARBOHYDRATE RICH DIET WITH DIFFERENT GLYCAEMIC INDICES IN RECREATIONAL ACTIVE ATHLETES

MOITZI, A., ROGI, B., KRUPICKA, R., FEICHTER, A., KOENIG, D.

UNIVERSITY OF VIENNA

INTRODUCTION: An increasing number of recreational active athletes are considering a low-carbohydrate, high-fat (LCHF) diet for health and performance reasons. Nevertheless, the question remains whether an LCHF diet can be considered healthy, especially for individuals at higher risk for cardiovascular diseases. Therefore, the objective was to investigate the impact of a LCHF diet on blood lipid profiles in endurance trained individuals, comparing it to a high carbohydrate (CHO) diet with varying glycaemic indices.

METHODS: In a randomised, parallel group design, recreationally active runners (n=65, VO2 peak=55±8 mL·min-1·kg-1) completed 10 weeks of an ad libitum dietary intervention (LOW-GI:≥65% low GI CHO per day, n=24; HIGH-GI:≥65% high GI CHO per day, n=20; LCHF:≤50g CHO daily, n=21) together with prescribed five sessions of an endurance training program. Dietary recalls were conducted twice a week during the intervention phase. Serum was collected at the beginning and after 10 weeks and was analysed for fasting total cholesterol (TC), triglycerides (TG), LDL-C and HDL-C. Data were analysed using a 2-way mixed ANOVA und are presented as mean±STD.

RESULTS: Significant time x group interactions were found for TC, HDL-C and LDL-C and are presented in the following. After the intervention, TC was significantly higher in LCHF (196±37 mg·dL-1) compared to LOW-GI (171±41 mg·dL-1) or HIGH-GI (152±28 mg·dL-1, $p<0.001$, $\eta p2=0.201$). LDL-C was reduced in LOW-GI (-14±20 mg·dL-1) and HIGH-GI (-13±18 mg·dL-1), increased for subjects in LCHF (17±21 mg·dL-1, $p<0.05$ respectively) and differed significantly between all groups after 10 weeks ($p<0.001$, $\eta p2=0.257$). Participants in HIGH-GI experienced a reduction in HDL-C (-3±9 mg·dL-1, $p=0.006$), while the changes in the other two regimes were not significant. Additionally, during the intervention, intake in saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA) was significantly higher in LCHF compared to CHO groups ($p<0.001$, $\eta p2 = 0.459$, $\eta p2 = 0.520$). Compared to LOW-GI intake in SFA (27±13 vs. 60±20 g·day-1) and MUFA (28±11 vs. 63±23 g·day-1) was around 45% higher in LCHF. Intake in soluble and insoluble fibre differed significantly between groups ($p<0.001$, $\eta p2 = 0.507$, $\eta p2 = 0.378$) with the highest intake in LOW-GI (12±3 and 28±6 g·day-1) and the lowest intake in LCHF (6±2 and 18±8 g·day-1).

CONCLUSION: Although a LCHF diet is often recommended for weight loss and improvement of fat oxidation, the current data suggest that a LCHF diet, even if together with regular endurance exercise, significantly impairs blood lipids compared to a high CHO diet. In addition, a higher fibre intake combined with a lower intake of SFA, resulted in favourable changes in blood lipids during a CHO rich diet, independent of GI. These findings suggest that active individuals should consider the potential effects of their diet on blood lipid levels, as a LCHF diet may counteract the benefits of exercise thereby potentially increasing their atherogenic risk profile.

EFFECT OF LOW VS. HIGH CARBOHYDRATE DIET AFTER GLYCOGEN DEPLETING SESSION ON 1500M RUN PERFORMANCE IN HIGH-LEVEL RUNNERS

VENCKUNAS, T., MINDERIS, P., SILINSKAS, V., BULIUOLIS, A., MAUGHAN, R.J., KAMANDULIS, S.

LITHUANIAN SPORTS UNIVERSITY

INTRODUCTION: Carbohydrate (CHO) metabolism is crucial for performance in middle distance races. However, it has so far not been studied robustly if low glycogen stores could interfere with the exercise capacity in the field conditions of relatively short endurance events. It thus remains to be determined if diminished glycogen stores affect sports performance where relatively small amounts of CHO are required to complete the race. The present study tested how 1500 m race is affected by dietary manipulation intended to alter pre-race glycogen reserves in high-level runners.

METHODS: National level middle distance runners [n=11 (4 females); age: 21.4 (SD 4.3) y, height: 179.5 (10.5) cm, BMI: 21.2 (1.5), training volume: 12.3 (1.8) h/wk, 69 (25) km/wk] completed, in a randomized cross-over design, a 1500 m time trial

(TT) after abundant (High) or restricted (Low) CHO consumption for 2 days after glycogen depleting session (60 min of continuous moderate intensity run followed by 10 x 200 m at planned 1500 m TT pace).

CHO intake during 5 days before the each glycogen depleting session averaged 4.8 (1.4) g/kg/d. To keep the diet between glycogen depleting session and TT eucaloric, the Low condition required substitution of most of the diet CHO with fats, while the High condition required consumption of foods high in CHO and low in fats (protein intake was aimed to be unchanged). During Low and High conditions, CHO intake was <2 g/kg/d (average 1.0 (0.4) g/kg/d) and >5 g/kg/d (average 9.7 (2.6) g/kg/d), respectively. The TT took place in an indoor 200 m track and was run individually with time recorded every 100 m split. Striding pattern, heart rate (HR), capillary blood lactate and glucose dynamics and plasma malondialdehyde (MDA, an oxidative stress marker) response were determined.

RESULTS: Time to complete 1500 m TT was slower in Low vs. High condition by 4.5 (4.5) s (i.e. by ~2%; p<0.01). Slowing in the later stages of the race in Low condition was largely due to decrease in stride length (p<0.05) rather than stride frequency. HR response to TT was not affected by feeding condition. Blood lactate and glucose were lower immediately before TT in Low vs. High condition (1.8 (0.5) vs. 2.2 (0.7) mmol/l and 5.4 (0.7) vs. (5.9 (0.8) mmol/l, p=0.022 and 0.007, respectively), peak lactate was higher in High vs. Low condition (16.8 (3.1) vs. 14.5 (4.2) mmol/l, p=0.039), while glucose was not affected by feeding condition during the 15 min of passive recovery. Plasma MDA levels did not differ between the conditions before TT, and 15 min after TT increased similarly by 15 % in Low (p=0.03) and High (p<0.01) conditions.

CONCLUSION: In conclusion, compared to CHO restriction, a diet with ample CHO after a glycogen depleting session allowed for faster 1500 m race in high-level distance runners. Restriction of CHO to <2 g/kg/d after the glycogen exhaustion session slightly reduced baseline and peak blood lactate values but did not markedly change blood glucose or plasma MDA response to 1500 m race.

DOES DIFFERENT CARBOHYDRATE INTAKE AFFECT BETA-HYDROXYBUTYRATE ELEVATION AND GLUCOSE METABOLISM IN A STATE OF LOW ENERGY AVAILABILITY?

HAYASHI, N., LIN, C., YAMADA, M., ISHIKAWA, A., SAKAMAKI-SUNAGA, M., GOTO, K.
NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: Low energy availability (LEA) occurs when there is an imbalance between energy intake and energy expenditure. Carbohydrate (CHO) intake in a state of LEA may decrease by 20-60% (Mountjoy et al., 2023), which can lead to alteration of CHO availability in the body. The different CHO availability may affect beta-hydroxybutyrate (BHB) concentration and glucose metabolism during endurance exercise in short-term LEA status (i.e., adaptable LEA). Therefore, the present study investigated the effect of different CHO intakes on BHB concentration and glucose metabolism in a state of adaptable LEA.

METHODS: Nineteen active men and women are allocated to LEA with a higher CHO (HCHO, 70%CHO; 4.9 ± 0.5g/kg CHO) intake group [n = 9 (4 women, 5 men); Age, 23 ± 3 yrs; VO2peak 47.4 ± 5.2 ml/kg/min] or LEA with a lower CHO (LCHO, 35%CHO, 2.3g/kg CHO) intake group [n = 10 (6 women, 4 men); 23 ± 2 yrs; VO2peak 48.5 ± 6.6 ml/kg/min] during a 3-day endurance training. Then, participants consumed the prescribed diet (20 kcal/FFM with higher or lower CHO diet) during the 3-day training. Before and after the intervention (pre, post), they conducted a 60-minute treadmill running at 70%VO2peak, and blood samples were collected before (at rest), immediately, 1 hour, and 3 hours after the completion of the exercise. Respiratory samples were collected before exercise (at rest) and during exercise at 25-30 minutes and 55-60 minutes.

RESULTS: Serum BHB concentrations significantly increased 3 hours after exercise both pre- (p = 0.000) and post-intervention (p = 0.000). Serum BHB concentration was significantly higher post-intervention than pre-intervention (p = 0.000); however, no difference was observed between the HCHO and LCHO groups. Post-intervention presented a significantly lower blood glucose concentration when compared to pre-intervention (p = 0.015). The LCHO group showed significantly lower RER at rest (p = 0.020) and during exercise at 25-30 minutes (p = 0.000) and 55-60 minutes (p = 0.000). The HCHO group presented a significantly lower respiratory exchange ratio (RER) during exercise at 55-60 minutes (p = 0.000). The LCHO group tended to decrease in CHO oxidation post-intervention than pre-intervention (p = 0.051); however, the HCHO group did not reveal a significant difference between pre-and post-intervention. Fat oxidation at rest and during exercise at 25-30 minutes and 55-60 minutes significantly increased post-intervention than pre-intervention (p = 0.027, p = 0.000, p = 0.000, respectively); however, no significant difference was observed between the groups.

CONCLUSION: The different CHO intakes did not affect BHB increases and glucose metabolism when in a state of LEA. Therefore, lower CHO intake in adaptable LEA may not further impair glucose metabolism and/or cause acute further training adaptation.

MODERATELY ELEVATED BILIRUBIN LEVELS, AS OBSERVED IN GILBERT'S SYNDROME, POSITIVELY AFFECT METABOLIC HEALTH AND EXERCISE PERFORMANCE

STELZER, T., MOITZI, A., KÖNIG, D., WAGNER, K.H.
UNIVERSTIY OF VIENNA

INTRODUCTION: Moderately elevated unconjugated bilirubin (UCB) levels, as observed in people with Gilberts syndrome (GS) have previously been described to have beneficial effects on metabolic health. A specific metabolomics profile was identified for GS subjects, where downstream metabolites associated with ketogenesis, and fatty acid oxidation were significantly increased. However, until now there is no data on exercise performance or substrate utilization during exer-

cising. We therefore determined maximal fat oxidation (MFO), Fatmax and ventilatory thresholds during a graded step protocol

METHODS: 41 male (n=24) and female (n=17) GS subjects (UCB>17µmol/l) between 18 and 65 years of age as well as their 41 age and gender matched healthy controls (UCB <17µmol/l) were included. Participants were moderately physically active. After a 12h overnight fast, all subjects completed a graded exercise test on a cycle ergometer until reaching a RER of 1.00 to determine MFO, Fatmax and ventilatory thresholds (VT1, VT2). 48h prior to the exercise test subjects were asked to avoid strenuous physical activity and consume carbohydrates only at moderate amounts the day before. During the exercise test heart rate and gas exchange were continuously collected. Body composition (fat mass, FM, fat free mass, FFM, skeletal muscle mass, SMM, and total body water TBW) and body weight (BW) were determined using bioelectric impedance. VO2max was calculated using a regression model designed by Nunes et al. in 2018. UCB was measured via high performance liquid chromatography (HPLC).

RESULTS: BMI tended to be lower in GS subjects (p=0.065). FM (kg) was significantly lower in subjects with GS over 35 years of age (p=0.037). No significant difference was found in absolute MFO (g/min) between groups (p=0.143), or Fatmax (p=0.358). However, MFO relative to BW (p=0.042) and FFM (p=0.043) was significantly higher in the GS group (g/min/kg BW: 0.0040±0.0011; g/min/kg FFM: 0.0053±0.0015) compared to controls (g/min/kg BW: 0.0034±0.0014; g/min/kg FFM: 0.0045±0.0016). Between MFO and FFM (kg) as well as SMM (kg) there was a significant positive correlation (p<0.001). Power (W/kg BW) at VT1 was significantly (p=0.023) higher in GS (1.1±0.4) compared to controls (0.9±0.3). Power output (W/kg BW) at VT2 tended to be higher in GS subjects (p=0.062), while oxygen uptake (ml/min/kg BW) was significantly higher (p=0.021) in GS (32.1±8.0) compared to controls (27.5±9.2). Predicted VO2max was higher in GS (41.1±9.5) than in controls (37.0±9.9) but not significant (p=0.058). However, in GS over the age of 35 predicted VO2max was (p=0.003) significantly higher

CONCLUSION: Even though, there is no significant difference in absolute MFO, MFO relative to BW and FFM is significantly higher in the GS group. Together with the higher performance at VT1 and VT2, this indicates that moderately elevated UCB levels seem to somehow enhance metabolic health and exercise performance.

Oral Presentations

OP-MH03 Ageing

AEROBIC CAPACITY AND MUSCLE STRENGTH IN LIFELONG MASTER ENDURANCE RUNNERS COMPARED TO YOUNG ENDURANCE RUNNERS: HOW DO THEY DIFFER?

ORESKÁ, L.1, SEDLIAK, M.1, BERISHA, G.1, STRELECKÝ, M.1, BUZGÓ, G.1, HAMAR, D.1, CVECKA, J.1, VAJDA, M.1, VARGA, L.2, KERN, H.3

1 FACULTY OF PHYSICAL EDUCATION AND SPORTS, BRATISLAVA, SLOVAKIA; 2 FACULTY OF MEDICINE, BRATISLAVA, SLOVAKIA; 3 INSTITUTE FOR PMPR, ST. PÖLTEN, AUSTRIA

INTRODUCTION: Advanced ageing is naturally associated with a decline in physical fitness. However, master athletes who stay physically active may slow down this decline. Yet, there are some differences in physical functioning between master and young athletes. The study aimed to assess physiological function and muscle morphology in lifelong master endurance runners against their young trained counterparts

METHODS: In a cross-sectional design, groups of 8 young best endurance runners (YER: age: 27.38 ± 3.07 yrs, BW: 72.21 ± 7.06 kg) and 10 best master endurance runners (MER: age 70.22 ± 3.87 yrs, BW: 71.44 ± 9.99 kg;) who underwent assessments of body composition, aerobic capacity, muscle strength and muscle morphology. The inclusion criteria were the following: 1) above 300 mins per week of endurance running, 2) regular participation of YER (at least 3 years) and MER (at least 25 years) in running competitions (in 10 km, half, and full marathon), 3) to have their personal best time on 10 km run in last season under 35 mins in YER and under 55 mins in MER.

To compare the two groups, body composition (weight, muscle mass, body fat, BMI) was measured using bioimpedance, lower limb muscle strength was tested with knee extension on a dynamometer, and aerobic capacity was measured on a cycle ergometer (heart rate, maximum oxygen consumption, power output). Muscle biopsies were taken from the Vastus Lateralis to examine Immunohistochemically analysed muscle structure and myonuclear domain determination.

RESULTS: In body composition, significant differences were observed in body fat (YER: 10.61 ± 3.35 %; MER: 19.07 ± 6.36 %, p ≤ .005) and muscle (p ≤ .005) in favour of young endurance runners, but not in BMI. According to maximal and relative voluntary contraction, in both, young endurance runners were significantly stronger, as well as in comparing dominant and nondominant legs separately. Testing aerobic capacity, young endurance runners also proved their VO2max is significantly higher compared to their master counterparts (YER: 64.60 ± 5.51 ml/kg.min-1; MER: 42.88 ± 5.88 ml/kg.min-1, p < .000). The significant difference was also observed in HRmax (YER: 174.75 ± 5.55 bpm, MER: 15.00 ± 14.76 bpm, p ≤ .001) and maximal (YER: 374.50 ± 49.13W, MER: 228.89 ± 33.33W, P < .001) as well as relative power-output (P < .001). The differences were also observed on the muscle morphological and myonuclear domain levels

CONCLUSION: Finally, our findings demonstrate that lifelong Master endurance runners display superior aerobic capacity, body composition, and muscle fibre morphology, yet there is still a deterioration due to natural ageing in the parameters

compared to young endurance runners. Therefore, regular lifelong endurance activity can offer significant protection against declining physiological health and function as individuals age.

The study was funded by the INTERREG V-A Slovakia—Austria (acronym CAA, ITMS2014 + 305041X157) and by the Slovak Research and Development Agency (Grant no. APVV-21-0164)

AN INVESTIGATION OF THE EFFECTS OF HIGH INTENSITY INTERVAL TRAINING (HIIT) AND MODERATE INTENSITY CONTINUOUS TRAINING (MICT) ON FUNCTIONAL MOVEMENT AND NEUROMUSCULAR ADAPTATIONS IN OLDER ADULTS.

STERN, G., PSYCHARAKIS, S., PHILLIPS, S.

UNIVERSITY OF EDINBURGH

INTRODUCTION: Background: An important training goal for older adults (OA) is improving and retaining Functional Movement (FM), defined as fundamental movement patterns that require a balance of mobility and stability (including neuromuscular/motor control) used in the performance of basic locomotor, manipulative, and stabilizing movements [1]. While FM has been positively associated with physical activity and increases in muscular power, it is not clear whether high intensity interval training (HIIT) or moderate intensity continuous training (MICT) is more effective for preserving and promoting FM.

Objective: To determine the differences in adaptation to HIIT and MICT on FM, the relationship between FM and neuromuscular mechanical power development, the relative efficiency of HIIT vs MICT, and the association between FM and health related quality of life (HRQoL) in adults aged 50-70 years.

METHODS: A mixed sex sample of 31 healthy, physically active participants was recruited for the free-living intervention study. Testing included FM screening (FMS), a graded exercise test (GXT) to 90% of maximum heart rate, and counter movement jump (CMJ) trials recorded with integrated kinematic and kinetic data. The participants were randomized by FMS score into HIIT and MICT intervention groups. Training protocols were executed 3 x week-1 for six weeks with exercise session location, duration, intensity and adherence collected from GPS enabled heart rate monitors. Exercise volume and estimates of energy expenditure were calculated from HR data directly.

RESULTS: Both HIIT and MICT groups increased FM scores by 9.3 ± 12.3% and 10.5 ± 12.9% respectively. The effect size of HIIT vs MICT on FM was trivial and insignificant (d = 0.09 95% CI [-0.69, 0.88] p = 0.82).

The CMJ outcome measures were net vertical impulse (NVI), maximum knee angle (MKA), knee joint angular velocity (JAV), pelvic vertical displacement (PVD), pelvic vertical velocity (PVV), and jump height performance. Within-group measures that reached statistical significance/near significance were PVD: HIIT d = 0.31, 95% CI [-0.01, 0.66] p = 0.06; MICT d = 0.32, 95% CI [0.08, 0.58] p = 0.01 and Jump Performance: HIIT d= 0.21, 95% CI [0.08, 0.37] p = 0.003; MICT d = 0.25, 95% CI [0.06, 0.47] p = 0.01. All other within and between group measures were trivial to small and did not achieve statistical significance.

Training effects of HIIT and MICT on the physical summary and mental summary of the HRQoL scores was trivial to small and did not reach statistical significance.

CONCLUSION: Both HIIT and MICT can improve FM and produce small but statistically significant change in neuromuscular mechanical power generation. HIIT can produce equivalent adaptations to MICT in 28.5% less time, 24.7% lower energy expenditure, and 21.2% lower exercise volume.

References:

1. Cook G, Burton L, Hoogenboom BJ, Voight M. Functional movement screening: the use of fundamental movements as an assessment of function. Int J Sport Phys Ther. 2014.

DETRAINING EFFECTS ON MUSCULAR FUNCTION AND STRUCTURE FOLLOWING TWELVE WEEKS OF ECCENTRIC RESISTANCE TRAINING IN OLDER ADULTS.

BAXTER, B.A., BAROSS, A.W., RYAN, D.J., KAY, A.D.

UNIVERSITY OF NORTHAMPTON

INTRODUCTION: Periods of inactivity are common amongst older adults, accelerating the loss of muscle strength and size. This inactivity is problematic as low adherence is reported to the recommended twice-weekly resistance training guidelines [1]. While eccentric-only resistance training has demonstrated a superior ability to preserve training-induced adaptations compared to traditional training modalities [2], the influence of weekly dosage on this preservation remains unknown. Therefore, following the cessation of once- or twice-weekly (unmatched volume) 12-week eccentric resistance training programmes, this study examined the effects of a 12-week detraining period on muscle function and structure in older adults.

METHODS: Participants were randomly assigned to a once- (n = 12) or twice-weekly (n = 11) training programme and completed 12 weeks eccentric resistance training at 50% of their maximal eccentric strength. To determine detraining effects, muscular function (eccentric and isometric strength, power, and timed up-and-go [TUG]) and structure (vastus lateralis muscle thickness, fascicle angle, and length) were measured at post-training (week 1), mid-detraining (week 7), and post-detraining (week 13). Two-way mixed model ANOVAs were conducted to identify significant ($P < 0.05$) differences with effect sizes (d) calculated to determine the magnitude of change.

RESULTS: No significant interaction effects indicated a similar regression profile between training groups. No significant regression occurred in any metric of muscular function between post-training and post-detraining (eccentric strength [-1%; d = -0.03], isometric strength [-6%; d = -0.39], power [-6%; d = -0.42], and TUG [-3%; d = -0.39]), resulting in 97, 68, 100, and 100% retainment of training-induced improvements of eccentric strength, isometric strength, power, and TUG, respectively. Conversely, muscle thickness (-10%; d = -1.32) and fascicle angle significantly decreased (-1.8°; d = 0.65]) following the detraining period, resulting in 19 and 0% retainment of training-induced improvements of muscle thickness and fascicle angle, respectively.

CONCLUSION: Whilst muscle thickness and fascicle angle significantly regressed during detraining, the preservation of improvements in lower-limb muscular strength, power, and functional ability, 12 weeks after the cessation of once- or twice-weekly eccentric resistance training, is indicative of a potent functional training stimulus. Importantly, as training frequency had no effect on the sustainment of training-induced adaptations, these findings have important clinical implications for exercise prescription with the use of eccentric resistance training as a once-weekly strategy to counteract the poor adherence to current twice-weekly resistance training guidelines and age-related declinations in neuromuscular function.

EFFECTS OF DIFFERENT INTERMITTENT HYPOXIA PROTOCOLS ON COGNITIVE PERFORMANCE IN OLDER ADULTS WITH OR WITHOUT COGNITIVE IMPAIRMENT: A SYSTEMATIC LITERATURE REVIEW

BOULARES, A., FAUCHER, C., PICHON, A., DUPUY, O.

POITIERS UNIVERSITY

INTRODUCTION: In recent years, intermittent hypoxia (IH) has increasingly attracted the interest of the scholarly community. An accumulating body of research has explored its effects in varied contexts, including clinical and sports medicine, spanning a wide range of populations. This includes older adults both with and without underlying health conditions [1,2]. Multiple protocols of IH have been developed to quantify its impact [2,3]. This systematic review aims to enrich our comprehension of the potential benefits of IH protocols on cognitive function in old adults with or without cognitive impairment.

METHODS: A systematic search was conducted following PRISMA guidelines across four databases: PubMed, Scopus, Web of Science, and the Cochrane Library. The search encompassed the earliest available records up to January 2023 using the following eligibility criteria: 1-Original research with sufficient quantitative details; 2-Studies involving old adults, with or without cognitive impairment; 3-Studies including old adults exposed to any intermittent hypoxia protocols or undergoing interventional programs including intermittent hypoxia protocols; 4-Articles focusing on the analysis of cognition performance in older adults.

RESULTS: Out of 556 initial search records, seven studies and four registers met inclusion criteria, revealing that Intermittent hypoxia training (IHT) and Intermittent hypoxia-hyperoxia (IHHT) protocols may enhance cognitive functions, with variations in efficacy depending on the presence of cognitive impairment. IHHT, especially when combined with physical exercise, showed more promise in improving cognitive scores and cerebral hemodynamics. Cognitive improvements were more pronounced in participants with existing cognitive impairments.

CONCLUSION: This systematic review indicates that IHT and IHHT offer beneficial cognitive effects for older adults, with IHHT yielding more substantial improvements. These findings advocate for further research to optimize hypoxic training protocols as a therapeutic strategy for age-related cognitive decline.

Oral Presentations

OP-BM11 Gait

THE IMPACT OF A HEAD- AND TAILWIND ON THE METABOLIC COST OF WALKING AND RUNNING

LUCIANO, F., MESQUITA, R.M.2, CATAVITELLO, G.2,3, DEWOLF, A.H.2, NATALUCCI, V.1, PAVEI, G.1, WILLEMS, P.A.2, MINETTI, A.E.1

1 UNIVERSITY OF MILAN, ITALY; 2 UNIVERSITÉ CATHOLIQUE DE LOUVAIN, BELGIUM; 3 CURRENT ADDRESS: BUSINESS AND DECISION LIFE SCIENCE MEDICAL COMMUNICATION SERVICE CENTER, BRUSSELS, BELGIUM

INTRODUCTION: The metabolic cost (C) of walking and running is reported to increase with headwind and decrease with tailwind (1). In analogy with gradient locomotion, air drag may increase C by impacting the mechanical work done on the body center of mass and the proportion between its positive and negative fractions (2-4), although limited evidence exists on the underlying mechanisms. Elucidating the relationship between wind speed and C would shed further light on the energy demands of overground locomotion, where people move through air, and the generalizability of treadmill studies, where relative wind speed is nil. This study aimed to assess how air drag affects the metabolic and mechanical demands of walking and running.

METHODS: After sample size estimation, eight male endurance athletes (age: 32±6 y, mass: 63.2±6.6 kg; height: 1.77±0.05 m, PB 10000 m: 31:20±01:12 min:s) were recruited. Participants walked at 1.5 m/s and ran at 4.0 m/s on an instrumented treadmill in a wind tunnel. Wind speeds (v) ranged from –12.5 to 12.5 m/s, where negative and positive signs indicate wind from the back (tailwind) or the front (headwind) of participants, respectively. A portable metabograph

measured steady-state gas exchanges, and an eight-camera optoelectronic system recorded the position of reflective markers on the main body segments. This allowed calculating C (J/(kg*m)), drag force (Fd, N/kg), internal kinetic mechanical work (Wintk), positive and negative external mechanical work (Wext+ and Wext–). Mixed-effects models regressed such variables over v and v^2: those with the lowest Akaike Information Criterion were reported with their fixed effects and t-values.

RESULTS: Headwind increased C for walking (C=2.72–0.05*v+0.01*v^2; t_v=–1.5; t_v^2=3.1) and running (C=4.28–0.08*v+0.01*v^2; t_v=–3.3; t_v^2=6.4), while tailwind decreased it (C=2.72+0.12*v; t_v=14.7 and C=4.28+0.15v; t_v=19.3, respectively). Similarly, Wext+ increased with headwind and decreased with tailwind; the opposite was observed for Wext–, whereas Wintk was negligibly affected by wind. Across the whole range of wind speeds (–12.5 to 12.5 m/s), variations in C followed linearly those in Fd (C=2.52+1.9*Fd; t_Fd=17.2 for walking, and C=4.0+2.5*Fd; t_Fd=20.1 for running).

CONCLUSION: Our study confirms that the C of walking and running increases with headwind and decreases with tailwind; variations in C have similar magnitude in walking and running, and parallel those in Fd. The relations between C, Wext+ and Wext– with a head- and tailwind align with those observed in uphill and downhill locomotion, respectively (2). As for this case, variations in C may be determined by the partitioning between positive and negative work, together with their different efficiencies.

REFERENCES:

(1) Davies, J Appl Physiol, 1980

(2) Minetti et al., J Physiol, 1993

(3) Mesquita et al., Eur J Appl Physiol, 2020

(4) Dewolf et al., Eur J Appl Physiol, 2020

SPATIOTEMPORAL ANALYSIS IN WALKING AND RUNNING: A VALIDITY AND RELIABILITY STUDY OF THE OPTOGAIT SYSTEM COMPARED TO MOTION CAPTURE

SANCHEZ-ALVARADO, A., JOOST, T., WILLE, M., HENNING, O., RAJA, A., ENGEL, T.

UNIVERSITY OF POTSDAM

INTRODUCTION: Analysing walking and running gait is pivotal for clinical diagnosis and athletic performance assessments. Motion capture (MOCAP) systems are recognized as the gold standard for gait analysis; however, their complexity, cost, and setup time limit their widespread use. The Optogait (OP) system, known for its portability, ease of setup, and user-friendly interface, has emerged as a popular alternative [1, 2]. However, its validity and reliability remain under scrutiny. Therefore, this study aimed to assess the validity and reliability of selected gait parameters during walking and running derived from the OP system in comparison to a reference MOCAP system.

METHODS: Twenty-four asymptomatic participants were recruited from Potsdam and its surroundings. Participants underwent two walking (4.75 km/h) and two running (9.00 km/h) trials on a treadmill, during two consecutive measurements (M1 and M2) in a single day, for a test-retest setup, with a 5-minute break in between. Both on M1 and M2 the trial started with walking and was followed by running. Data were simultaneously captured using a 13-camera MOCAP system (500 Hz) and the OP system (1000 Hz). After an initial familiarization, recordings were analysed for specific intervals (0-15 seconds and 90-105 seconds), during both measurements. The outcome variables for walking were: cycle, stance, swing, step times (seconds); step, stride lengths (meters); and for running: stance, swing times (seconds); step, stride lengths (meters). Bland-Altman with limits of agreements, intra-class correlation coefficients (ICC), paired t-tests, and test-retest variability percentages were estimated to compute the Optogait's validity at M1 and M2 and its reliability (M2-M1).

RESULTS: Data from 17 out of 24 participants were suitable for analysis (28.0±5.4 years old, 173.2±10.0 cm height, 69.9±9.0 kg weight, 6 females/11 males). In walking, the OP demonstrated moderate to excellent reliability and validity for most variables except for stance time (M2: ICC [95% CI]: 0.257 [-0.780-0.716], p=.261, M2-M1: 0.138 [-1.341-0.686], p=.384 during the first 15 seconds; and M2-M1: 0.457 [-0.430-0.800], p=.111 during the second 15-seconds period). Also, the OP mean values deviated slightly from the MOCAP values (-2% to +5%). In contrast, running trials exhibited weak or poor agreement between OP and MOCAP across all variables. Moreover, the OP mean values deviated from the MOCAP values (-33% to -76% for temporal parameters and -3 to +5% for spatial parameters).

CONCLUSION: The Optogait system proved a valid and reliable tool for analysing walking gait, offering a feasible alternative to MOCAP technology. Nevertheless, its application in running gait analysis did not meet the criteria for reliability or validity, indicating a need for further refinement of the system for comprehensive gait analysis across different modalities.

REFERENCES

[1] Lee M et al. Med. Sci. Mon. 20, 2014.

[2] Healy A et al. J. Biom. Eng. 141, 2019.

ENHANCED JOINT ENERGY TRANSFER POTENTIAL BY THE BIARTICULAR GASTROCNEMII MUSCLES DURING PERTURBED WALKING

THEODORAKIS, C., BOHM, S., EPRO, G., MERSMANN, F., WERTH, J., KARAMANIDIS, K., ARAMPATZIS, A.
HUMBOLDT-UNIVERSITÄT ZU BERLIN

INTRODUCTION: Due to their biarticularity, the gastrocnemii muscles are able to transfer and redistribute energy between the ankle and knee joints [1] [2]. Opposite signs in the mechanical power of the gastrocnemii at the ankle and knee joint (in-phase) lead to an energy transfer between the two joints [2], while same signs in the mechanical power (anti-phase) indicate a simultaneous energy absorption or production at the two joints [2]. The contribution of such biarticular mechanisms of the gastrocnemii to counteract locomotor perturbations is currently unknown. Therefore, the current study aimed to gain a better understanding of how the potential for energy transfer between the ankle and knee joint via the gastrocnemii muscles is modulated during unpredictable and adapted walking perturbations.

METHODS: In two separate experiments we investigated horizontal (trip-like, n=20) and vertical (15 cm drop of the support surface, n=26) unpredictable and adapted walking perturbations. Whole body kinematics were measured by a motion analysis system. The coupling angle (CA) of the ankle and knee joint angles was calculated during the perturbed stance phase based on a vector coding technique. The potential (λ) of the energy transfer and simultaneous energy absorption or production by the gastrocnemii was derived from the relative CA frequency of in-phase and anti-phase during the stance phase. In addition, the electromyographic (EMG) activities of the gastrocnemii, soleus and tibialis anterior muscles were captured during the vertical perturbations.

RESULTS: There was a significant increase ($p<0.05$) of the knee-to-ankle joint energy transfer potential during both horizontal ($\lambda=0.26$) and vertical ($\lambda=0.40$) perturbations compared to normal unperturbed walking ($\lambda=0.02$). The results evidenced an important ankle-to-knee joint energy transfer in the first 20% of the stance ($\lambda=0.29$) during the vertical perturbations. The energy transfer potentials between unpredictable and adapted perturbations did not show significant differences. The EMG-activity of the gastrocnemii muscles was significantly greater ($p<0.05$) in the perturbed trials compared to unperturbed walking and highest ($p<0.05$) during the unpredictable perturbations.

CONCLUSION: The increased knee-to-ankle joint energy transfer potential via the gastrocnemii muscles during perturbed walking demonstrates a crucial modulation of biarticular mechanisms to counteract locomotor perturbations. Further, the ankle-to-knee joint energy transfer at the beginning of the stance during the vertical perturbations suggests an important contribution of biarticular mechanisms to the absorption of the center of mass energy. Finally, the increased activation of the gastrocnemii during the ankle-to-knee and knee-to-angle joint energy transfer phases provide evidence for an enhanced energy transfer between the two joints during perturbed walking.

REFERENCES:

1) van Ingen Schenau 1989, Hum Mov Sci 8, 301-337

2) Kharazi et al. 2023, Biology 12, 872

THE CAPACITY OF MARKERLESS MOTION CAPTURE TO DETECT CHANGES IN GAIT KINEMATICS AT DIFFERENT SPEEDS

WALKER, J., THOMAS, A., LUNN, D., BAGLEY, A., PARELKAR, P., COOKE, M., NICHOLSON, B., POLLITT, L., BENNETT, T., AMINI-AGHDAM, S., HANLEY, B., NICHOLSON, G., TUCKER, C.
LEEDS BECKETT UNIVERSITY

INTRODUCTION: Markerless motion capture (MMC) is increasing in popularity among biomechanists because of the reduced data collection time and removal of subjects needing to wear tight, minimalist clothing [1]. However, gait analysis often requires subjects to walk or run at multiple speeds, such as in an incremental exercise test. The sensitivity of MMC to detect kinematic changes across speeds has yet to be thoroughly explored, so the aim of this study was to compare kinematic responses to changes in gait speed when measured with a widely used marker-based system versus a MMC system.

METHODS: Fifteen healthy, adult participants walked on an instrumented treadmill (1,000 Hz; Gaitway3D; h/p/cosmos) at 3 and 5 km/h and ran at 10, 11, and 12 km/h. A 14-camera optoelectronic motion capture system (Oqus 7+, Qualisys) was used to collect marker data, where markers were placed according to Cappozzo et al. [2]. Markerless video data were collected synchronously with 12 high-speed video cameras (Miqus, Qualisys). Both systems were sampling at 100 Hz. Markerless data were exported to Theia3D for processing, before being exported to Visual3D for modelling alongside marker data. Gait events were determined using the kinetic data, which was the same for both motion capture systems. Kinematic data were exported to MATLAB to calculate changes in sagittal angular data between gait speeds.

RESULTS: For walking (changes between 3-5 km/h), MMC demonstrated the capacity to measure similar changes in joint range of motion (ROM), peak flexion, and peak extension for hip, knee, and ankle joints ($ICC[3,1] \geq 0.892$) when compared to marker-based data, and there were no significant differences between the change in joint kinematics between systems ($p > 0.05$). MMC also displayed moderate-to-excellent agreement for knee and ankle joint kinematics during running (changes between 10-11 and 11-12 km/h), including ROM and peak flexion/extension ($ICC \geq 0.626$). However, the hip joint was less consistent, with poor-to-moderate agreement generally being found, especially in peak hip extension ($ICC = 0.198$ when comparing differences between 11-12 km/h). There were no significant differences between systems during running ($p < 0.05$).

CONCLUSION: MMC was able to measure small changes in joint angles during walking at similar magnitudes to traditional marker-based motion capture, which is promising for clinical biomechanists and gait analysis clinics. However, MMC importantly performs less well when trying to measure joint angle changes during different running speeds, with varying results between lower limb joints. Researchers and practitioners should be cautious when interpreting sagittal-plane kinematic changes during running when employing MMC as the chosen method of motion capture.

REFERENCES:

[1] Kanko, RM et al. (2021) J Biomech;127:110665

[2] Cappozzo, A et al. (1995) Clin Biomech;10:171-8

Oral Presentations

OP-AP39 Olympic Sports

SKI QUALITY ASSESSMENT BASED ON IMU DATA - A USE CASE FOR RECREATIONAL SKIERS

KRANZINGER, S., KRANZINGER, C., HOLLAUF, E., RIESER, H.

SALZBURG RESEARCH FORSCHUNGSGESELLSCHAFT MBH

INTRODUCTION: Objective assessment of ski quality can help beginners and advanced skiers to improve their technique and ski instructors to monitor the progress of their students. Existing algorithms [1] for ski quality assessment based on IMU data have been trained with very advanced skiers, which raises the question whether the algorithm can also be applied to recreational skiers. Therefore, this study presents the first results of a comprehensive data collection to answer the question whether self-reported skiing quality is consistent with the results of an algorithm-based ski quality score.

METHODS: Data was collected from 62 recreational skiers (16 female and 46 male participants; age: avg = 46.6, sd = 14.5) who were equipped with an IMU to collect the necessary data for the algorithm during the 2022/23 season. In addition, participants were instructed to install a self-developed app to process the algorithm and transmit their ski quality score directly after skiing. We use an algorithm developed by Snyder et al. (2021) to assess ski quality. The score of this algorithm ranges from 1 (snowplough) to 10 (excellent carving). Before the start and at the end of data collection, the participants answered a questionnaire in which they rated their own skiing quality - "How would you rate your skiing style in terms of carving" - on a ten-point Likert scale from 1 (no carving) to 10 (mostly carving). A Spearman correlation coefficient was used to calculate the correlation between the average ski quality score of all runs and self-reported ski quality.

RESULTS: On average, the self-reported skiing quality with an average score of 7.0 (sd = 2.1) is around 1.4 points higher than the algorithm-based ski quality score with an average score of 5.5 (sd = 1.3). The results show a significant moderate positive correlation of 0.53 ($p < 0.01$) between the algorithm-based ski quality assessment and self-reported skiing quality. On a gender-specific level, the correlation is significant for both genders with a moderate positive correlation of 0.40 ($p < 0.01$) for male and a strong positive correlation of 0.69 ($p < 0.01$) for female participants.

CONCLUSION: We find that, on average, the participants tend to overestimate their skiing quality, or that the algorithm tends to underestimate the skiing quality of the participants. In order to answer this, however, an expert-based assessment of the skiing quality based on video recordings would be necessary. Establishing such a gold standard would therefore be an important goal for future studies. The results show a positive, moderate correlation between self-reported ski quality and objectively assessed ski quality based on IMU data. Interestingly, the correlation is higher for female compared to male participants.

[1] Snyder et al., Sensors, 2021

LONGITUDINAL DEVELOPMENT OF TRAINING CHARACTERISTICS AND PERFORMANCE-DETERMINING PHYSIOLOGICAL VARIABLES IN ENDURANCE ATHLETES

SKOVERENG, K., TALSNES, R.K., SANDBAKK, Ø.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: The sport science literature currently lacks longitudinal data on the development of training characteristics and physiological capacities in endurance athletes. While there are numerous case studies, they are predominantly retrospective, and there is a scarcity of prospective studies on the group level that span longer durations. Consequently, this study aims to address this gap by focusing on the investigation of the longitudinal development of training, performance-determining variables, and competition performance in cross-country skiers.

METHODS: Nine national-level (6 male and 3 female) skiers were included in the study. All participants performed a minimum of one sub-maximal and maximal laboratory test in the general preparation period over two consecutive years (2022 and 2023). The sub-maximal laboratory test included determination of work rate at 4 mmol/L of lactate and corresponding gross efficiency and fractional utilization of VO2peak. The maximal test was used for determining VO2peak (ml·kg-1·min-1) and peak power output (PPO; highest one-minute work rate achieved in W·kg-1). Additionally, participants provided self-reported training data, and official competition rankings (i.e., FIS-points) were collected from the International

Ski and Snowboard Federation. FIS-points were considered as the performance level in the main statistical analysis. We anticipate that additional data will be available for presentation during ECSS2024.

RESULTS: FIS-points did not change significantly between the two seasons (85.2±28.8 and 72.3±24.3, p=0.320). Similarly, there were no significant differences observed in VO2peak (68.6±7.7 and 66.8±6.7 ml·kg-1·min-1, p=0.605), PPO (4.3±0.5 and 4.4±0.5 W, p=0.680) or gross efficiency (14.3±0.9 and 14.8±0.9%), p=0.256). However, higher VO2peak (r=-0.60, p=0.008) and PPO (r=-0.63, p=0.005) were both associated with lower FIS-points, as was gross efficiency (r=-0.74, p=0.001), but not fractional utilization of VO2peak (r=-0.40, p=0.096). Total annual training (r=-0.69, p=0.002), the amount of LIT (r=-0.68, p=0.002) and MIT (r=-0.77, p<0.001) were associated with lower FIS-points, whereas HIT (r=0.51, p=0.030) was associated with higher FIS-points.

CONCLUSION: Our data reveal that the variations in performance-determining variables from one season to another in national-level skiers are minimal. Nevertheless, at these performance levels, our data demonstrate distinct relationships between laboratory-derived variables and competition performance. It is essential to interpret these findings considering the specific characteristics of the sampled group. The correlations between the amount of LIT and MIT and FIS-points provide insights into the practices of elite athletes, indicating what the top performers currently engage in, rather than explicitly outlining the paths they took to achieve their performance levels.

EFFECTS OF OFFENSIVE, DEFENSIVE AND MIXED PLAYING STRATEGY CONDITIONS ON RUNNING AND TENNIS SHOT ACTIVITY IN ELITE YOUTH TENNIS PLAYERS

TÓTH, P.J., TRZASKOMA-BICSÉRDY, G., NÉGYESI, J., DOBOS, K., ÖKRÖS, CS.

HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: Tennis requires a specific preparation of the players in the spirit of their playing style [1]. Four playing styles are distinguished (counterpuncher, aggressive baseliner, serve and volleyer, and all-court player), which are predominantly associated with various technical-tactical elements of an offensive or defensive strategy [2]. Our study aimed to investigate the differences in the running and tennis shot activities between offensive, defensive and mixed playing strategy conditions in elite youth tennis players.

METHODS: Six youth male tennis players (age: 15.7 ± 1.0 years; body height: 180.7 ± 6.5 cm; body weight: 71.0 ± 10.8 kg) played simulated matches in four playing conditions (offensive vs. offensive, defensive vs. defensive, offensive vs. defensive, defensive vs. offensive) for 10 minutes each. To determine running activities, one locomotive and five mechanical intensity parameters were measured using portable micro-sensors (Catapult OptimEye S5, Catapult Sports, Melbourne, Australia) at a sampling frequency of 10 Hz for the GPS and 100 Hz for the tri-axial accelerometer, gyroscope, and magnetometer. In addition, we also assessed six tennis shot activity parameters with smart tennis sensors (Zepp Tennis 2 Sensor, Zepp Labs, USA) which we mounted on the end of players' rackets. Differences between the conditions were calculated using the Friedman test and planned Wilcoxon post-hoc tests with Bonferroni correction. The significance level was set at $p < 0.05$.

RESULTS: Although the Friedman test showed significant condition effects for six running activity parameters (Total Distance/min, Player Load/min, Acceleration Low/min, Acceleration High/min, Deceleration Low/min, Deceleration High/min) and four tennis shot parameters (Backhand Shot Rate, Forehand Velocity, Forehand Spin, Backhand Spin) post-hoc tests with Bonferroni correction revealed no differences between the different types of game plays (each $p > 0.05$).

CONCLUSION: In the present study, the intensity of the running activities, and the quality and occurrence rate of each tennis shot do not differ markedly between the different strategy conditions. It is possible that the relatively low sample size prevented us from revealing between-condition effects, nevertheless, our preliminary results indicate that tennis players need to train all physical qualities and playing strategies to achieve the best possible performance against the opponent, regardless of his/her playing style choice. In addition to all this, a style of play that best suits the tennis players personality and psycho-physical qualities must be developed by adulthood at the latest.

REFERENCES:

1. Kovacs, Sports Med, 2007

2. Roetert & Kovacs, Human Kinetics, 2019

YOUTH BREAKDANCERS: PROFILING MORPHOLOGY AND PHYSICAL FITNESS CHARACTERISTICS

ZHAO, Y., WEI, X., ZHAO, K.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: This study aims (i) to profile the body composition, morphology and physical fitness characteristics of adolescent breakdancers aged 12 to 17 from a national training camp and (ii) to analyze whether these factors affected by the state of maturity (determined by years from peak height velocity) and (iii) to examine the validity of test battery for youth elite breakdancers.

METHODS: Morphological attributes and selected physical fitness performance were measured on twenty-three male breaking athletes (14.47±1.95yrs). Biological maturational parameters (maturity offset) were calculated by linear equation based on peak height velocity and APHV were recorded. Information such as the athletes chronological age and training background is collected before the test. ANOVA was employed to examine the differences between different maturation groups, and Spearman Correlation Analysis was conducted to investigate intragroup correlation.

RESULTS: Anthropometric variables, including height (F=23.957, $p<0.01$, $\eta^2=0.706$), sitting height (F=25.279, $p<0.01$, $\eta^2=0.717$), leg length (F=14.414, $p < 0.01$, $\eta^2=0.590$) and body mass (F=14.429, $p<0.01$, $\eta^2=0.591$) were significantly differentiated by APHV, and these measurements were correlated with jump (r=0.702, $p<0.01$ for height; r=0. 619, p=0.002 for sitting height; r=0.535, p=0.08 for body mass), 30m sprint (r=-0.670, p=0.004 for height; r=-0.636, p=0.008 for sitting height; r=-0.636, p=0.008 for body mass), 40m sprint (r=-0.540, p=0.031 for heigh), 50m sprint (r=-0.736, p=0.001 for height; r=-0.686, p=0.003 for sitting height; r=-0.707, p=0.002 for body mass), 30s push-up (r=0.495, p=0.019 for height; r=0.426, p=0.048 for sitting height; r=0.463, p=0.030 for body mass), 400m run (r=-0.638, p=0.001 for height; r=-0.584, p=0.003 for sitting height; r=-0.594, p=0.003 for body mass), and 1500m run (r=-0.423, p=0.044 for body mass; r=-0.647, $p<0.01$ for fat mass percentage).

CONCLUSION: The height, weight and body fat percentage of adolescent breakdancers are relatively low which could be the result of specific choices. These morphological characteristics can prompt talent orientation. Furthermore, maturity levels can still forecast the different performance of athletes by the test battery in this study. Early-maturing athletes tend to excel in jumping, speed, and the 400m run. Coaches can use this to understand the adolescent development status of athletes. It is recommended that professionals continue researching more suitable field test components.

Oral Presentations

OP-BM26 Muscle and tendon function II

TEN WEEKS OF MINUTE OSCILLATION STRETCHING REDUCES THE ENERGY COST OF WALKING IN DIABETIC PATIENTS

MAGRIS, R.1, TRINCHI, M.1, NARDELLO, F.1, MONTE, A.1, NEGRI, C.2, VIGOLO, N.1, MOGHETTI, P.1, ZAMPARO, P.1
1 UNIVERSITÀ DEGLI STUDI DI VERONA, VERONA, ITALY;

INTRODUCTION: Type 2 diabetes is a chronic, degenerative, metabolic disorder characterized by an increased accumulation of advanced glycation end products (AGEs) that can impair muscle and tendon function by increasing their stiffness (1). An increased Achilles tendon (AT) stiffness in this population was associated to an increase in the energy cost (C) of walking (2); thus, a reduction in AT stiffness could be expected to lead to a decrease in C. Recently, Ikeda and colleagues (3) proposed a stretching modality (minute oscillation stretching, MOS) effective in reducing AT stiffness without impairing contractile capacity. The aim of this study was to investigate the effect of MOS training on AT and muscle stiffness (gastrocnemius medialis) and on the energetics of walking in type 2 diabetic patients.

METHODS: Type 2 diabetes is a chronic, degenerative, metabolic disorder characterized by an increased accumulation of advanced glycation end products (AGEs) that can impair muscle and tendon function by increasing their stiffness (1). An increased Achilles tendon (AT) stiffness in this population was associated to an increase in the energy cost (C) of walking (2); thus, a reduction in AT stiffness could be expected to lead to a decrease in C. Recently, Ikeda and colleagues (3) proposed a stretching modality (minute oscillation stretching, MOS) effective in reducing AT stiffness without impairing contractile capacity. The aim of this study was to investigate the effect of MOS training on AT and muscle stiffness (gastrocnemius medialis) and on the energetics of walking in type 2 diabetic patients.

RESULTS: No differences were observed in MVT, RTD or MS after training. Differences in TS were observed in the lowest range of torque values (e.g at 10 Nm) (6.9±3.1 and 4.9±2.8 Nm/mm from pre to post, p=0.03). No changes in Vopt were observed (about 4.7 km/h) but Copt significantly decreased after training (2.3±0.4 and 2.1±0.3 J/m kg from pre to post, p=0.01); a decrease in C was also observed at the slowest tested speed (2 km/h: 3.1±0.4 and 2.8±0.5 J/m kg from pre to post, p=0.01). Training-induced changes were also observed in stride length (increased after training, $p < 0.05$) and stride frequency (decreased after training, $p<0.05$) at speeds between 2 and 4 km/h.

CONCLUSION: These results allow for a better understanding of the altered muscle and tendon mechanical properties in diabetic patients and of the effects that these alterations have on muscle contraction and locomotion capability. Our study suggests the effectiveness of a new stretching protocol in decreasing tendon stiffness without affecting muscle stiffness and, more importantly, in decreasing whole bodys energy consumption during walking. These data can help in improving our understanding on how diabetes may affect physical capacity, leading to inactivity.

REFERENCES:

1) Couppé et al, J Appl Physiol, 2016

2) Petrovic et al, J Appl Physiol, 2015

3) Ikeda et al, Scand J Med Sci Sport, 2020

THE ACUTE AND REPEATED BOUT EFFECTS OF STATIC STRETCHING VERSUS ECCENTRIC CONTRACTIONS ON PLANTARFLEXOR RANGE OF MOTION AND MUSCLE-TENDON MECHANICS

KAY, A., BAROSS, A., BAXTER, B., BLAZEVICH, A.
THE UNIVERSITY OF NORTHAMPTON

INTRODUCTION: Chronic increases in joint range of motion (ROM) are usually achieved through various muscle stretching modes, however a recent meta-analysis revealed large increases (g = 0.86) in ROM after eccentric resistance training

programmes [1]. While the chronic effects of eccentric training have been examined, the acute and repeated bout effects on ROM and muscle-tendon mechanics remain unknown. Therefore, the present study compared the acute and repeated bout effects of static stretching and eccentric contractions on plantarflexor ROM and muscle-tendon mechanics.

METHODS: Using a randomised, crossover design, 18 recreationally active subjects completed four trials under two experimental conditions (static stretches [SS1, SS2]; eccentric contractions [EC1, EC2]), with each trial separated by 48-72 h. During SS trials, participants performed 5 sets of 30-s static stretches, whilst EC trials consisted of 5 sets of 10 repetitions of 3-s isokinetic eccentric contractions (total loading matched at 150 s). Before and after the trials, passive dorsiflexion ROM and passive gastrocnemius medialis and Achilles tendon stiffness were recorded using isokinetic dynamometry and ultrasonography.

RESULTS: Acute effects: Significant increases in ROM (SS1 = 2.2 ± 2.9°, d = 0.76; EC1 = 6.0 ± 3.6°, d = 2.00) and decreases in muscle stiffness (SS1 = 10.7 ± 14.5% [0.17 ± 0.28 Nm·mm-1], d = 0.59; EC1 = 6.1 ± 22.2% [0.15 ± 0.40 Nm·mm-1], d = 0.38) occurred after the initial trials in both conditions, with Achilles tendon stiffness also reduced after the EC1 condition (12.0 ± 9.2% [0.91 ± 0.79 Nm·mm-1], d = 1.15). Repeated bout effects: Baseline ROM was significantly greater after two bouts of eccentric contractions (7.1 ± 4.6°, d = 1.55) whereas no significant change occurred after two bouts of static stretching. No significant change occurred after two bouts of either condition for baseline muscle stiffness or tendon stiffness.

CONCLUSION: The greater (~threefold mean increase) acute increases in ROM following eccentric contractions and concomitant reductions in muscle (both conditions) and tendon stiffness (eccentric contraction condition only) may have important practical implications for warm-up design. Furthermore, the significant increase in baseline ROM after only two bouts (i.e. 1 week) of eccentric contractions also demonstrate the potential for a more rapid adaptive profile than muscle stretching (i.e. current practice), data consistent with large increases in ROM reported after as few as four weeks of eccentric training [2,3]. Collectively, these data indicate that eccentric contractions may deliver a more potent stimulus to increase ROM by influencing muscle and tendon stiffness simultaneously than current muscle stretching techniques.

References

1. Kay et al. (2023). Med Sci Sport Exerc. 55(4):710-21.

2. Aune et al. (2019). J Sports Sci. 37(2):138-45.

3. Leslie et al. (2017). Appl Physiol Nutr Metab. 42(10):1044-53.

EFFECT OF SEX AND MENSTRUAL CYCLE ON TRICEPS SURAE MUSCLE-TENDON UNIT ADAPTIVE RESPONSES TO FREQUENT HIGH MAGNITUDE OF MECHANICAL LOADING

EPRO, G.1, SUHR, F.2,3, KARAMANIDIS, K.1,4

1. LONDON SOUTH BANK UNIVERSITY, UK; 2. UNIVERSITY OF BAYREUTH, GER; 3. RWTH AACHEN UNIVERSITY, GER; 4. UNIVERSITY OF KOBLENZ, GER

INTRODUCTION: Both muscle and tendon adapt to mechanical loading (1), with muscles demonstrating faster tissue renewal rates than tendons (2). In young male adults we recently observed a persistent reduction in tendon stiffness and signs of molecular damage accumulation within the tendon in response to a frequent high strain cyclic loading exercise (3). Given, that hormonal fluctuations across female menstrual cycle may potentially affect tendinous tissue, we aimed to examine the effects of consecutive daily repetitive high strain cyclic loading on triceps surae (TS) muscle-tendon unit (MTU) mechanical properties in young male and young female adults, and determine whether tendon's adaptive response is affected by different serum levels of estradiol.

METHODS: 11 young healthy male (26±6 yrs) and 20 female adults (24±4 yrs) underwent 8 consecutive days of isometric resistance exercise for ankle plantarflexors using high Achilles tendon (AT) strain cyclic loading by exercising three times a day (90% MVC; ~2h rest between sessions within day). Female group consisted of both eumenorrheic females and females using oral contraceptives, with the first being trained either in high or low estradiol level of their hormonal cycle. Serum estradiol levels were determined every day along their menstrual cycle. At baseline and every second day of the exercise intervention TS MTU mechanical properties were assessed using synchronized dynamometry, ultrasonography and motion capture. Baseline levels were determined as an average of two measurement sessions on separate days.

RESULTS: At baseline female adults demonstrated on average ~20% lower AT stiffness and maximal AT force in relation to males leading to no sex-related difference in maximal tendon strain during MVCs. Following the 8 consecutive days of high AT strain cyclic loading, both groups showed similar relative increase in maximal AT strain (~16%) along with a corresponding ~20% decrease in AT stiffness ($P<0.05$). Moreover, the rate and magnitude of relative changes in maximal AT strain and stiffness over the 8 days cyclic loading exercise were not affected by menstrual cycle in eumenorrheic females. Accordingly, no significant correlation was detected between the average estradiol levels and relative or absolute changes in tendon stiffness or strain.

CONCLUSION: This study showed that frequent high-magnitude and volume of tendon strain cyclic exercise can lead to a reduction of tendons tolerance to resists deformation in response to mechanical loading irrespective of the sex and female hormonal fluctuation. Hence, suggesting that fluctuations in the hormonal levels across the female menstrual cycle do not necessarily affect the homeostasis and adaptive response of the tendinous tissue under frequent high loading.

REFERENCES:

1) Arampatzis et al. 2007 JExpBiol

2) Heinemeier et al. 2013 FASEB J

3) Epro et al. 2023 JExpBiol

EFFECT OF THE TEMPORAL COORDINATION AND VOLUME OF LOADING ON HUMAN ACHILLES TENDON ADAPTATION IN ADULT MEN

TSAI, M.S.1,2, DOMROES, T.1,2, PENTIDIS, N.1,2, KOSCHINSKI, S.1,2, SCHROLL, A., BOHM, S.1,2, ARAMPATZIS, A.1,2, MERSMANN, F.1,2

HUMBOLDT-UNIVERSITÄT ZU BERLIN

INTRODUCTION: Human tendons adapt to their mechanical environment. The acute to loading response shows a positive net collagen synthesis after 24 to 48 hours (1), which could be a particularly effective window for further stimulation. An increase of loading volume may increase the anabolic response, yet there are indications for a ceiling-effect (1). Therefore, in the present longitudinal study we examined the hypotheses that (a) repeated loading after 24 to 48 h of recovery (i.e., high frequency loading) elicits faster and greater adaptation effects than when the net anabolic state may already decline (i.e., ≥ 48 h recovery; low frequency), and (b) that human tendons show a non-linear dose-response relationship, with greater effects of a high compared to low but not intermediate loading volume.

METHODS: We assigned 91 adult men to either a control or an intervention group. In the latter, the two legs were randomly assigned to one of five Achilles tendon (AT) high-intensity loading protocols (i.e., 90% maximum voluntary contraction, about 4.5 to 6.5% tendon strain) that were systematically modified in terms of loading frequency (i.e., sessions per week) and overall loading volume (i.e., total time under loading). Before the intervention, after eight and 16 weeks, AT mechanical properties were determined using inverse dynamics and ultrasonography. The cross-sectional area (CSA) and length of the free AT were measured using magnetic resonance imaging pre- and post-intervention. The data was analyzed using a linear mixed model.

RESULTS: There were significant increases of muscle strength (average over all protocols: 11%), normalized AT stiffness (31%) and CSA of the free AT (4%) in the intervention group ($p < 0.05$), yet with no marked differences between protocols ($p > 0.05$). While no clear effects were found considering the temporal coordination of loading and overall loading volume, combining the data from each of the two high and low volume protocols (i.e., with high and low frequency, respectively), greater changes in stiffness were found following low compared to high volume loading ($p = 0.04$). In all protocols, the major changes in normalized AT stiffness occurred within the first eight weeks of the intervention.

CONCLUSION: The present study provides first experimental evidence that the adaptation of the human AT mechanical and morphological properties in men is rather independent of the temporal coordination of loading and recovery and can be effectively stimulated with a comparatively low loading volume (i.e., 180 seconds per week at 4.5 to 6.5% tendon strain). An increase in loading volume does not seem to further promote tendon adaptation, which supports the idea of a "ceiling-effect" in the acute responses to loading. Thus, low-volume loading programs seem to be the more time-efficient and attractive approach for the practical field.

REFERENCES:

1) Magnusson et al. 2010, Nat Rev Rheumatol 6, 262–268

ASSESSING THE VALIDITY OF THE MYOTONPRO AS A METHOD OF MEASURING STIFFNESS OF HUMAN RECTUS FEMORIS MUSCLE

LEY, C., MARTINEZ-VALDES, E., DRUST, B.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Tissue biomechanical properties are important for both optimising musculoskeletal performance and reducing injury risk. The MyotonPRO was developed as a simple, portable, non-invasive, and highly reliable method for the estimation of muscle stiffness (Aird et al., 2012). It has not, however, been comprehensively validated against shear wave elastography (SWE), a validated ultrasound-based method for the assessment of tissue stiffness. For this purpose, we estimated the stiffness of the rectus femoris (RF) muscle and supra-adjacent tissue with both the MyotonPRO and SWE, in order to assess the validity of the MyotonPRO for the assessment of RF mechanical properties. The RF was chosen due to its high injury prevalence among elite soccer players as a result of its contributions to both hip flexion and knee extension as a biarticular muscle (Cross et al., 2004).

METHODS: 20 participants (10 male and 10 female; age: 26.3 ± 4.0 years; BMI: 23.2 ± 2.8kg/m2) completed 2 visits in which RF stiffness was measured twice with the MyotonPRO device and SWE at three distinct muscle regions (proximal, medial, and distal), three muscle lengths

(relaxed - REL, neutral - NEU, and passively stretched - PAST), and four depths (skin - SKIN, fascia - FAS, superficial muscle - SUP, and deep muscle - DEEP). Additionally, subcutaneous adipose tissue thickness (SAT) was recorded at each location under every condition using B-mode ultrasound imaging. To investigate the relationship between MyotonPRO measurements and shear wave velocity (SWV) at each depth, as well as SAT, simple linear regressions were conducted on the mean values obtained from the assessments.

RESULTS: In REL, the MyotonPRO exhibited none to poor negative correlations with SWV. In NEU, stiffness reported by the MyotonPRO had a moderate positive relationship with SWV of the skin ($r = .67^{***}$, $R2 = .45$), but smaller relationships with deeper tissue (FAS, $r = .25^{*}$, $R2 = .06$; SUP, $r = .26^{*}$, $R2 = .07$; DEEP, $r = .33^{**}$, $R2 = .11$). Similarly, in PAST, stiffness reported

by the MyotonPRO had a moderate positive relationship with SWV of the skin (r = .61***, R2 = .38), but smaller relationships with deeper tissue (FAS, r = .19, R2 = .04; SUP r = .29*, R2 = .08; DEEP, r = .46***, R2 = .22). Stiffness measured by the MyotonPRO was negatively correlated with SAT in every region under every condition. When comparing SAT with stiffness measured by the MyotonPRO, REL R2 values were .32, .14, .67, in NEU R2 values were .54, .31, .47, and in PAST R2 values were .53, .35, .61 at proximal, medial and distal portions of the muscle, respectively.

CONCLUSION: These data indicate that the MyotonPRO measures different mechanical properties to SWE and/or is potentially influenced by the stiffness of overlying adipose and connective tissue. The results suggest that the two methods cannot be used interchangeably to estimate stiffness of the RF muscle of young, healthy adults (Bravo-Sánchez et al., 2021).

Oral Presentations

OP-BM23 Neuromuscular Physiology V

INTER-MUSCULAR COORDINATION: SEX DISPARITIES IN ENDURANCE TASKS

ABENZA, Ó., GARCIA-RETORTILLO, S., BALAGUÉ, N., IVANOV, P.
UNIVERSITAT DE BARCELONA

INTRODUCTION: Inter-muscular coordination measures how muscle groups synchronize their activation to move effectively and efficiently. A recent method has been developed to assess inter-muscular cross-frequency interactions through surface electromyogram (sEMG) (Garcia-Retortillo et al., 2023). The examination of spectral components within different frequency bands in sEMG signals can provide information about motor unit recruitment and fiber-type contributions to muscle activation.

Females exhibit greater muscle endurance due to their higher proportion of intermediate and Type I fibers compared to males, who typically present a higher proportion of Type II fast fibers. However, sex-related differences in the coordination of distinct fiber types across muscles have not yet been investigated. This study aimed to compare inter-muscular coordination during an endurance squat test performed until exhaustion in males and females.

METHODS: Thirty-one sport science students (eleven males and twenty females) performed a bodyweight squat test until exhaustion. The squatting pace was controlled using a metronome (3:3 tempo; 3 sec. for eccentric and concentric phases, respectively). Simultaneous recordings of EMG signals from specific leg and back muscles were obtained during the squat test. The EMG recordings were initially decomposed into ten frequency bands [F1-F10], representing the activation of distinct muscle fiber types. Subsequently, inter-muscular coordination was quantified by pairwise coupling (cross-correlation C; amplitude-amplitude coupling) between the time series for all EMG spectral power frequency bands in each leg/back muscle.

RESULTS: Overall, female adults exhibited higher coupling strength for all EMG frequency bands in leg and back muscles (CMEAN= 0.59, SD= 0.10) compared to male adults (CMEAN= 0.48, SD= 0.13; $p < 0.05$). Notably, these differences were more pronounced for intermediate [F4-F7] and high [F8-F10] EMG frequency bands, associated with the activation of type-II fast fibers (CMEAN= 0.48, SD=0.15 in males; CMEAN= 0.60, SD=0.12 in females), compared to the lowest frequency [F1-F3] EMG bands (CMEAN = 0.62, SD= 0.12 in males; CMEAN = 0.65, SD=0.11 in females).

CONCLUSION: The uncovered higher degree of inter-muscular coordination in young female adults suggests greater neuromuscular efficiency during muscle endurance tasks, leading to a greater tolerance to fatigue. The increase in coordination among type-II fast fibers across muscles may serve as a compensatory mechanism to offset the reduced proportion of type-II fibers in females. This dynamic network approach to inter-muscular coordination has the potential to improve the understanding of sex-related differences during exercise.

REFERENCES:

1. Garcia-Retortillo, S., Romero-Gómez, C., & Ivanov, P. C. (2023). Network of muscle fibers activation facilitates inter-muscular coordination, adapts to fatigue and reflects muscle function. Communications Biology, 891(6). https://doi.org/10.1038/s42003-023-05204-3

THE EFFECTS OF HYDRATION STATUS ON MUSCLE CONTRACTILE FUNCTION, STRENGTH, AND POWER

MACGREGOR, L., BUDDE, A., RODRIGUEZ-SANCHEZ, N.
UNIVERSITY OF STIRLING

INTRODUCTION: Many athletes, such as those involved in weight category sports, opt to reduce their body mass temporarily by limiting fluid intake before competing with the goal of improving their performance. However, the negative consequences of decreased hydration levels on endurance performance have been widely acknowledged. Still, there is limited understanding regarding the impact of sub-optimal hydration on strength- and power-related function. In particular, it is unclear whether acute hypohydration - in the absence of fatigue and/ or hyperthermia - influences muscle mechanical properties and neuromuscular control – therefore, performance benefits may be achievable in strength- and/ or power- based activities, without the concomitant decrements commonly observed in endurance events. We aimed to

investigate the impact of passively-induced hypohydration, via fluid restriction, on muscle stiffness and contraction speed, and on strength and power performance.

METHODS: Twenty healthy active participants (12 male, 8 female) were assessed in a randomized cross-over design (EUH = euhydrated and HYPO = hypohydrated conditions). Participants underwent fluid restriction (0 L consumed) during the 14-hour period prior to HYPO testing; 500 mL of water was consumed the night before and on the morning of EUH testing. Hydration status was determined by urine osmolality. Unilateral knee extensor maximal voluntary isometric contraction (MVC) and bilateral countermovement jump (CMJ) were completed to determine lower-limb strength and power, respectively. Vastus lateralis and rectus femoris contractile mechanics were assessed using tensiomyography. Neural activation was estimated from electromyogram amplitude during submaximal isometric knee extension contraction to failure. Between condition differences were explored using paired sample Student's t-test and effect sizes were described using Cohen's d.

RESULTS: Urine osmolality was analysed to verify hydration status (HYPO = 808.5 ± 84.9 mOsm/kg vs. EUH = 251.5 ± 137.5 mOsm/kg, $p < 0.001$, $d = 3.47$), participants' body mass decreased by 1.3 ± 0.1% in HYPO vs. EUH. Hypohydration was associated with a 4.3% reduction in strength (MVC) ($p = 0.045$, $d = 0.51$) and a 1.5% reduction in peak power (CMJ) ($p < 0.001$, $d = 1.08$). Time to submaximal contraction failure was unaffected by hydration status ($p = 0.163$). Neural activation was not different between conditions ($p = 0.408$). Knee extensor muscle contractile mechanics were unaltered between conditions ($p = 0.053$-0.480).

CONCLUSION: Strength and power were reduced by fluid restriction-induced hypohydration, but this reduction in function was not associated with impaired muscle contractile mechanics or neural activation, nor was time to contraction failure impacted. Our findings can be used to inform athletes and practitioners regarding the negative impact of hypohydration on performance in strength- and power- related activities, this may be particularly important for competitors in weight category sports.

NEUROMUSCULAR CHARACTERISTICS OF THE PERONEAL MUSCLES IN INDIVIDUALS WITH CHRONIC ANKLE INSTABILITY: A SYSTEMATIC REVIEW WITH META-ANALYSIS

ALTUN, A., DIXON, S., RICE, H.
UNIVERSITY OF EXETER

INTRODUCTION: There is a need for a comprehensive investigation of the specific neuromuscular control dysfunctions linked to chronic ankle instability (CAI), particularly of the peroneal muscles (1).

METHODS: This systematic review with meta-analysis synthesised the findings related to neuromuscular characteristics of the peroneal musculature, including corticospinal excitability, strength, force sense, and electromyographic measures, in individuals aged 18-45 with CAI and compared them to their healthy counterparts (2,3). Relevant papers were retrieved from electronic databases including EBSCOhost, Ovid, Web of Science, Scopus and Cochrane Library as well as Grey literature sources. Two reviewers assessed the eligibility and methodological quality of the included studies (4,5), and the random effects model and the standard mean difference with a 95% confidence interval were used to obtain pooled estimates of the overall effect size.

RESULTS: The systematic review encompassed 42 studies out of 13,670 retrieved publications. Of these, 25 were eligible for meta-analysis. The meta-analyses revealed significantly reduced evertor force accuracy at 10% ($d = 0.50$ [0.06, 0.94], $p = 0.03$; $I2 = 0\%$, $p = 0.50$) and 20% of MVIC ($d = 1.14$ [0.64, 1.64], $p < 0.00001$; $I2 = 0\%$, $p = 0.57$), and decreased evertor force steadiness ($d = 0.43$ [-0.01, 0.87], $p = 0.05$; $I2 = 0\%$, $p = 0.91$) at 10% of MVIC in individuals with CAI compared to the control group. The pooled findings also demonstrated significantly longer peroneus longus latency ($d = 1.69$ [0.92, 2.46], $p < 0.0001$; $I2 = 30\%$, $p = 0.23$) in the CAI group than the control group during single leg landing inversion perturbation test under unexpected conditions.

CONCLUSION: Individuals with CAI exhibited distinct deficiencies in evertor force accuracy, steadiness, and peroneus longus latency during landing tasks, suggesting a potential association between neuromuscular dysfunction in the peroneal muscles and the underlying mechanisms of CAI pathogenesis. This underscores the importance of specifically targeting and addressing peroneal neuromuscular deficits in the rehabilitation of individuals with CAI.

REFERENCES:

1) Hertel and Corbett, J Athl Train, 2019

2) Page et al., Inter J Surgery, 2021

3) Higgins et al., Coch Hand for SRs Interv, 2019

4) Downs and Black, J Epidem & Comm Health, 1998

5) Moisan et al., Gait & posture, 2017

ASSOCIATIONS BETWEEN VOLUNTARY ACTIVATION AND DIFFERENCE IN CRITICAL TORQUE ESTIMATION BETWEEN GOLD STANDARD METHODS IN UNTRAINED PARTICIPANTS

LE CORRE, A., TURPIN, N., BEGUE, J., CHOUCHOU, F., MARIANI, A., CARON, N., DALLEAU, G.
UNIVERSITÉ DE LA RÉUNION

INTRODUCTION: While motor unit recruitment may be impaired for some clinical populations, and while allout testing procedures involve repeated maximal contractions to accurately estimate critical torque (CT), no previous study has precisely examined the relationships between voluntary activation (VA, translating the ability to produce a MVC) and difference in CT estimation according to gold standards methods. The aim of the present study was to investigate whether the level of voluntary activation influences the CT estimated according to the two reference methods.

METHODS: In the present study, CT was estimated during a 5-min all-out test involving the plantar flexor muscles in untrained participants, separated in two groups including subjects with low levels of VA (VALow; n=14), and high levels of VA (VAHigh; n=13). The participants performed 60 maximal isometric contractions (3s of contractions/2s of rest) and VA was estimated before, every six contractions and after the all-out test using the interpolated twitch technique.

RESULTS: The major findings were that participants in the VALow group had lower CT than VAHigh participants ($p=0.02$) and showed lower exponential curvature constant (τ; $p<0.0001$). Differences in CT estimation methods was accounted for by baseline VA and τ (~55% of variance).

CONCLUSION: The present study demonstrates the inconsistency between two standard CT estimation methods and show that the differences are linked to the ability to produce MVCs. While CT is an important parameter for quantifying neuromuscular fatiguability in clinical populations, the all-out test is limited in its current form. We suggest new ways for estimating CT that rely less heavily on VA capacity, which would therefore be more adapted to untrained participants and clinical populations subject to neuromuscular deconditioning.

ACTIVATION LEVEL-CONTROLLED STRETCHING INFLUENCES THE FOLLOWING SHORTENING AND ISOMETRIC TORQUE IN IN-VIVO HUMAN KNEE EXTENSORS

JO, I., LEE, H.
YONSEI UNIVERSITY

INTRODUCTION: Stretch-shortening cycle (SSC), a natural muscle behavior that occurs during various human movements, has been known to enhance muscle performance (1). Currently, the effect of SSC is accounted for by activation dynamics, stretch reflex, utilizing elastic energy, as well as residual force enhancement (RFE) (2). Nevertheless, it is unclear how SSC influences human performance in vivo due to the complexity of neural control and muscle-tendon interaction. Therefore, this study investigated how the level of muscle activation during the stretching phase influences the following shortening and isometric contraction.

METHODS: Healthy young male (n = 6, age: 25.7±2.8, height: 174.4±4.8, weight: 78.7±6.3) and female participants (n = 2, age: 26±2.8, height: 166.0±1.6, weight: 72±5.4) performed knee extensor SSC on a dynamometer (CON-TREX MJ); activation-controlled eccentric knee extension (40, 80, 100% MVC, 20° to 80°, 60°/s, 0° for the fully-extended knee angle) followed by concentric (80° to 20°, 120°/s) – steady-state isometric (20°) contraction at maximum effort. Electromyography feedback from the vastus lateralis (VL) was provided to gradually reach the target eccentric activation level during the eccentric phase. As references, isometric contraction at 20° and 80° and shortening-isometric contraction was measured. The average knee extension torque and work and muscle activation were obtained during the concentric phase of contractions. Residual force depression (RFD) was assessed during the isometric phase. Data were normalized to body weight and analyzed using One-way ANOVA.

RESULTS: In the SSC trials, both 80% (0.19±0.03 Nm/BW) and 100% (0.20±0.03 Nm/BW) resulted in higher normalized peak and average torque during the concentric phase compared to trials without a preceding eccentric contraction (0.13±0.03 Nm/BW). Specifically, at 100%, the torque was greater than at 40% (0.15±0.03 Nm/BW). Similarly, work during the concentric phase was higher at 100% and 80% compared to the shortening contraction only, while torque at 40% was lower than at 100%. Force enhancement relative to the shortening-isometric contraction increased at 100% (0.07±0.04%), whereas it was 0.02±0.03% at 40%. Average VL activation during the concentric phase was higher at 80% (86.22±15.95%) and 100% (85.96±16.52%) compared to the no stretching phase (62.43±11.06%). However, there was no difference in RFD during the steady-state isometric phase between trials.

CONCLUSION: This study showed that concentric knee extension performance was enhanced when the eccentric contraction was preceded, suggesting influences of the preceding eccentric contraction-induced increase in muscle activation and force enhancement. The observed results suggest that RFE plays a crucial role in enhancing the SSC during in vivo human movements, such as the countermovement jump.

REFERENCES:

1) Komi, P. V, Journal of biomechanics, 2000

2) Seiberl, Wolfgang, et al. Frontiers in physiology, 2021

Oral Presentations

OP-AP34 Recovery Interventions

CHILL WITHOUT THRILL: A CROSSOVER STUDY ON WHOLE-BODY CRYOTHERAPY AND POST-MATCH RECOVERY IN HIGH-LEVEL YOUTH BASKETBALL PLAYERS

PERNIGONI, M.1, TESSITORE, A.2, DIGNO, M.3, PERAZZETTI, A.2, KAMANDULIS, S.1, CONTE, D.2,1

1, LITHUANIAN SPORTS UNIVERSITY; 2, UNIVERSITY OF ROME FORO ITALICO; 3, STELLA AZZURRA BASKETBALL ACADEMY

INTRODUCTION: The intense nature of basketball match-play, combined with the increasing occurrence of congested match schedules, may lead to fatigue accumulation throughout the competitive season [1]. Therefore, the use of recovery interventions has gained popularity, with the aim of preserving players' readiness and high-level performance [2]. Among these strategies, cold water immersion has shown beneficial effects on recovery in basketball, likely due to reductions in muscle damage and inflammation [2]. However, other cold-based interventions – such as whole-body cryotherapy (WBC) – remain unexplored in basketball-specific research. Therefore, the aim of this study was to investigate the effect of post-match WBC on measures of performance, physiological and perceptual recovery following a basketball match in high-level, youth basketball players.

METHODS: Using a crossover design, 17 youth male players (top-tier under-15 and under-17 Italian leagues) completed two simulated basketball matches (4x10-min quarters; 33 min of actual playing time for each player), followed by either WBC (4 min, -75 to -85°C) or placebo (CON; fictitious stimulation of the main lower limbs muscles through inactivated infrared devices). To assess the effectiveness of WBC, countermovement jump height (CMJ), change-of-direction performance, 10 and 20-m sprint times, heart rate variability (Ln-rMSSD), muscle soreness and perceived recovery (PRS) were recorded at pre-match, post-match, post-recovery and 24 h post-match. Additionally, Ln-rMSSD was recorded upon awakening on match day, and the following morning.

RESULTS: Compared to CON, higher PRS values were reported in WBC at pre-match ($p = 0.023$, moderate effect size [ES]) and post-recovery ($p = 0.026$, moderate ES), while no significant between-interventions differences were found for any other variable ($p > 0.05$). Regarding the effect of time, our main findings revealed that 20-m sprint times ($p = 0.045$, small ES), Ln-rMSSD ($p < 0.001$, large ES) and PRS ($p < 0.005$, large ES) significantly deteriorated in both interventions from pre-to-post-match (i.e., acute changes), while muscle soreness worsened in WBC only ($p < 0.004$, large ES). Conversely, CMJ, change-of-direction performance and 10-m sprint times were unaffected by match-play in the acute phase ($p > 0.05$), while none of the investigated variables showed residual impairments at 24 h post-match, compared to pre-match ($p > 0.05$).

CONCLUSION: The present findings indicate that WBC was ineffective for improving recovery of performance, cardiac autonomic activity and muscle soreness in high-level, youth male basketball players following a simulated match. Conversely, WBC might have a potentially beneficial effect on perceived recovery in the acute phase (i.e., post-recovery), although caution is advised when interpreting these findings, given the observed differences at baseline (i.e., pre-match) between WBC and the placebo intervention.

REFERENCES:

1. Edwards et al., Sports, 2018

2. Davis et al., Sports Med, 2022

SLEEP QUALITY IMPACTS MEASURES OF TRAINING AND PERFORMANCE IN ELITE SWIMMERS

LUNDSTROM, E., DE SOUZA, M.J., WILLIAMS, N.

PENNSYLVANIA STATE UNIVERSITY

INTRODUCTION: High-quality sleep of a sufficient duration is necessary for optimal health and several factors contributing to athletic performance, such as promoting physical recovery from training. Sleep quality can include metrics of sleep duration and other more specific sleep measures. Previous data suggests a high prevalence of poor sleep duration and other sleep metrics in athletes. Poor sleep quality during high training loads has been identified as an early sign of overreaching, which may yield improper recovery and limit training adaptations, and subsequently impact sport performance. Reduced sleep duration has been shown to be deleterious to performance but less is known regarding other sleep metrics and their relationship to training and performance. Therefore, our objective was to determine the associations between sleep quality, training metrics, and performance, we assessed sleep quality (sleep duration (hrs), sleep debt (hrs), percentage and hours of: slow wave sleep (SWShrs and SWS%), and rapid-eye movement (REMhrs and REM%)), training measures (strain (AU), average heart rate (HR) (ExHRavg) and maximum exercising HR (ExHRmax)), and performance via 200yd Time Trial Swim (TTperf).

METHODS: Twenty six elite male (n=10) and female (n=16) collegiate swimmers were studied during heavy training. Collection of sleep data were matched to days of training metric data collection, and also to the day preceding TTperf. Training measures include; strain (AU), average exercising heart rate (ExHRavg) and maximum exercising heart rate (ExHRmax) collected via a wearable device. Pearson correlations were utilized to determine relationships between variables unless sex effects existed in which case linear regression analyses were utilized to control for sex-differences in variables.

RESULTS: In all swimmers, there were associations between sleep and training metrics, where sleep duration and sleep debt were related to strain (R=-0.85; p=0.01, R=0.35; p=0.045, respectively). Similarly, sleep duration and sleep debt were related to ExHRavg (R=-0.65; p=0.001, R=0.51; p=0.01, respectively) and ExHRmax (R=-0.48; p=0.01, R=0.57; p=0.003, respectively). SWShrs was inversely related to ExHRavg (R=-0.41; p=0.04). Regarding the effects of sleep on performance, when controlling for sex, sleep duration the night preceding the race predicted TTperf (R2 = 0.881; p<0.001), where swimmers with greater sleep durations exhibited faster TTperf race times. Similarly, when controlling for sex, SWS% the night preceding the race predicted TTperf (R2 = 0.883; p<0.001), whereby swimmers with a greater SWS% exhibited faster TTperf race times.

CONCLUSION: Sleep quality measures were related to swim training in all swimmers. Similarly, in all swimmers, swimming performance was predicted by sleep quantity and quality when assessing sleep the night prior to the race. Athletes should get adequate sleep to support recovery and optimize training and performance.

THE ACUTE EFFECTS OF FOAM ROLLING PRIOR TO INTENSE ECCENTRIC EXERCISE ON HAMSTRING STIFFNESS

VATOVEC, R., KOZINC, Ž., VOGLAR, M.

UNIVERSITY OF PRIMORSKA, FACULTY OF HEALTH SCIENCES

INTRODUCTION: Eccentric training is commonly prescribed to improve athletic performance. However, exercise-induced muscle damage (EIMD) is a potential limitation of eccentric training due to its detrimental impact on subsequent performance. Recovery strategies aimed at decreasing the negative impact of EIMD are commonly implemented following strenuous exercise. In this regard, foam rolling (FR) has shown promising effects in promoting recovery after EIMD [1]. On the other hand, the effects of FR prior to eccentric exercise on markers of EIMD are still unknown. In addition, EIMD has been recently associated with increased muscle stiffness [2], which could potentially serve as a marker of EIMD. The aim of this study was to investigate the effects of FR prior to intense eccentric exercise on measures of hamstring stiffness.

METHODS: The study sample consisted of 14 healthy young adults (7 males, 7 females; age range = 18-35 years). We conducted a within-subject randomized controlled trial, in which one leg served as the intervention and the other as the control leg. Outcome measures were assessed at baseline, immediately after and one hour after eccentric exercise. Following baseline measurements, the participants completed an aerobic warm-up and a short bout of FR on the posterior thigh of intervention leg (2 × 60 s of FR at a predetermined tempo of 27 bpm). The eccentric training protocol included three sets of 10 repetitions of maximal eccentric knee extensions on an isokinetic dynamometer, followed by three sets of six repetitions of the Nordic hamstring exercise. Passive stiffness of the long head of biceps femoris (BF) and semimembranosus (SM) were measured via ultrasound-based shear wave elastography in a prestretched position, whereas passive knee extension torque (PKET) was measured on an isokinetic dynamometer. The data were analysed using the repeated measures analysis of variance (3×2) with two within-subject factors (time and condition). The margin for statistical significance was set at α=0.05. The effect size was expressed as $\eta 2$ and interpreted as small ($\eta 2$=0.01), moderate ($\eta 2$=0.06) or large ($\eta 2$=0.14).

RESULTS: Our results showed a significant time effect for BF stiffness (p<0.001, $\eta 2$=0.50) and PKET (p=0.002, $\eta 2$=0.40). The time effect for SM stiffness was not significant (p=0.37, $\eta 2$=0.07). Furthermore, we did not find a significant condition (p=0.17–0.60, $\eta 2$=0.02–0.15) or interaction effect (time×condition) (p=0.08–0.49, $\eta 2$=0.06–0.18) for none of the included outcome measures.

CONCLUSION: Eccentric training leads to increased stiffness of the long head of BF and PKET. Moreover, a short bout of FR prior to eccentric exercise does not have a significant impact on changes of hamstring stiffness. It appears that FR does not decrease the amount of EIMD following eccentric exercise.

1. Wiewelhove et al. (2019) 2. Ličen & Kozinc (2022)

EFFECTIVENESS OF BLOOD FLOW TRAINING DURING A TAPER PHASE IN BASKETBALL PLAYERS

SMITH, H., BIRD, S.P., KAVANAGH, T., OLSEN, P., HAMLIN, M.J.

LINCOLN UNIVERSITY

INTRODUCTION: Blood flow restriction (BFR) training, shown to enhance muscular strength and hypertrophy, has been studied for its potential in aiding various groups, including older people and recovering athletes. It's effectiveness, however, in maintaining or enhancing performance among highly trained athletes during a taper phase at a season's end remains undecided. This study aimed to explore if BFR could help maintain athletic performance in a taper phase where the aim was to reduce the external load, but maintain intensity, in basketball players.

METHODS: The study involved 17 experienced basketball players divided into two groups: a placebo group (n = 8, 22 ± 2.1 years mean ± SD) and a BFR group (n = 9, 21.1 ± 1.5 years). Typically, their training schedule included strength training 3 days/week, alongside 2 team training sessions, 2 individual skill sessions, and 1 competitive basketball game per week. For the studys taper period, players adhered to this weekly routine but reduced the volume of lifting while either maintaining (placebo) or reducing (BFR) lifting intensity. For 4 weeks during the taper the BFR group exercised with 60% arterial occlusion pressure at an intensity of 25-30% of their one-repetition max (1RM), while the placebo group completed their normal taper training at an intensity of 80% of their 1RM wearing BFR cuffs which were only inflated to 20% arterial occlusion pressure. Additional metrics, such as arterial oxygen saturation, heart rate, rate of perceived exertion, and average bar velocity, were also monitored during the training sessions.

RESULTS: Compared to the placebo group, the BFR group increased sprint performance over 5m (-1.4 ± 1.5% mean ± 95% CI, p = 0.032), 10m (-1.1 ± 0.5%, p = 0.0003), and 20m (-0.3 ± 0.5%, p = 0.223). Compared to the placebo group improvements were also observed in the BFR group in their barbell back squat (9.6 ± 8.0%, p = 0.013), trap bar deadlift (1.3 ± 5.5%, p = 0.427), barbell bench press (4.5 ± 4.8%, p = 0.106) and barbell prone row (3.3 ± 5.1%, p = 0.199). Countermovement jump performance also improved in the BFR compared to placebo participants (1.1 ± 0.8%, p = 0.035).

CONCLUSION: Implementing BFR to maintain exercise intensity while reducing overall work volume has shown to not only be effective in sustaining performance levels during a taper phase, but this type of training can actually increase performance in many cases. This information can be used to develop targeted interventions throughout a macrocycle in different phases of the season and may be useful in team sports where players must peak a number of times throughout the season.

RESISTANCE TRAINING: TRAINING MODELS CAN AFFECT THE TIME TO THE RECOVERY.

BARBIERI, R.A., LUCHES-PEREIRA, G., CARVALHO, C.D., SERRANO, V.

UNIVERSITY OF BOLOGNA

INTRODUCTION: The relationship between volume, intensity, and periodicity is crucial for resistance training and the manipulation of these variables creates different stimuli, which can promote different magnitudes of decrease in performance. However, it isnt clear how the recovery is affected by the combination of these variables when repetitive stimuli are performed until concentric muscle failure. This study aimed to verify the effect of two different combinations of volume and intensity of the resistance training sessions on fatigue and the time course of recovery.

METHODS: Twelve males participated in the study (23.3±2.6yrs, 179.3±5.2cm, and 87.3±13.4kg). Firstly, a period of 5 weeks of resistance training adaptation was performed. Then, it was done two experimental acute sessions (training model A -TMA- and B - TMB) with an interval of at least 72h. TMA had high volume and less intensity (4 sets of 16 to 18 maximum repetitions - 50 to 60% of one repetition maximum; 60sec of the interval; free cadence). TMB had less volume and high intensity (4 sets of 8 to 10 maximum repetitions - 80 to 90% of one repetition maximum; 180sec of the interval; the cadence of 4sec/repetition). All resistance exercise sessions were performed for the lower limbs following the same exercise sequence (free squat, 45º leg press, leg curl machine, leg extension, adductor, and abductor machine). The internal training load was calculated through the Rate of Perceived Exertion (RPE). The Twitch Interpolation technic, heart rate variability (HRV), countermovement jump (CMJ) and squat jump (SJ) were applied in five moments: pre and post training sessions, and 6 hours, 24 hours, and 48 hours after the training sessions.

RESULTS: RPE was similar for TMA and TMB (9,0±0,5 and 8,7±0,71a.u.), however, the internal load of TMA was significantly higher in comparison to TMB ($p < 0.05$). Reduction in peak force (PF) after the experimental sessions was significant only to the MTA (TMA: -20.1±11.3%; TMB: -7.7±10.9%), and the PF keep reduce until 6hrs after the session to TMA (11.1±8.6%; $p < 0.01$). TS and Voluntary activation did not show any significant difference ($p < 0.05$) in the moments analyzed for both TMA and TMB, however, twitch control showed a significant reduction ($p < 0.05$) in the post TMA session indicating peripheral fatigue. The SJ and CMJ presented a significant reduction ($p < 0.05$) after the training sessions for both TMA and TMB with a complete recovery after 6 hours for MTA and 24 hours for MTB. HRV presented a significant reduction post training (SDNN, RMSSD, HF), with a recovery after 6 hours only for MTA.

CONCLUSION: The complete session with higher volume and lower intensity, with repetition stimuli performed until concentric muscle failure can generate peripheral fatigue, reduce jump performance increase the sympathetic activity after the training session, and demand longer neuromuscular recovery time (more than 6 hours) compared to a higher intensity and lower volume training session.

Oral Presentations

OP-AP35 Youth Football: Scientific Support

LONGITUDINAL DEVELOPMENT OF ANTHROPOMETRICS AND PHYSICAL PERFORMANCE IN ADOLESCENT FOOTBALL PLAYERS

TINGELSTAD, L., RAASTAD, T., LUTEBERGET, L.S.

NORWEGIAN SCHOOL OF SPORT SCIENCE

INTRODUCTION: Adolescence brings significant physiological changes, with boys and girls experiencing divergent physical performance trajectories due to unique maturation differences, leading to increasing performance differences between sexes (1). In this study we investigated the sex- and age-specific physical performance development in adolescent football players.

METHODS: In this longitudinal study we followed 132 adolescent football players from Norway, categorized into girls and boys U14 and U16 groups. Using a repeated measures design, data were collected twice with one year apart. Assessments included anthropometrics and physical abilities (sprint, change of direction, countermovement jump (CMJ), leg force and power, eccentric hamstring strength, isometric hip and shoulder strength, and intermittent endurance performance), conducted over two days. Statistical analysis was performed using a mixed model approach and multiple regression.

RESULTS: Significant time and sex effects were found, with boys outperforming girls at most tests at baseline and showing greater improvements in 30 m sprint (-3.6% vs. -2.3%), CMJ (12% vs. 3%), total power (24% vs. 13%), and abduction strength (21% vs 11%). Group comparisons showed that there was no significant difference in 1-year physical performance development between girls U14 and U16. On the other hand, U14 boys had a significantly greater 1-year improvement in both total (30% vs. 14%) and relative force (12% vs. 4%) than the U16s, and in 30 m sprint (-3.8% vs. -2.7%), CMJ (11% vs 5%), total force (30% vs 16%) and power (26% vs. 18%) compared to U14girls. U16 boys had greater 1-year improvement in CMJ (13% vs 0.1%), hip adduction (11% vs 2%) and hip abduction (14% vs 6%) than the U16 girls. Increases in height and body mass was significant for all group comparisons, with greater changes seen in boys and for the younger age group. Multiple regression analysis sheds light on the determinants of physical development, pinpointing baseline performance levels and sex as key factors for improvement.

CONCLUSION: In contrast to previous research indicating a greater gap in performance between boys and girls with increasing age, our results highlights that this is not the case for all physical characteristics. Although differences in maturation processes will differentiate performance development between the sexes, this might be mitigated by increased volume of targeted physical training in girls. These results underscore the importance of considering various variables to understand the intricacies of physical development within this athlete population. Tailored training programs could potentially enhance the physical development and injury resilience of adolescent football players. By adopting this approach, it is possible to provide a more tailored path towards peak performance and injury prevention, accounting for the unique trajectories and adaptive responses of each athlete.

1) Malina et al., Human Kinetics, 2004

ASSESSING ISOMETRIC HIP STRENGTH IN YOUNG PROFESSIONAL SOCCER PLAYERS: DOES HIP-FLEXION ANGLE MATTER?

TAYLOR, J., PALLOTTA, H., HUNTER, M., WRIGHT, M.

TEESSIDE UNIVERSITY

INTRODUCTION: Hip and groin injuries are commonplace in soccer and often result in considerable time-loss [1]. The hip adductors contribute to sprint, jump, and change of direction [2], and deficits in isometric hip adductor strength are associated with groin injuries [3]. Similarly, hip abductor strength is associated with stability and landing mechanics [4], and strength deficits may be a risk factor for lower limb injuries [5]. This underlines the value of assessing isometric hip strength. Short and long-lever hip strength has been reported at various hip flexion angles [6-8], yet comparison between angles is lacking. This study assessed the effects of hip flexion angle on peak force production and relationship between angles in soccer players.

METHODS: Twenty-four soccer players (Age 17.4 ± 0.8 years) completed 3 testing sessions during which isometric hip strength (i.e., adduction and abduction) was assessed at 45-, 60-, and 90-degree angles, using a fixed frame-dynamometer (Vald ForceFrame). Players completed testing in a counterbalanced order across a 2-week period and were in a similar physiological state for each. Three 5-s maximal voluntary contractions were completed in each position with a 30-s rest between trials. Peak force achieved across the trials for each limb was retained for analysis. A robust repeated measures ANOVA was used to detect changes between positions, with significance set at $P<0.05$ and Pearson's correlations used to quantify associations.

RESULTS: Significant mean differences were observed in peak adduction force between all positions. Mean differences were -25.9 ±23.1N (±95% confidence limit) and -33.4±19.1N for the right and left limbs, respectively, between 45- and 60-degrees; 46.8±23.2N and 32.6±19.9N for the right and left limbs, respectively, between 45- and 90 degrees; and 72.7±22.9N and 66.1±19.9N for the right and left limbs, respectively, between 60- and 90-degrees. Significant mean differences were observed in peak abduction force between 45- and 90- degrees, and 60 and 90-degrees. Mean differences were 32.2±20.8N and 25.7±21.1N for the right and left limbs, respectively between 45- and 90-degrees; and 42.4±20.9N and 41.6±21.3N for the right and left limbs, between the 60- and 90-degrees. Very large correlations were observed between adductor force at 45- and 90- degrees and force at 60 degrees ($r = 0.77$ to 0.87) and similarly for abductor force ($r = 0.77$ to 0.79)

CONCLUSION: Peak adduction force varies between short-lever test positions, while peak abduction force varies between a 90-degree and other hip flexion angles. However, very large associations between peak adduction and abduction force at different hip flexion angles existed.

References

1, Werner et al. 2018; 2, Jones et al. 2021; 3, Markovic et al. 2020;4, Sebesi et al. 2021; 5, Kawaguchi et al. 2021; 6, O'Connor et al. 2022; 7, Kadlec et al. 2019; 8, Lovell et al. 2011

ASSESSMENT OF A DOSE-RESPONSE RELATIONSHIPS BETWEEN 1-WEEK AND 4-WEEK CUMULATIVE TRAINING LOAD AND PHYSICAL PERFORMANCE OUTCOMES IN ELITE YOUTH SOCCER

CONNOLLY, D.R., MERCER, R., MCLEAN, B., RAMPININI, E., COUTTS, A.

JUVENTUS FOOTBALL CLUB S.P.A.

INTRODUCTION: At present, little evidence is available relating to associations between training load and fitness in elite youth soccer players, or how these may vary across different age groups. This study aimed to evaluate the dose-response relationships between internal and external training load variables recorded over acute (1-week) and chronic (4-week) periods with changes in elite youth players physical fitness.

METHODS: A retrospective observational design was employed to assess the relationship between training load and variations in measures of physical fitness across 5 competitive seasons (2017-18 to 2021-22). Three age groups (U16, U17 and U19) performed fitness tests aimed at assessing aerobic (Mognoni test), intermittent running (HIT test) and muscular qualities (Countermovement jump test (CMJ)), four times each season (preseason (PRE), start (IN1), middle (IN2) and end of season (IN3)). Internal and external training loads were quantified during every training session and match, and the sum of load accumulated over 1- and 4-weeks calculated for the subsequent analysis. Linear mixed models were applied to explore associations between six training load variables, across 1- and 4-week time frames, and changes in fitness test outcome measures.

RESULTS: A significant effect for age group and test period was found for each of the three fitness tests (Mognoni, HIT and CMJ, $p < 0.002$). U19 and U17 recorded significantly higher scores Mognoni and HIT than U16 ($p < 0.009$), with no significant difference between U17 and U19 ($p > 0.280$). Mognoni and HIT demonstrated a significant improvement from PRE to all in-season test periods and no significant difference across in-season periods. CMJ power was significantly different between the three age groups ($p < 0.0002$). CMJ did not significantly change between PRE and IN1 ($p = 0.63$) but there were increases between PRE and IN2 and IN3, respectively ($p < 0.025$). A small significant positive association was found between HIT and time spent >90% heart rate max (HR90%) recorded across 4-week period ($p = 0.016$, $d = 0.21$). Very high-speed running (VHSR) accumulated in 4-weeks had a small positive association with CMJ power ($p < 0.0003$, $d = 0.23$).

CONCLUSION: The longitudinal approach, across a season and different age groups, provides an insight into the progression of youth soccer players physical capacity across different physiological assessments. Aerobic and HIT capacity improve throughout the preseason period, whilst muscular qualities (CMJ) increase in the later part of the season. Improvements in test outcomes were observed with load accumulated over the longer timeframe assessed, specifically a 4-week period in VHSR for CMJ and HR90% for HIT. More details regarding the periodization of load (i.e., frequency, duration, mode, intensity, and distribution of training) within the time frames assessed and how they are manipulated are important for informing applied practitioners and their decision-making process.

CHANGES IN RUNNING ANAEROBIC SPRINT TEST PERFORMANCE IN YOUNG MALE SOCCER PLAYERS ACCORDING TO MATURATION

KOCA, C., KIN-ISLER, A., KOSE, M.G.

HACETTEPE UNIVERSITY

INTRODUCTION: Soccer is an intermittent, high-intensity sport that demands high levels of aerobic and anaerobic energy production. In addition to the aerobic capacity, a soccer players anaerobic power and capacity must also be developed in order to perform activities such as sprinting, jumping and change of direction. Running Anaerobic Sprint Test (RAST) is a valid, easily implemented and low cost field test for evaluating anaerobic performance in young soccer players1. Biological maturation is also one of the most important factors affecting both performance and player selection in young soccer players2. Therefore the aim of this study was to examine the effects of maturation on RAST performance in young male soccer players.

METHODS: 50 volunteer young male soccer players participated in the study. Biological maturation of the participants was calculated according to Mirwalds formula3 and participants were categorized into three groups according to their peak height velocity (PHV) as: below - 0.5 (PHVpre; n=23), between -0.5 and + 0.5 (PHVcirca; n=12) and above + 0.5 (PHVpost; n=15)4. Participants performed the RAST as stated in the literature1 in random order. Sprint times were recorded with telemetric chronometers (Fusion Sport, Australia), heart rate (HR) of participants were recorded continuously with telemetric monitors (Polar M400, Finland) and ratings of perceived exertion (RPE) were obtained with Borgs' scale5. Peak power (PP), average power (AP), minimum power (MP) and fatigue index (FI) were calculated from the sprint times by using the related formulas1. Normality of the data was tested by the Kolmogorov-Smirnov test. Changes in RAST performance according to maturation was determined by using one way analysis of variance (ANOVA) and Bonferroni post-hoc test was used to detect differences between groups. Significance was set at $p<0.05$.

RESULTS: In PP ($F(2:49):60.458$; $p=0.000$; $\eta2:0.747$), AP ($F(2:49):90.160$; $p=0.000$: $\eta2: 0.810$) and MP values ($F(2:49):66.181$; $p=0.000$; $\eta2: 0.750$) significant differences were found between different maturation groups. Bonferroni post hoc results indicated that PHVpost had significantly higher power values (PP, AP and MP) than other maturation groups. In addition, PHVcirca had significantly higher power outputs (PP, AP and MP) than PHVpre. In FI on the other hand, no significant differences were found among the groups ($F(2:49):0.341$; $p=0.713$; $\eta2: 0.034$). In addition HRpeak ($F(2:48): 0.175$; $p=0.840$; $\eta2: 0.007$), HRmean ($F(2:48):0.264$; $p=0.769$; $\eta2:0.025$) and RPE ($F(2:49): 0.204$; $p = 0.816$; $\eta2: 0.013$) did not differ significantly between the groups.

CONCLUSION: The results of this study showed that anaerobic power improved as the level of biological maturation increased, however, the effect of biological maturation on FI and physiological responses was similar in young male soccer players.

1. T. Hazir et al. (2018) 2. Malina (2004) 3. Mirwald (2002) 4. Bradley et al. (2019) 5. Borg at el. (1987)

Topic: Training and Testing

Presentation Form: Oral

THE EFFECT OF LONG-TERM SOCCER TRAINING ON LEFT VENTRICULAR STRUCTURE AND FUNCTION IN ELITE MALE YOUTH SOCCER PLAYERS

UNNITHAN, V., BEAUMONT, A., ROWLAND, T., GEORGE, K., STEWART, L., SCULTHORPE, N., LORD, R.N., OXBOROUGH, D.L.
UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Cardiac adaptations in elite, male adolescent, youth soccer players have been demonstrated in relation to training status, but the time course of these adaptations and the delineation of the influence of growth and maturation from the training effect on these adaptations remain unclear. Consequently, the aims of the study were to evaluate the impact of 3-years of elite-level soccer training on changes in left ventricular (LV) structure and function in a group of highly trained elite youth male soccer players (SP) as they transitioned through the pre-to-adolescent phase of their growth and development.

METHODS: Twenty-two elite male youth SP from the highest Level of English Premier League Academy U-12 teams were evaluated once a year for 3 consecutive soccer seasons as the players progressed from the U-12 to U-14 teams. In tandem, a group of fifteen recreationally active control participants (CON) were also evaluated over the same 3-year period. Two-dimensional transthoracic echocardiography was used to quantify LV structure and function.

RESULTS: A linear mixed effect model was developed to simultaneously control for the fixed effects of Group (SP, CON), Year (1, 2, 3) and with maturity offset adjusted as a covariate on all the dependent variables between each year. After adjusting for the influence of growth and maturation, training-induced increases in Years 2 and 3 were noted for: LV end diastolic volume (LVEDV; p=0.02) and LV end systolic volume (LVESV; p=0.02) in the SP compared to CON. Training-induced decrements were noted for LV ejection fraction (LVEF; p=0.006) and Tissue Doppler (TDI) derived S (p=0.001).

CONCLUSION: The major finding from this novel, three-year observational investigation was that after controlling for the influence of growth and maturation , there was more evidence of eccentric remodeling (LV chamber enlargement) rather than eccentric hypertrophy (concomitant LV chamber dilatation and increase in LV wall thickness) in SP compared to CON. Furthermore, there was also evidence of functional adaptations in the form of decrements in LVEF and TDI-S' over time in SP compared to CON after adjusting for a period of rapid growth. Significant training volume increases (Years 2 and 3) were aligned with LV volumetric adaptations (LVEDV and LVESV) and decrements in systolic function (LVEF, S) in the SP that were independent of the influence of growth and maturation . Decrements in systolic function were suggestive of a functional reserve for exercise. The evidence from this original body of work suggests that there is a training volume-based threshold that stimulates LV structural and functional adaptations independent of the influence of growth and maturation in highly-trained youth soccer players.

Oral Presentations

OP-MH38 Exercise and female medical conditions

THE EFFECT OF RESISTANCE TRAINING ON PATIENTS WITH NON-OBESE POLYCYSTIC OVARY SYNDROME : A RANDOMIZED CONTROLLED TRIAL

YU, C., NAN, L., LIHUA, W., JUN, Z., MINGMING, Y., KAIYUAN, Q., ANQI, L., XIN, Y., JIAOYANG, Z., HAILING, Z., JIE, C., DAN, W.
SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Metformin is a conventional drug for the treatment of non-obese polycystic ovary syndrome (PCOS), but the clinical features of the disease vary in their manifestations, leading to variable therapeutic effects. Low percentage of skeletal muscle is one of the important mechanisms of insulin resistance in non-obese PCOS patients. Exercise has been considered by the medical community as an important means of treating PCOS, but effective exercise intervention for non-obese PCOS patients has not been demonstrated yet. PURPOSE: to compare the effect of resistance training and metformin in the treatment of non-obese patients with PCOS.

METHODS: Twelve non-obese PCOS patients were enrolled in this study and randomized in experiment group (EG = 6, 28.2±1.7yrs, 158.0±4.1cm, 53.1±3.2kg) which underwent resistance training, and control group (CG = 6, 27.7±3.7yrs, 163.5±1.9cm, 58.2±5.9kg) which took metformin, for continuous 12 weeks. Skeletal muscle mass, body fat percentage, and testosterone were measured pre-and post-intervention. Data analysis was performed using repeated ANOVA.

RESULTS: Significant interactions between time and group were noted for testosterone ($F = 10.072$, $P = 0.010$, $\eta 2p = 0.816$), significant differences between time were noted for skeletal muscle mass ($F = 6.398$, $P = 0.030$, $\eta 2p = 0.627$), body fat percentage ($F = 5.784$, $P = 0.037$, $\eta 2p = 0.584$).

CONCLUSION: Twelve weeks of resistance training is effective in improving blood indicators, skeletal muscle mass, and body fat percentage in non-obese PCOS, in addition to improving sex hormone levels associated with PCOS while developing strength.

SEVERITY OF MENOPAUSAL SYMPTOMS AND PHYSICAL ACTIVITY TIME: A CROSS-SECTIONAL STUDY

LE BOURVELLEC, M., BOIS, J., DELPECH, N., AIBAR, A., BOSQUET, L., ENEA, C.
UNIVERSITÉ DE POITIERS

INTRODUCTION: The menopausal transition induces symptoms (e.g., hot flashes, anxiety, and sleep disorders, etc.), associated with an increased risk of developing cardiovascular (CV) disease [1]. In this population, regular physical activity (PA) appears to be an attractive non-pharmacological strategy to both improve symptoms and reduce CV risk [2]. However, several studies have shown that menopause has a negative impact on the duration and frequency of PA in women [3], which may be due to menopausal symptoms. The aim of this study is to evaluate the association between menopausal symptoms and PA levels in women.

METHODS: An online cross-sectional study was conducted among peri- and postmenopausal women aged 40-60 years.

Menopausal symptoms were assessed using the Menopausal Rating Scale, the Hospital Anxiety and Depression questionnaire, the Insomnia Severity Index, the Hot Flash Related Daily Interference Scale, and the same anxiety and depressive interference scales developed in this study. The moderate-to-vigorous PA (MVPA) time (at work, during travel and during leisure time) and sedentary time were assessed using the Global Physical Activity Questionnaire.

Hierarchical clusters were created using scores from all questionnaires assessing menopausal symptoms, using the Ward method with a squared Euclidean distance measure. Nonparametric MANOVA, Kruskal-Wallis test, and Dunn post hoc with Bonferroni correction were used to compare MVPA and sedentary time as dependent variables between clusters. Data are presented as medians (interquartile ranges).

RESULTS: N=349 women completed the questionnaire. 147 women were classified as "low", 147 as "moderate" and 57 as "severe" symptoms. Manova mutivariate effects was significant (F=5.087, p=0.02) between the clusters in terms of total MVPA and sedentary time. Regarding PA type, only MPVA during leisure time differed between clusters (H=7.449, p=0.02). Women with moderate and severe symptoms had lower levels of leisure MVPA compared to women with low symptoms (low : 120 (240) vs. moderate 60 (195), p=0.04), (low: 120 (204) vs severe : 7 (180), p=0.03). MVPA differences between moderate and severe groups were non-significant.

CONCLUSION: These results suggest that women with moderate or severe symptoms are also those with low leisure-time PA levels. Further data are needed to better identify women at risk for lowering their PA levels during the menopausal transition, to allow for better management and reduction of CV risk.

References

[1] Muka, T. et al., (2016). Association of Vasomotor and Other Menopausal Symptoms with Risk of Cardiovascular Disease : A Systematic Review and Meta-Analysis. PloS One, 11(6), e0157417.

[2] Liu, T., et al., (2022). Effects of exercise on vasomotor symptoms in menopausal women : A systematic review and meta-analysis. Climacteric, 1-10.

[3] ONAPS. (2023). Enquête sur les comportements sédentaires et la pratique d'une activité physique lors des transitions de vie de la femme.

THE ASSOCIATION BETWEEN VITAMIN D, SEX-HORMONES, PHYSICAL ACTIVITY, BODY COMPOSITION AND CARDIOMETABOLIC MARKERS IN ARAB WOMEN IN QATAR

CHRISMAS, B., MAJED, L., WESTON, K., TAYLOR, L.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: A hyperandrogenemic metabolic phenotype is prevalent in Qatari women with polycystic ovarian syndrome (PCOS), a population demonstrating higher PCOS prevalence (12%) compared to Caucasian women (6%). Reproductive hormones may effect vitamin D status. Vitamin D deficiency in Qatari women (80%), accompanied by high prevalence of PCOS and metabolic syndrome (43%), obesity (46%) and low physical activity [(PA); 44% <5000 steps.d) poses severe clinical risk for these females across their reproductive years. No study has investigated the association between 25(OH)D [vitamin D (VD)], sex-hormones, PA, body composition and cardiometabolic markers in Qatari women

METHODS: Data obtained for this cross-sectional study consisted of a random sample of 1000 Arab (n = 929 Qatari) women from the Qatar Biobank. Blood samples were collected in anticoagulant-coated evacuated tubes (BD, Mississauga, ON, Canada). Plasma concentrations of the hormones, enzymes, and lipid markers were analyzed at Hamad Medical Corporation (HMC) diagnostic laboratory using Cobas 6000 analyzer (Roche Diagnostics). Serum 25(OH)D was analyzed using a LIAISON 25 OH Vitamin D TOTAL assay. Full body dual energy X-ray absorptiometry (iDXA; General Electric) was performed to assess bone mineral density and body composition. Body mass, height, body mass index (BMI), were measured by a trained nurse. PA was measured via a self-reported questionnaire. Linear mixed models (random coefficient models) examined associations between VD and sex-hormones [estradiol, testosterone, sex hormone-binding globulin (SHBG)], and cardiometabolic biomarkers (insulin, glucose, cholesterol). Chi-square analyses examined associations between VD and PA and BMI classification

RESULTS: 23% were VD deficient (<30 nmol.L-1) and 43% inadequate (30-50 nmol.L-1). 86% did not meet the American College of Sports Medicine PA guidelines. 30% were overweight and 47% were obese. 1% had testosterone >2.7nmol/L and 18% had not menstruated for ≥12 months. There was an inverse association between VD and glucose (-2.25, p<0.001), but no association with estradiol (p=0.19), SHBG (p=0.44) or testosterone (p=0.75). There was a significant asso-

ciation between VD and BMI classification ($\chi2=29.8$, $p=0.01$), but no significant association with PA classification ($\chi2=2.9$, $p=0.70$).

CONCLUSION: These data show highly prevalent obesity (47%) alongside VD (66%) and PA (86%) insufficiency in a female Qatari Arab population. No association between sex-hormones and VD are shown in the present sample, in contrast to elsewhere. Further objective data (e.g. PA, diet, supplementation) across the menstrual cycle and reproductive years are required to understand the interplay of these variables and the variability between samples. Better understanding of these would provide more secure evidence to inform interventional work upon (e.g., VD supplementation combined with PA) in an attempt to improve health outcomes in similar samples.

Oral Presentations

OP-MH37 Exercise in children

FAT OXIDATION RATES DURING EXERCISE IN PRE-PUBERTAL CHILDREN: THE ROLE OF OBESITY, FITNESS AND LEAN MASS

RODRÍGUEZ GÓMEZ, I., MARTÍN-GARCÍA, M.1,2, ALEGRE, L.M.1,2, GARCÍA-CUARTERO, B.4, GONZÁLEZ-VERGAZ, A.4, CARCAVILLA, A.5, ARAGONÉS, A.6, ARA, I.1,2

1.GENUD-TOLEDO RESEARCH GROUP, UNIVERSITY OF CASTILLA-LA MANCHA; 2.CIBER OF FRAILTY AND HEALTHY AGING ; 3.HOSPITAL VIRGEN DEL VALLE; 4.ENDOCRINOLOGY AND DIABETES UNIT; 5.HOSPITAL UNIVERSITAR

INTRODUCTION: With childhood obesity rates on the rise, researchers are studying the factors that explain excessive fat accumulation during growth, including exercise-related energy substrate metabolism [1,2]. Nevertheless, there are some factors involved that have not been entirely studied despite the fact that they are determinant, especially in pre-pubertal children [3]. Thus, the aim was to determine fat oxidation values during a graded cyclo-ergometer exercise in pre-pubertal children considering cardiovascular fitness (CRF) and lean mass based on obesity status and sex. Moreover, to elucidate whether body mass index (BMI) or fat accumulation mediate the relationship between CRF and fat oxidation.

METHODS: We analysed 118 pre-pubertal children with Tanner ≤II (59 girls [11.5±2.0 yr]). Body composition was assessed using dual-energy X-ray absorptiometry and anthropometry, CRF (peak oxygen uptake -VO2peak) and fat oxidation rates were determined during a graded cycling test. Participants were classified as normal-weight, overweight or obesity according to the international cut-off points for BMI in children.

RESULTS: In absolute values, obese pre-pubertal children displayed higher maximal fat oxidation (MFO) compared to overweight and normal-weight counterparts. However, after adjusting by CRF the difference in MFO disappeared. When MFO was expressed with respect to lean mass and adjusting by CRF, MFO in normal-weight children was significantly greater (7.2±0.3 vs. 6.9±0.5 vs. 6.4±0.4 mg·min-1·kgleanmass-1, normal-weight, overweight and obesity, respectively). Similar results were found in boys and girls. Furthermore, both fat accumulation and BMI acted as mediators in the relationship between CRF and fat oxidation (38%).

CONCLUSION: Fat oxidation levels are comparable among pre-pubertal children, regardless of obesity status, upon CRF adjustment. Nevertheless, when contextualized within body and lean mass, obese and overweight children demonstrated reduced fat oxidation capacity compared to their normal-weight peers during exercise and with no sex-related differences. Thus, it seems that impaired metabolic flexibility due to obesity occurs even before the puberty independently of sex. Furthermore, fat mass seems to be a mediator factor between CRF and fat oxidation, which reinforces the need to consider obesity status when talking about energy substrate metabolism.

FOOTWEAR RECOMMENDATIONS FOR HEALTHY CHILDREN AND ADOLESCENTS, ARE THEY EVIDENCE BASED? A SCOPING REVIEW.

HUGHES, L., JOHNSON, M.I.2, PERREM, N.3, FRANCIS, P.1

SOUTH EAST TECHNOLOGICAL UNIVERSITY CARLOW

INTRODUCTION: Introduction: The foot has a variety of roles in bipedal locomotion, including adapting to uneven terrain (ensuring stability), bearing weight, acting as a shock absorber, generating forward motion by transmitting propulsive forces, and providing proprioceptive information via the plantar surface (Eils et al., 2004). The monitoring of shoe fit in relation to individual foot characteristics is important for children and adolescents because poorly fitted shoes can lead to various foot problems, including deformities, pain, and impaired function. The aim of this scoping review was to identify current footwear recommendations present in the available literature, inclusive of government, professional bodies, and expert clinical panel guidelines. A secondary aim was to assess whether there was evidence to support these recommendations.

METHODS: Methods: This review was structured in line with the PRISMA-Scr framework (Tricco et al., 2016) and used an iterative five-step process as previously described by Arksey and O' Malley (2005) and Levac, Colquhoun, and O' Brien (2010). A structured literature search of Google Scholar, Scopus, ScienceDirect, PubMed, and Embase was undertaken using the following terms: (children* OR adolescent* OR paediatric*) AND (footwear* OR shoes*) AND (recommendations* or guidelines*). Additional clinical and governmental guidelines were sourced via email and phone call to the relevant departments.

The inclusion criteria required articles to include healthy children and adolescents aged from 18 months to 18 years old, include sports shoes, school shoes, and conventional shoes, be published in English between 1970 and 2023, and include randomised control trials, prospective studies, research articles, and Delphi studies. The selected articles were summarised by synthesising the study's findings based on the research question.

RESULTS: Results: Thirteen articles were included: three recommendations from governmental and national bodies (HSE, NHS, and AMPA), two Delphi studies, two cross-sectional observational studies, a literature review, a longitudinal study, a prospective study, an observational review, a repeated measures trial, and a randomised control trial. The review identified a need for further research in the area of children's footwear, particularly in understanding how the shoe design affects the developing foot over the long term.

CONCLUSION: Conclusion: The results underscore the critical role of properly fitted and designed footwear in supporting healthy foot development in children. It highlights the need for further research, better education for parents and carers, and the development of standardised guidelines and taxonomy to improve the selection of children's footwear.

UTILITY OF FIELD-BASED PHYSICAL FITNESS TESTS FOR PREDICTING BLOOD LIPIDS AMONG JAPANESE CHILDREN

KIDOKORO, T., KITANO, N., KLUG, M., MAGNUSSEN, C.G., TOMKINSON, G.R.

NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: Although the health benefits of cardiorespiratory fitness (CRF) have been well-established, evidence for other components of PF (muscular fitness [MF] and flexibility) is lacking. Multiple PF components, including CRF, MF, and flexibility, may improve health-related predictive accuracy over single PF tests. However, no study has examined this. Given that childhood blood lipid levels track strongly into adulthood and are major risk factors for cardiometabolic disease, identifying the best predictive model using multiple PF tests in children could aid in describing current and future health. Therefore, the aim of the study was to identify the best predictive model for blood lipid levels among Japanese children using national physical PF tests (including eight PF items).

METHODS: Participants were 983 Japanese children (489 boys and 494 girls) aged 9–12 years. PF was assessed as part of the national PF surveillance and anthropometric assessments (height and body mass). Blood lipids (triglycerides, high-density lipoprotein cholesterol [HDL-C], non-HDL-C) were directly measured or calculated from a non-fasted venous blood sample. To identify the model with the highest predictive utility for blood lipid levels, receiver operating characteristic analyses were performed to examine the area under the curve (AUC) for all combinations of the eight PF tests (1,530 models were examined).

RESULTS: For boys, the best single predictor PF tests were the standing long jump [AUC:0.64-0.67], 20-m shuttle run [AUC:0.64-0.67], 50-m sprint [AUC:0.63-0.80], and softball throw [AUC:0.60-0.69]. These AUC values were greater than those for body mass index (BMI) [AUC:0.58-0.67], and the models remained significant even after adjusting for BMI and maturity offset. For girls, no PF test demonstrated significant discriminatory utility after adjusting for BMI and maturity offset. Using multiple PF tests (up to eight) improved the AUC; however, the changes in the AUC were negligible (<6% for boys and <4% for girls), except for HDL-C in girls.

CONCLUSION: Our study identified the PF tests with the best utility for predicting blood lipid levels in Japanese children. For boys, the standing long jump, 20-m shuttle run, 50-m sprint, and softball throw emerged as the most superior PF tests, with their discriminatory ability superior to BMI. In contrast, no single or combination of PF test showed improved discrimination for girls after considering key covariates. Our findings suggest that multiple PF tests do not markedly improve prediction over a single PF test. Thus, using the national PF tests as an initial screening tool can identify children at risk of dyslipidaemia in Japan, potentially complementing BMI and other risk factors and aiding early education and intervention strategies.

A NEW PHYSICAL PERFORMANCE ADJUSTMENT MODEL LINKED TO THE EFFECT OF RELATIVE AGE IN ELITE YOUTH HANDBALL PLAYERS

GUILLAUME, J.P., NOEL, C., MAURELLI, O., RENOUF, F., PRIOUX, J.

ATHLETICA

INTRODUCTION: Biological maturation and relative age influence selection process and performance in team sports (1,2). The asymmetry in the distribution of dates of birth favouring players born in a cohort refers to the notion of relative age effect (RAE) (3). The aims of this study were (i) to validate a new model (Multilevel regression analysis) for analysing the effects of relative age on the physical performance of elite youth handball players and (ii) to test the predictive capacity of this model

METHODS: The data were collected over 17 years on 439 elite youth handball players. Players were classified by chronological age, maturity status (advanced, normal, delayed) and birth quartile (Q1:January-March;Q2:April-June;Q3:July-September;Q4:October-December). Each year, the 10 m speed test, the Counter Movement Jump (CMJ) test and agility test (T-test) were carried out. The relative age corresponded to the difference between the test date and the date of birth. The birth month of each participant was collected to categorize them into birth semesters: S1 (January to June) and S2 (July to December). Estimated maturity was expressed by a z-score relative to the age group and by the mean and standard deviation of the prediction of the groups adult height. Peak growth velocity was estimated using the Mirwald equation (4). In each annual-age category, a chi-square test was conducted to assess differences between the observed distribution of relative ages and the adjusted distribution based on a uniform distribution. To assess the models accuracy, weve selected

a test group of 56 athletes who have taken the same tests under identical conditions but at different time periods, at least twice, the first measure is denoted the base data.

RESULTS: Preliminary results for the 10 m speed test (p=0.003) and the T-test (p=0.014) show a significant influence of relative age on performance, while the maturity index for the 10 m speed (p=0.11) and the T-test (p=0.237) had no significant effect. For the CMJ test, none of the variables was significant (relative age: p=0.281; maturity index: p=0.205). RAE effects are observed across all annual-age categories, with more pronounced effects among the youngest participants, which diminish as age increases. Specifically, for the 10 m speed, the RAE effect ranges from large (e.g., 12 years, top 50%, χ^2=7.2, p=0.02, S1 vs. S2, odds ratio=4) to small, and for the t test, it ranges from medium to small.

Based on the test group the results for the 10-meter speed indicate a significant difference between the distribution of the base data and the observed (p=4.92e-07) and adjusted (p=6.054e-06) data, but not between the observed and adjusted data (p=0.4668). Concerning the T-test, the Wilcoxon test revealed significant differences between all the sample groups, particularly between the observed and adjusted data (p=5.555e-06).

CONCLUSION: The model presented here makes it possible to reduce the effect of RAE on the results of physical tests and accurately predicts performance

Oral Presentations

OP-SH09 Mentoring and Coaching

A COMPARATIVE QUALITATIVE STUDY OF THE DISTINCTIVE NEEDS OF COACHES WHO ARE COACHING FEMALE ATHLETES

SOLSTAD, B.E., AUSLAND, Å., KNIGHT, C.J., IVARSSON, A., TORSTVEIT, M.K.
UNIVERSITY OF AGDER

Introduction: Despite the increasing participation rates of female athletes in competitive sports, they still remain underrepresented in sport science research. Neglecting the distinct biological, psychological, and social factors influencing female athletes' participation, development, and performance underscores a significant oversight in this area. The interdependence of factors, ranging from physiology to coaching communication, necessitates a thorough exploration of optimal athletic development. Hence, the purpose of this study was to explore the current knowledge among coaches and the specific requirements of future coach education programs tailored to enhance coaching practices in female sports.

Methods: Sixteen Norwegian coaches both in the recreational tiers (n=8) and elite sport levels (n=8) participated in semi-structured, in-depth interviews. Two coaches from eight different sports participated in this study. This diverse sample facilitated a nuanced perspective on coaching practices in female sports. Reflexive thematic analysis (Braun & Clarke, 2022) was employed to delve into the lived experiences of these coaches, uncovering prevalent coaching approaches, experiences, and discerning challenges encountered in coaching female athletes.

Results: The data analysis generated a pressing need for enhanced knowledge and coach education programs to effectively guide coaches of female athletes. The participants expressed a lack of exposure to methodologies specifically tailored to female athletes, often relying on generalized approaches derived from coaching male athletes. Notably, elite sport coaches prioritized resilience-building strategies and performance optimization, while recreational coaches emphasized inclusion and well-being outcomes. Moreover, team sport coaches were less inclined toward individualization compared to individual sport coaches. However, the overarching necessity for refined knowledge and coach education content remained consistent across diverse sports and coaching tiers.

Discussion: The findings underscore the importance of addressing knowledge gaps and customizing coach education programs to meet the distinctive needs of coaches working with female athletes. While disparities existed between different groups of coaches, the overarching need for improved female-specific coaching practices remained consistent. Recognizing and bridging these gaps might empower coaches to better support female athletes, promoting development and performance outcomes. The discussion advocates for a more nuanced and inclusive approach to coach education, mindful of the diverse contexts and priorities inherent in sports coaching of female athletes. Moreover, incorporating well-being outcomes in coach education programs can further enhance support for female athletes.

References:

Braun, V., & Clarke, V. (2022). Conceptual and design thinking for thematic analysis. Qualitative Psychology, 9(1), 3–26. https://doi.org/10.1037/qup0000196

DAILY MEASURES OF FEMALE ADOLESCENT HANDBALL PLAYERS SPORT EXPERIENCE AND PARTICIPATION

BUGTEN, J., HAUGEN, T., IVARSSON, A., KNIGHT, C.J., OMMUNDSEN, Y., SPENCER, M., STENLING, A., SOLSTAD, B.E.
AGDER UNIVERSITY

Introduction

Youth sport participation can provide various physical, psychological, and social benefits; hence, understanding factors contributing to sustained sport participation is important. Whereas antecedents of long-term sport participation have been

extensively studied, the antecedents of short-term participation in youth sport have received less attention. Thus, the aim of the current study was to investigate early adolescent female handball players' sport enjoyment and the immediate social impact of their peers and coach and assess their associations with the likelihood of attending subsequent practice sessions.

Methods

A diary study methodology was used, obtaining data from one team of adolescent female players (N = 27) during 11 practices across 4 weeks (n = 297 measurement points). To investigate the potential relationship between coach and peer motivational climates, sport enjoyment, and attendance at the next practice session, three Bayesian two-level logistic regression models using Mplus, version 8.3 were applied.

Results

The findings revealed that immediate social impacts, such as coach controlling use of rewards during practice, increased the risk of non-attendance at the next practice session, while supportive peer interactions post-practice enhanced attendance probability. However, peer conflict, coach negative conditional regard, and sport enjoyment did not predict subsequent practice attendance, suggesting that peer support and coach controlling use of rewards may outweigh other negative social experiences and intrinsic pleasure in short-term sport participation decisions for this demographic.

Discussion

These insights underscore the importance of timing and the nature of feedback and interactions in the youth sport context. For instance, the findings provide practical insights for coaches and sport program designers about the sensitive timings where interventions could be the most impactful. Coaches might focus on providing a more supportive environment during practice, while sports organizations could facilitate positive peer interactions immediately following practice sessions. The study's findings and limitations pave the way for several directions in future research, suggesting the need to expand to diverse demographics and sports, using a more intensive longitudinal design to explore how short-term participation influences long-term sport participation.

MIXED-METHOD EVALUATION OF A RESEARCH-INFORMED COACH EDUCATION PROGRAM TO FACILITATE EFFECTIVE COACHING FOR SOCCER TALENT DEVELOPMENT

BERGMANN, F.1, WACHSMUTH, S.1, DUGANDZIC, D.2, METKE, C.2, HÖNER, O.1

1EBERHARD KARLS UNIVERSITY TÜBINGEN; 2GERMAN FOOTBALL ASSOCIATION

Introduction

Coaches' learning support is critical to facilitate youth athletes' development. To this end, coaching should be informed by a blend of practical experiences and scientific evidence. Therefore, a research-informed coach education program (CEP) was developed to enhance learning-conducive coaching practice within the German Football Association's (DFB) talent development program. A multiplier approach was used to rollout the CEP to ensure a nationwide, yet contextually tailored implementation [2]. This study introduces and evaluates the CEP through multipliers' (i.e., DFB full-time coaching coordinators) and coaches' perspectives.

Methods

Guided by the Context, Input, Process, and Product evaluation model [CIPP; 2], a mixed-methods approach was applied. This combines an online survey (n = 8 multipliers; n = 145 coaches) and a total of 24 qualitative interviews (n = 8 multipliers, n = 16 coaches). After completing the CEP, participants rated 22 items pertaining to the quality of the program on a 6-point scale ('very good' [1] to 'very bad' [6]). Follow-up interviews conducted two (multipliers) and five weeks (coaches) later aimed to evaluate the CEP's implementation and practical transferability. Descriptive statistics were calculated for the survey data and a template analysis was applied to analyze the qualitative interviews.

Results

Descriptive statistics for features relating the CEP's input (Mcoaches = 2.19, SD = 0.76; Mmultipliers = 2.09, SD = 0.62), process (Mcoaches = 1.79, SD = 0.73; Mmultipliers = 1.78, SD = 0.82), and product (Mcoaches = 2.15, SD = 0.97; Mmultipliers = 2.13, SD = 0.46) show an overall good satisfaction. Moreover, qualitative findings indicate a more goal-directed use of game-based practices by coaches following the CEP. However, the program was perceived as less beneficial regarding in-session coaching as respective situations were difficult to simulate within the CEP. It was suggested that this could be addressed via follow-up measures that encourage CEP-related self-reflection in coaches' everyday practice.

Discussion

The research-informed CEP was considered suitable to facilitate coaching practice within the DFB's talent development program. Yet, to meet coaches' needs even better, they should be provided with opportunities to partake in the design of professional development measures. Consequently, practice transfer could be enhanced by a closer link between course content and coaching reality.

References

[1] Stufflebeam, D. L. (2003). The CIPP Model for Evaluation. In T. Kellaghan & D. L. Stufflebeam (Eds.), Interna-tional Handbook of Educational Evaluation. Springer.

[2] Wachsmuth, S. et al. (2022). Evaluating a Multiplier Approach to Coach Education within the German Football Association's Talent Development Program. International Sport Coaching Journal, 9(3), 305-318.

A MONODISCIPLINARY APPROACH TO STUDY PERFORMANCE PREDICTORS IN RUNNING

THUANY, M., GOMES, T.N., ROLIM, R., SANTOS, M.A.M.
UNIVERSITY OF PORTO

Introduction: Despite researchers increased interest in enhancing training methods, technologies, and evidence-based training in the context of running, no scientific information is currently available regarding the trends and development of this field of study. Our objective was to conduct a bibliometric analysis to identify the evolution of the "running performance" research field.

Methods: We searched for original articles using the "advanced search" feature of Web of Science 65 Core Collection. The terms "running," "long-distance running," "marathon," "half-marathon," "5km," "10km," "performance," and "prediction" were combined using Boolean operators. We included original articles published in English and peer-reviewed journals, employing both qualitative and quantitative approaches. Exclusions comprised studies involving untrained subjects, ultramarathons, cross-country events, and skiers. Studies assessing the effects of running on specific outcomes, investigating time-limited events, trail runs, and simulated races were also excluded. We employed a polynomial equation model to analyze temporal trends in the number of studies. To analyze the development of the field, we examined the main organizations and countries (based on the authors affiliation), keywords used in the published studies, and top 10 journals in terms of the number of published studies. Bibliometric networks were constructed and visualized using VOSviewer software (version 1.6.18).

Results: A total of 564 original studies were identified in WoSCC, with 324 studies included in this bibliometric review. Publication data ranged from 1983 to 2023. There were 509 listed organizations, with the University of Zurich (n=10), the University of Cape Town (n=9), James Cook University (n=7), and the University of Zaragoza (n=7) ranking as the top three, constituting 42.30% of documents among the top 10 organizations. North American countries (United States and Canada) had the highest influence in this field, followed by European countries like England, France, Switzerland, and Spain. The contributions among authors tend to the clustered by geographical location. The leading journals were the International Journal of Sports Medicine, the Journal of Strength and Conditioning Research, and the Medicine and Science in Sports and Exercise. Keyword analysis revealed that early studies focused on physiological tests/variables (e.g., lactate threshold, VO2max, ventilatory threshold), while recent years saw a trend towards investigating biomechanics, pacing, and technology in running (footwear).

Conclusion: Understanding the historical foundations of the field is the initial step to progress. The running field has predominantly followed a monodisciplinary approach, emphasizing physiological and biomechanical determinants as the most important for athletes performance. An emerging trend involves exploring the impact of technology on performance.

09:30 - 10:45

Invited Symposium

IS-MH07 We don't need to put our house in order, we need to build a better house: Improving research quality and trust in the age of open research

IF YOU FAIL TO PLAN, YOU ARE PLANNING TO FAIL: THE SIGNIFICANCE OF A WELL-DEFINED RESEARCH QUESTION AND OPTIMAL METHODOLOGY

IMPELLIZZERI, F.
UNIVERSITY OF TECHNOLOGY OF SYDNEY

Various phases of the research process involve subjective and arbitrary decisions. When these choices, referred to as researcher degrees of freedom, are made opportunistically, they increase the risk of false positive results and exaggerated effects [1]. At the start of the research process, a vague and ambiguous research question constitutes an initial source of researcher degrees of freedom [2]. Such vagueness facilitates practices like p-hacking and HARKing (hypothesizing after the results are known), with the latter being particularly common for example when exploratory studies are "rebranded" as confirmatory during manuscript preparation. Unclear research questions and hypotheses can result from a superficial or suboptimal approach to the research development phase, rather than being intentionally introduced for post-results ad hoc explanations. Vagueness may also result from the absence of well-operationally defined concepts within the question and unclear dependent variables and outcomes. The research projects methodology (design and analysis) is closely linked to the research question. Clarity and transparency are therefore essential to ensure a robust research process and integrity. Preregistration is an important initiative to enhance transparency but should not be mistaken for a quality certification' [3]. While it promotes transparency, it does not inherently address issues like vague research questions and methodologies (i.e., authors can register a "bad" study). An alternative approach, such as registered reports, presents a more robust initiative for improving the research design phase [4]. With registered reports, authors submit their research design before conducting the study, enabling error correction beforehand. Furthermore, the requirement for a detailed research plan encourages authors to be more specific and unambiguous. Considering and implementing the estimand as recommended by the International Council for Harmonisation (ICH E9-R1) [5] in intervention

studies would also be valuable in sports science and medicine. This presentation aims to elucidate why dedicating sufficient time to formulating a research question and selecting appropriate methods is the crucial first step for successful, relevant, robust and replicable studies.

[1] https://doi.org/10.1177/0956797611417632

[2] https://doi.org/10.3389/fpsyg.2016.01832

[3] https://doi.org/10.31234/osf.io/jbh4w

[4] https://doi.org/10.1016/j.cortex.2012.12.016

[5] https://www.ema.europa.eu/en/ich-e9-statistical-principles-clinical-trials-scientific-guideline

"I'M NOT THAT GREAT AT STATS" AND OTHER CAUTIONARY TALES: WHY DATA AND STATISTICAL LITERACY ARE VITAL

ABT, G.

THE UNIVERSITY OF HULL

In the 1820s more than 80% of the world was illiterate [1], but now most people can read and write. Yet in the 2020s we face a new kind of illiteracy – data illiteracy. Data literacy has broadly been defined as the ability to ask and answer real-world questions from data, including the abilities to select, clean, analyse, visualise, critique, and interpret data [2]. Data literacy is increasingly important in a digital world [3] and should be considered a 'life skill' [2]. However, fewer than 20% of university graduates feel their degree prepared them 'very well' for the data skills needed for employment [4], including academia and research. Yet academics and researchers would probably agree that formal statistical inference methods are required if we are to avoid 'fooling ourselves' [5]. For example, the banning of null hypothesis significance testing by Basic and Applied Social Psychology in 2015 [6] often led to researchers overstating their conclusions beyond what the data supported [7]. If we couple data illiteracy with the 'surprisingly high' prevalence of questionable research practices [8], the perverse incentives that often drive those behaviours [9], and a replication crisis [10], and yes Houston, we clearly have a problem. While most degree programmes include research methods and statistics classes, recent evidence on teaching statistics in psychology [11] and our own discipline [12] suggests that we focus too much on hypothesis testing and not enough on conceptual understanding or topics such as open research, confidence intervals, and replication. Academics and researchers also need to ensure their own data and statistical literacy are adequate to conduct high-quality research, yet based on the problems outlined, this might not be the case [13]. Yet the rapid rise of artificial intelligence needs to be considered, and particularly how these technologies might not only help us to learn statistical concepts [14] but do it for us [15]. This presentation will address these issues and suggest a range of possible solutions that can be taken at individual, discipline, and institutional level. We all need to take data and statistical literacy seriously if we are to ensure high-quality research outputs and a future workforce that has the data skills required for employment.

[1] https://ourworldindata.org/literacy

[2] 10.15353/joci.v12i3.3275

[3] https://royalsociety.org/blog/2022/06/envision-adrian-smith/

[4] https://www.gov.uk/government/statistical-data-sets/ad-hoc-statistical-analysis-202021-quarter-2

[5] https://calteches.library.caltech.edu/51/2/CargoCult.htm

[6] 10.1080/01973533.2015.1012991

[7] 10.1080/00031305.2018.1537892

[8] 10.1177/0956797611430953

[9] 10.1123/kr.2022-0039

[10] 10.1098/rsos.220946

[11] https://doi.org/10.31234/osf.io/gp9aj

[12] https://osf.io/vh7dw

[13] 10.1002/tesq.128

[14] 10.30935/cedtech/13152

[15] 10.1145/3570220

MY RESEARCH GOT PUBLISHED, SO WHAT'S THE BIG DEAL? THE NEED FOR FORMAL REPLICATION IN SPORTS SCIENCE

MURPHY, J.

TECHNOLOGICAL UNIVERSITY DUBLIN

Publication is the successful pinnacle for any research project but the methodological quality of that research should be priority for robust knowledge gain. The scientific process has its foundations in replicability and transparency, and requires a verification process that eliminates redundant paths after non-replicability (1). Yet, formal replication of published sports science research is undervalued. Concerns about replicability are high as 75% of surveyed researchers believe there is a replication crisis in the field and 42% believe this is a significant crisis (2). Lack of transparency with data (4.3%) and code sharing (<1%) rates (3) is worrisome as a clear association was found between the willingness of authors to share their data and increased statistical errors (4). Evidence of publication bias also likely contributes to replication concerns (5); our

indisputable focus on significant effects and the high proportion of supported hypotheses in the field (81%)(6), given average statistical power, should be a major cause for unease. With the absence of replication research, many published findings will often remain unchallenged. This presentation will outline the different types of replication, and highlight the conceptual and practical challenges in running replication studies based on the first large replication project in the field (7). Initial outcomes of this replication attempt will also be discussed in addition to a perspective on why formal replications should be incorporated more broadly in the research cycle (e.g. in PhD programs).

1. Errington TM, Mathur M, Soderberg CK, Denis A, Perfito N, Iorns E, et al. Investigating the replicability of preclinical cancer biology. Elife. 2021;10:1–30.

2. Murphy J, Mesquida C, Warne JP. A Survey on the Attitudes Towards and Perception of Reproducibility and Replicability in Sports and Exercise Science. Communications in Kinesiology. 2023;1(5).

3. Borg DN, Bon JJ, Sainani KL, Baguley BJ, Tierney NJ, Drovandi C. Comment on: 'Moving sport and exercise science forward: a call for the adoption of more transparent research practices'. Sports Medicine. 2020;50(8):1551–3.

4. Wicherts JM, Bakker M, Molenaar D. Willingness to share research data is related to the strength of the evidence and the quality of reporting of statistical results. PLoS One. 2011 Nov 2;6(11):1–7.

5. Mesquida C, Murphy J, Lakens D, Warne J. Replication concerns in sports and exercise science: a narrative review of selected methodological issues in the field. R Soc Open Sci. 2022;9(220946).

6. Twomey R, Yingling VR, Warne JP, Scheider C, McCrum C, Atkins WC, et al. The nature of our literature: A registered report on the positive result rate and reporting practices in kinesiology. Communications in Kinesiology. 2021;1(3):1–14.

7. Murphy J, Mesquida C, Caldwell AR, Earp BD, Warne JP. Proposal of a Selection Protocol for Replication of Studies in Sports and Exercise Science. Sports Medicine. 2023;53:281–91.

Oral Presentations

OP-AP32 Running: Critical speed and performance testing

DOES THE SURFACE INFLUENCE RUNNING CRITICAL POWER AND W ASSESSMENT? AN IN-FIELD STUDY WITH HIGHLY TRAINED TRAIL RUNNERS

JAÉN-CARRILLO, D.1, ROCHE-SERUENDO, L.E.2, RUIZ-ALIAS, S.A.3, GARCÍA-PINILLOS, F.3

1 UNIVERSITY OF INNSBRUCK, AUSTRIA 2 UNIVERSIDAD SAN JORGE, SPAIN 3 UNIVERSITY OF GRANADA, SPAIN

INTRODUCTION: To optimize performance, testing and monitoring are vital for coaches and athletes to understand training adaptations. The critical power (CP) metric, highlighting the highest intensity for maintaining metabolic balance and the excess work capacity (W), stands out for its ease of use through non-invasive methods. Despite its growing popularity for setting training zones, the interchangeability of CP and W across different flat terrains like the athletic track, road, and trail is unclear. This study aims to examine the influence of flat running surfaces on CP and W values among highly trained trail runners, hypothesizing exchangeable values across surfaces.

METHODS: Thirteen highly trained trail runners, injury-free and competing internationally, participated in the study. A repeated measures design examined the effect of different flat terrains on Critical Power (CP) and W. Participants underwent three testing sessions on road, track, and groomed trail. Each session included a 9- and 3-min run separated by a 30-min rest. CP and W were determined using a linear model. Participants refrained from vigorous activity 24 hours before each test. Testing conditions were consistent, including environmental factors and footwear. Warm-up included 10 minutes of low-to-moderate intensity running and dynamic exercises. The Borg CR-10 scale assessed perceived effort, and a Stryd power meter measured power output.

RESULTS: The analysis using repeated measures ANOVA reveals no significant difference in power output across the 9-minute and 3-minute running intervals conducted on the different flat surfaces, with p-values of 0.387 and 0.624, respectively. In addition, critical power (CP) values, both in absolute terms (watts) and relative terms (w/kg), did not differ significantly across terrains ($p = 0.541$ and $p = 0.583$, respectively). Furthermore, the analysis showed no significant difference in W' ($p = 0.743$). The perceived exertion, measured by the Borg CR-10 scale, was similarly reported to be consistent immediately after the completion of the 9-minute ($p > 0.147$) and the 3-minute ($p > 0.066$) running bouts on each terrain.

CONCLUSION: This study is aimed at evaluating the influence of flat running surfaces (athletic track, road, and trail) on running CP and W' in highly trained trail runners. The results revealed that the CP and W' determined on the three different flat running surfaces are similar, showing no significant differences between the values. This offers coaches and athletes the opportunity to use any of these flat surfaces to complete a running CP test and extrapolate the value to training sessions to the two other flat surfaces here evaluated. Similarly, coaches and athletes may be confident when determining the W' on any of the three flat surfaces here reported.

A SIMPLE METHOD FOR ASSESSING RUNNING CRITICAL VELOCITY WITHOUT EXHAUSTION: THE RAMP ABOVE CRITICAL LEVEL ENDURANCE TEST

VONDERSCHER, M., SAMOZINO, P., BOWEN, M., MOREL, B.
INTERUNIVERSITY LABORATORY OF HUMAN MOVEMENT SCIENCE

INTRODUCTION: Critical intensity is an important fatigue threshold with considerable potential for enhancing performances or quality of life of individuals experiencing chronic diseases (1). Traditionally, critical velocity (Vc) is assessed from 3 to 5 tests-to-exhaustion, time-trials (TT) or all-out, making regular assessments of athletes or frail populations challenging. Recently, Bowen et al. (2) formalised a mathematical model that describes the evolution of maximal capacities at any time of severe exercises. This model, along with the Vc concept suggests that maximal velocity (Vmax) decreases when running above Vc and recover for intensity below Vc. Thus, performing a decreasing ramp starting above and finishing below Vc, Vmax is assumed to decrease and then rise again, the ramp value at switch point corresponding to Vc. Based on this idea, the Ramp Above Critical Level Endurance Test (RACLET) has been validated in cycling (3). The RACLET consists in a 5-min non-exhaustive test following a decreasing ramp velocity target during which ~3s sprints assess Vmax every 30s. This study aimed to test the reliability and validity of the RACLET during running.

METHODS: 17 participants completed 4 sessions separated by 24h, starting with a 30-min standardised warmup. Session 1 included 2 identical RACLET separated by a 10-min rest, and during which participants running velocity was measured using GPS (GPexe, 18Hz). RACLET started at 65% of the initial maximal velocity (Vi) and gradually decreased to reach 3m/s at 5min. To maintain the target pace, participants followed a pacing bike that shifted to the side during sprints. Sessions 2 to 4 included randomised TT on 400, 1500 and 3000m. Vmax reached during each sprint of the RACLET or mean velocity performed during the TT allowed to fit the following equation: $Vmax(t)=Vi-(1/Tau)*(int(V(t)-Vc)dt)$ where V is the target velocity and Tau is a time constant. Vc reliability was quantified using SEM and ICC between the 2 RACLET. Validity was assessed using systematic and random errors compared with the gold standard method (TT).

RESULTS: Mean Vc was 13.5±2.1km/h on RACLET. This value is in line with data reported in the literature (4). Vc determined with RACLET showed good absolute (SEM=3.7%) and relative (ICC=0.95) reliability and presented a good concurrent validity with low systematic (0.1km/h; 1.3%) and random (0.7km/h; 5.6%) errors. Vc obtained from RACLET and TT were highly correlated ($r=0.95$, $p<0.001$).

CONCLUSION: The RACLET is a valid and reliable method to assess Vc in running. This test has the advantage of being short, carried out in a single session and mainly submaximal (excluding short Vmax evaluations). The RACLET is interesting for research purposes to evaluate Vc (e.g. for experimental designs with numerous conditions) but also for follow-up monitoring requiring frequent reassessment of Vc, which was hitherto difficult to do.

REFERENCES:

Poole et al., MSSE, 2016

Bowen et al., JTB, 2023

Bowen et al., ECSS, 2023

Kramer et al., EJAP, 2020

EVALUATION OF THE AGREEMENT BETWEEN MUSCLE OXYGENATION AND PULMONARY GAS MEASURES FOR IDENTIFYING VENTILATORY THRESHOLDS IN RUNNING EXERCISE ACROSS A PERIOD OF TRAINING

AITKENHEAD, R., WALDRON, M., CONWAY, G., HORNER, K., HEFFERNAN, S.
SWANSEA UNIVERSITY

INTRODUCTION: Breakpoints in muscle oxygen saturation using near-infrared spectroscopy (NIRS) have been associated with ventilatory thresholds during exercise and are assumed to represent the same physiological constructs. However, whether both methods are able to track training-induced changes in these thresholds equivalently across time has not been established. We compared two methods of identifying the transition from the moderate-to-heavy exercise domain, during an incremental treadmill protocol: 1) NIRS-derived tissue saturation index (TSI%) and 2) pulmonary gas exchange (ventilatory threshold 1; VT1). Thresholds were expressed as a percentage of peak oxygen consumption (%V̇O2peak) and agreement between methods was assessed before and after a period of training to evaluate their equivalence when monitoring changes in thresholds across time. An analytical goal of 3% (%V̇O2peak) was set based upon the error of pulmonary gas measurement [1].

METHODS: Eighteen males (27 ± 7 yrs) performed two (pre- and post-training) incremental running tests, interspersed by 12-weeks of training, wearing a portable NIRS system and pulmonary gas exchange measured. Across both tests, the NIRS-derived breakpoints in TSI% were identified with segmental regression and compared with pulmonary gas measures (VT1). Agreement was assessed using paired t-tests (mean bias) and 95% Limits of Agreement (95% LoA).

RESULTS: For pre- and post-testing, there were no significant differences between methods ($p = 0.17$ and $p = 0.81$, respectively), with thresholds identified at 67.9 ± 3.7% and 66.9 ± 3.6% of %V̇O2peak for all tests. There was no mean bias for %V̇O2peak during pre-testing (95% LoA: -0.44 ± 5.59%) and post-testing (95% LoA: 0.06 ± 4.87%) but the LoA was beyond the analytical goal. Assessment of the change values between pre- and post-training was also not significantly different between the pulmonary (mean ± SD: 0.72 ± 2.27 %, range: 5.0 to 5.0) and NIRS (mean ± SD: 1.22 ± 2.10 %, range: -3.0 to 6.0) methods ($p = 0.11$), indicating uniform changes in thresholds across both methods.

CONCLUSION: The NIRS-derived method did not uniformly disagree with pulmonary measures, across two time points. Therefore, irrespective of individual training effects, deflections in TSI% identified via segmental regression will not over- or underestimate VT1 but will randomly vary to an unacceptable level during incremental exercise tests in trained runners. These findings offer more insight into how NIRS can be applied as a method for continuous monitoring of ventilatory breakpoints throughout the training process but question the ability to identify equivalent thresholds in all cases.

Reference

[1] Gaskill, S. E., Ruby, B. C., Walker, A. J., Sanchez, O. A., Serfass, R. C., & Leon, A. S. (2001). Validity and reliability of combining three methods to determine ventilatory threshold. Medicine & Science in Sports & Exercise, 33(11), 1841-1848. 10.1097/00005768-200111000-00007

PREDICTION OF 3000-M STEEPLECHASE PERFORMANCE USING A SIMPLE EQUATION

BARBRY, A., LEREBOURG, L., RACIL, G., CJLID, M., COQUART, J.
UNIV. LILLE, UNIV. ARTOIS, UNIV. LITTORAL CÔTE DOPALE, ULR 7369 - UREPSSS - UNI

INTRODUCTION: The purpose of the current study was to develop and test the validity and accuracy of a simple equation in predicting 3000-m steeplechase performance (PerfSteeple) from individual variables (e.g., age, height, body mass and BMI) in men.

METHODS: The official rankings of French runners for the 3000-m track-running (Perf3000) and 3000-m steeplechase events were examined. Moreover, age, height and body mass of runners were collected. From 146 included athletes, two groups were randomly composed: one comprising 80% of the sample (n = 117) to develop a simple equation to predict PerfSteeple (i.e., development group) and the other comprising the remaining 20% (n = 29) to test the validity and accuracy of the developed prediction equation (i.e., cross-validation group).

RESULTS: The simple prediction equation included Perf3000 and age: PerfSteeple = -57.165 + 1.147 × Perf3000 + 0.955 × age. No significant difference was noted between the actual and predicted performances. Predicted performances were significantly correlated with the actual ones, with a very high correlation coefficient ($p < 0.001$; $r = 0.929$). Bias and 95% limits of agreement were -5 ± 24 s, i.e., -0.8 ± 7.6%.

CONCLUSION: This equation (PerfSteeple = -89.740 + 1.153 × Perf3000m + 0.952 × age + 14.810 × sex) is a valid tool to predict 3000-m steeplechase performance according to a performance on 3000-m. This tool could be useful for athletes and coaches to predict a 3000-m steeplechase. It can enable them to adapt their training and to select the optimum speed for the athletes performance. This tool can also be useful for national directors in charge of performance in athletics federations to detect talent in the 3000m steeplechase and thus orient young athletes more easily towards this discipline.

CHARACTERIZING THE EXPONENTIAL PROFILE OF W RECOVERY FOLLOWING PARTIAL DEPLETION

VAN DYCK, M., LIEVENS, M., BOONE, J., GHIJS, M., BOURGOIS, J.G., VERMEIRE, K., BOURGOIS, G., COLOSIO, A.L., CAEN, K.
GHENT UNIVERSITY

INTRODUCTION: The aim of this study was to characterize W recovery kinetics in response to a partial W depletion. We hypothesized that W recovery following partial depletion would be better described by a two-phase than a one-phase exponential model.

METHODS: Nine healthy men performed a ramp incremental test, three to five constant load trials to determine critical power and W, and ten experimental trials, each consisting of two constant load work bouts (WB1+WB2) interspersed by a recovery interval. In WB1, participants were subjected to a 25% or 75% W depletion (DEP25%+DEP75%) and subsequently recovered for 30,60,120,300 and 600s. WB2 was performed to exhaustion and used to calculate the observed W recovery (WOBS). WOBS was fitted using a monoexponential and a biexponential model. For each model, the root mean square error (RMSE) and the Akaike information criterion (AICc) was calculated to evaluate their goodness-of-fit.

RESULTS: ΔAICc favoured the use of a monoexponential model for both DEP25% (-15.6) and DEP75% (-23.3), despite a lower RMSE for the biexponential model (DEP25%:0.4%vs.3.2% and DEP75%:3.8%vs.1.0%). Time constants (Tau) and amplitudes (A) derived from the monoexponential model were: Tau=32±11s and A 31±2.5% for DEP25% and Tau=81±16s and A=58.1±3.8% for DEP75%. WOBS values were strongly correlated between both depletion conditions (r=0.92) and significantly associated with VO2peak, CP and GET (r=0.67-0.77).

CONCLUSION: The present study results demonstrate that a biexponential model fit does not outperform a simple exponential model to describe W recovery following a partial depletion. Also, our findings confirm that W recovery is positively associated with aerobic fitness, and that a single and fixed time constant does not work to model W recovery across different levels of depletion.

Invited Symposium

IS-PN09 Harnessing big data in exercise biology: using omics to understand how mitochondria adapt to activity and inactivity

SINGLE MUSCLE FIBRE PROTEOMICS REVEALS FIBRE-TYPE-SPECIFIC FEATURES OF HUMAN INACTIVITY AND AGING

MURGIA, M.
UNIVERSITA DEGLI STUDI DI PADOVA

In the absence of sufficient mechanical loading, skeletal muscle undergoes atrophy with loss of strength and detrimental metabolic effects. This can occur due to physical inactivity (including bed rest), space flight, and aging, and may affect different muscle fibre types unequally. This presentation will highlight the findings from studies that have used mass spectrometry-based proteomics to compare single skeletal muscle fibres of healthy volunteers before and after 10 days of continuous bed rest (and 6 months of space flight), and also single skeletal muscle fibres from younger and older humans. Protein complexes responsible for force transmission and energy production by the mitochondria are strongly downregulated in the unloading phase, with different changes in slow (type I) and fast (type II) fibre types. Parallel proteomic analysis of muscle biopsies of astronauts before and after a 6-month mission on the International Space Station highlights similar changes caused by lack of gravity despite daily exercise. Similarly, human aging is characterised by diverging metabolic and protein quality control adaptations in the different fibre types. Whereas mitochondrial content declines with aging in both fiber types, glycolysis and glycogen metabolism are upregulated in slow but downregulated in fast muscle fibers. These changes in metabolism and sarcomere quality control may be related to the ability of slow, but not fast, muscle fibres to maintain their mass during aging. These single muscle fibre analyses by proteomics have elucidated mitochondrial alterations in a sub-type-specific manner, and lay a molecular basis for countermeasures to combat detrimental mitochondrial changes with inactivity and aging.

THE MITOCHONDRIAL MULTI-OMIC RESPONSE TO EXERCISE TRAINING ACROSS TISSUES

LINDHOLM, M.
STANFORD

Mitochondria are adaptable organelles with diverse cellular functions critical to whole-body metabolic homeostasis. While endurance exercise training is known to alter mitochondrial activity, these adaptations have not yet been systematically characterised. In this presentation, Dr Malene Lindholm will summarise recent findings from the Molecular Transducers of Physical Activity Consortium (MoTrPAC), mapped the longitudinal, multi-omic changes in mitochondrial analytes across 19 tissues in male and female rats endurance trained for 1, 2, 4 or 8 weeks. Training elicited substantial changes in the adrenal gland, brown adipose, colon, heart and skeletal muscle, while we detected mild responses in the brain, lung, small intestine and testes. The colon response was characterized by non-linear dynamics that resulted in upregulation of mitochondrial function that was more prominent in females. Brown adipose and adrenal tissues were characterized by substantial downregulation of mitochondrial pathways. Training induced a previously unrecognized robust upregulation of mitochondrial protein abundance and acetylation in the liver, and a concomitant shift in lipid metabolism. The striated muscles demonstrated a highly coordinated response to increase oxidative capacity, with the majority of changes occurring in protein abundance and post-translational modifications. This work has also revealed exercise upregulated networks that are downregulated in human type 2 diabetes and liver cirrhosis. This presentation will also provide delegates with a multi-omic, cross-tissue atlas of the mitochondrial response to training and identify candidates for prevention of disease-associated mitochondrial dysfunction.

PROTEOMIC PROFILING OF SKELETAL MUSCLE MITOCHONDRIAL ADAPTATIONS TO EXERCISE TRAINING

BISHOP, D.
VICTORIA UNIVERSITY

Given the importance of mitochondrial biogenesis for skeletal muscle performance, considerable attention has been given to understanding the molecular changes that help to determine mitochondrial adaptations to exercise. With the adoption of high-throughput proteomics within the field, the depth of mitochondrial proteome coverage has increased many-fold within the last decade. Information on protein abundance changes following exercise training now exists for hundreds of mitochondrial proteins across multiple studies. In this session, Prof. Bishop will present unpublished 'omics data, and an unpublished meta-analysis of all mitochondrial proteomics studies to date, that provide new and exciting insights into the many molecular changes that contribute to exercise-induced mitochondrial adaptations. The results of training studies incorporating whole-muscle proteomics will then be used to highlight an intricate and previously undemonstrated network of differentially prioritised mitochondrial adaptations that occur in response to different types of training. It will be shown that changes in hundreds of transcripts, proteins, and lipids are not stoichiometrically linked to the overall increase in mitochondrial content. The results of single-fibre proteomics show how exercise intensity influences fibre recruitment and ultimately induces fibre-specific changes in mitochondrial proteins that can help to explain how different types of exercise induce divergent mitochondrial adaptations. Finally, this presentation will highlight how these exciting new tools can help exercise and sport scientists to better understand how best to prescribe exercise to achieve

specific mitochondrial adaptations. The target audience will be both exercise and sport scientists with an interest in the mechanisms that underlie adaptations to exercise training.

Oral Presentations

OP-PN25 Physiology/Strength

RELATIVE FAT MASS IS NOT ASSOCIATED WITH ALTERED MUSCLE ADAPTATIONS TO RESISTANCE TRAINING

HAMARSLAND, H., ELLEFSEN, S., HAMMARSTRÖM, D.
INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Obesity has been linked to decreased fasted muscle protein synthesis and anabolic resistance in response to feeding and exercise (summarised in 1). Although not a consistent finding, it may be of great clinical relevance if excess fat mass indeed drives anabolic resistance and hampers adaptations to exercise in obesity.

METHODS: To investigate the effects of obesity on long-term adaptations of muscle hypertrophy and strength, we recruited 95 healthy inactive individuals (♂: 46, ♀: 49, age: 47.9 ± 7.2 years, fat % range: 21.3-57.4) to 13 weeks of bi-weekly sessions of supervised progressive heavy resistance exercise. Exercises were leg press, knee extension, knee flexion, bench press and dumbell row. Upper body exercises were performed to failure with three sets of 10RM. The leg training was unilateral, with each leg randomly assigned to three sets of 10RM or three sets of 30RM to failure. Dual-energy X-ray absorptiometry and ultrasound of the thigh were completed at baseline and after the intervention to measure total lean body mass and vastus lateralis thickness, respectively. After a familiarisation session, leg press 1RM was performed before and after the intervention. Linear models explaining post-intervention vastus lateralis thickness, lean mass, and 1RM by baseline values, sex, relative fat mass at baseline and condition (1RM and vastus lateralis thickness) were fitted. Data are reported as mean ± SE.

RESULTS: The intervention effectively increased vastus lateralis muscle thickness by ~ 14%, total lean mass by ~ 2.5% and leg press 1RM strength by ~ 15 %. For every percentage point difference in baseline fat mass, lean body mass increased by 3 ± 13 grams ($p = 0.824$), vastus lateralis thickness decreased by 0.02 ± 0.039 millimetres ($p = 0.436$), and 1RM leg press increased by 0.05 ± 0.25 kg ($p = 0.841$). The different RM conditions induced no difference in vastus lateralis growth (30RM: +0.97 ± 1.02 ($p = 0.366$)). In leg press strength, 30RM improved 10.8 ± 4.94 % ($p = 0.032$) less than 10RM.

CONCLUSION: In conclusion, relative fat mass does not interfere with muscle hypertrophy or strength adaptations in healthy middle-aged individuals in response to 13 weeks of heavy progressive resistance training.

1. Freitas, E. D. S. & Katsanos, C. S. (Dys)regulation of Protein Metabolism in Skeletal Muscle of Humans With Obesity. Front. Physiol._13, 843087 (2022).

HOW LOW CAN LOW-LOAD RESISTANCE TRAINING GO? INSIGHT FROM METABOLIC PERTURBATION, MUSCLE EXCITATION AND FATIGUE OVER THE FULL REPETITION CONTINUUM.

COLOSIO, A., D'HOE, B., BOURGOIS, J., BOONE, J.
UNIVERSITY OF GHENT

INTRODUCTION: Low-load resistance training (RT, loads <50 % the 1 repetition maximum (RM)) performed to muscle failure is an emerging form of RT for populations that cannot train with high external loads due to practical or health constraints. However, uncertainty is still present regarding the minimum load threshold to perform this form of training, the acute muscle and whole-body responses to RT performed at different %1RM, and the training stimulus and fatigue accumulated when exercising with different external loads. Accordingly, this study was aimed at gaining insight into these aspects of exercise prescription across different %1RM.

METHODS: 12 participants (6 women, RT experience >2 months, 21.8±1.8 years, 70.2±10.8 kg, 177.0±9.7 cm) performed a 1RM test and 5 exhaustive protocols of unilateral leg extension (at 10, 30, 50, 70, 90 %1RM). During the leg extension protocols, local muscle metabolic perturbation and muscle excitation were measured at the vastus lateralis (respectively with near-infrared spectroscopy (NIRS) and electromyography (EMG)), vastus medialis and rectus femoris (EMG only). Heart rate, blood lactate accumulation and rate of perceived exertion were measured as indicative of whole-body responses, while electrically stimulated maximal voluntary contractions (MVC) were executed before and up to 30 min after each protocol to determine fatigue accumulation and recovery. Responses between different %1RM were compared using 1-way repeated measures and Friedman ANOVAs, followed by post-hoc analyses. Spearman's correlations were calculated between fatigue accumulation and the main physiological variables.

RESULTS: The 30, 50, 70, 90 %1RM protocols induced muscle failure and similar levels of local and whole-body metabolic perturbation, while the 10% did not lead to failure (in 30 min) and presented lower levels of metabolic perturbation. Muscle excitation upon exhaustion increased with increasing external loads and did not lead to common EMG signals between %1RM. All protocols induced fatigue and significant drops in MVC. There was no evident difference in the changes in voluntary activation between %1RM. Moderate correlations were found in fatigue accumulation and parameters of metabolic perturbation, while fatigue accumulation and recovery were moderately correlated with the total kg lifted. Finally,

post-hoc modelling of participants critical load (CL, the boundary between sustainable and unstainable exercise), detected this important metabolic threshold at 31.7 ± 11.9 %1RM.

CONCLUSION: Our findings highlight a common level of metabolic perturbation with loads of ≥30 %1RM, contrasting with lower loads. %1RM seem an important determinant of maximal muscle excitation levels upon muscle failure, and we potentially identified the minimum RT load threshold in coincidence with the exercises CL. Furthermore, we observed a relationship between fatigue, volume of training and metabolic perturbation which might have important implications when designing low-load RT.

THE EFFECT OF CONCURRENT TRAINING COMBINED WITH RESISTANCE AND HIGH-INTENSITY INTERVAL EXERCISE ON SKELETAL MUSCLE HYPERTROPHY IN MICE

SHINKAI, H., SHIRAI, T., UEMICHI, K., IWATA, T., TANIMURA, R., IWAI, R., SUGIYAMA, S., TAKEMASA, T.

UNIVERSITY OF TSUKUBA

INTRODUCTION: Concurrent training (CT) is a combination of different modalities of exercise. It has been reported that CT, especially which consists of resistance exercise (RE) and endurance exercise (EE), suppresses muscle strength and muscle hypertrophy compared with RE alone, this is a phenomenon known as the interference effect (Hickson, 1980). The interference effect is thought to be caused by the suppression of mTOR, which promotes RE-associated protein synthesis, by AMPK, which is activated by EE (Coffey & Hawley, 2017). Intensity of exercise is one of the key factors that influences metabolic adaptation, so its modulation may reduce interference effects. Therefore, we focused on high intensity interval exercise (HIIE) and conducted experiments based on the hypothesis that interference effects would not occur in CT consisting of RE and HIIE.

METHODS: Male C57/BL6J mice were used as experimental animals. Mice were devided into 3 groups, The Sham group; underwent sham operation, the myotenectomy induced functional overload (OL) group; underwent compensatory plantaris muscle hypertrophy with Achilles tendon resection as a RE model, and the OL+HIIE group; underwent HIIE by forced swimming exercise in addition to OL (n=6-8 for each group). After 4 weeks of intervention, plantaris muscles were collected and analyzed.

RESULTS: Plantaris muscle wet weight and muscle fiber cross-sectional area, and molecular signals related to muscle hypertrophy, were significantly higher in the OL and OL+HIIE groups than the Sham group ($p<0.05$). Metabolism-related protein and mRNA expression levels were significantly higher in the OL+HIIE group than the Sham group ($p<0.05$).

These results indicate that CT combined with RE and HIIE does not suppress muscle hypertrophy. HIIE is a modality of exercise in which the glycolytic system is utilized, and recently the involvement of the glycolytic system in muscle hypertrophy has been focused. Previous studies have reported that dihydroxyacetone phosphate (DHAP), an intermediate metabolite of the glycolytic system, promotes mTOR activity (Orozoco et al., 2020), and that 2-deoxy-D-glucose, an inhibitor of the glycolytic system, decreases protein synthesis after electrical stimulation: an RE model (Suginohara et al., 2021). Therefore, it is possible that the enhancement of the glycolytic system by HIIE suppressed the interference effect directly or indirectly through metabolites such as DHAP, lactate, and exerkines.

CONCLUSION: CT combined with RE and HIIE does not cause interference effects and induces muscle hypertrophy as when RE alone is performed.

EFFECTS OF RESISTANCE TRAINING ON MUSCLE STRENGTH AND HYPERTROPHY IN INDIVIDUALS WITH DIFFERENT MUSCLE FIBER TYPE COMPOSITION

TERZIS, G., MPAMPOULIS, T.1, VEKAKI, E.1, PAPADIMAS, G.2, PAPADOPOULOS, C.2, BITZANAKIS, E.1, PLATIAS, G.1, SAKELLARIOU, O.1, MINOPOULOU, E.1, BOGDANIS, G.1

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Resistance training (RT) induces large increases in muscle strength and hypertrophy but with great variability among individuals, despite a similar initial level of strength and muscle mass. The muscle fiber type composition has been claimed as one of the critical biological factors dictating individual RT-induced changes in muscle mass and strength [1], with individuals with type II fiber predominance having an advantage. However, a recent study challenged this outcome showing that the fiber type composition does not dictate changes in muscle strength and hypertrophy [2]. The discrepancy between these results might be due to the application of inappropriate resistance training loads in individuals with different muscle fiber type composition. Aim of the present study was to compare the effects of resistance training with high and low loads on muscle strength and hypertrophy in individuals with different muscle fiber type composition.

METHODS: Eighteen young females (age 20.7±3.0yrs, height 1.64±0.06m, mass 59.9±7.0kg), unaccustomed to RT, were selected from a larger group of female physical education students according to their right vastus lateralis fiber type composition (needle muscle biopsies) and assigned to two different groups: G1 with 60,3±7.2% type I muscle fibers (range 50.2%-73.0%), and G2 with 59.8±5.8% type II muscle fibers (range 51.2%-66.1%), $p<0.01$. All participants followed 10 weeks (2/week) of progressive single-leg press RT, with one leg performing 4-5 sets x 6-8 reps at 80-85% maximum strength (1RM) and the opposite leg 3 sets x 20 repetitions at 55-60% 1RM, with equal training volume between legs and similar rate of perceived exertion. The training sequence between legs was alternated in every session. Single leg press 1RM and quadriceps cross sectional area (CSA, ultrasonography) were measured before and after the intervention. Two-way repeated measures ANOVA was mainly used to analyze the data at $p\leq0.05$.

RESULTS: The initial 1RM was similar between G1 and G2 and between the lower extremities training with either low or high load ($p>0.05$). Leg press 1RM increased more with high load RT compared to low load RT, both in G1 and G2 ($p<0.05$). Leg press 1RM increased more with high load RT in G2 compared to G1 (91.1±26.8% vs. 62.7±17.6%, $p<0.05$). Quadriceps CSA increased more with high load RT in G2 compared to G1 (14.7±9.1% vs. 4.0±4.8%, $p<0.05$), but similarly between G1 and G2 after low load RT (8.7±6.4% vs. 11.9±9.9%, $p>0.05$).

CONCLUSION: These results suggest that young females with type II muscle fibers predominance, unaccustomed to RT, may experience a higher increase in muscle strength and hypertrophy when exposed to high load RT compared to females with type I muscle fibers predominance. Low load RT induces similar increases in muscle strength and hypertrophy regardless of the muscle fiber type composition.

1.Haun et al. (2009), Front Physiol 10, 1-17.

2.Van Vossel et al. (2023), J Physiol 601.12, 2307-2327.

DOES ONE BIOPSY CUT IT? REVISITING HUMAN MUSCLE FIBER TYPE COMPOSITION VARIABILITY AND ACROSS-MUSCLE PHENOTYPE USING REPEATED BIOPSIES

VAN DE CASTEELE, F., VAN VOSSEL, K., HARDEEL, J., HORWATH, O., APRO, W., MOBERG, M., VAN THIENEN, R., LIEVENS, E., DERAVE, W.

GHENT UNIVERSITY

INTRODUCTION: Sports scientists typically measure an individual's muscle fiber type composition (MFTC) by evaluating the myosin heavy chain isoform distribution in a single vastus lateralis biopsy. Given the substantial, non-systematic variation along the length of the muscle it is questionable if one biopsy gives an accurate representation of the whole muscle (1). Additionally, the vastus lateralis' MFTC might not be representative for the other muscles, even though an across-muscle phenotype has been proposed (2). Therefore, we firstly investigated MFTC variation and how many fibers and biopsies one should analyze to determine MFTC within a certain margin of error and secondly, whether the vastus lateralis' MFTC is representative for the gastrocnemius medialis.

METHODS: Forty participants (20 women) were subjected to two biopsies in the vastus lateralis and two in the gastrocnemius medialis. For each biopsy, the outer needle was twisted 180° around its axis after the first cut to perform the second one and these were analyzed separately. Samples were cut into cross-sections, stained for myosin heavy chain type I, IIa and IIx and visualized. MFTC was determined as the percentage of type I fibers and absolute MFTC differences between cuts and biopsy sites were calculated. Pearson correlations examined the relationship between vastus lateralis and gastrocnemius medialis MFTC. Additionally, data from a recent study using near identical techniques, were reanalyzed (1). They took 10 vastus lateralis biopsies across two legs in 7 men. We determined the 95% limits of agreement for differences between the average MFTC of one to five biopsies and the average MFTC based on 10 biopsies, which was considered true MFTC. Within this analysis, we also tested the effect of the amount of analyzed fibers by randomly sampling subsets of 50 to 800 fibers.

RESULTS: Absolute MFTC differences between first and second cut samples were smaller than between proximal and distal sites in vastus lateralis (4.5±4.0 vs. 6.9±6.0 percentage points, respectively; $p=0.017$), but not in gastrocnemius (4.4±4.1 vs. 5.5±4.2 percentage points, respectively; $p=0.064$). When increasing the amount of analyzed fibers in one biopsy from 100 to 200 fibers, the 95% limits of agreement for the difference with true MFTC narrowed from ±21 to ±20 percentage points. However, when analyzing 200 fibers from 3 biopsies, 95% of measured MFTCs lie within -10 and 10 percentage points of true MFTC. There is only a moderate positive correlation between MFTC in the vastus lateralis and the gastrocnemius ($r^2=0.22$, $p=0.006$; at least 200 fibers in each of 3 to 4 cross-sections per muscle).

CONCLUSION: To determine MFTC and stay within ±10 percentage points of true MFTC, at least 3 biopsies with at least 200 counted fibers need to be analyzed. Even when doing so, vastus lateralis MFTC could only explain 22% of variance in the gastrocnemius MFTC.

1 Horwath et al. (2021). J Appl Physiol. 131(1), 158-173

2 Vikne et al. (2012). Muscle Nerve. 45(4), 527-535

Oral Presentations

OP-BM12 Neuromuscular Physiology/Exercise

ACUTE EFFECTS OF ACTIVE DYNAMIC STRETCHING WITH DIFFERENT LOADING CONDITIONS ON MUSCLE STRENGTH AND RANGE OF MOTION

HITIER, M., EHEMBA, J.N., VIEIRA, D., DURIGAN, J.L.Q., BABAULT, N.

UNIVERSITÉ DE BOURGOGNE

INTRODUCTION: Dynamic stretching is recommended during warm-up routines (Opplert and Babault, 2018). Mechanisms remained unclear and are partly related to a warm-up effect (Vieira et al., 2021). One can question whether increasing the intensity of dynamic stretching could exacerbate any warm-up effect. The present study aimed to explore the effects of various loading conditions during active dynamic stretching on hamstring muscle strength and range of motion.

METHODS: 12 physically active volunteers (3 women and 9 men) were included in this cross-over randomized study. Experimental sessions included a standardized comprehensive warm-up followed by 1 of the 3 experimental conditions: 1. unloaded dynamic stretch, 2. loaded dynamic stretch, and 3. control (no stretch). Dynamic stretching was 5 series of 15 repetitions at 1 Hz without or with an extra-load during the concentric phase (i.e., 20 or 40 N.m for women and men, respectively). Tests were performed before all sessions (Pre), after warm-up (Post-Warm), and after the experimental conditions (Post-Stretch). Tests included maximal voluntary isometric contractions of the hamstrings combined with the electromyographic activity (EMG) of biceps femoris (BF) and semitendinosus (ST) muscles and a passive maximal range of motion (ROM) test until maximal discomfort. Tests and experimental conditions were conducted on the right hamstrings on an isokinetic dynamometer. Two-way analysis of variances was used to compare conditions (unloaded vs. loaded stretch vs. control) and time (Pre vs. Post-Warm vs. Post-Stretch) effects.

RESULTS: No significant condition x time interactions were obtained for the maximal torque (p=.456). A very slight increase in maximal torque was observed Post-Warm but did not reach the level of significance (p=.129). No interaction was observed for BF and ST EMG (p=.676 and p=.587, respectively). A significant time effect was obtained for ST EMG (p=.01) with lower values Post-Warm and Post-Stretch compared to Pre. No significant interaction was observed for the ROM (p=.134). A significant time effect revealed maximal ROM was significantly increased Post-Warm as compared to Pre (p=.001) and increased further Post-Stretch (p=.001).

CONCLUSION: Active dynamic stretching whether performed unloaded or with an extra-load did not alter the force production capacity. Regardless of the extra-load, dynamic stretching increased the maximal ROM. Interestingly, dynamic stretch is not mandatory for ROM increases as it was already increased after the comprehensive warm-up. Thus, performing dynamic stretching within a warm-up routine remained questioned.

REFERENCES:

(1) Opplert J, Babault N. Sport Med, 2018, 48:299–325.

(2) Vieira D, Opplert J, Babault N. Eur J Appl Physiol, 2021, 121,957-967.

A FLYWHEEL-SQUAT WARM-UP AND 3-MINUTE RE-WARMUP: IMPACT ON JUMP PERFORMANCE AND NEUROMUSCULAR MECHANISMS.

SELVAMOORTHY, R., DONALD, N., HUNTER, A.M., MACGREGOR, L.J.

UNIVERSITY OF STIRLING

INTRODUCTION: Flywheels are ideal for warm-ups as they are transportable and produce an appropriate stimulus to enhance jump performance. Certain sports, such as swimming and athletics, have a transition period lasting at least 20 minutes between the warm-up and the competition, rendering most warm-up practices diminished as any warm-up-related enhancements typically last 3-9 minutes. Adding a small body weight exercise re-warmup at regular intervals could prolong the warmup-related enhancements time decay. Enhanced mechanical power can be mediated by increased central drive from the brain or enhanced muscle contractility of the target muscles.

METHODS: Eight males and eight females underwent a control and an intervention session separated by at least seven days. In both sessions, the participants underwent a lunge complex warm-up, followed by one set of flywheel squats of three reps of high inertia followed immediately by three reps of low inertia; in the intervention session, the participants performed a lunge complex re-warmup every 3-minutes post the flywheel squat, while in the control session, the participants remained rested in the supine position. Measurements were taken at baseline, after the lunge complex warm-up, after the flywheel squat, and then every 9 minutes after the flywheel squat until a total of 27 minutes was reached. At every measurement time point, the participants performed three countermovement jumps on a force plate, and the maximum height (cm) obtained was used for analysis: motor evoked potential (MEP(V)) and cortical silent period (cSP (ms)) were measured using TMS; peak evoked torque (Nm) was measured by delivering a 2ms wide pulse at 280V (10-150mA) to the femoral nerve while the participants sat on an isokinetic dynamometer, with their hip and knee angle at 90° to the ground. Furthermore, the participants vastus lateralis (VL) and rectus femoris (RF) muscle normalised response speed (Vrn (mm/s/mm)) were measured using tensiomyography. A one-way ANOVA (time x condition) was performed separately for all the dependent variables for males and females.

RESULTS: There was a significant increase in Vrn in the RF in males for the intervention session compared to the control session ($P = 0.02$), while in females, there was a significant change in Vrn for time ($P = 0.006$). There were no changes in jump height ($P > 0.05$), TMS MEP ($P > 0.05$), TMS cSP ($P>0.05$), evoked torque ($P > 0.05$), normalised response speed ($P > 0.05$) for any of the conditions at any time point in both males and females.

CONCLUSION: A flywheel-based warm-up alone or accompanied by a lunge complex re-warmup every 3 minutes can produce changes to individual muscle contractility, with no changes to jump performance and central drive or global knee extensor contractility. The findings of this study are essential for practitioners who may be using similar warm-up protocols that may be sub-optimal for enhancing jump performance in their athletes.

EFFECTS OF BLOOD FLOW RESTRICTION ON ANKLE PROPRIOCEPTION

EDGINGTON, H., LAMBERT, A., MCMANUS, C., LIEW, B.

UNIVERSITY OF ESSEX

INTRODUCTION: Blood flow restriction (BFR) training has gained increasing interest as a technique to enable muscular adaptations at lower training loads. It has been thought to be a safer training method when high training loads are contraindicated, such as during injury rehabilitation (1). However, it is unclear how BFR impacts proprioception, which is crucial for joint stability and function. Joint proprioception relies on mechanoreceptors that may be affected by tissue hypoxia induced by BFR. This study aims to explore the effects of BFR on ankle proprioception, contributing valuable insights for rehabilitation and performance enhancement.

METHODS: Twenty-one participants were divided into three intervention groups: control (n=5), sham BFR (n=8), and BFR (n=8) groups. Joint position sense (JPS) was assessed using a passive-passive test on an isokinetic dynamometer. Participants' ankles were plantarflexed to a "target angle" of 20°, then moved from 0° to 40° of plantarflexion, stopping when participants felt the target angle was "matched". Ten matching trials were performed. The JPS test was performed before, during, and after the intervention. For the BFR group, a cuff was applied with 80% limb occlusion pressure at the mid-thigh, while for the sham group, the same cuff was applied with minimal pressure (2-5mmHg) (1). A linear mixed model analysis was used to evaluate the effect of the intervention on the outcome of JPS error (match-target).

RESULTS: No significant differences were observed between BFR and Control (Estimate =1.64, 95% CI [-4.31,7.53], p = 0.995), between BFR and Sham (Estimate = 2.21, 95% CI [-3,7.43], p = 0.892) and Sham and Control (Estimate = -0.58, 95% CI [-6.52,5.37], p = 0.995) during the intervention. This trend was similarly observed before and after the intervention.

CONCLUSION: The study demonstrated that BFR does not impair ankle JPS. This outcome might be attributed to using a passive JPS test, where the demand for blood flow is less critical than in active tests (2). Passive tests involve lower levels of capillary recruitment, blood flow demand, muscle pump activation, and autonomic response compared to active tests (2). The restricted blood flow during BFR might be sufficient for the normal functioning of the mechanoreceptors, hence preserving normal JPS. Confirming that BFR does not impair proprioception supports its broader use in rehabilitation, potentially improving outcomes by enhancing muscle strength without impairing normal joint function. These findings pave the way for further research to refine BFR training for diverse populations, contributing to developing guidelines that maximise its benefits while ensuring safety and effectiveness.

References:

1. Patterson et al., Frontiers in physiology, 2019, DOI: 10.3389/fphys.2019.00533

2. Trinity et al., Sports Medicine, 2019, DOI: 10.1007/s40279-019-01146-1

Oral Presentations

OP-MH09 Ageing, balance and motor control

THE INFLUENCE OF FEAR OF FALLING ON THE CONTROL OF UPRIGHT STANCE ACROSS THE LIFESPAN

HILL, M., DUNCAN, M., MUEHLBAUER, T., LORD, S.R., ELLMERS, T.J.

1COVENTRY UNIVERSITY, UK, 2UNIVERSITY OF DUISBURG-ESSEN, GERMANY, 3NEUROSCIENCE RESEARCH AUSTRALIA, 4IMPERIAL COLLEGE LONDON, UK

INTRODUCTION: Standing at height, and subsequent changes in emotional state (e.g., fear of falling), lead to robust alterations in balance in adults [1]. However, little is known about how height-induced postural threat affects balance performance in children. Children may lack the cognitive capability necessary to inhibit the processing of threat- and fear-related stimuli [2], and as a result, may show more marked (and perhaps detrimental) changes in postural control compared to adults. This work explored the emotional and balance responses to standing at height in children and compared responses to young and older adults.

METHODS: Children (age: 9.7 ± 0.8 years, n=38), young adults (age: 21.8 ± 4.0 years, n=45) and older adults (age: 73.3 ± 5.0 years, n=15) stood in bipedal stance in two conditions: on the floor and 80 cm above ground. Centre of pressure (COP) amplitude (root mean square), frequency (mean power frequency) and complexity (sample entropy) were calculated to infer postural performance and strategy. Emotional responses were quantified by assessing balance confidence, fear of falling and perceived instability.

RESULTS: Young and older adults demonstrated a postural adaptation characterised by increased frequency and decreased amplitude of the COP, in conjunction with increased COP complexity (sample entropy). In contrast, children demonstrated opposite patterns of changes: they exhibited an increase in COP amplitude and decrease in both frequency and complexity when standing in a hazardous situation.

CONCLUSION: Children and adults adopted different postural control strategies when standing at height. Whilst young and older adults exhibited a (potentially protective) "stiffening" response to a height-induced threat, children demonstrated a (potentially maladaptive) ineffective postural adaptation strategy. These observations expand upon existing postural

threat related research in adults, providing important new insight into understanding how children respond to standing in a hazardous situation.

REFERENCES:

[1] Adkin & Carpenter, Front Neurol, 2018

[2] De Sonneville et al., J Clin Exp Neuropsychol, 2002

ASSESSING REACTIVE DYNAMIC BALANCE: IMPLICATIONS FOR FALL RISK - INSIGHTS FROM THE SEFALLED STUDY

STUCKENSCHNEIDER, T., SCHMIDT, L., HACKBARTH, M., KOSCHATE, J., ZIESCHANG, T.

CARL VON OSSIETZKY UNIVERSITY

INTRODUCTION: According to the Global Burden of Disease Reports, there are 172 million falls annually, resulting in short- or long-term health impairments. Older individuals are particularly affected, making falls prevention programs crucial to reduce nursing care and mortality. Perturbation-based balance training (PBT) has gained importance in training-based falls prevention efforts due to its task-specific nature. Moreover, assessing an individual's reactive dynamic balance in response to perturbations may serve as both an highly relevant indicator of future fall risk and a target for interventions. Early research suggests that a single session of PBT may reduce the risk of falls. Therefore, it is imperative to ascertain the impact of a diagnostic protocol on subsequent falls, which is one aim of the SeFallED study [1].

METHODS: The ongoing SeFallED study follows individuals aged 60 and above, who visit the emergency department after a fall without subsequent hospital admission. Participants undergo a comprehensive geriatric assessment and gait analyses in a laboratory (four weeks after the emergency department, and 6, 12, and 24 months later). Falls are monitored via fall calendar and monthly phone calls. In the laboratory, participants are randomly stratified to either walk on a treadmill at their preferred treadmill walking speed or experience nine different perturbations while walking on the treadmill (M-Gait, Motek Medical B.V., Amsterdam, the Netherlands). Fall rates were compared between groups six months after their initial assessment for reactive dynamic balance.

RESULTS: Out of 185 eligible participants, 160 (mean age 72.2 □ 7.7; 59 males) provided complete baseline data. Thus far, 83 participants (mean age 73.0 □ 7.7; 36 males) have been followed up for 6 months with 29% of these individuals experiencing another fall. The number of fallers did not differ between the groups ($p = 0.487$). Thirteen individuals (33%) in the perturbation group experienced another fall, compared to eleven individuals (26%) in the group without perturbations.

CONCLUSION: Preliminary findings indicate that the protocol employed in the SeFallED study does not impact future fall risk significantly. However, further analysis and extended follow-up durations are essential to comprehensively grasp the role of diagnosing reactive dynamic balance and its implications for future fall risk. Nevertheless, these initial results contribute to ongoing discussions regarding the optimal dosage of PBT. In high-risk individuals who have recently suffered a severe fall, a single session does not appear to provide an adequate training stimulus to induce relevant improvement.

References:

1. Stuckenschneider T, et al: Sentinel fall presenting to the emergency department (SeFallED) - protocol. BMC Geriatr 2022, 22(1):594.

DIFFERENTIAL EFFECTS OF CONCENTRIC AND ECCENTRIC CONTRACTIONS ON THE PRIMARY MOTOR CORTEX IN YOUNG AND OLDER HEALTHY PARTICIPANTS

DESACHY, M.1,2, HERAUD, N.2, LAGARDE, J.1, VARRAY, A.1

<1> EUROMOV DIGITAL HEALTH IN MOTION, UNIVERSITY MONTPELLIER, IMT MINES ALES, MONTPELLIER, FRANCE <2> DIRECTION DE LA RECHERCHE ET DE L'INNOVATION EN SANTÉ, CLARIANE, FRANCE

INTRODUCTION: Eccentric (ECC) contractions generate greater force with lower metabolic cost and cardio-respiratory constraint than concentric (CON) ones. In 2004, through electroencephalography (EEG) analysis, Fang et al. highlight that ECC induce greater cortical activity during movement planning and execution than CON contractions and more specifically greater amplitude and latency movement-related cortical potentials (MRCP). Interestingly, this was observed either in sensory-motor area and others areas. These results indicate that the use of ECC contractions could be potentially highly relevant to fight against insufficient cortical activation significantly implicated in muscle weakness of older persons or COPD patients (1). However, these results were obtained in young subjects' upper limbs, while cortico-muscle dysfunction mainly affects the lower limbs and older persons. Thus, the purpose of this study was to compare cortical activity during quadriceps CON and ECC contractions in young (20-35 years) vs. older (50-75 years) healthy participants.

METHODS: 17 young and 16 older participants (62 ± 7 and 23 ± 4 years respectively) performed 40 voluntary ECC and CON quadriceps contractions against 20% of their maximal isometric force on a Biodex isokinetic ergometer. Surface EEG signals from Cz electrode (more proximal area of quadriceps motor command) and 8 others overlying sensorimotor cortical areas, were recorded. MRCPs were derived from EEG signals in order to analyze the negative peak (NP). The amplitude and latency of the NP were calculated as indicators of cortical activation related to movement execution and planning respectively.

RESULTS: As main result, Cz NP amplitude was greater during ECC contractions ($p < 0.05$, $\eta 2p = 0.13$) for both groups ($p =$ 0,48) despite systematic lower values in older group ($p < 0.05$, $\eta 2p = 0.24$). As secondary results, only FC5 shows significant greater amplitude and latency during ECC contractions for both age group ($p < 0.05$, $\eta 2p = 0.26$ and 0.20).

These results exhibit a higher cortical activity during ECC contractions whatever age, and a decreased cortical activity with aging. In addition, ECC contractions performed on the lower limbs are not associated with a higher activation extended to the whole cortex areas, as found in upper limb studies.

CONCLUSION: Our study shows that despite an overall reduction in motor cortex activity involved in the lower limbs during aging, the higher activity during ECC contractions of the lower limbs always exists in the older group. Consequently, this raises the interest of eccentric training to induce higher cortical activity in older individuals or COPD patients to fight against the cortical component of muscle weakness.

REFERENCES:

(1) Alexandre et al. (2020) Specific motor cortex hypoexcitability and hypoactivation in COPD patients with peripheral muscle weakness. BMC Pulm. Med. 20, 1. https://doi.org/10.1186/s12890-019-1042-0

PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR IN OLDER ADULTS WITH LOW AND HIGH RISK FOR MOBILITY LIMITATION LIVING IN A CONTINUING CARE RETIREMENT COMMUNITY

SEBASTIAO, E., BAKARE, J., SIQUEIRA, V.

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

INTRODUCTION: Mobility limitation (ML) is highly prevalent among older adults (OAs), and it has been associated with increased fall risk, hospitalization, a decreased quality of life, and even mortality. In addition, ML has been associated with low levels of physical activity (PA) and high amounts of sedentary behavior (SB) in community-dwelling OAs. However, there are a paucity of data on ML, physical activity and sedentary behavior in OAs living in community dwelling facilities such as Continuing Care Retirement Communities (CCRC). This study examined differences in PA and SB in OAs living in a CCRC as a function of risk for ML.

METHODS: One hundred OAs (84.7±6.3 years; 27.2±6.8 kg/m2; 70% female) were recruited from a CCRC in the United States. Risk for ML was determined based on scores from the Short Physical Performance Battery (SPPB). OAs with a score <10 in the SPPB were classified as high risk for ML (HRML), while those with a score ≥10 were classified as low risk for ML (LRML). PA was assessed using the Physical Activity Scale for The Elderly (PASE) and expressed as a score. SB was assessed using a questionnaire developed for OAs, in which time spent in non-screen- and screen-related activities were computed and expressed as sedentary time (ST) in minutes. Data were analyzed using descriptive and inferential statistics. As the dependent variables were not normal distributed, the comparison between LRML and HRML was conducted using Mann-Whitney U test with significance set at $P<0.05$.

RESULTS: Based on the SPPB scores of the sample, 59% of OAs were classified as HRML. Significant differences between groups were observed for total PA (LRML 67.1±41.8 vs HRML 49.2±40.5; P=0.012), leisure PA (LRML 30.5±25.1 vs HRML 21.2±23.5; P=0.035), total ST (LRML 645.8±209.6 vs HRML 567.0±290.8; P=0.007) and non-screen ST (LRML 447.1±182.7 vs HRML 350.0±164.8; P= 0.002). Groups with different risk for mobility limitation were similar for household PA (LRML 26.6±19.0 vs HRML 20.8±20.7; P=0.097), work-related PA (LRML 10.0±20.5 vs HRML 7.2±14.9; P=0.533), and screen ST (LRML 198.8±89.1 vs HRML 217.0±179.5; P=0.681).

CONCLUSION: Our findings suggest that OAs living in a CCRC classified as LRML present with significant higher total and leisure time PA, and significant less total and non-screen ST compared with their OAs counterpart classified as HRML. With the aging process, the chances of ML increases in OAs due several reasons including but not limited to motor dysfunctions, impaired balance, decrease muscular strength and functional capacity. To this end, given the well-known benefits of PA, interventions focusing on increasing PA and reducing ST among OAs are important to help counteract functional and physiological alterations occurring during the aging process that may lead to ML.

EFFECTS OF AGING ON MOTOR MEMORY FORMATION – A SYSTEMATIC REVIEW

KRAFT, V.1, WANNER, P.2, ROIG, M.3,4, HERMSDÖRFER, J.1, STEIB, S.2

*1 TECHNICAL UNIVERSITY OF MUNICH, GERMANY, 2 HEIDELBERG UNIVERSITY, GERMANY, 3 CRIR, CANADA, 4 MCGILL UNIVERSITY, CANADA, *EQUAL CONTRIBUTION*

INTRODUCTION: People across the lifespan regularly engage in motor practice to learn new, improve, or adapt skills in sports, activities of daily living, or rehabilitation settings. However, recent cross-sectional studies suggest a drastic drop in motor memory formation in the 50s (Coats et al., 2014) that have been associated with age-related brain changes (King et al., 2013). Early studies indicate impaired motor memory encoding with increasing age, whereas current data instead suggests deficits in overall performance during skill practice. Regarding the consolidation of motor memories, results are also ambiguous, which is why reliable conclusions are highly relevant. Therefore, this review addresses how motor memory formation declines in older adults (≥50 years) compared to younger populations. Specifically, we wanted to answer how old age affects motor memory (i) encoding and (ii) consolidation. Additionally, we aim to unravel the role of motor task nature, participants characteristics, retention interval, and sleep on age-related changes in motor memory formation.

METHODS: We conducted a systematic literature search per PRISMA guidelines with a predefined list of keywords using the PECO (Population, Exposure, Comparator, Outcome) framework and boolean strategies in relevant databases, including MEDLINE (PubMed), Web of Science, SPORT Discuss, and PsycINFO. Two authors autonomously screened the retrieved records by examining the titles, abstracts and subsequently evaluating the full-text articles of those not considered out of

scope. The same authors extracted data components from the included studies for calculating effect sizes and potential moderators, and the meta-analysis is currently being prepared.

RESULTS: The comprehensive search across four electronic databases yielded 3211 records after removing duplicates. Screening these records resulted in 278 studies meeting the inclusion criteria. Qualitative and preliminary results concerning the association of age and motor memory formation are mixed and demonstrate the influence of study design, motor task characteristics, and retention interval.

CONCLUSION: With the extent of the literature identified in our search, we cannot only answer the central questions of how old age impacts encoding and consolidation but also illuminate the variability observed across various setups, motor learning tasks, retention intervals, and age ranges studied. While not only helping to explain some of the observed variability, our results can be relevant for providing tailored recommendations on approaching motor memory formation in different scenarios for older individuals.

Coats, R. O., Wilson, A. D., Snapp-Childs, W., Fath, A. J., & Bingham, G. P. (2014). The 50s cliff: Perceptuo-motor learning rates across the lifespan. PLoS ONE, 9(1).

King, B. R., Fogel, S. M., Albouy, G., & Doyon, J. (2013). Neural correlates of the age-related changes in motor sequencing learning and motor adaptation in older adults. FRONTIERS IN HUMAN NEUROSCIENCE, 7, 142.

Oral Presentations

OP-PN11 Nutrition/Ergogenic Aids and other supplements II

SUPPLEMENTATION WITH BCAAS HAD NO EFFECT ON ENDURANCE PERFORMANCE, BUT IT COULD ENHANCE FAT OXIDATION DURING EXERCISE AND INCREASE CARBOHYDRATE OXIDATION DURING SUBSEQUENT HIGH-INTENSITY EXERCISE

LUAN, C., GONG, L., WANG, X., LI, J., WANG, Y., NI, Z.

BEIJING SPORT UNIVERSITY

INTRODUCTION: BCAAs have a potential role on fat oxidation. However, the impact of supplementation with BCAA during exercise is unknown.This study aims to investigate whether the intake of BCAAs can increase fat oxidation during endurance exercise and enhance endurance performance.

METHODS: Eleven recreationally active young male participated in this randomized, double-blind, crossover design study. Participants reported to the laboratory on two occasions, BCAA or placebo (0.2g/kg) was supplemented in the morning and evening for 3 consecutive days in each experiment, and exercise was started 30 minutes after supplementation in the morning on the 4th day. Each test started with 60 minutes of cycling at 60%VO2max, followed by time to exhaustion(TTE) cycling at 80%VO2max. During one hour of constant load exercise(CLE),heart rate, rating of perceived exertion(RPE), and visual analogue scores(VAS)were recorded; gas was collected to calculate the rate of carbohydrates(CHO)and fat oxidation, and fingerstick blood was collected to test blood glucose and lactate. Elbow venous blood was collected on an fasting, pre-exercise and post-exercise to measure free fatty acids(FFA), triglycerides(TG), β-hydroxybutyrate(β-HB), insulin, and blood ammonia.

RESULTS: There were no significant differences in TTE time,HR, RPE, VAS, blood glucose, and blood lactate during the exercise ($p>0.05$). The VAS value post-exercise of BCAA was significantly lower than placebo ($p=0.042$). At the 30th, 40th and 50th minutes of 1h CLE, the rate of fat oxidation of BCAA was significantly higher than placebo ($p<0.05$). During the 60th minute of 1h CLE and throughout the TTE exercise period, the rate of CHO oxidation of BCAA was significantly higher than placebo ($p<0.05$). There were no significant differences in blood glucose and TG between the two groups over the three time periods ($p>0.05$). The FFA in the two groups pre-exercise were significantly lower than fasting ($P<0.01$), and post-exercise the FFA and β-HB were significantly higher than fasting and pre-exercise ($P<0.001$), but there was no significant difference between the two groups ($P>0.05$). Post-exercise insulin levels of two groups were significantly higher than fasting and pre-exercise ($p<0.001$), and the insulin levels of placebo were significantly higher than BCAA post-exercise ($p<0.05$). The blood ammonia level of BCAA pre-exercise was significantly higher than fasting ($p<0.001$) and higher than placebo at the same time ($p<0.05$), and the blood ammonia level of placebo post-exercise was significantly higher than pre-exercise ($p<0.01$) and higher than BCAA at the same time ($p<0.05$).

CONCLUSION: Supplementation with BCAAs doesn't have a significant effect on endurance performance, but it can increase fat oxidation during exercise, save carbohydrate consumption during exercise, and use more carbohydrates for energy in subsequent sprint exercises. Supplementation with BCAAs can also effectively reduce the level of fatigue immediately after exercise.

EFFECTS OF PYRROLOQUINOLINE QUINONE (PQQ) SUPPLEMENTATION ON AEROBIC EXERCISE PERFORMANCE IN NON-ENDURANCE-TRAINED ATHLETES

CHARRIER, D., SIMONI, L., ALFIER, A., SLANZI, G., MORO, T., PAOLI, A.
UNIVERSITY OF PADOVA

INTRODUCTION: Pyrroloquinoline quinone (PQQ) is a newly compound acting on redox modulation, cellular energy metabolism, and mitochondrial biogenesis. Recent evidence indicates that supplementing with PQQ can enhance mitochondrial biogenesis by increasing PGC-1alfa protein. Increasing mitochondrial biogenesis can enhance the maximum capability of skeletal muscles to generate ATP through oxidative phosphorylation, positively impacting the ability to utilize fatty acids during moderate-intensity exercise and so improving aerobic performance. The aim of this study was to examine the effects of PQQ supplementation on body composition, endurance performance, and mitochondrial activity in a group of non-endurance-trained athletes (basketball players).

METHODS: Twenty basketball players (10 males and 10 females, age: 22.9±2.36, VO2max: 42.9±6.49 mL/min/Kg) were randomized to consume a supplement containing 20 mg/day of PQQ or placebo (PLA) during a six-week intervention. Subjects were encouraged to maintain their usual diet and training schedule. Body composition was assessed by dual-energy-x-ray-absorptiometry and bioimpedance analysis. Aerobic exercise performance was evaluated through a graded exercise protocol (six 5-minutes steps followed by n 2-minutes steps until exhaustion; the initial workload was 60 watts and increased by 35 watts at the end of each step) performed on a cycle ergometer. VO2, respiratory quotient (RQ), energy derived from carbohydrates (kcal/day) and fats (kcal/day) were assessed by gas analysis system. Capillary blood lactate samples were collected at the end of each step. Blood and urine samples were also collected, and proteomics analysis will be performed.

RESULTS: Body composition nor aerobic performance were altered by the intervention. Although a reduction in RQ and carbohydrate consumption was graphically visible, statistical significance was not achieved, probably due to a high inter-individual variability of response in the PQQ group. We indeed identified a group of responders (5 subjects) who significantly (p=0.02) reduced their RQ, as well as carbohydrate consumption, after supplementation compared to (5 subjects) non-responders. In particular, a significant reduction was observed during the third step (10-15min, p=0.002) and the fourth step (15-20min, p=0.004).

CONCLUSION: Supplementation of PQQ does not appear to elicit any ergogenic effects regarding aerobic performance or body composition in a group of not endurance athletes. However, we have observed a significant range of responses in the PQQ group, which deserve further investigation. Subsequent proteome analysis may contribute to a more comprehensive understanding of the relationship between PQQ supplementation and the metabolic responses.

THE EFFECT OF SHORT-CHAIN FATTY ACID SUPPLEMENTS ON EXERCISE PERFORMANCE AND RECOVERY

GREEN, C., ONG, M., ROWLAND, S., BAILEY, S., CLIFFORD, T., BONGIOVANNI, T., HEANEY, L.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Short-chain fatty acids (SCFAs) are gut microbiome derived metabolites that have been shown to affect whole-body physiology and health in humans. Animal studies have demonstrated that chronic SCFA supplementation can increase endurance capacity and reduce the amount of muscle damage experienced during exercise. Additionally, SCFAs have been reported to have anti-inflammatory properties that may help to alleviate the negative effects of exercise induced muscle damage (e.g., delayed onset muscle soreness (DOMS)). The impact of SCFA supplementation on exercise performance and recovery in humans is yet to be investigated. We therefore assessed the effect of chronic SCFA supplementation on 5 km running performance and subjective response to muscle damage in recreationally active humans.

METHODS: In a randomised control trial study design, 18 (1 female) healthy participants completed a 31-day supplementation period consuming either SCFA supplements (sodium acetate, calcium propionate and sodium butyrate) or placebo. Supplement group: 8 (1 female) participants (22 ± 3 yrs, 70.53 ± 11.71 kg). Placebo group: 9 (0 female) participants (23 ± 2 yrs, 77.01 ± 14.20 kg). On day 1 and day 28 of supplementation, participants completed a 5 km running time trial on a treadmill. Immediately post the 2nd time trial, a drop jump protocol to induce muscle damage was completed. Subjective measurement of lower body DOMS after performing a bodyweight squat was recorded using a 200 mm visual analogue scale on each of the 3 remaining days of supplementation (recovery days 1 to 3). A two-way ANOVA for independent groups was performed to detect differences in time trial performance between and within groups. A linear mixed effects model was performed to detect differences in DOMS between and within groups during the recovery period. All data are presented as mean ± SD.

RESULTS: Time trial performance was not different pre vs post supplementation for either group or between supplements at any time (all, $p \geq 0.433$). Running times in the SCFA group were 23.49 ± 3.51 and 22.79 ± 2.98 mins for pre and post supplementation period respectively. Running times in the placebo group were 22.46 ± 2.28 and 22.35 ± 2.18 mins for pre and post supplementation period respectively. DOMS at baseline was not different between groups ($p = 0.838$). DOMs were 18 ± 16 and 16 ± 13 mm, for SCFA and placebo respectively. In both groups DOMS was greater than baseline on day 1 (52 ± 22 and 46 ± 19 mm, for SCFA and placebo respectively) and day 2 (51 ± 26 and 42 ± 27 mm) (all, $p < 0.001$) and returned to baseline by day 3 (28 ± 18 and 18 ± 19 mm, for SCFA and placebo respectively) (both $p \geq 0.188$). DOMS was not different between groups at any time (all, $p \geq 0.294$).

CONCLUSION: Unlike data obtained from animal studies, 4 weeks of combined SCFA supplementation did not affect 5km running performance in recreationally active individuals. Subjective response to muscle damage was also unaffected by supplementation.

DOES SUPPLEMENTATION WITH FREEZE DRIED BLUEBERRY POWDER INFLUENCE SYMPTOMS AND THE CARDIOVASCULAR, MUSCULAR, AND PERFORMANCE EFFECTS OF A 22.2-KM TRAIL RUN?

GILES, L., BRANDENBURG, J.P.
UNIVERSITY OF THE FRASER VALLEY

INTRODUCTION: Exercise with an eccentric component (e.g., running with a downhill portion) results in oxidative stress and inflammation, as well as transient increases in arterial stiffness, muscle damage, and dysfunction. During prolonged strenuous exercise, supplementation with foods rich in antioxidants, such as blueberries, could augment antioxidant and anti-inflammatory defences, thus reducing any adverse physiological effects, countering fatigue, and enhancing performance. Therefore, the purpose of this study was to assess if supplementation with freeze dried blueberry powder influences symptoms and the cardiovascular, muscular, and performance effects of a 22.2-km trail run.

METHODS: 10 Healthy runners (4F 6M, 176.0 ± 8.8 cm, 71.1 ± 12.4 kg, 38.4 ± 8.9 y; mean ± SD) performed two 22.2-km trail runs as fast as possible (3 x 7.4 km loops, 280 m elevation per loop) following 7-days of supplementation with freeze dried blueberry powder or placebo (order randomized, double blind). Prior to, immediately following, and 24 h following the run, participant symptoms, pulse wave analysis (PWA), pulse wave velocity (PWV), muscle function (reactive strength index [RSI] and jump height via a drop jump), and muscle soreness were measured. Exercise heart rate (HR) was measured during the run while blood lactate was assessed before and after the run. Time to complete the trail run, and mean and maximum HR during the run, were analysed using a paired t-test. Pre and post blood lactate were analyzed using a 2 (supplement vs. placebo) X 2 (time: pre-post) repeated measured ANOVA. Loop times were analyzed using a 2 (supplement vs. placebo) X 3 (loop 1-2-3) repeated measured ANOVA. Symptoms, PWV, PWA, RSI, jump height, and muscle soreness were analyzed using a 2 (supplement vs. placebo) X 3 (time: pre-post-24h) repeated measured ANOVA.

RESULTS: Trail run time was significantly faster following blueberry powder supplementation (p=0.003; 9425.22 ± 1311.29 vs. 9870.11±1521.30 s). There was a main effect of supplement on average loop time, with loop time being significantly faster following blueberry powder supplementation (p=0.005; 3141.63 ± 439.75 VS. 3291.15 ± 504.70 s). There was a main effect of supplement for HR measured during PWA (p=0.026) and feelings of tiredness measured prior to or following the run (p= 0.007). Both HR (56.37 ± 9.42 vs. 58.70 ± 10.08 BPM) and tiredness (1.37 ± 1.11 vs. 2.07 ± 1.16 on a 7-point scale) were significantly lower following blueberry powder supplementation. There were no significant differences in mean and maximum run HR, or blood lactate prior to and following the run. There were no other main or interaction effects for RSI, jump height, muscle soreness, PWV, or other measures of PWA or symptoms.

CONCLUSION: These results indicate that supplementation with freeze dried blueberry powder improves prolonged trail running performance and feelings of tiredness.

CASE STUDY: NUTRITION PLANNING AND INTAKE DURING THE NORSEMAN EXTREME TRIATHLON IN A RECREATIONAL MALE TRIATHLETE

AKTITIZ, S.
HACETTEPE UNIVERSITY

INTRODUCTION: The Norseman Xtreme Triathlon, considered one of the worlds toughest endurance races, is an Ironman-distance triathlon characterized by cold waters, challenging mountainous terrain, and a marathon that concludes with a climb to the mountain summit. Despite the crucial role of sports nutrition for ultra-endurance performance, no documented case studies addressing nutrition of the Norseman or other extreme-triathlon have been identified. This case study describes the nutrition plans and intake of a recreational male triathlete focusing on the race-day nutrition planning based on scientific recommendations.

METHODS: The recreational male triathlete is 39 years old, with 8 years of training experience, and body fat percentage of 18.1% (DXA, GE Healthcare, Madison, Wisconsin, USA). Food and fluid intakes were recorded and analyzed.

RESULTS: For race-day nutrition planning, individualized carbohydrate (CHO)-loading strategies were implemented 72 hours prior to the race, involving a CHO intake of 6 g/kg/day and ˜2900 kcal/day, with a macronutrient distribution of 67% CHO (481 g), 17% protein (123 g), and 16% fat (50 g). However, the athlete consumed equal or slightly fewer CHO than planned leading up to the race, with intakes of 6.1, 5, and 5.1 g/kg/day, respectively. Additionally, despite the planned CHO intake of 2 g/kg in the last 2 hours before the race, the athlete consumed only 1.3 g/kg. On the race day, due to extended swimming times caused by countercurrent conditions, the intake of gels 5 minutes before and during the swimming stage emerged as a crucial strategy. For both the cycling and running stages, CHO intake of 60 g/h was planned, determined based on the athletes tolerance during training. However, on race day, the athlete consumed 47.4 g/h during the cycling stage and 39 g/h during the running stage, both of which were below (82% and 72%) the planned intake. During the latter part of cycling stage, a challenge was encountered in opening gel or solid food packets due to adverse weather conditions and leading to sports dietitian to incorporate gels into water bottles as a solution. The total CHO intake during the race (46.7 g/h), though slightly below (%78) the planned intake (58 g/h), remained within the recommended range (30-90 g/h). Furthermore, the athlete consumed ˜9.5 L of fluid (700 ml/h) and ˜4300 mg of sodium (300 mg/h), closely aligning with the planned fluid intake (800 ml/h) and slightly below the planned sodium intake (500 mg/h),

yet remaining within the recommended range for ultra-endurance athletes (450-750 ml/h for fluid, 300-600 mg/h for sodium).

CONCLUSION: The first case study on extreme-triathlon nutrition aims to contribute to the development of strategies for maintaining optimal performance and overall health in future extreme-triathlons. By emphasizing the significance of a planned nutrition strategy considering race conditions and individual tolerance, it also highlights the necessity for flexible solutions to unexpected challenges during races.

Oral Presentations

OP-BM27 Kinematics

AN EMBEDDED SYSTEM TO REDUCE ERRONEOUS ASSESSMENTS OF THE MOMENT-ANGLE AND MOMENT-ANGULAR VELOCITY RELATIONSHIP AT THE KNEE JOINT IN ISOKINETIC DYNAMOMETRY

ALBUQUERQUE PLACIDO, M., WERTH, J., WANG, Z., EPRO, G., XIAO, P., KARAMANIDIS, K.

LONDON SOUTH BANK UNIVERSITY

INTRODUCTION: Accurate assessment of the joint moment-angle and moment-angular velocity relationships is crucial for objective evaluation of muscle function in sports and clinical settings. However, conventional isokinetic devices neglect the non-rigidity of the dynamometer-body system. This leads to erroneous assessments and interpretations of muscular capacities related to the force-length-velocity relationship (1) and hence may result in false information about rehabilitation post injury. We aimed to account for these methodological errors in isokinetic dynamometry by developing an automated mechatronic system and prove its validity for immediate and accurate assessment of muscle strength capacities.

METHODS: 20 young adults (20-30yrs) performed unilateral maximal voluntary isometric and isokinetic knee-extension (KE) and knee-flexion (KF) contractions at preset joint angles ranging from 80 to 160deg (180deg: fully extended) and angular velocities of up to 300deg/s on a dynamometer (HUMAC NORM). An automated custom-built software was used to record the dynamometer's output for joint moments, angles, and angular velocities. The effects of the joint's axis misalignment on the measured moment were calculated using a synchronised video camera positioned at the centre of the dynamometer's axis. Inertial sensors were used to determine joint angular changes during contractions. Second-order polynomial fits on measured and corrected outputs were performed to estimate moments at the corresponding preset angles and angular velocities. Peak joint moments in all conditions were obtained from respective preset angles and angular velocities. Potential changes in the moment-angle and moment-angular velocity relationships were investigated with statistical parametric mapping and t-tests.

RESULTS: There were significant differences in the shape of the joint-moment angle relationship for the KE when comparing the measured with the corrected data. The measured moment at short muscle-tendon unit lengths was overestimated whilst underestimated at long lengths ($p<.05$). Furthermore, there was an ~8deg shift in the optimal knee joint angle for peak moment output towards shorter muscle-tendon unit lengths during KE and KF contractions ($p<.05$). Concerning the moment-angular velocity relationship there was a significant ($p<.05$) overestimation in the peak moments at low velocities with no effects at higher velocities.

CONCLUSION: This study confirmed that inevitable errors during conventional isokinetic dynamometry cause erroneous assessments of joint-moment and joint-angular velocity relationships in the knee which leads to an overestimation of the optimal muscle-tendon unit length for force production. Our introduced system allows for immediate corrections of such errors as well as reliable evaluation of muscular capacities and may challenge current concepts using hamstrings-to-quadriceps imbalances as a clinical marker for knee injury risks in sports. (1) Arampatzis et al. 2004, Clin Biomech

THOMAS (FLARE) IN BREAKING: KINEMATICS AND MUSCLE ACTIVITIES ANALYSIS

YOON, J.H., LEE, S., KIL, S., PARK, S., KIM, M., KWON, M., LEE, H., KIM, T.

KOREA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Breaking, one of the hip-hop dance styles, has achieved recognition as an official sports discipline through its inclusion in the 2022 Hangzhou Asian Games and the 2024 Paris Olympics. Despite its popularity and significant attention, there is a notable lack of research on breaking. In addition, there is a complete absence of research on motion analysis to aid in understanding Power Moves. Therefore, this study aimed to investigate the kinematics and muscle activities during the Thomas, a representative Power Move. Furthermore, we sought to compare expert and non-expert groups to quantitatively illustrate effective movements and leverage foundational data based on scientific evidence for athlete development.

METHODS: Six professional breaking dancers with numerous achievements in international competitions and seven amateur breaking dancers performed three trials of the Thomas. Joint kinematics were collected by 3D motion capture during the Thomas. Muscle activation of nine muscles (anterior deltoid, biceps brachii, triceps brachii, rectus abdominis, gluteus maximus, pectoralis major, vastus lateralis, rectus femoris, and flexor carpi radialis) were also recorded using surface electromyography. Mann-Whitney U test was performed to investigate the difference between experts and non-experts in

the joint kinematics, center of mass (CoM) dispersion, CoM velocity, lower extremities' joint angular velocity, and muscle activation.

RESULTS: Experts showed more abducted hip joints and less flexed knee joints compared to non-experts during the Thomas ($p<.05$). Angular velocity in the x-axis of the dominant hip joint was significantly different between experts and non-experts ($p<.05$). However, during the Thomas, there was no significant difference in CoM dispersion and muscle activation between experts and non-experts ($p>.05$).

CONCLUSION: In circles on the pommel horse in gymnastics, maintaining body balance is crucial while rotating the lower limbs around the arms (1). Additionally, these need to rotate both lower limbs sequentially around the axis of rotation with the knee joints relaxed on a small base (2). Like circles on the pommel horse in gymnastics, professional breaking dancers performed the Thomas by extending both knee joints and increasing the abduction of hip joints to increase the radius of rotation. This is interpreted as a factor that enhances the perfection of the technique and allows for achieving high scores simultaneously. The absence of a significant difference in muscle activation between the two groups implies that variations in performance ability may be attributed to differences in joint angles and angular velocities required for performing the Thomas rather than the extent of muscle recruitment.

REFERENCES:

1) Fujihara, T., & Kobayashi, T, ISBS Proceedings Archive, 2018

2) Baudry, Ludovic, et al, The Journal of Strength & Conditioning Research, 2009

INFLUENCE OF REPETITIVE UPPER EXTREMITY MOVEMENTS ON CERVICAL KINEMATICS AND NEUROMUSCULAR CONTROL IN PEOPLE WITH CHRONIC NECK PAIN

CHENG, K.C., WU, H., TSAI, Y.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Neck pain is a prevalent musculoskeletal problem with a 75.1% lifetime prevalence, and 30% of neck pain may develop into chronic neck pain (CNP). Nowadays, the prevalence of CNP is dramatically increased, which may be attributed to the extremely high daily usage of 3C devices and repetitive upper extremity tasks. A higher prevalence of CNP is also found in occupations that often be required to perform overhead and repeated arm movements. However, how performing repetitive arm movements would affect cervical kinematics and stability remains unknown, especially in people with CNP. Therefore, the main purpose of this study was to investigate the changes in cervical alignment, steadiness, and muscle activations while performing repetitive upper extremity movements in adults with and without CNP.

METHODS: A total of 49 participants including 23 patients with CNP and 26 healthy asymptomatic adults were recruited in this study. All participants were instructed to perform a hundred times of high-velocity and small amplitude shoulder oscillation task around 150-degree shoulder flexion while maintaining their head and neck stable. The VICON optical motion analysis system with a sampling rate of 100 Hz and Delysis surface electromyography (EMG) with a sampling rate of 1200 Hz were recorded the cervical kinematic and EMG data simultaneously. The data of the initial 10 oscillations and the final 10 oscillations were extracted for further analysis. Cervical kinematics including maximal angle, minimal angle, and angle range were obtained. Cervical steadiness was evaluated using the coefficient of variance (CV) calculated by standard deviation divided by mean. The higher the angle and the CV indicate the more extension cervical position and larger spinal variability, respectively. In addition, root mean squared of EMG activation and median frequency were analyzed for bilateral superficial cervical flexors and extensors. Two-way repeated measured ANOVA was used for statistical analysis. Post hoc with Bonferroni correction was done if indicated.

RESULTS: Significant time main effects were observed for the maximal angle, minimal angle, and the CV showing that the cervical angle decreased and the CV increased during the end of the task for all participants. However, there were no group main effects or interactions found. The median frequency of the left cervical extensor showed significant interactions that healthy asymptomatic adults had higher median frequency at the end of the task but no change in people with CNP. However, the EMG activations did not show any difference between groups.

CONCLUSION: The current results found that both groups were unable to maintain cervical alignment and stability during the repetitive arm movements task, and tended to move into more flexion position at the end of the task. However, healthy asymptomatic adults were able to recruit a much larger motor unit of cervical extensors to maintain cervical stability and posture.

LOAD-VELOCITY RELATIONSHIP BETWEEN PRONE BENCH PULL AND HALF SQUAT WITH PERFORMANCE IN FEMALE TRADITIONAL ROWERS

PENICHET-TOMÁS, A., PUEO, B., VILLALON-GASCH, L., JIMENEZ-OLMEDO, J.M.

UNIVERSITY OF ALICANTE

INTRODUCTION: Rowing, a sport involving propelling a boat through water using generated forces, has two main modalities: mobile seat rowing, where the seat moves stern and bow, and traditional rowing, featuring a fixed bench supporting the rower's ischial region. Muscular strength, and boat speed are closely related, with exercises like prone bench pull and squat correlating with mobile seat rowing performance (1). Recent studies also link load-velocity variables with performance in this modality (2). Given the biomechanical differences between modalities, the present study aims to identify mechanical variables potentially correlated with traditional rowing performance.

METHODS: Eight highly trained/national level female rowers participated in the study (3). The load–velocity relationships were evaluated through an incremental loading test, culminating in the individual's 1-repetition maximum (1-RM) for prone bench pull and half squat. The initial load was set at 15 kg and increased in 5-10% increments. Three repetitions were performed with light loads until the mean velocity (MV) decreased (MV>1.1 m/s), two with medium loads (1.1 m/s≤MV≤0.8 m/s) and one with heavy loads (MV<0.8 m/s). All repetitions were recorded using the Chronojump linear velocity transducer. Rowing performance was assessed with a Graded Exercise Test on a Concept II rowing ergometer. The protocol consisted of 30-s stages without rest, starting with an initial workload of 60 W and increasing by 10 W for each stage. Pearson correlation coefficient was used to establish the relationships, applying the following thresholds: trivial (≤0.1), low (0.1–0.3), moderate (0.3–0.5), high (0.5–0.7), very high (0.7–0.9) and almost perfect (≥0.9).

RESULTS: A very high correlation was observed between the 1-RM prone bench pull load (54.3±4.9 kg; r=0.755; p=0.034) and MV for load of 30% (1.178±0.198 m/s; r=0.827; p=0.011) with rowing performance. However, no association was observed with 1-RM half squat load. In contrast, a very high correlation was noted between MV for load of 30% (0.970±0.097 m/s; r=0.755 p=0.030) and rowing performance. High correlations were also observed with MV for load of 40% (0.828±0.084 m/s; r=0.664) and 50% (0.731±0.106 m/s; r=0.664) in half squat, although these were not statistically significant.

CONCLUSION: The MV at low loads in prone bench pull and half squat shows a high correlation with performance in female rowers. Notably, only the maximum load achieved in prone bench pulls exhibited a significant correlation with performance. These findings provide the first evidence linking load-velocity variables with performance in female traditional rowers. This insights offers coaches a valuable tool to precisely and efficiently tailor strength training for their their female athletes.

FUNDING: Generalitat Valenciana (grant number CIGE/2022/15).

REFERENCES:

1) McNeely et al., Strength Cond J, 2005.

2) Pérez-Castilla et al., Eur J Sport Sci, 2022.

3) McKay et al., Int J Sports Physiol Perform, 2022.

Oral Presentations

OP-AP27 Female athletes

MENSTRUAL PHASE AND SYMPTOMS AFFECT MATCH RUNNING FOR ELITE FOOTBALL PLAYERS.

BROWN, G., DUFFIELD, R.

UNIVERSITY OF TECHNOLOGY SYDNEY

INTRODUCTION: Menstrual cycle phases are reported to affect athletic performance, though research related to football match running remains inconclusive1. Further, the influence of menstrual symptoms (e.g., stomach cramps) on athletic performance has received increasing attention2,3, though research in football is also scarce. Given a variety of studies report 24-100% of professional footballers perceive negative effects of the menstrual cycle on match performance4,5, further research is required. Therefore, this study aimed to examine whether menstrual cycle phase (menstruation [MP], late follicular [FP], luteal [LP]) and symptoms affect running performance during professional matches.

METHODS: Twenty-one naturally cycling football players from 4 professional teams were monitored for up to 4 menstrual cycles during the 2022/23 season. Menstrual status and phase were determined by self-reporting of menstruation and two urinary hormone tests, including luteinizing hormone and pregnanediol (urine progesterone metabolite), respectively. Menstrual phase was classified as MP, FP and LP. On match day evenings players reported menstrual symptom severity from an 18-item questionnaire. Players wore GPS each match and GPS measures (total distance, high-speed running distance, sprinting distance, acceleration count, deceleration count, peak speed) were expressed relative to minutes played. Linear mixed models were performed for each GPS measure with menstrual phase or symptoms as the fixed effect, player ID nested in team as a random effect and position as a random effect.

RESULTS: Data for 7 players was included for analysis, resulting in 54-57 observations per model. A significantly higher total distance and was reported during the FP compared to MP (p=0.04) and LP (p=0.007). Significantly greater high-speed running was reported during the FP compared to MP (p=0.012) and LP (p=0.007). No significant effect of menstrual phase was found for sprinting, accelerations, decelerations or peak speed (p>0.05). Accelerations declined with increasing overall menstrual symptom severity (p=0.021). Accelerations also declined with increasing severity of cravings (p=0.03), bloating (p=0.025), lower back pain (p=0.011), joint pain (p=0.023), dizziness (p=0.03) and nausea (p=0.016). Menstrual symptom severity did not affect any other GPS measures (p>0.05).

CONCLUSION: Our study is novel in exploring menstrual phase and symptom effects on match running in football. Total and high-speed running distances were greatest during the FP, though large variability existed between and within players, suggesting an individualised approach is still required. Menstrual symptoms can also affect match running, thus management of symptoms may reduce the negative impact on performance.

REFERENCES:

1. McNulty et al (2020)
2. Bruinvels et al (2022)
3. McNamara (2022)
4. Mkumbuzi et al (2021)
5. Read et al (2021)

CHANGES IN ELITE FINNISH FEMALE FOOTBALL PLAYERS PHYSICAL QUALITIES OVER A SINGLE SEASON: A LEAGUEWIDE STUDY.

SAVOLAINEN, E., IHALAINEN, J.K., WALKER, S.
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Higher-level female football players have better physical qualities compared to lower-level counterparts (1) and therefore it is important to develop players' physical qualities. Typically, in team sports, the aim is to maximize physical qualities in pre-season and then maintain the level throughout in-season (2). However, previous evidence in female football players show no systematic changes in physical qualities in either pre-season or in-season, suggesting inadequate training methods (3,4). Such observations come from only a single team and, thus, those findings may reflect a single team's training approach. Therefore, this study confirmed potential changes in physical qualities over a single season using a leaguewide study.

METHODS: One hundred and fifty-eight players from seven (of ten) Finnish national league teams voluntarily participated in the study. Players were tested at three times during season 2023: at the beginning of the pre-season (PREstart, January), at the end of the pre-season (PREend, March) and at the end of the in-season (INend, October). The following field tests were conducted to characterize physical qualities of the players: 30-meter sprint test with 10-meter split time for speed, countermovement jump (CMJ) for lower-body power, and 1200-meter shuttle running test (i.e., Bronco test) was used to calculate maximal aerobic speed (MAS). Generalized linear mixed model was used to investigate potential differences between season phases.

RESULTS: MAS improved significantly ($p < 0.05$) during pre-season and after that remained stable throughout the in-season (PREstart 4.00 ± 0.19 m/s, PREend 4.10 ± 0.19 m/s and INend 4.11 ± 0.19 m/s). The 30-meter sprint time also improved significantly ($p < 0.05$) during pre-season and after that remained stable (PREstart 4.77 ± 0.13 s, PREend 4.66 ± 0.13 s and INend 4.66 ± 0.13 s). The 10-meter sprint time was significantly better ($p < 0.05$) at the end of the in-season than at the beginning of the pre-season (PREstart 1.94 ± 0.06 s, INend 1.91 ± 0.06 s). CMJ did not change in either pre- or in-season.

CONCLUSION: This leaguewide study showed that elite female football players' speed and endurance qualities improved during the pre-season and the level was maintained during the in-season. The results are largely consistent with previous findings on team sports but challenge the findings of previous single football team observational studies where female players appeared not to develop during the season.

REFERENCES:

1. Haugen et al. Int J Sports Physiol Perform. 2012;7(4):340–9.
2. Mujika et al. Int J Sports Physiol Perform. 2018; 13(5): 538-561.
3. Peart et al. J Strength Cond Res. 2018 Jul;32(7):2010-2017.
4. Gonçalves et al. IJERPH. 2021;18(19):10015.

ACCELERATION AND MAXIMUM SPRINTING SPEED SPRINT PERFORMANCE DIFFERENCES IN ELITE AND SUB-ELITE LADIES GAELIC FOOTBALL: A PRELIMINARY ANALYSIS

MCGUINNESS, E.1, BEATTIE, K.1, LYONS, M.2, LANE, A.1, HIGGINBOTHAM, C.1, HEALY, R.1
1. SHE RESEARCH GROUP, TECHNOLOGICAL UNIVERSITY OF THE SHANNON: MIDLANDS MIDWEST, IRELAND 2. SPORT AND HUMAN PERFORMANCE RESEARCH CENTRE, UNIVERSITY OF LIMERICK, LIMERICK, IRELAND

INTRODUCTION: Gaelic football is a multidirectional field-based team sport. The sport requires a range of appropriately developed physical qualities, with speed being crucial (Malone et al., 2023). Acceleration is vital as it allows players to pursue opponents and compete for possession while maximum sprinting speed enables players to evade opponents and create scoring opportunities. Mooney et al. (2019) reported significantly faster 5 and 20 m sprint times (effect sizes: 0.38 to 0.88) in elite men's Gaelic football U20 players compared to sub-elite players. Acceleration and maximum sprinting speed differences in elite and sub-elite ladies Gaelic football have yet to be investigated. Therefore, the current study aimed to determine the acceleration and maximum sprinting speed differences between elite and sub-elite ladies Gaelic football.

METHODS: Twenty-four elite (23.3 ± 4.2 years, 1.67 ± 0.06 m, 67.9 ± 6.7 kg) and sixty-three sub-elite (25.8 ± 7.9 years, 1.67 ± 0.07 m, 65.1 ± 8.6 kg) ladies Gaelic football players participated in the current study. Participants performed two maximal effort sprint trials over 40 m. Sprint performance was monitored using dual-beam timing gates placed at 5 m intervals. The fastest time over a 5 m interval served as a proxy for maximum sprinting speed, while sprint times at 5 and 20 m were used to gauge acceleration performance. Normality of the data was assessed via a Shapiro-Wilk test using an alpha level of 0.05. Independent t-tests and Mann-Whitney tests were performed to assess differences in sprint times and

maximum sprinting speed, respectively. Cohen's d effect sizes were used to assess the standardised differences between playing standards.

RESULTS: Descriptive statistics (mean ± SD) for maximum sprinting speed were 7.09 ± 0.43 m.s-1 for sub-elite and 7.57 ± 0.37 m.s-1 for elite players. The median (IQR) for 5 and 20 m times were 1.18 (0.08 s) and 3.47 (0.25 s) for the sub-elite and 1.13 (0.06 s) and 3.28 (0.16 s) for the elite cohort. Elite players were found to have significantly ($p < 0.001$, cohen's $d = 0.41$, small) faster maximum sprinting speed in comparison to sub-elite players. The Mann-Whitney tests revealed that elite players were significantly ($U = 425$, $p = 0.002$, $U = 306.5$, $p < 0.001$) faster over 5 m and 20 m than their sub-elite counterparts.

CONCLUSION: The preliminary findings suggest that elite Ladies Gaelic football players had a significantly faster 5 and 20 m time and achieved a significantly faster maximum sprinting speed than their sub-elite counterparts in a 40 m sprint performance test. Future work should investigate if positional differences exist within the two cohorts.

PADDLE TO PODIUM: MAXIMISING SPRINT PADDLING VELOCITY IN ELITE FEMALE SURFERS. A THREE-YEAR OLYMPIC PROJECT.

PARSONAGE, J., MACDONALD, L., GOSNEY, S., DENNY, A., WEBSTER, H., MINAHAN, C.

SURFING AUSTRALIA

INTRODUCTION: In 2020, Teahupo'o was announced as the location for the Paris 2024 Olympic games. Teahupo'o is one of the largest waves of consequence in the world, and until 2022 was a wave not surfed by females in the modern era. This ignited a three-year performance strategy aimed at maximising sprint paddling velocity in elite female surfers, resulting in improved wave-riding performance at Paris 2024 and beyond.

METHODS: A three phased approach to maximising sprint paddle velocity in elite female surfers was executed. Reliability (phase 1): The intra-session reliability of a 15-m sprint paddle assessments in ten elite female surfers was assessed. Characterisation (phase 2): Temporospatial analysis of sprint-paddling technique in thirty-one elite surfers (Female n=15, Male n=16), was undertaken, identifying characteristics of sprint paddling technique that commensurate with superior sprint-paddling velocity in a 15-m sprint paddle assessment. Technique Intervention (phase 3): Based on the aforementioned phases, a two-week paddle technique training intervention (10, one-hour sessions) focused on 'reach' and 'catch' was implemented to evaluate the magnitude of improvement in sprint-paddling velocity of an elite female surfer.

RESULTS: The 15-m sprint paddling test demonstrated good to excellent intra-session reliability (ICC=0.76-0.94, CV%=1.55-2.52, TE=0.16-0.33), across 5, 10 and 15-m splits. Female surfers were significantly slower ($p<0.0001$) than their male counterparts across all splits and also demonstrated significantly shorter stroke length and propulsive distances ($p<0.05$) in both acceleration (ACC) and stroke maintenance (SM) phases. A longer pull distance in ACC was predictive of a faster 5-m sprint paddle time, in males but not females. The technique training intervention resulted in a superior time to ACC (pre: 5.84s at 8-9m, post: 3.52 at 4-5m). Furthermore, temporospatial analysis reported decreased stroke count (pre: 23 strokes, post: 20 stroke), increased stroke length in ACC [pre: right (R) =1.15 m left (L) =1.18 m, post: R=1.35m, L=1.31 m], and longer pull distance in ACC [pre: R=0.28m, L=0.29m, post: R=0.35m, L=0.33m]. However, no differences in sprint paddle velocity across 5, 10 and 15-m splits were reported.

CONCLUSION: Paddle to Podium three-year strategy created a reliable measure of sprint paddle velocity in elite female surfers. Temporospatial results suggests that pull distance may play a crucial role for acceleration, and the absence of this within female surfers provided direction for phase 3 intervention. The performance improvements in temporospatial characteristics and time too ACC in an elite female surfer, is the first of its kind to be noted. The integrative and applied nature of this research project, resulted in biomechanists, physiologists, skill acquisition specialists and performance coaches uniting to deliver real world application and performance improvements.

INFLUENCE OF SEX IN THE MATCH DEMANDS OF ELITE BEACH FOOTBALL NATIONAL TEAMS.

REIS, J., COSTA, J.1, PRATA, A.1, NASCIMENTO, L.1,3, BRITO, J.1

1.PORTUGAL FOOTBALL SCHOOL, FPF, OEIRAS, PORTUGAL; 2.CIPER, FACULDADE DE MOTRICIDADE HUMANA, UNIVERSIDADE DE LISBOA, LISBOA, PORTUGAL; 3.POLYTECHNIC INSTITUTE OF LEIRIA, LEIRIA, PORTUGAL

INTRODUCTION: Beach soccer is played by 5 players in a 35–37 m long and 26–28 m wide pitch covered with sand. It consists of three 12 minutes periods, with unlimited substitutions. It is characterized as an high intensity intermittent sport involving running, accelerations, jumps, and technical actions, hampered by the unstable surface (1). Current research does not provide information regarding the match demands of elite teams, especially in women (2). Therefore, we aimed to compare the match workload between male and female elite beach soccer players from national teams during official international competitions.

METHODS: Thirteen matches from two national teams which were top-three finishers at the European Beach Soccer League 2022 were analyzed during the competition (Women: 7 matches, 10 players, 42 observations; Men: 6 matches, 11 players, 46 observations). Only field players participating in more than 25% of each match time were included in the analysis. Players used 10-Hz global positioning system units during all matches. External load variables included total distance covered (TD), high-speed distance (HSD, >13 and >10 km/h for men and women, respectively) number of sprints (>18 and >16 km/h) (2,3), number of accelerations and decelerations (> 2 m/s2; > -2 m/s2) and maximal Speed (MS). All variables were analyzed for absolute values and normalized to effective time played, expect MS. A mixed model analysis was used to compare the aforementioned variables between sexes.

RESULTS: Men reached higher MS (22.5 ± 1.5 and 19.6 ± 1.5 km/h for men and women, respectively). On average, during the match, men completed significantly more HSD (350 ± 138 vs 172 ± 63 m); number of sprints (11.7 ± 8.8 vs 1.1 ± 1.1), sprint distance (102 ± 79.2 vs 8 ± 9.1 m) and number of accelerations and decelerations (83.2 ± 30.6 vs 39.4 ± 10.7, respectively) than women. There were no significant differences for TD between sex (2216 ± 648 vs 1890± 372 m). However, when normalizing for the effective time played (18.0 ± 6.1 vs 17.6 ± 3.7 min for men and women, respectively), men performed more TD (135 ± 29.9 and 112 ± 18.8 m/min), HSD (21.3 ± 8.1 and 10.9 ± 4.9 m/min), number of sprints (0.8 ± 0.8 and 0.6 ± 0.6 per min), accelerations and decelerations (5.0 ± 1.3 and 2.4 ± 0.8 per min).

CONCLUSION: Our findings describe and compared the physical match demands of elite men beach soccer players with women, both in volume and intensity. Although both National teams can be considered as elite, these differences could be due to the fact that women's beach soccer is less developed and amateur which can lead to fewer training opportunities and consequently less demanding physical match play.

References:

1. Costa et al. (2022); 2. Castellano et al. (2010); 3. Larsen et al. (2021)

Oral Presentations

OP-BM25 Biomechanics/Balance and Posture II

IS THE VESTIBULAR COMPONENT OF BALANCE AFFECTED BY ACUTE SLEEP IMPAIRMENT?

CIORCIARI, A.M., MULÈ, A., GALASSO, L., CASTELLI, L., ROVEDA, E., ESPOSITO, F., MONTARULI, A.

UNIVERSITY OF MILAN

INTRODUCTION: Balance can be defined as the ability of integrating vestibular, somatosensory, and visual afferents to maintain the body's center of gravity within the limits of stability. It depends on several factors, and many of them are closely related to the circadian preferences of the subject and to their rest-activity rhythm. Chronic poor sleep habits can worsen postural control, and recent studies have shown some effects, although controversial, also in acute (1). The aim of this study was to verify by an objective sleep and balance assessment whether the sleep of the night before the test can affect postural control.

METHODS: Forty-eight subjects (males = 24; females = 24; age = 22.1±3.2; BMI = 22.2±2.3) were recruited for this study. They underwent the modified Clinical Test of Sensory Interaction in Balance (2), able to discriminate the vestibular, proprioceptive, and visual balance components through a stabilometric platform by four different experimental conditions: eyes open on a rigid surface, eyes closed on a rigid surface, eyes open on a soft surface, eyes closed on a soft surface. Subjects had to wear an actigraph the night before the tests, which were performed at two different times of the day, at 09:00 AM and at 06:00 PM. Based on actigraph data and National Sleep Foundation cut-offs, participants were categorized as Bad Sleepers (BS = 5), Good Sleepers (GS = 17), and Intermediate Sleepers (IS = 26).

RESULTS: The results show that BS had a very higher Oscillation Index than both IS and GS (p = 0.01) in the PM session, while IS and GS showed no difference.

CONCLUSION: It seems that bad sleep, also in acute, can heavily affect balance in its vestibular component, mainly during the afternoon. These findings can be useful to better understand the physiological relationship between sleep and balance, and may open a new approach to injury prevention in athletes and risk of fall in the elderly.

(1) Fullagar, H. H. K., Skorski, S., Duffield, R., Hammes, D., Coutts, A. J., & Meyer, T. (2015). Sleep and Athletic Performance: The Effects of Sleep Loss on Exercise Performance, and Physiological and Cognitive Responses to Exercise. Sports Medicine, 45(2), 161–186.

(2) Dawson N, Dzurino D, Karleskint M, & Tucker J (2018). Examining the reliability, correlation, and validity of commonly used assessment tools to measure balance. Health Science Reports, 1(12).

APPLICABILITY AND RELIABILITY OF A MACHINE LEARNING TECHNIQUE FOR THE ASSESSMENT OF HUMAN POSTURE

ROGGIO, F., TROVATO, B., MUSUMECI, G.

UNIVERSITY OF CATANIA

INTRODUCTION: Various methods exist to evaluate human posture, each with unique benefits and drawbacks. Recently, markerless methods combined with machine learning techniques have become a promising alternative due to their efficiency. MediaPipe, a sophisticated machine learning algorithm created by Googles research team, is engineered for precise tracking of body posture, capable of identifying 33 landmarks throughout the human body [1]. Other studies validated its accuracy in joint tracking technique against the gold standard Qualisys motion capture system, providing Pearson's correlation coefficients of 0.80 ± 0.1 for lower limbs and 0.91 ± 0.08 for upper limbs, indicating so, MediaPipes high reliability in estimating joint angles [2]. This study aimed to demonstrate the applicability and reliability of a machine learning method for the analysis of posture, provide normative data on the posture of healthy men and women, and also to investigate potential new posture patterns with the principal component and cluster analyses.

METHODS: Healthy participants (n=192) with a mean age of 26.4 ± 1.2 years, were photographed in the frontal, dorsal, and lateral views. The Student's t-test and Cohen's effect size (d) were used to evaluate sex differences in the postural parameters assessed. The Intraclass Correlation Coefficient (3,k) was used to evaluate the reliability of the measures in a subgroup of participants. We also conducted multivariate statistical techniques to highlight any alternative pattern within the sample. Both Principal Component Analysis and five clustering methods categorized participants into two distinct groups (CG1, CG2).

RESULTS: The data revealed sex differences, such as shoulder adduction angle (men = 16.12° ± 1.92°, women = 14.13° ± 1.53°, d= 1.14) and hip adduction angle (men = 9.90° ± 2.22°, women = 6.71° ± 1.53°, d= 1.67) while no sex differences were present for horizontal inclinations. The ICC results ranged from 0.67 to 0.95 supporting the reliability of the measures. The clustering analysis highlighted a shoulder-hip difference: 86.58 ± 10.73 normalized pixel distance for CG2 vs 57.51 ± 7.02 normalized pixel distance for CG1, with a significant effect size of d= 3.21.

CONCLUSION: This study introduces a novel unsupervised machine learning approach for postural analysis, offering significant clinical benefits by identifying specific postural categories and reducing subjectivity in evaluations. This method, efficient and non-invasive, has potential applications in physical therapy, ergonomics, and sports, aiding in personalized treatment plans.

1. Lugaresi C, et al. Mediapipe: A framework for building perception pipelines. arXiv preprint arXiv:190608172. 2019;

2. Lafayette TBdG, et al. Validation of Angle Estimation Based on Body Tracking Data from RGB-D and RGB Cameras for Biomechanical Assessment. Sensors. 2023;23:3.

THE EFFECT OF AERIAL YOGA ON POSTURAL CONTROL IN YOUNG ADULT FEMALE YOGI

LIANG, Y., HUANG, X.G., XI, Y.B.

ANHUI NORMAL UNIVERSITY

INTRODUCTION: Aerial yoga has the potential to stimulate the vestibular system due to the inverted nature and vertical acceleration associated with many of the fundamental skills. However, little research has been conducted on the effects of aerial yoga on postural control. It is not known how yoga exercise affects the stability of body posture due to the posture changes both on the ground (hatha yoga) and upside-down (aerial yoga). Postural control in the former relies on somatic sensory input while the latter induces challenges to vestibular sensory system. The purpose of this study was to determine the effect of aerial yoga on postural stability in female hatha yogi, and to determine whether typical linear measures and nonlinear measure (e.g. sample entropy) can differentiate between the postural control.

METHODS: 24 age and stability matched female hatha yogi were randomly divided into two groups for a further 8 weeks training. One group continued to train hatha yoga whilst the other trained aerial yoga for two 60 mins sessions per week. Pre and post-intervention both groups completed static standing tests in eyes-open and eyes-closed conditions for 20s (tree posture) and 30s (bipedal and unipedal) on a force plate sampling at 1000 Hz. Linear measures included sway length and average sway velocity in the anterior-posterior and medio-lateral directions. The nonlinear measure was the sample entropy of the centre of pressure time-series in the anterior-posterior and medio-lateral directions. Group comparisons were accomplished via pairwise testing and effect size calculations.

RESULTS: Linear and nonlinear measures showed that both types of yoga improved postural stability in the anterior-posterior and medial-lateral directions. Sample entropy in the medio-lateral direction in unipedal stance was significantly larger in the eyes-open condition compared to the eyes-closed condition for the hatha group.

CONCLUSION: Both aerial and hatha yoga exercises can improve static postural control of young females. However, in comparison with hatha yoga, aerial yoga does not produce a superior improvement. Vestibular and proprioceptive adaptation can alter sensory weighting in postural control and the effect of the latter appears stronger in quiet unipedal standing.

TRANSFER AND RETENTION OF LOCOMOTOR ADAPTATIONS FROM VIRTUAL-BASED PERTURBATION EXERCISE TO THE PHYSICAL WORLD

WERTH, J., EPRO, G., WEBER, A., PLACIDO, M., HARTMANN, U., KARAMANIDIS, K.

LONDON SOUTH BANK UNIVERSITY

INTRODUCTION: The use of virtual reality (VR) in locomotor exercise is demonstrating potential for rehabilitating neuromusculoskeletal disorders, with a focus on enhancing neuromuscular function during movement(1). However, to ensure these VR-acquired skills are beneficial for daily life locomotion, a deeper understanding of whether skills transfer in the physical world is necessary. This study aimed to explore the transfer and retention of locomotor adaptations and improvements in stability recovery from exercised tripping simulations and obstacle perturbations in VR to the physical world.

METHODS: Fifty-two healthy adults, aged 20 to 34 years, were divided into two exercise groups: TRP, focusing on visually induced tripping simulations that involved tilts of the VR world around three axes, and OBS, involving sudden virtual obstacles on the treadmill, along with a control group undergoing unperturbed gait in VR. Subsequently (transfer), and one week later (retention) participants in the TRP group and controls were exposed to mechanically induced tripping during treadmill walking, while those in the OBS group and controls encountered a physical obstacle with similar dimensions to those in VR. Gait kinematics were analysed on both occasions using an optical motion capture system. Lower limb joint

kinematics during the swing phase of recovery steps (tripping task) or crossing leg (obstacle crossing task) were compared between virtual and physical conditions using statistical parametric mapping. Performances and adaptations in locomotor safety and effectiveness were analysed by using the margin of stability (MoS; tripping) and toe clearance (obstacle crossing).

RESULTS: Repeated exercise of visually induced tripping as well as obstacle simulations led to adaptive changes in lower extremity joint kinematics and enhanced performances, i.e. MoS increased on average by 5cm in TRP ($p<0.05$), and toe clearance decreased by 4.7cm in OBS ($p<0.001$).

During subsequent mechanically induced tripping, the TRP group revealed a higher MoS compared to controls ($p<0.05$), with no decline one week later. In contrast, the OBS group crossed physical obstacles with a lower toe clearance compared to controls but revealed significantly higher values compared to the VR condition ($p<0.01$).

CONCLUSION: This studys findings indicate that adaptive changes in locomotor safety and effectiveness enhanced through repeated visual gait perturbations in virtual reality can partly be transferred and retained in physical scenarios. However, transferability appears to be constrained when navigating obstacles during walking, which may stem from a discrepancy in visual perception and motor response between virtual and physical environments. (1) Janeh & Steinicke, 2021, Front Hum Neurosci

INTERSESSION RELIABILITY OF A COMPUTERIZED EYE-HAND COORDINATION TEST

DI ROCCO, F., PAPALE, O., FESTINO, E., DE MAIO, M., FUSCO, A., CORTIS, C.
UNIVERSITY OF CASSINO AND LAZIO MERIDIONALE

INTRODUCTION: Computerized wobble boards (WB) offer a novel method for assessing dynamic balance in the lower limbs, providing the advantage of evaluations outside the traditional laboratory settings. Although the reliability and validity of these devices in evaluating lower limb balance have been well documented, their potential for assessing eye-hand motor coordination remains unexplored. In order to address this gap in the literature, our study aimed to establish the intersession reliability of WB assessments for eye-hand motor coordination in young healthy subjects.

METHODS: 53 subjects (age:24.8±2.7years; body mass:67.7±13.3kg; height:169.8±9.5cm) were evaluated across two sessions separated by a 48-hour rest period. A custom software connected to a laptop for the WB test, displaying real-time performance on a monitor, was used. The software setup included a Motion Marker (MM) and a Target Zone (TZ). Subjects performed four 15-second trials for each limb, with a 30-second recovery period between trials. During the trials, the tested limb was positioned at a 90° on the WB. Subjects were instructed to move the MM in various predefined patterns (clockwise (C), counterclockwise (CC), antero-posterior (AP), medial-lateral (ML)) on the screen, aiming to maintain it within the TZ for as long as possible while standing. Times (s) for the dominant and non dominant limbs under each condition were recorded. The intersession reliability was assessed using Intraclass Correlation Coefficient (ICC), Standard Error of Measurement (SEM), and 95% Minimal Detectable Change (MDC95).

RESULTS: Results revealed good to excellent intersession reliability for dominant limb (ICC range:0.62-0.80; SEM range:1.15–1.77), except in the AP condition (ICC=0.52), and for non dominant limb (ICC range:0.72–0.78; SEM range:0.96–2.14), except in the ML condition (ICC=0.62). For the dominant limb, MDC95 ranged from 2.28 to 3.03, whereas for the non dominant ranged from 1.90 to 4.25.

CONCLUSION: Findings shows the reliability of WB eye-hand motor coordination assessments, crucial for tasks requiring complex movement patterns. The low SEM highlights precision, while differences in MDC95 shows different sensitivity to performance changes across limbs and conditions. The dominant limb smaller MDC95 values shows a greater ability to detect performance changes, critical for adapting athletic training, especially in sports like basketball where such coordination is crucial. The results might allow coaches to adapt training to enhance weaker areas, mainly in the non dominant limb, improving overall performance in skills like dribbling. Beyond sports, WB testing might uncover eye-hand coordination deficits in students, suggesting adjustments in eye-hand training and lecture strategies to increase cognitive skills such as attention and memory, thus enhancing focus and note-taking. This highlights WB evaluations role in adapting athletic and academic approaches, addressing specific needs to optimize physical and cognitive development.

Oral Presentations

OP-AP37 Track and field

SPATIOTEMPORAL ANALYSIS OF 289 WORLD-CLASS 400-METER RUNNING PERFORMANCES

SCHWARZ, Y., WIEDENMANN, T., LEMBERG, P., BÖDDEKER, K., CHRISTMANN, R., SCHWARZ, A., REIN, R., BRAUNSTEIN, B.
KARLSRUHE INSTITUTE OF TECHNOLOGY

INTRODUCTION: Sprint running performance is the product of the spatiotemporal variables step frequency [SF] and length [SL].[1] While the 100-m dash has been in the spotlight of biomechanical investigations, less research has looked at the 400-m distance. Hence, purpose of this study was to extract spatiotemporal parameters from a large sample of world-class 400-m performances and gain insights on potential determining factors.

METHODS: Publicly available video footage was obtained from 84 world-class 400m races (Olympics, World & Europ. Champ., Diamond League), including 289 performances of 101 athletes (m=51; f=50) between 2015 to 2020. Footage was only considered valid if athletes were visible without interruption and if markings were visible every 100m. Time and step count were extracted visually and mean velocities, SL and SF calculated for each 100m section of the race. Differences in performance and sex were evaluated via Welch two sample t-test for every section.

RESULTS: Over the entire 400m distance, mean velocity was 8.85±0.15 m·s-1 for male and 7.81±0.14 m·s-1 female sprinters. On average male athletes displayed a SL of 2.31±0.11 m and SF of 3.84±0.17 steps·s-1, while female athletes had a mean SL of 2.09±0.09 m and SF of 3.75±0.13 m·s-1. Greater differences between men and women were found in SL (11.8%; p<0.001) than in SF (2.4%; p<0.001) and even if SL was normalized to body height (3.9%, p<0.001). Both sexes showed highest velocity between 100m and 200m (m=9.68±0.26 m·s-1; f=8.43±0.22 m·s-1) and a decrease in velocity thereafter (m=-20.7%, f=-22.8%). The velocity decrease in the 2nd half of the race seems to coincide with decreases in SF (m=-11.7%, f=-10.9%) and SL (m=9.2%, f=8.9%). In relation to their mean race velocity, the 1st 100m were slightly faster in women (104.7% vs. 103%, p<0.001), whereas the 2nd (109.3% vs. 107.9%, p<0.001) and 3rd (101.2 vs. 100.3%, p<0.001) 100-m sections were faster in men. No difference was found for the last 100m section (89.0 vs. 89.4%, p=0.23). When the fastest male (n=20) and females (n=21) performances were compared with the slowest (n=19; n=21), the greatest group differences for both sexes were found to be mean SL (m= 5.52%, p<0.001; f= 6.00%, p<0.001) and relative velocity during the final 100m (m=1.96%, p=0.04; f=1.72%, p=0.04).

CONCLUSION: Previously reported, fast first half and decrease in velocity during the second half of world-class 400-m running, can be confirmed for both sexes by this analyses.[2,3] The velocity decrease coincides with reduction in SL and SF, which are likely caused by decreased force production and muscular acidosis.[4] However, higher mean SL in all sections seems to distinguish superior performance on a world-class level, while SF plays a subordinate role. Additionally, a more even positive pacing strategy might be optimal for 400-m performance.

1) Haugen et al. (2019) Eur J Appl Physiol

2) Pollitt et al. (2017a) World Athletics

3) Pollitt et al. (2017b) World Athletics

4) Nummela et al. (1992) J Sports Sci

3K RACE MEAN SPEED IS NOT A RELIABLE PARAMETER FOR THE ESTIMATION OF MAXIMAL AEROBIC SPEED IN SUB-ELITE MIDDLE-DISTANCE RUNNERS

BUDEL, L., NARDELLO, F., BETTEGA, S., SCHENA, F., TARPERI, C.

UNIVERSITY OF VERONA

INTRODUCTION: 3000 m track race intensity (s3K) is a popular and easy method commonly used by coaches both to estimate an athlete's Maximal Aerobic Speed (MAS) and to prescribe High-Intensity Interval Training (HIIT) (1). The 3000m race involves aerobic and anaerobic energy sources (2). MAS does not consider the anaerobic contribution once the plateau has been reached, while the ramp peak velocity (vPeak) also considers this anaerobic contribution. The aim of this study was to compare the ecological performance (s3K) with MAS and vPeak in middle-distance runners with different profile characteristics. We hypothesized that s3K would be more similar to vPeak (i.e., by considering the anaerobic pattern over the plateau) rather than MAS.

METHODS: A sample of thirty sub-elite middle-distance male runners (22.5±4.73 years, VO2max: 71.0±5.31 mlO2/min/kg) was analyzed: i) as a whole group; ii) by separating athletes into 2 subgroups according to their race characteristics. In particular, 15 runners were classified as Endurance-based group (3000-5000 m) (VO2max: 73.7±5.27 mlO2/min/kg), while the Speed-based group (800-1500 m) involved the other athletes (67.9±3.37 mlO2/min/kg). For the laboratory session, a ramp test was performed on a motorized treadmill (H/P Cosmos Saturn) and metabolic data (CPET, Cosmed) were collected to obtain MAS and vPeak. For the ecological test, all athletes ran a 3000 m race with pacers in an official competition (2023-2024). The s3K was obtained by knowing the distance and the official Federation timing. To assess the differences among speeds, a series of t-tests for paired samples has been conducted (p<0.05).

RESULTS: By considering the whole group, the average s3K, MAS, and vPeak were 20.5±0.74, 19.4±0.82, and 20.6± 0.80 km/h, respectively. In the Endurance-based group, s3K, MAS, and vPeak were 20.5±0.75, 19.5± 0.96, and 20.6± 0.92 km/h; in the Speed-based, they were 20.4±0.74, 19.25± 0.64, and 20.7±0.67 km/h. MAS was significantly different from s3K in all the investigated populations (p<0.001 for all the paired comparisons). On the other side, vPeak is not significantly different from s3k in Endurance-based group (p=0.857), as well as in the whole group (p=0.115), while a poor significant trend (p=0.041) has been observed for the Speed-based runners.

CONCLUSION: Both assessment and prescription of workouts at MAS starting by a 3000m mean speed lead to errors and inaccuracies regardless of the runner's characteristics. Our data showed that s3K was always faster than MAS. From practice, using s3K to prescribe HIIT could lead to excessive lactate buildup. Such accumulation could negatively interfere with time spent above 90% VO2max by limiting adaptations whether the goal of the session is to stimulate aerobic power (3). Therefore, we recommend using a direct measurement to assess maximal aerobic speed and to prescribe HIIT in sub-elite middle-distance runners.

1-Haugen T, et al. Sports Med. 2021

2-Pèrronet F et al. J Appl Physiol. 1989

3-Billat LV, et al. Sports Med. 19

NATIONAL-STANDARD MIDDLE-DISTANCE RUNNERS MAINTAIN MAXIMAL 1500 M RUNNING PERFORMANCE ON SUCCESSIVE DAYS

BIRDSEY, L.P., DOSSANTOS, T.1, EVANS, D.1, RUNACRES, A.1, WESTON, M.1,2, FIELD, A.1

1. MANCHESTER METROPOLITAN UNIVERSITY INSTITUTE OF SPORT. 2. UNIVERSITY OF EDINBURGH

INTRODUCTION: To reach the final of high-standard middle-distance running events, athletes must perform two rounds of competition separated by ~24h. As some athletes slow in the final [1] it is unclear as to why performance changes between rounds. Our aim therefore was to examine the impact of successive 1500 m time-trials on running performance, physiological, metabolic, neuromuscular, and perceptual responses.

METHODS: Using a within-subjects design, twelve national-standard (10 male, 2 female, mean age ± SD: 27 ± 7 years, mass: 66 ± 8 kg, height: 1.8 ± 0.1 m, season's best 1500 m time: 244.1 ± 18.8 s) middle-distance specialists completed a familiarisation 1500 m time trial (260.6 ± 21.3 s) followed by two 1500 m time-trials, separated by 24 h (during which time refrained from exercise or specific recovery practices), on a motorised treadmill (Gaitway 3D, h/p/cosmos sports and medical GmbH, Germany). Wellbeing (mood, fatigue, confidence, soreness, motivation) and neuromuscular performance, assessed via the countermovement jump (CMJ) using a portable force platform (HD Gen4, Hawkin Dynamics, USA), were measured prior to both time-trials. Respiratory gases, measured continuously (Vyntus CPX Metabolic Cart, Vyaire Medical Inc., USA), and session and differential ratings of perceived exertion (RPE, CR100®) confirmed no between-trial differences during a standardised 12.5-min warm up. During the time-trials, speed was controlled by athlete's treadmill position (i.e., moving forwards to increase speed). Respiratory gases were measured continuously, and session (sRPE) and differential RPE (breathlessness [RPE-B], leg muscle exertion [RPE-L]) collected two min post. Blood lactate concentration (Biosen C-line, EKF Diagnostics, Germany) was measured post-exercise until a peak was obtained. All variables were log transformed before analysis with mixed linear models (fixed effect = trial, random intercept = athlete) with effect uncertainty expressed as 95% confidence intervals (95%CI).

RESULTS: Pre time-trial CMJ was consistent between days (trial 1: 33 ± 5 cm, trial 2: 33 ± 5 cm, effect -0.1%: 95%CI -3.0% to 3.0%), whereas between-day effects in wellbeing were inconsistent and imprecise (range -4%;-17%, 10% [motivation] to 24%; -12%, 74% [mood]). Running performance (260.6 ± 21.3 s, 259.1 ± 22.6 s, -0.6%; -1.6%, 0.3%), mean VO2 (55.8 ± 3.9 ml·kg-1·min-1, 56.2 ± 4.2 ml·kg-1·min-1, 0.2%; -1.4%, 1.8%), heart rate (175 ± 7 b·min-1, 176 ± 6 b·min-1, -0.6%; -1.0%, -0.2%) and peak blood lactate (14.9 ± 2.3mM, 14.9 ± 1.8 mM, 0.8%; -0.6% to 8.1%) were consistent between trials. For RPE, effects were larger but with substantial imprecision (range 3.2%; -1.8%, 8.4% [sRPE] to 7.8%; -1.0%, 17.3% [dRPE-B]).

CONCLUSION: National-standard middle-distance runners can maintain maximal 1500 m running performance on successive days. Further investigations of track-based competitions are required to fully understand the effects of successive day running performance.

[1] Hanley and Hettinga (2018)

PSYCHOLOGICAL FACTORS ARE PROSPECTIVELY ASSOCIATED WITH THE MUCOSAL IMMUNE RESPONSE TO EXERCISE AND RESPIRATORY INFECTION RISK POST MARATHON

HARRISON, S., EDWARDS, J.P., ROBERTS, R., WALSH, N.P.

BANGOR UNIVERSITY

INTRODUCTION: Psychological factors, such as stress, anxiety and low mood, are widely considered to influence immunity and infection susceptibility in rested individuals. However, whether psychological factors influence the mucosal immune response to endurance exercise and subsequent infection risk remains unknown. In Study 1, we prospectively examined the association between psychological factors, mucosal immunity and respiratory infection risk in response to a marathon race. In Study 2, we further examined the observed association between psychological factors and the mucosal immune response to exercise shown in Study 1, in a rigorously controlled-laboratory setting.

METHODS: In Study 1, 406 marathon runners (67% male) consented to providing daily respiratory infection symptom data for two weeks before and after a mountainous marathon race. In Study 2, 45 healthy young adults (51% male) consented to complete exercise (60 min running at 65% VO2peak) under laboratory conditions controlling diet, hydration, and time of day. In both studies, measures of anxiety, total mood disturbance and psychological stress were made, and saliva samples were collected pre- and post-exercise and analysed for secretory immunoglobulin A (SIgA). Logistic and linear regressions were performed with covariates including: age; sex; body mass index; respiratory infection pre-marathon; race duration and sleep (Study 1 only).

RESULTS: After accounting for covariates, trait anxiety (odds ratio = 3.2) and total mood disturbance (odds ratio = 3.3) assessed before the marathon were significant risk factors for post-marathon respiratory infection (Study 1; $P<0.05$). Further, after accounting for covariates, greater levels of trait anxiety, total mood disturbance and psychological stress were also significantly associated with a greater post-marathon reduction in saliva SIgA secretion rate (Study 1; trait anxiety Δ $R^2=0.029$, total mood disturbance Δ $R^2=0.037$, psychological stress Δ $R^2= 0.044$). In a rigorously controlled-laboratory setting, psychological factors were also significantly associated with the saliva SIgA secretion rate response to exercise in men (Study 2; trait anxiety r= -0.55, total mood disturbance r= -0.61, psychological stress r= -0.66, state anxiety r= -0.65).

CONCLUSION: Psychological factors are prospectively associated with the mucosal immune response to exercise and increased respiratory infection risk after a marathon. Where possible, athletes should take steps to minimise exposure to high stress and anxiety and improve mood to support immune health and infection resistance. Researchers should take account of psychological factors when examining the mucosal immune response to exercise.

Oral Presentations

OP-MH40 Exercise and cardiovascular responses

COMPARISON BETWEEN THE EFFECT OF AEROBIC AND RESISTANCE EXERCISE WITH DIFFERENT INTENSITIES ON POST EXERCISE BLOOD PRESSURE RESPONSES IN NORMOTENSIVE SUBJECTS

AL-HORANI, R.1, MALKAWI, T.1

DEPARTMENT OF SPORTS SCIENCE, YARMOUK UNIVERSITY, JORDAN

INTRODUCTION: The variation in resting blood pressure among individuals engaging in aerobic and/or resistance exercise training might be due to the acute drop in blood pressure after exercise. Therefore, this study aimed to compare the acute effect of resistance and aerobic exercise with different intensities on post-exercise blood pressure responses.

METHODS: Seven normotensive and physically active males participated in this study (age: 25.3 ±6.2; Body mass index (BMI): 23.7 ± 2.6). Baseline blood pressure, heart rate (HR), heart rate reserve (HRR), and maximum strength (1RM) of 6 resistance exercises were measured. Accordingly, participants performed two 40-min cycling sessions at 60% of HRR (C60) and 75% of HRR (C75), and two sessions of resistance exercise (6 exercises) at 60%1RM (RE60) and 75%1RM (RE75) in random order. After each exercise session, participants sat for 60 min, during which blood pressure, HR, and the rate of perceived exertion (RPE) were measured at 0, 15-, 30-, 45-, and 60 minutes post-exercise. The anxiety state Y1 was obtained at 0-, 30-, and 60-min post-exercise.

RESULTS: Systolic blood pressure decreased significantly at 15 – 60 min post C75 and 60 min post RE75. Diastolic blood pressure decreased at 0-, 15-, and 30-min post-RE60 and at 30 min post-RE75 only, and did not decrease after C60 and C75. Mean arterial pressure was decreased at 0 and 15 min post-RE60 and 15 post-RE75 without changes after C60 and C75. The decrease in mean arterial pressure was lower in RE60 and RE75 compared to C60 and C75. There were no changes in the state of anxiety Y1.

CONCLUSION: We conclude that higher-intensity aerobic exercise has the greatest effect on lowering systolic blood pressure. In contrast, low-intensity resistance exercise is more effective in reducing diastolic blood pressure and mean arterial pressure.

PILOT STUDY ASSESSING THE EFFECTS OF TWO REGIMENS OF COMBINED EXERCISE ON LEFT ATRIAL FUNCTION IN PATIENTS WITH ISCHEMIC CARDIOMIOPATHY

CAMINITI, G., VOLTERRANI, M., IELLAMO, F., SILVESTRINI, M., GISMONDI, A., DANTONI, M., MORSELLA, V., PERRONE, M.A.

SAN RAFFAELE OPEN UNIVERSITY OF ROME; IRCCS OSPEDALE SAN RAFFAELE, ROME; UNIVERSITY OF ROME TOR VERGATA

INTRODUCTION: Purpose: Left atrial dysfunction has showed a prognostic role in patients with ischemic cardiomyopathy (ICMP) and is becoming a therapeutical target for pharmacological and non-pharmacological interventions. The effects of exercise training on atrial function in patients with ICMP has been poorly investigated. In this study we investigated the effects of a 12-weeks combined exercise training (CT) program on left atrial function in patients with ICMP

METHODS: Methods: The study included 45 stable patients, who were randomly assigned to one of the following three groups: fifteen to a supervised CT with low frequency sessions (two/week) (CTLF); fifteen to supervised CT with ahigh frequency sessions (three/week) (CTHF); a third group followed contemporary exercise preventive guidelines at home (control). Before and after training, all patients performed a symptoms-limited exercise test on a treadmill and an echocardiography. The training included aerobic continuous exercise and resistance exercise. Intra-group and inter-group comparisons were made by analysis of variance (ANOVA).

RESULTS: At 12-weeks, the duration of ergometric test increased significantly in the CTLF and CTHF groups compared to control (ANOVA p <0.001). Peak atrial longitudinal strain (PALS) presented a significant increase in the CTHF group and were unchanged in the CTLF and control groups (ANOVA p 0.003). Peak atrial contraction strain (PACS) presented a significant greater increase in the CTHF compared CTLF and control. Left ventricular global longitudinal strain, increased significantly in both CTHF and CTLF compared to control (ANOVA p 0.017). Systolic blood pressure decreased in CTHF and CTLF while was unchanged in control. No side effects leading to discontinuation of training were observed

CONCLUSION: We demonstrated that a CT program effectively improved atrial function in ICMP in a dose-effect fashion. We think that this result can help with programming exercise training in these patients. Our results should be validated in further larger trials

ASSOCIATION BETWEEN MOVEMENT BEHAVIOURS AND VASCULAR HEALTH: ORISCAV-LUX 2 CROSS-SECTIONAL STUDY

PORTUGAL, B., BACKES, A., COLLINGS, P.J., LE COROLLER, G., MALISOUX, L.

LIH

INTRODUCTION: Cardiovascular diseases are a leading cause of death and disability worldwide. The pulse wave velocity (PWV), a non-invasive measure and the gold standard of arterial stiffness assessment is one of the earliest indicators of cardiovascular risk. Previous studies found that a physically active lifestyle is associated with a decreased risk of cardiovascular diseases. However, most studies investigated the time spent in moderate-to-vigorous physical activity (MVPA), which represents a small portion of the daily time compared with other movement behaviours such as sedentary time. Hence, this study investigate the relationship between movement behaviours, taking its complex nature into account, and arterial stiffness in the Luxembourgish population.

METHODS: We included 988 participants from the second wave (2016-2018) of the "Observation of Cardiovascular Risk Factors in Luxembourg" (ORISCAV-LUX 2) study, who had a physical examination, agreed to wear an accelerometer for 1 week and presented no personal history of myocardial infarction or stroke. PWV was assessed with the validated Complior instrument. Movement behaviour was measured with accelerometers (ActiGraphTM GT3X+). Accelerometer data was used to calculate wearable-specific indicators of physical activity (PA) behaviour which describe the distribution of PA intensities, activity accumulation, and the temporal correlation and regularity of movement behaviour[1]. Since the indicators of movement behaviour are highly correlated, elastic-net models were used, and sex-stratification was performed.

RESULTS: Participants were on average 50.4 years and 53.6% were females. Compared to men, women presented a lower intensity gradient, shorter median sedentary bout length, a lower number of prolonged sedentary bouts (>30min), a lower proportion of sedentary bouts lasting at least 60 min, and a higher average 24h acceleration, scaling exponent alpha (>120 min) and autocorrelation at lag 24h. Our findings revealed distinct associations between movement behaviours and PWV in men and women. In women, a longer median MVPA bout length and a higher scaling exponent alpha (higher long-range temporal correlation) at larger time scales (>120 min) were associated with a lower PWV. In men, a longer median sedentary bout length and a greater proportion of sedentary time accumulated in bouts longer than 60 min were associated with a higher PWV.

CONCLUSION: Our study underscores the sex differences of the association between movement behaviour with PWV. We highlight the importance of engaging in regular physical activity and reducing sedentary behaviour to promote a lower PWV and consequently enhance vascular health in adults. Longitudinal studies are warranted to confirm our results and better understand the association between movement behaviour and arterial stiffness.

1.Backes, A. et al., Advanced analytical methods to assess physical activity behavior using accelerometer time series: A scoping review. Scand J Med Sci Sports, 2022. 32(1):p.18-44.

CARDIO-RESPIRATORY RESPONSE DURING DIFFERENT PROTOCOLS OF DEEP WATER RUNNING VS INDOOR CYCLING IN HEALTHY ACTIVE SUBJECTS

CARPENTIER, M., NOISET, M., FAORO, V.

UNIVERSITÉ LIBRE DE BRUXELLES - ULB

INTRODUCTION: Running sports often lead to lower limb mechanical injuries. Unloaded training, such as indoor cycling (IC), are often advised during recovery, to limit cardio-pulmonary capacity deconditioning with limited mechanical stress(1). Deep water running (DWR) is an alternative training method to reduce low-limb overload, improve muscle strength(2) and balance(3), with greater muscular forces than in air(4). While validated DWR training protocols still need to be established, we compared the cardio-pulmonary response during exercise sessions of DWR vs IC. It also remains unclear if sessions need to be calibrated on heart rate (HR) or oxygen consumption (VO2).

METHODS: 15 healthy active subjects were enrolled in the study; 22±3 yo, 53% women, 43±7 ml/min/kg maximal VO2 measured during cyclo-ergometric cardio-pulmonary exercise test (CPET) which also allowed determination of HR and VO2 at the first ventilatory threshold (VT1). All subjects performed randomly one IC and DWR continuous exercise session calibrated on HR at VT1 (respectively IC(HR) and DWR(HR)) consisting of: 5-minutes warm-up at 80% of heart rate (HR) at the first ventilatory threshold (VT1), followed by 2 sets of 10 minutes at 100% HR@VT1 separated by 2 minutes rest. A subgroup of 7 subjects performed an additional DWR session calibrated by VO2 at VT1 (DWR(VO2)). HR, ventilation (VE) and gas exchange were measured continuously during CPET and DWR/IC sessions, with blood lactate levels measured 30s after exercise. When comparing DWR(HR) with DWR(VO2) values are given as med [Q1; Q3].

RESULTS: At identical exercise HR, VO2 was higher during DWR(HR) (38±9 ml/min/kg; 88% of VO2max) as compared to IC(HR) training (31±6 ml/min/kg; 72% of VO2max, p<0.0001) as well as VE (DWR(HR) : 74±2 L/min, 60% of VEmax vs IC(HR) : 54±6 L/min, 36% of VEmax, p<0.0001) with no difference in lactate concentrations (DWR(HR) : 3.9±1.7 mmol/L, vs IC(HR) : 3.6±2 mmol/L). Higher VE (p=0,047) (DWRHR : 80 [57; 84] L/min, DWR(VO2): 50 [44; 55] L/min) and higher HR (p=0,047) (DWRHR : 143 [138; 157] bpm, DWR(VO2) : 113 [99; 158] bpm) were observed during DWR(HR) compared to DWR(VO2), with a greater respiratory exchange ratio (RER) for DWR(HR) (p=0,03) (0.92 [0.86; 0.96] vs. 0.81 [0.75; 0.88]) but with no difference in lactate concentrations (DWR(VO2) : 2.7 [1.1; 2.9] mmol/L).

CONCLUSION: DWR(HR) reaches higher exercise intensity, as measures by VO2 and VE levels, compared to IC(HR), but with identical lactate production. This is likely attributed to the chronotropic response of hydrostatic pressure inherent in DWR, which enhances venous return and stroke volume. The validation of this hypothesis through DWR(VO2) underscores the

necessity of acquiring detailed knowledge regarding the physiological effects of each exercise modality. It seems therefore important to consider accurately adapting DWR training programs to meet specific performance objectives and optimize training/rehabilitation outcomes.

1 Glass, 2 Foley, 3 Simmons, 4 Miyoshu

EFFECTS OF MEASUREMENT POSTURE ON A CENTRAL ARTERIAL STIFFNESS

OGOH, S., KARAKI, M., KUNIMATSU, N., WATANABE, K., TOMOTO, T., FUKUIE, M., SUGAWARA, J.
TOYO UNIVERISTY

INTRODUCTION: Previous studies have reported an elevation in carotid-femoral pulse wave velocity (cfPWV), considered an index of arterial stiffness, during upright posture compared to the supine position. This suggests that the upright position acutely induces arterial stiffening. However, evidence supporting this assertion has not been presented. This study aims to investigate aortic impedance, a more rigorous index of arterial stiffness evaluated from the dynamic blood flow-pressure relationship, to determine whether cfPWV accurately reflects arterial stiffness in the seated position.

METHODS: Twenty young, healthy subjects (14 males and 6 females) underwent arterial stiffness measurements in both supine and seated positions to validate the credibility of alterations in cfPWV specifically. Arterial stiffness in both positions was evaluated using aortic impedance measured with applanation tonometry and ultrasonography, as well as cfPWV using applanation tonometry.

RESULTS: Similar to a previous study, cfPWV values significantly increased in the seated position compared to the supine position (supine vs seated; 5.41±0.62 vs 6.19±0.77 cm/s, $P < 0.001$). However, there were no significant differences in aortic impedance between the two positions (333±94 vs. 363±134 dyne-s/cm3, $P = 0.259$).

CONCLUSION: The findings of the present study suggest that changes in body position may not lead to immediate changes in arterial stiffness. This implies that measuring cfPWV during the supine position is crucial for accurately identifying arterial stiffness.

Oral Presentations

OP-MH39 Exercise and Sarcopenia

PUTZ: A NEW MITOCHONDRIAL MICROPROTEIN AND A MOLECULAR TARGET IN SARCOPENIA AND FRAILTY

KUMAGAI, H., MILLER, B., KIM, S.J., WAN, J., RAMIREZ, R., MEHTA, H., YEN, K., COHEN, P.
UNIVERSITY OF SOUTHERN CALIFORNIA

INTRODUCTION: Skeletal muscle dysfunction, known as sarcopenia, not only impairs physical function but also increases the risks of morbidity and mortality. Previous approaches demonstrated that mitochondrial dysfunction could be a trigger of muscle loss, however, the precise link between mitochondria and skeletal muscle atrophy has not been fully elucidated. Until recently, mtDNA was considered to encode only 13 proteins. However, over the past decade, multiple, previously unannotated peptides called mitochondrial microproteins, such as Humanin, MOTS-c, SHLPs, and SHMOOSE were identified to be encoded from mtDNA-encoded small open reading frames (smORFs). Here, we discovered a novel mitochondrial microprotein that negatively regulates skeletal muscle by analyzing mitochondrial-focused genetics and transcriptomics data.

METHODS: We analyzed publicly available genetic and transcriptomics datasets to identify a novel mitochondrial microprotein. To examine its biological function, we utilized mouse and human skeletal muscle cells, as well as young and aged mice.

RESULTS: We observed several SNPs related to skeletal muscle mass and function by analyzing mitochondrial genetic data. Interestingly, two of these SNPs were within an ORF that putatively encodes a new microprotein resulting in amino acid substitutions of this peptide. We named this new microprotein PUTZ (Peptide Under the alanine Transfer RNA Zone). Furthermore, mRNA expression of PUTZ in skeletal muscle is negatively correlated to physical fitness in human subjects. The mRNA expression levels of PUTZ were also elevated in elderly subjects, obesity, and in individuals subjected to bed rest. Expression of PUTZ mRNA was decreased by exercise training. We could detect PUTZ by mass spectrometry in human skeletal muscle cells. In skeletal muscle cells, PUTZ treatment significantly decreased MTT, oxygen consumption rate, myotube size, and muscle hypertrophy-related AKT signaling. In young mice, one month of PUTZ treatment significantly reduced skeletal muscle mass, and strength, while increasing fat mass and biomarkers of insulin resistance and inflammation. We also observed similar phenotypes in old mice. An unbiased RNA sequencing approach demonstrated that PUTZ downregulated multiple genes related to muscle cell differentiation and extracellular matrix organization. We examined the effect of PUTZ treatment on skeletal muscle and confirmed that a significant effect on suppressing the differentiation of skeletal muscle cells. Importantly, PUTZ-neutralizing antibody treatment exhibited the opposite biological actions to the PUTZ treatment in human skeletal muscle cells, by increasing metabolism and promoting muscle differentiation.

CONCLUSION: In summary, PUTZ is a novel mitochondrial microprotein that negatively regulates skeletal muscle function and PUTZ inhibition represents a novel therapeutic strategy for sarcopenia and frailty.

PREVALENCE OF SARCOPENIA AMONG SLOVENIAN OLDER ADULTS AND MUSCLE QUALITY ASSESSMENT WITH TENSIOMYOGRAPHY

PUŠ, K., ŠIMUNIC, B.
SCIENCE AND RESEARCH CENTER KOPER

INTRODUCTION: Sarcopenia affects between 10 and 27 % of the aged population, depending on the used classification protocol. To date, despite the burden of the disease, there is no unified classification protocol to be used in clinical practice. Further, the data about sarcopenia prevalence in Slovenia does not exist which highlights the need for further research in this area. Globally, there are different protocols in use, for European population most used are two (2010 and 2019) from European Working Group on Sarcopenia in Older People (EWGSOP). The latest, EWGSOP2, emphasizes the muscle quality at a confirmatory stage. And since muscle quality should reflect muscle composition and architecture, Tensiomyography (TMG) plays an important candidate for that purpose. Therefore, the aim of our study is twofold: 1) to present the agreement between the EWGSOP sarcopenia classification protocols on Slovenian older adults and 2) to assess association between TMG-derived parameters and EWGSOP2 classification tests.

METHODS: The sample consisted of 611 participants (aged 71.9±8.3; 70 % females) which performed classification tests for sarcopenia and were classified regarding the presence of sarcopenia according to diferent protols (SDOC, EWGSOP, EWGSOP2, EWGSOP2 with SarCALF and without Sarc-F). We have used TMG to assess contractile properties in vastus lateralis (VL), biceps femoris (BF) and gastrocnemuis medialis (GM) of the right leg.

RESULTS: Prevalence of sarcopenia was 15.2 %, 11.5 %, 3.03 %, 3.34 % and 6.5 % for SDOC, EWGSOP, EWGSOP2, EWGSOP2 with SarCALF and EWGSOP2 without Sarc-F, respectively. Overall agreement between protocols was low (Cohen κ between .200 and .696). Radial amplitude of all three muscles was positively correlated with handgrip strength and gait speed (ps < .001; r between .167 and .370) and negatively with timed up-and-go and sit to stand test (ps < .001; r between -.294 and -.195), while delay time correlated negatively with hand grip strength and gait speed (ps < .001; r between -.396 and -.148) and positively with with timed up-and-go and sit to stand test (ps < .001; r between .153 and .363). Contraction velocity was found to have positive association with handgrip strength and gait speed (ps < .001; r between .225 and .356;) and negative with timed up-and-go and sit to stand test (ps < .001; r between -.311 and -.191). Overall correlations were low.

CONCLUSION: The findings of our study shed light on the prevalence of sarcopenia among the elderly population in Slovenia and offer valuable insights into the agreement between different classification protocols. TMG parameters were previously correlated with muscle fibre composition, muscle architecture and muscle atrophy, and we confirmed its correlation with sarcopenia classification tests in previous studies. Therefore, TMG should be considered to be valid for assessing muscle quality in sarcopenic population.

THE FRAIL-LESS (LESS SITTING AND SARCOPENIA IN FRAIL OLDER ADULTS) REMOTE INTERVENTION TO IMPROVE SARCOPENIA AND MAINTAIN INDEPENDENT LIVING VIA REDUCTIONS IN SEDENTARY BEHAVIOUR

BAILEY, D., HARPER, J., KILBRIDE, C., MCGOWAN, L.J., VICTOR, C., BRIERLEY, M., CHATER, A.M.
BRUNEL UNIVERSITY LONDON

INTRODUCTION: Sarcopenia is associated with ageing, leading to functional disability, dependence in activities of daily living, and frailty. Reducing and breaking up sedentary time is beneficially associated with sarcopenia and frailty outcomes. The aim of this study was to determine the feasibility, safety and acceptability of delivering and evaluating a remotely delivered sedentary behaviour intervention to improve sarcopenia and independent living in older adults with frailty.

METHODS: A two-arm randomised controlled feasibility trial was conducted in older adults with very mild or mild frailty. Participants were randomly allocated to the Frail-LESS (LEss Sitting and Sarcopenia in Frail older adults) intervention or usual care control group for 6 months. The intervention comprised tailored feedback on sitting, standing and stepping; a psychoeducation workbook centring on providing information, goal setting and action planning; one-to-one health coaching; online peer support; and a Garmin Vivofit wrist-worn device for self-monitoring sedentary time and steps. Feasibility was assessed via participant recruitment (% of eligible individuals recruited), retention and data completion rates. Acceptability was explored using interviews and safety evaluated in relation to pain, fatigue, unplanned healthcare utilisation and number of falls. Measures of sitting, standing, stepping (activPAL device) and sarcopenia were taken to descriptively (mean ± SD) evaluate potential changes in these outcomes.

RESULTS: The target sample size of n=60 participants (aged 74±6 years) was recruited. Participant recruitment and retention rates were 72% and 83%. Outcome measurement completion rates ranged from 70-100%. The trial was safe and acceptable in the context of randomisation to the intervention or control group and measurement procedures. Overall acceptability of the intervention was good with most participants perceiving it to have helped them reduce and/or break up their sedentary behaviour. The wrist-worn device and health coaching were the most acceptable and useful components. Acceptability of the workbook, tailored feedback and peer support was mixed. Descriptive analysis found that daily sitting was 25 ± 82.1 min/day lower in the intervention group and 6.4 ± 60.5 min/day higher in the control group at 6 months compared with baseline. The intervention group increased steps by 456 ± 2718 per day, while the control group reduced their steps by 245 ± 1977 per day. Hand grip strength improved by 1.3 ± 2.4 kg and sit-to-stand score improved by 0.7 ± 1.0 at 6 months, with no improvements in the control group.

CONCLUSION: The findings demonstrate the feasibility and safety of delivering and evaluating an intervention to reduce and break up sitting in older adults with frailty. The intervention was acceptable and had potential for reducing sitting and improving sarcopenia outcomes, supporting its evaluation in a full definitive randomised controlled trial.

EFFECTS OF ONE-YEAR-LONG PHYSICAL AND COGNITIVE TRAINING INTERVENTION ON MUSCLE STRENGTH, MUSCLE MASS, AND GAIT SPEED IN INSUFFICIENTLY ACTIVE COMMUNITY-DWELLING OLDER ADULTS (PASSWORD-STUDY)

HÄMÄLÄINEN, O.1, TIRKKONEN, A.1, SAVIKANGAS, T.2, ALÉN, M.1, HAUTALA, A.1, SIPILÄ, S.
1 UNIVERSITY OF JYVÄSKYLÄ, 2 OULU UNIVERSITY HOSPITAL

INTRODUCTION: Physical exercise plays a protective role against sarcopenia. We investigated how a one-year combined physical and cognitive training intervention, and adherence to it, affected muscle strength, muscle mass, and gait speed in insufficiently active community-dwelling older adults. We also investigated whether changes in these measures differed between different sarcopenia groups.

METHODS: Community-dwelling older adults (n=314, 60 % women, mean age 74.5 ± 3.8 years, body mass index 28.0 ± 5.1) who did not meet the international PA recommendations participated in the RCT-study (ISRCTN52388040). Intervention lasted 12 months and included supervised resistance/balance and walking/balance training once a week, home exercises, and in total of 150 min of moderate aerobic activity per week for both study groups. In addition, other group performed computer based executive functions exercises 3–4 times per week. Groups were pooled for analysis in this study. Grip and knee extension strength were measured with dynamometers, muscle mass with dual-energy x-ray absorptiometry, and habitual gait speed over 20 meters. Adherence to strength and walking training was assessed from exercise logs. Age, sex, and training adherence adjusted linear generalized estimation equations models were used to explore changes in the outcomes and to see differences of changes between sarcopenia and non-sarcopenia groups. Sarcopenia was determined by using the European Working Group of Sarcopenia in Older People 2019 criteria.

RESULTS: In total, 286 older adults (91 %) participated in the post measurements. Adherence of supervised strength and walking training were 73 ± 21 % and 60 ± 30 %, respectively. Grip strength, knee extension strength, and gait speed increased (1.3 kg, 95 % CI 0.79–1.90, $p < 0.001$; 4.2 kg 95 % CI 3.6–4.7, $p < 0.001$, and 0.08 m/s, 95 % CI 0.06–0.09, $p < 0.001$) in whole sample, and higher adherence to walking training increased knee extension strength (ß = 0.05, 95 % CI 0.01–0.1, $p = 0.017$). When the participants were divided into sarcopenia (including probable and confirmed sarcopenia, n=49) and non-sarcopenia (n=264) groups, we observed that in both groups strength measures and gait speed increased and in sarcopenia group grip strength increased on average 1.9 kg more than in non-sarcopenia group (group x time interaction: ß = 1.867, 95 % CI 0.39–3.35, $p = 0.013$). No significant group x time interactions were observed for other outcomes.

CONCLUSION: Physical and cognitive training has positive effects on muscle strength and gait speed, and adherence to training is important. Improvement in grip strength was higher in sarcopenia group when compared to non-sarcopenia group. Given the low attrition rate and relatively high adherence to a year-long combined physical training intervention, it may be effective in preventing sarcopenia in clinical settings, whereas more targeted and intensive interventions may be necessary to increase muscle mass.

PRELIMINARY RESULTS OF THE GROW YOUR MUSCLE (GYM) STUDY: A 48-WEEK RANDOMIZED CONTROLLED STUDY OF A HOME-BASED, APP-MONITORED PHYSICAL EXERCISE INTERVENTION FOR OLDER PEOPLE WITH SARCOPENIA.

BONATO, M., MARMONDI, F., GALLI, L., INZAGHI, C., CERIZZA, C., ANNICCHIARICO, G., BAGLIVI, A., DELLA TORRE, L., VERCESI, R., CASTAGNA, A., SCIORATI, C., ZAGATO, L., LA TORRE, A., BANFI, G., CINQUE, P.
UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Sarcopenia is a pathophysiological process of aging, caused by reduction of muscle strength, mass and function and it is associated with an increased risk of falls, fractures, physical disability, and death. To date no controlled studies have assessed the efficacy of physical activity for treatment of sarcopenia. We present here the preliminary results at 12 weeks of the Grow Your Muscle (GYM) randomized-controlled study, consisting of a 48-week home-based, app-monitored body-weight resistance training program that aims to improve muscle function and mass in elderly persons with sarcopenia both in the general population (GP) and in persons with HIV (PWH).

METHODS: The study enrolls sedentary persons with sarcopenia, as defined by low appendicular skeletal muscle mass index (ASMMI) by bioimpedentiometry (BIA) and/or low muscle strength by handgrip, >60-year-old in the GP and >50-year-old in the PWH group. Participants are randomized 1:1, separately in each group (elderly and PLWH), to: 1) Exercise group (EG), where they perform a home-based, app-monitored resistance-training program; 2) Control group (CG), without exercise prescription. At BL and W12 participants are tested for muscle function (handgrip, chair-stand-test, right and left maximal isometric strength of knee extensors, Mini-BESTest, and 6MWT), blood lipids and cognitive function [trail-making A (TMA), trail-making B (TMB) and digit symbol]. At BL and W48, participants also perform a whole-body dual energy x-ray absorptiometry with evaluation of the Appendicular Skeletal Muscle Mass Index (ASMMI), % of fat mass (FM) and fat free mass (FFM) at arms, limbs, and total body, and a magnetic resonance imaging of thigh to evaluate Intermuscular Adipose Tissue (IMAT) and muscle Cross Sectional Area (CSA).

RESULTS: Out of 196 subjects planned, 134 were enrolled (44 GP and 90 PWH), 83 (EG: 39; CG: 44) completed the first 12 weeks and 30 [(EG: 13, age: 63 (58-71); CG:17, age: 65 (59-71)] completed the 48-week assessment. Fifteen participants (11%) dropped-out during the study. At W12 participants showed an increment of muscle function tests, including handgrip

strength (p=0.023), chair-stand (p=0.0016), maximal isometric strength of right (p=0.0125) and left (p=0.0103) knee extensors. At W48, participants showed an increase from BL in EG, but not in CG of some muscle function tests, including the chair-stand- (p=0.015), maximal isometric strength of right (p=0.004) and left (p=0.0002) knee extensors, and 6MWT (p=0.048); of %FFM at legs (p=0.048); and of cognitive function by TMA (p=0.047), TMB (p=0.021) and digit symbol (p=0.002).

CONCLUSION: With the limitations of the low number of participants who completed the whole program, preliminary data of this home-based, app-monitored body-weight resistance training program approach indicate an increase of muscle strength after 12 weeks and of muscle mass and of cognitive function at the final 48-week evaluation.

Oral Presentations

OP-AP38 Training and Testing/Rugby

THE EFFECTIVENESS OF A HYBRID RUGBY TACKLE SKILL AND PHYSICAL CONDITIONING PROGRAMME ON TACKLE COMPETENCY AND TACKLE CONFIDENCE IN GRASSROOTS RUGBY UNION

OWEN, R., KNIGHT, C., WALDRON, M.
SWANSEA UNIVERSITY

INTRODUCTION: It has been recently suggested that "rugby is child abuse"[1], and contact rugby should be banned in schools[2]. Rising concerns over brain health have coincided with a reduction in youth rugby union participation, and lack of enjoyment is the most frequent reason for drop out in youth[3]. Whilst there have been some attempts to improve grassroots player experiences and safety during contact rugby[4], these programmes have been limited by an alleged lack of contact-specific skill development and adequate physical preparation, which is unfortunate, since these are factors that could improve player safety by enhancing skill competency. Therefore, it appears to be important that training should be considerate of both technical skill and physical conditioning of young people who are developing towards contact rugby. This study evaluated the effectiveness of a hybrid tackle skill and physical conditioning programme on i) grassroots tackle competency; ii) physical performance measures; and iii) the attitudes of players towards rugby.

METHODS: Fifty-six participants (INT) performed the 'Lions Tackle TEK' hybrid training programme for 20 min, once per week, across a school term. Thirty-five participants were controls (CON), who received no training but continued with their normal school and extra-curricular activities. Testing was performed at the beginning of term, half-term, and end-of-term. Physical testing included peak height velocity (PHV), tackle competency, trunk stability, overhead squat (OHS), push-ups, pull-ups, and squats in 60 s. Focus groups were performed at testing intervals and field notes were taken continuously to monitor player attitudes to rugby across the school term. Two-way repeated measures ANCOVAs were conducted to assess each outcome variable between three testing stages and two groups, with the baseline measure used as the covariate. Thematic analysis was used to identify key themes in focus groups and field notes to determine the players' attitudes towards rugby.

RESULTS: The INT group had higher scores compared to CON for tackle competency, OHS,

and trunk stability ($P<0.05$). There were no differences ($P>0.05$) between INT and

CON groups, across any programme stage, for push-ups, pull-ups, or squats. The

INT group appeared to be more confident and had a more positive attitude towards

rugby by the end of term compared with the CON group.

CONCLUSION: The Lions Tackle TEK programme improved tackle competency, movement

competency and players' attitudes towards contact rugby. However, it did not

change physical performance measures, such as pull-ups, push-ups, and squats. Qualitatively, players in the INT group who initially disliked rugby, shared that they began to enjoy being physical and feeling safe when doing so.

REFERENCES:

1) Anderson et al, Spor Eth Phil, 2023

2) Pollock et al, Brit J Spor Med, 2017

3) Witt & Dangi, J Park Rec Admin, 2018

4) Barden et al, Brit J Spor Med, 2022

INTERPRETING KICK DYNAMICS IN PROFESSIONAL RUGBY UNION UTILISING CLUSTERING ANALYSIS.

SCOTT, G., BEZODIS, N.E., BENNETT, M., WALDRON, M., CHURCH, S., KILDUFF, L.P., BROWN, M.R.
SWANSEA UNIVERSITY

INTRODUCTION: Previous studies have identified the importance of kicking in modern rugby union, irrespective of league, level, or player gender (1,2). However, there is limited research that quantifies the physical requirements of supporting players during kicking. This study aimed to interpret the spatio-temporal requirements of kick collection when considering

(i) different kick types, (ii) kick outcomes, and (iii) playing circumstances. A secondary aim was to investigate whether kicks can be grouped on these metrics, with potential to influence future kicking and training strategies.

METHODS: Coded video analysis files were downloaded from 144 matches within the 2021-22 season of the United Rugby Championship. All kicks from hand were collated and 4451 kicks were analysed after data cleansing. Distance and time from the location and instant of the kick to the collection were determined and used to calculate the average speed. Descriptive statistics on these metrics were reported for kick types (n = 7) and kicks in different zones (n = 5). This was repeated for kicks grouped by the outcome of the kick itself, such as whether the kick was collected on the full or on the bounce, and kicks grouped by the action of the collecting player, such as whether the ball was passed or kicked immediately by the collecting player. K-means clustering was utilised to group kicks based on their distance and collection time.

RESULTS: Mean kick distance by type ranged from 22.7 to 51.4 m, with corresponding collection times ranging from 2.9 to 4.4 s. Mean kick distance for different zones of the field and collection times ranged from 19.8 to 44.0 m and 2.4 to 4.2 s, respectively. Distances and collection times also varied between different kicking outcomes and field circumstances. The cluster analysis indicated four distinct groups, where cluster centres were located at the coordinates (25.7 m, 4.2 s), (57.5 m, 6.2 s), (20.8 m, 2.3 s), and (48.9 m, 3.7 s), respectively.

CONCLUSION: The differences in mean spatiotemporal values highlighted a difference between long 'territorial' kicks and shorter 'contestable' kicks. Outcomes tended to match this, with balls caught by the opposition being longer distanced on average, compared to those caught by the kicking team. Two of the four identified clusters represented longer-distance kicks: one with a higher mean collection time and one with a lower mean collection time. The other two comprised shorter-distance kicks, again with each cluster differing by a higher or lower mean collection time. This suggests that kicks can be broadly split into four key groups, fast and slow territorial kicks as well as fast and slow contestable kicks. These groups can be utilised to create drills and tactics for different in-match scenarios and also to inform the demands for return-to-play protocols.

THE DEMANDS AND DETERMINANTS OF SUCCESS OF THE TACKLE AND RUCK BETWEEN THE POOL AND KNOCKOUT STAGES OF THE MEN'S INTERNATIONAL WORLD RUGBY SEVENS SERIES

HENDRICKS, S., DE KLERK, S.
UNIVERSITY OF CAPE TOWN

INTRODUCTION: Rugby Sevens (henceforth called 'Sevens') is an Olympic sport that has grown rapidly worldwide, both in terms of participation and commercialisation. The most frequent physical-technical contests are the tackle and ruck. Success in Sevens is, in part, dependent on the teams ability to repeatedly "win" these physical-technical contests. In addition to the Olympics, World Rugby (the sports governing body) has run a World Sevens Series since 1999, featuring national teams from all rugby nations. The series has grown to ten tournaments and the competition structure for each tournament uses a pool stage (four teams in each pool) to knock-out stage format, whereby teams will play against all opponents in their pools with the top two teams from each pool progressing through to the knockout stages. Studies in Rugby Union have shown that match variables in the knockout-stages may differ compared to the pool stages in terms of frequency of occurrence, however this is not know for Sevens. Therefore, the purpose of this study was to compare tackle and ruck frequencies between pool and knockout matches during the Men's International World Rugby Sevens Series and also determine which technical determinants increase the likelihood of tackle success within each stage of the tournament.

METHODS: Video analysis of all matches during the 2018/2019 International Men's Rugby Sevens World Series was conducted (n=449 matches). This equated to 21 226 tackle contact events and 6 345 rucks events. Each tackle event was further coded for tackle descriptors (type of tackle, direction of contact, point of body contact) and tackle outcomes (successful and unsuccessful). The unpaired T-test was used to compare the frequency of tackle and ruck events per match between pool- and knockout matches. Logistic regression was used to identify tackle determinants that were associated with tackle success within each tournament stage.

RESULTS: No differences were found between the mean tackles per match of pool and knockout stages (Pool 47.5, 95% CI 46.5-48.6 vs Knockout 46.9, 95% CI 45.7-48.0). There was a significant difference ($p < 0.001$) in mean rucks per match between pool and knockout stages (Pool 14.8, 95% CI 14.2-15.4 vs Knockout 13.3, 95% CI 12.7-13.9). Within pool stages, type of tackle, point of body contact, tackle sequence, attacker intention, and match rank were associated with success, while in the knockout stages, only point of body contact and attacker intention were significantly associated.

CONCLUSION: While no differences in tackle frequency between the two tournament stages were observed, ruck frequency decreased during the knock-out stage. The ruck is an opportunity for the opposition to contest the ball on the ground, therefore teams may be avoiding this contest more during the knock-out stages. Fewer tackle determinants were associated with tackle success during the knock-out stages, which may be reflection of how closely these teams are matched during this stage.

OPTIMIZATION OF TRAINING FOR PROFESSIONAL RUGBY UNION PLAYERS: INVESTIGATING THE IMPACT OF DIFFERENT SMALL-SIDED GAMES MODELS ON GPS-DERIVED PERFORMANCE METRICS

REN, X., HENRY, M., BOISBLUCHE, S., PHILIPPE, K., DEMY, M., DING, S., PRIOUX, J.

1EAST CHINA NORMAL UNIVERSITY; 2ÉCOLE NORMALE SUPÉRIEURE DE RENNES; 3RUGBY CLUB VANNES; 4UNIVERSITY OF PAU AND PAYS DE L'ADOUR

INTRODUCTION: Professional rugby union players can improve their performance by engaging in small-sided games (SSGs), which simulate the movement patterns of the game [1]. This study collected metrics related to running performance and mechanical workload and their relative values from both forward and back positions, aiming to explore the impact of different SSGs factors on athlete workload, as well as the workload difference between official games (OGs) and SSGs.

METHODS: The monitored GPS data were collected from SSGs with different player numbers and field sizes (five sessions), SSG rules (five weeks, four sessions per week), and OGs conducted throughout the year. Additionally, the study compared changes in players sprinting performance before and after two SSG sessions. Considering the varying training participants and field areas, this study employed a two-way analysis of variance (ANOVA) to investigate the interactions among these factors. The Mann-Whitney U test, Kruskal-Wallis H-test and its subsequent post hoc comparison procedure (Dunns post hoc analysis) were applied due to the non-normal distribution of the GPS metrics, the heterogeneity of the variance and the comparison of SSG models and OGs. The statistical significance was set at $p<0.05$. Effect size (ES) was evaluated using Cohen's d and partial eta squared (ηp^2) along with a 95 % confidence interval. Cohen's d=0.2, 0.5, and 0.8, ηp^2=0.01, 0.06 and 0.14 correspond to small, medium and large effects respectively.

RESULTS: The results showed that backs had greater workload than forwards. Less space and number of players SSG (4 vs. 4, 660m2) was conducive to facilitating training for players in acceleration and deceleration. Conversely, larger spaces were associated with improved running performance. However, the introduction of a floater had no significant impact on performance improvement. Additionally, the 7 vs. 4 model (seven players engaged with four opponents) resulted in the greatest workload during medium-hard accelerations ($p<0.001$, ηp^2=0.19-0.28). Japan touch model allowed for more high-speed running training ($p<0.001$, ηp^2=1.52). The workload performed by SSGs can almost cover that of OGs ($p<0.05$, ηp^2=0.03-0.57).

CONCLUSION: This study provided insight into the impact of player numbers, field size, and rules on rugby-specific SSGs. Coaches should optimize SSG setups for enhanced training outcomes, ensuring the long-term development of physical capacity, technical and tactical skills. However, given the significantly higher workload of SSGs and the slight decrease in sprinting performance, further research is required to examine the training patterns of SSGs.

REFERENCE:

1. Gabbett T, Jenkins D, Abernethy B. Game-Based Training for Improving Skill and Physical Fitness in Team Sport Athletes. International Journal of Sports Science & Coaching. 2009/06/01 2009;4(2):273-283. doi:10.1260/174795409788549553

DEVELOPING A FIELD-BASED DRILL TO MEASURE BALL-CARRIER AND TACKLER CAPACITY IN ACADEMY LEVEL RUGBY UNION PLAYERS.

DAVIDOW, D., HOSKING, J., RILEY, J., PAUL, L., PITHEY, A., DEN HOLLANDER, S., JONES, B., HENDRICKS, S.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Proficient tackle technique (whether as a ball-carrier or tackler) in rugby union has been associated with a reduced risk of injury and higher likelihood of tackle success. In 2014, Hendricks and Lambert proposed a theoretical model showing well-conditioned players with a high technical proficiency can safely engage in repeated tackles, without negatively changing their injury risk and performance profile during matches – i.e. the ability to maintain technical proficiency in a fatigued state. Therefore, the purpose of this study was to test the feasibility of a novel field-based tackle capacity test and measure the effect of fatigue on tackler and ball-carrier technical proficiency during front-on tackle.

METHODS: Forty-one (n=41) rugby union players participated in a randomised cross over counterbalanced feasibility study (21 tacklers and 20 ball-carriers). An 8-tackle baseline drill (control) and field-based tackle capacity drill were performed on two separate occasions as a ball-carrier or tackler. The capacity drill was terminated if volitional termination was reach by player or the investigator noted technique dropped to an unsafe level or the player was unable to make 8 tackles/min. 971 tackles (tackler = 477, ball-carrier = 494) were performed in total. Each tackle was video recorded and analysed using a standardised list of tackling technical criteria, list of observable actions. A player is awarded either one point or zero depending on whether a particular action is performed or not. The sum of these points is used to represent the technical proficiency score of the player.

RESULTS: In the capacity drill tackler proficiency decreased during dominant shoulder tackles from interval 1 (11.38 [11.04±11.72] AU) to interval 6 (10.25 [9.45±11.05] AU p=0.002 ES=1.20 large) and for the non-dominant shoulder from interval 1 (11.53 [11.24±11.82] AU) to interval 4 (10.09 [9.27±10.91] AU p<0.001 ES=1.20 large). Ball-carrier technical proficiency decreased significantly in dominant shoulder tackles from interval 1 (10.02 [9.72±10.32] AU) to interval 5 (8.47 [7.74±9.19] AU p<0.000 ES=1.34 large) and interval 6 (8.25 [6.73±9.77] AU p=0.024 ES=1.70 large) and for non-dominant shoulder from interval 1 (9.84 [9.46±10.22] AU) to interval 4 (8.56 [8.35±9.36] AU p=0.043 ES=0.80 moderate).

CONCLUSION: This study showed a field-based tackle capacity test can measure tackle technical proficiency and assess the effect of fatigue on repeated tackling for both tackler and ball-carrier. Ball-carrier and tackler proficiency decreased from time interval 1 to drill player termination in the capacity drill with the non-dominant shoulder decreasing earlier then

the dominant shoulder. The findings of this study can be used to assess and monitor players technique proficiency and technical capacity, design and develop tackle training programmes to prepare players for match tackle demands, with the ultimate goal of reducing the risk of injury while improving tackling performance.

Oral Presentations

OP-SH06 Philosophy

TACTICS ANALYSIS OF CO-BIDING FOR OLYMPIC GAMES FOR CHENGDU-CHONGQING ECONOMIC CIRCLE UNDER THE NEW MECHANISM TO OLYMPIC HOSTING PLACE ELECTION:BASED ON THE GEODETECTOR

YANG, L.F.1, RAYNER, M.2, HE, T.1

1CHONGQING TECHNOLOGY AND BUSINESS UNIVERSITY, 2UNIVERSITY OF PORTSMOUTH

In todays normalized epidemic and global economic recession, hosting the Olympic Games is of great significance for urban development. At the same time, significant changes in the mechanism of hosting the Olympics have also brought new opportunities for the Chengdu-Chongqing Economic Circle to jointly host the Olympics. The article focuses on the phased characteristics of the real estate production mechanism during the Olympic Games and the 11 Olympic host sites from 1992 to 2032 as the research subjects to exploring the spatio-temoral evolution characteristics and influencing factors of the emergence of Olympic host sites through research methods such as geographic detector, and analyzing relevant strategies for the collaborative bidding of the Chengdu-Chongqing Economic Circle. The results indicate that the center of gravity of the Olympic host city is moving towards the southeast, showing characteristics of east-west expansion and north-south contraction. At the same time, its spatial accessibility is weakening, and the gap between the east and west is gradually narrowing. And the emergence of Olympic host sites is influenced by various factors, among which the annual growth rate of GDP, inflow of foreign direct investment, number of international inbound tourists, and per capita annual carbon dioxide emissions are important factors that affect the emergence of Olympic host sites. Based on the results, a constructive strategy is proposed to increase the attraction of foreign investment, fully showcase the charm of the city, and enhance the international tourism awareness, while ensuring environmental quality. The communication strategy emphasizes that the economy of the Chengdu-Chongqing Economic Circle is achieving high-quality development, and highlights that the Chengdu-Chongqing Economic Circle always adheres to the concept of green development, Provide theoretical and practical support for the collaborative bidding of the Chengdu-Chongqing Economic Circle for the Olympic Games.

THE REFORM AND DEVELOPMENT CHARACTERISTICS OF THE COMPETITION IN OLYMPIC GAMES

XU, G.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Competition is an important component of sports. In recent years, various sports have been promoting competition reforms. This article focuses on the reform and development characteristics of the competitions in Olympic Games and Olympic Winter Games.

METHODS: The methods of literature review, expert interview, survey and observation have been used.

RESULTS: Competition reform is an important driving force for the sustainable development of the Olympic Games. In response to the requirements of the times, the International Olympic Committee has issued and implemented planning documents such as the Agenda 2020, New Form, and Agenda 2020+5. The relevant measures mainly involve the establishment of competition events, optimization of competition methods, and adjustment of qualification systems, etc. Firstly, the adjustment of events changes the structure of Olympic competitions and stimulate new development vitality. Based on the number of events set for the 2008 Beijing Olympics Games, the number of events in the past three Summer Olympics has increased by 8.94% (2024), 12.25% (2020), and 1.32% (2016). Based on the 2006 Olympic Winter Games, the number of events in the past three Winter Olympics increased by 29.76% (2022), 21.43% (2018), and 16.67% (2014). The number of events increased significantly in 2020 and 2014 Games. By setting up more competition events, the event structure of Olympic Games has been changed while providing athletes with more competitive opportunities and adding new competitive highlights to the Olympics. Secondly, optimizing competition methods may enrich the connotation of specialized sports. The essential difference between sports lies in the different ways athletes compete in competitions, which are mainly limited through the formulation of competition rules and the design of competition methods. In order to improve the excitement and attractiveness of competitions, managers of sports have revised and improved the specialized competition methods based on actual needs, mainly involving scoring methods, scoring standards, venue and equipment standards, etc. The specialized competition methods determine the competitive characteristics of sports and the competition scenes are more exciting and intense. Thirdly, the changes in the competition system affect the qualification for participation. In order to control the scale of Olympic events, the IOC and relevant IFs set the number of Olympic athletes (teams) based on the development level and setting of each event. The qualification system for each project determine the allocation principles, acquisition methods while the basic principle is to determine participation qualifications based on relevant important competition results.

Conclusions:

Competition reform is an important driving force for the sustained development of the Olympic Games. The event setting, competition methods, competition system and qualification system are the important focus points.

UNDERSTANDING FAIR PLAY IN VIRTUAL AND SIMULATED SPORTS COMPETITION: A CASE STUDY ON "VIRTUAL TOUR DE FRANCE"

BI, X., HUANG, L., ZHANG, S.
BEIJING SPORT UNIVERSITY

INTRODUCTION

Sport is an institutionalized social practice in which participants performed and competed following established rules, with fair play being a key element[1] [2]. Digital technologies, such as mixed reality and online interactive platforms, have updated the form of sports, allowing professionals and amateurs to involved in virtual simulation competitions in different spaces simultaneously. This creates a new participatory culture where users/participants produce contents on the Internet while engaging in[3]. Thus, it is time to discuss the serious issue of fair play when a lot virtual and simulated events appear. Based on Sigmund Lolands moral system of fair play in sports[4], this study focus on 2 Research Questions: (1) What are the topics related to fair play in virtual and simulated sports? (2) What are the new negotiation mechanisms for fair play in virtual and simulated sports?

METHODS

Using digital ethnography method, this study choose cycling in the "Olympic Virtual Series" as a case to analyze, and crawled contents from the IOC official website, official mixed reality cycling platform Zwift(App and its forum), Youtube and other social media websites. The final sample includes 1653 texts and 130 videos (over 87 hours).

RESULTS

The results show that based on the sport specific goals(usually about winning), the structural goal (the way to win) and intentional goals (including self-challenge and sense of belonging etc.) , two topics related to fair play emerged, which are right sport and good sport. They are two sides of the same coin when it comes to fair play, involving following/breaking rules and gaining values in sport. Digital technology and virtual simulated platforms have added new social attributes to the competition, allowing users/participants to establish connections with others and form a culture of participation and sharing, thereby negotiating the rules of fair play in the process. This process have affected stakeholders positioning on the issues of fair play. Institutional power, technological agents, competitors and spectators have formed different goals, and the boundaries of the rules are determined during negotiation to maximize interests of all parties.

DISCUSSION

While technology has brought new possibilities to sports, it has also brought new problems, such as digital doping, sticky tiles, and data hacking, etc. Due to sufficient institutionalization, broad public following and reliable virtually-mediated physical interaction of virtual and simulated sports[5], the current review is important. More researches are needed to update systematic knowledge in the field of fair play[2].

REFERENCE

1 Molina et al., 2014

2 Serrano-Durá et al., 2020

3 Boni, 2017

4 Loland, 2013

5 Westmattelmann et al., 2021

ON THE LIMITS OF HUMAN DIGNITY AND FAIR PLAY AS A FRONTIER OF SPORTS LAW AND ETHICS

SZEKERES, D.1, BARCSI, T., WHYTE, I., SOOS, I.1
1 HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

Introduction

Sport is a specific social activity based on the principles of respect for others and appropriate participation in collective activities. Sports activities, policy, and governance must comply with the idea of fair play, founded on moral principles such as the fight against violence, sexual abuse, the prohibition of corruption, and non-discrimination. The Universal Declaration of Human Rights, the Olympic Charter, the European Charter for Sport and the Code of Ethics for Sport include specific ethical requirements in addition to the most basic moral standards.

In Hungary, these are reflected in ethics of the national sports federations and codes of conduct for working with children, with Hungarian sports being legally obligated to enforce codes of conduct under the Sports Act. Compliance with legislative objectives in the management of sport organisations, including good governance, is explicitly emphasised.

Material and methods

The aim was to investigate relationships between sports law and childrens law, and within sports law, issues of state and self-regulation. This was undertaken through an exploration and analysis of Hungarian and EU secondary literature, alongside an analytical presentation of the internal rules of sport organisations with respect to human dignity and fair play. European aspects of good governance in sport, with reference to the single sport policy approach and the fight

against corruption, were also considered. Finally, some focus was placed on the Hungarian Swimming Federation (MÚSZ) statutes and Code of Ethics and Child Protection.

Results

Self-regulation is characteristic of sport, but legal regulation also provides enforceability by virtue of its binding nature. Factors such as excessive success-centricity, a culture of condoning and covering up abuses in sport, have been identified as being weakening factors for a proper ethical attitude.

Conclusions

Possible solutions include setting appropriate limits, providing a complaints and whistle-blowing system in sports organisations, raising awareness of the issue, taking appropriate action against doping and promoting sports role models who live up to the ideal of fair play. To this end, it is essential to ensure that ethical and legal knowledge in this area is included in education, particularly in the training of physical education teachers, coaches and sports professionals, and in their professional development and further training. A good example of a signposting system for professional associations after the Túri Case could be the child protection officer set up by the MÚSZ and the institutionalised telephone and e-mail contact. Ethical behaviour, but also professional ethics, the example set by coaches and sports professionals, and social models and expectations can play a huge role in preventing abuse, abuse, offensive behaviour and non-conformist fair-play situations.

11:00 - 12:00

Conventional Print Poster Presentations

CP-MH13 Physical Activity/Inactivity

POST-PANDEMIC PHYSICAL ACTIVITY AND HEALTH STATUS AMONG UNIVERSITY STUDENTS IN ICELAND

RÖGNVALDSDÓTTIR, V.1, STEFANSDOTTIR, R.1, GISLADOTTIR, TH.1, JAKOBSDOTTIR, G.1, JOHANNSSON, E.1,2, GESTSDOTTIR, S.1

1. FACULTY OF HEALTH PROMOTION, SPORT SCIENCES AND LEISURE STUDIES, SCHOOL OF EDUCATION, UNIVERSITY OF ICELAND, 105 REYKJAVÍK, ICELAND 2. DEPARTMENT OF SPORT AND PHYSICAL ACTIVITY, WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES, 5063 BERGEN, NORWAY

INTRODUCTION: The daily physical activity of university students in Iceland notably decreased during the COVID-19 pandemic compared to before, and over 70% reported increased sedentary behavior. Additionally, more than half of the students indicated a decline in their physical and mental health [1, 2]. The aim of the study was to assess physical activity and physical and mental health status among university students following the COVID-19 pandemic.

METHODS: In early 2023, a cohort of 151 (23% male) university students in their third year, responded to questionnaire regarding their mental and physical health. The students were asked to assess their current levels of physical activity, participation in sports, sedentary behavior and happiness, as well as their physical and mental health post the COVID-19 pandemic compared to during the pandemic.

RESULTS: The mean age of the participants was 28.9 ± 7.6 years. About 18% engaged in organized sports while 74% participated in general exercise, averaging 3.98 ± 1.6 weekly sessions. Following the pandemic, half of the participants perceived their physical activity as insufficient, and 54% considered their sedentary behavior excessive. Additionally, 41% reported increased physical activity, 34% reported decreased sedentary behavior, and 36% and 37% reported improvements in physical and mental health compared to during the pandemic. There was an association between reporting more exercise sessions per week and happiness, as well as better post-pandemic physical health.

CONCLUSION: The study revealed a notable proportion of university students engaging in general exercise rather than specific sports activities. Despite this, a significant portion of the participants perceived their physical activity levels as inadequate, and a majority acknowledged excessive sedentary behavior. Encouragingly, post-pandemic, there was a positive shift with a considerable percentage reporting increased physical activity and reduced sedentary behavior, alongside notable improvements in both physical and mental health among a substantial portion of the participants. These findings underscore the importance of addressing physical activity and sedentary behavior in promoting overall health and well-being, particularly in the context of global challenges such as the COVID-19 pandemic. Further research and interventions are warranted to sustain and enhance these positive changes over the long term.

References

1. Gestsdottir, S., et al., Health and well-being of university students before and during COVID-19 pandemic: A gender comparison. PLoS One, 2021. 16(12): p. e0261346.

2. Jakobsdottir, G., et al., Changes in health-related lifestyle choices of university students before and during the COVID-19 pandemic: Associations between food choices, physical activity and health. PLoS One, 2023. 18(6): p. e0286345.

DAILY STEPS AND FITNESS: A PEDOMETER-BASED, CROSS-SECTIONAL STUDY IN AN ADULT SOUTH AFRICAN POPULATION

PILLAY, J., ROELOFSE, V., HEWER, G., ONWUBU, S., HAFFEJEE, F.
DURBAN UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Walking is a mode of physical activity (PA) promoted for health. Pedometers, typically measuring total steps/day, are tools motivating for and monitoring ambulatory PA. There is, however, little information concerning the association of volume and intensity of steps, and aerobic fitness among adults. We aimed to examine this association.

METHODS: A convenience sample (N=122; 32.5±13.6 years), wore a pedometer for at least five consecutive days. Aerobic fitness was determined through the Harvard step test culminating in a Physical Efficiency index (PEI) as an estimate of fitness. Steps/day data were sub-grouped according to volume/intensity-based categories aligned with steps/day recommendations. Analysis of covariance, adjusting for age, gender and total steps/ day were used to compare groups according to volume/intensity-based categories. Post-hoc Bonferroni tests were used to determine between-group effects.

RESULTS: Average total steps/day accumulated were 5,352±2 with more than half of the participants (54.1%; n=66) accumulating less than 5,000 steps/day, typically classified as sedentary and over two-thirds (68%; n=83) accumulating little/no aerobic activity. When categorized by average aerobic steps/day categories (<1,000 aerobic steps/day versus ≥1,000 aerobic steps/day), significance was found for aerobic fitness and most body fat estimates.

CONCLUSION: The integration of volume and intensity of ambulatory PA in pedometer-based messages is of relevance towards providing messages aligned with recommendations for daily PA. Based on our findings, steps/day recommendations should be aligned towards including the accumulation of aerobic steps.

THE RELATIVE CONTRIBUTION OF INTENSITY, DURATION, AND VOLUME IN THE 24-HOUR PHYSICAL ACTIVITY PROFILE TO MORTALITY IN US ADULTS

SCHWENDINGER, F., INFANGER, D., LICHTENSTEIN, E., HINRICHS, T., KNAIER, R., ROWLANDS, A.V., SCHMIDT-TRUCKSÄSS, A.
UNIVERSITY OF BASEL

INTRODUCTION: Accelerometer-assessed physical activity (PA) is associated with mortality (Rowlands et al., 2021). Recent developments make it possible to parse the relative contributions of intensity and volume of PA to a given health outcome (Schwendinger et al., 2023). It is currently unclear whether PA intensity, duration, or a combination of both is the driving factor for longevity. This study investigates how intensity, duration, and volume of PA contribute to all-cause and cardiovascular disease mortality in the US adult population.

METHODS: Adult participants of the 2011–2014 National Health and Nutrition Examination Survey Study (N=7518 in final analyses) wore accelerometers for 7 days on their wrists (Johnson et al., 2014). The volume, intensity distribution, and duration of 24-hour PA behaviour were described by average acceleration (AvAcc), intensity gradient (IG), and daily time spent active, respectively. Weighted Cox proportional hazards models estimated the mortality risk associated with these PA metrics.

RESULTS: Both IG and AvAcc demonstrated inverse curvilinear dose-response relationships with all-cause mortality, with IG showing a slightly better model fit compared to AvAcc alone, the combination of IG and AvAcc, or when PA duration was included. Desirable values of IG and AvAcc lie approximately between -2.7 to -2.5 and 35-45 mg, respectively as risk reduction plateaued above these ranges. For cardiovascular disease mortality, an inverse curvilinear association was observed with IG, but not with AvAcc. Representative reference values for IG and AvAcc were produced.

CONCLUSION: The intensity of PA is central to longevity with PA volume playing a secondary role, especially for cardiovascular disease mortality. The established age- and sex-specific reference values for intensity and volume of PA, informed by the dose-response relationship with mortality, provide desirable PA benchmarks.

REFERENCES:

Johnson, C. L., Dohrmann, S. M., Burt, V. L., & Mohadjer, L. K. (2014). National health and nutrition examination survey: sample design, 2011-2014. Vital and Health Statistics, Series 2 (162):1-33.

Rowlands, A., Davies, M., Dempsey, P., Edwardson, C., Razieh, C., & Yates, T. (2021). Wrist-worn accelerometers: recommending ~1.0 mg as the minimum clinically important difference (MCID) in daily average acceleration for inactive adults. Br J Sports Med, 55(14), 814-815. https://doi.org/10.1136/bjsports-2020-102293

Schwendinger F., Wagner J., Knaier R., Infanger D., V. Rowlands A. V., Hinrichs T., & Schmidt-Trucksäss A. (2023). Accelerometer metrics: healthy adult reference values, associations with cardiorespiratory fitness, and clinical implications. Med Sci Sports Exerc, 56(2):170-80. https://doi.org/10.1249/MSS.0000000000003299

LONGITUDINAL CHANGES IN SITTING TIME AND IMPACT ON WELLBEING AND QUALITY-OF-LIFE OF SEDENTARY WORKERS.

COSTA TENO, S., SILVA, M., SILVA, H., JÚDICE, P.
UNIVERSIDADE LUSÓFONA DE HUMANIDADES E TECNOLOGIAS

INTRODUCTION: Sedentary behaviour in the occupational domain has been linked to chronic diseases, mental health problems, and reduced wellbeing and quality-of-life. The reduction of sitting time (ST) can be achieved by contextual

modification promoted by a sit-stand desk in the workplace. However, few studies have investigated the effect of reduced ST on participants quality-of-life and wellbeing, and the results are unclear.

METHODS: An intervention with a psychoeducation session, motivational prompts, and contextual modification by a sit-stand desk in the workplace versus the control group (usual work) for 6 months was performed in 38 sedentary workers. In this investigation, data from a primary investigation were used to evaluate the changes in sedentary patterns, and we performed an analysis to evaluate the effect of the reduction in ST (objectively measured) on subjective wellbeing and quality-of-life, independently of the results found among groups. ActiPAL was used to assess ST, wellbeing was assessed via the World Health Organization Five Well-being Index (WHO-5), and EUROHIS-QOL 8-item instrument was used for quality-of-life. The T-test for independent samples and the paired T-test were used to evaluate the differences between groups before and after the intervention and repeated-measures ANOVA was conducted to evaluate the effects of the intervention on the interest outcomes.

RESULTS: The findings from our intervention showed no differences between the control and intervention groups for ST. Our secondary analyses indicated that 13 participants out of the 38 totals reduced ST by at least 30 minutes/day (on average -72 min/day [± 40.0; p<.001], while 25 participants slightly reduced or even increased ST (on average +36.7 min/day [± 40.3; p=<.001]). Both reducers and non-reducers had an improvement in quality-of-life scores, but only those who reduced ST significantly improved subjective wellbeing (p=0.028). However, although there was a larger statistical power within participants that reduced ST, no time*group interaction was found, indicating a low impact of reducing ST on both outcomes.

CONCLUSION: Although our results suggest improvement in subjective wellbeing from reducing ST in comparison to non-reducers, there was no longitudinal difference on the quality-of-life scores between the two groups, which suggests that simply providing office workers a psychoeducation session may positively change some health-related habits resulting in improved wellbeing and quality-of-life.

DIFFERENCES IN PHYSICAL ACTIVITY, POSTURAL STABILITY, EXPLOSIVE STRENGTH AND ACADEMIC SUCCESS OF SCIENCE-RELATED COURSES IN NORMAL WEIGHT, AND OBESE SCHOOLCHILDREN IN QATAR.

HERMASSI, S., KETELHUT, S., AL-MARRI, S., KONUKMAN, F., NIGG, C.R., SCHWESIG, R.
QATAR UNIVERSITY

INTRODUCTION: Physical inactivity among children and adolescents is a significant public health concern that is becoming increasingly prevalent1,2. This study compared the levels of physical activity (PA), postural stability, explosive strength, and academic performance in normal weight and obese middle school students in Qatar.

METHODS: Fifty-nine healthy schoolchildren were recruited (age: 12.0 ± 0.6 years; body mass: 59.4 ± 13.1 kg; height: 1.58 ± 0.09 m; body mass index (BMI): 23.7 ± 3.8 kg/m2, seat height: 122 ± 10 cm; arm span: 157 ± 10 cm). Based on age-specific BMI percentiles, the children were classified as normal weight (n=22, male: n=10) or obese (n=37, male: n= 19). Measurements included anthropometric data (height, sitting height, arm span, body mass, BMI) and physical performance tests (medicine ball throw (MBT); postural stability (PS)). Academic achievement was assessed through school records of grades point average in Mathematics, and Science courses. The International Physical Activity Questionnaire Short Form was used to estimate the total amount of time engaged in PA per week classified into three intensity levels: moderate (4 METs), vigorous (8 METs), and walking.

RESULTS: With exception of the stork balance test (female obese: 1.92 ± 0.47 s), the female normal weight subjects showed the lowest performance level in all parameters. In contrast, the female obese subjects displayed the highest academic level in Arabic (85.0 ± 8.66), whereas, for the male obese group, the highest performance level in all other parameters (Medicine ball throw, stork balance test, Science, Mathematics) was calculated. In addition, the group of obese male subjects reported the largest amount of time engaged in moderate (533 ± 408 MET-minutes/week) and vigorous (1289 ± 827 MET-minutes/week) PA. Regarding daily walking time, female normal weight subjects reported the highest values (784 ± 514 MET-minutes/week).

CONCLUSION: This study determined physical performance and academic achievement in BMI-stratified obese and non-obese adolescents. Surprisingly, the predictor's gender and body weight did not influence the physical and academic performance of the investigated subjects. Future studies utilizing the gold standard for body composition measures or lean mass measures (e.g., hydrostatic weighing or D3-creatine) and additional parameters (e.g., sexual maturation status) are required to confirm our preliminary observations. Schools should consider strategies to improve physical performance as part of their overall strategy for improving academic achievement.

1García-Hermoso A et al., J Pediatr. 2017 Aug;187:127-133.e3.

2Chen X et al., BMC Public Health. 2020 Apr 5;20(1):444.

HOW CAN A PSYCHOEDUCATION SESSION ALTER THE RESULTS FOR A 3-MONTH SIT-STAND DESK-BASED INTERVENTION? SECONDARY ANALYSIS FROM SUFHA

JUDICE, P., TENO, S.C., SILVA, H.
UNIVERSIDADE LUSÓFONA, LISBON.

INTRODUCTION: Background: There is evidence on the effectiveness of sit-stand desk based interventions to reduce office workers' sitting time (ST). Previously designed interventions have been relying on the contextual change (i.e., introducing

sit-stand workstation in the workplace) coupled with frequent prompts throughout the intervention period, and in most cases kicked off with an initial psychoeducation session. Even though most sit-stand desk based interventions have shown good results, there is some heterogeneity between studies. The isolated impact of the psychoeducation session in boosting the results for this type of intervention has never been explored.

Aim: To examine changes in activPAL-derived outcomes from a 3-month intervention with a sit-stand workstation preceded by one psychoeducation session, in comparison to a control group that also used a sit-stand desk for 3 months but with the psychoeducation session being held 6 months before receiving the sit-stand desk.

METHODS: Data comes from a larger 6-month intervention, in which the intervention group had a psychoeducation session, motivational prompts, and contextual modification by a sit-stand desk in the workplace, while the control group also had the same initial psychoeducation session but then continued to work as usual in a traditional sitting desk for 6 months. After this period, the control group used the sit-stand desk for 3 months. For these analyses we considered the available data from both the intervention and control groups at 3 months. Repeated measures ANOVA was used to examine differences between groups from baseline to 3 months.

RESULTS: At baseline, there were no differences between groups for any of the demographic or activPAL-derived variables ($p>0.05$), except for standing time, favoring the intervention group (318 vs 221 min/day; $p=0.033$). A significant time*group interaction was found for ST ($p=0.003$), with the control group (N=10; 45.8±9.4 years) significantly reducing ST by 51 min/day, while the reduction in the intervention group (N=10; 48.5±5.7 years) of 44 min/day was non-significant. Regarding standing time, there was no time*group interaction, but while the intervention group significantly increased standing time by 47 min/day; $p=0.022$, the control group only increased this feature by 19 min/day ($p>0.05$). Finally, a significant time*group interaction was found for ST in bouts longer than 60 min ($p=0.015$), with the intervention group reducing 28 min/day, while the control group decreased prolonged bouts of sitting merely by 8 min day.

CONCLUSION: Our results highlight that a 3-month sit-stand desk based intervention can reduce ST, regardless of the timing of the psychoeducation session. However, when the aim is to increase standing time and reduce ST at the expense of prolonged bouts, having a psychoeducation session right before the intervention, may potentiate the intervention.

EFFECTS OF PROLONGED ENGAGEMENT IN VIDEO GAME AND SMARTPHONE USE ON SUBSEQUENT ISOMETRIC ENDURANCE EXERCISE AND INTENTION TO PHYSICAL ACTIVITY

VIDAL, L., PAGEAUX, B.2, BÉLARD, C.1, DUCHÉ, P.1, CHATAIN, C.1, GRUET, M.1

<1> UNIVERSITÉ DE TOULON, <2> UNIVERSITÉ DE MONTRÉAL

INTRODUCTION: Prolonged engagement in demanding mental exertion is known to alter subsequent endurance performance [1] and the intention to engage in physical activity [2]. Young adults are exposed daily to prolonged engagement in video games and social networks. This exposure is known to be highly demanding and proposed to induce mental fatigue. Recent studies demonstrated the negative effects of mental fatigue on various physical performances [3]. In this context, this study aimed to test the effect of prolonged engagement in video games and smartphone scrolling on social networks (VGSS) on subsequent isometric endurance performance and intention to physical activity in young adults.

METHODS: Thirty-eight young adults (13 female; 19±1y.o) participated in this randomized controlled crossover study. Following a familiarisation with all procedures, participants visited the laboratory twice. Participants engaged either in 90-min alternating between VGSS (experimental condition) or watching emotionally neutral documentaries (ND) for the same duration (control condition). Participants rated the perceived workload of each task with the NASA TLX scale. Mental fatigue was evaluated with changes in fatigue perception (visual analogue scale) during the cognitive tasks. To measure cognitive performance, participants performed a 2-Back test pre-post cognitive tasks. At the same time points, they also reported with the 6-20 Borg scale their intention to engage effort in a physical activity (i.e. 30-min cycling). Then, they performed an isometric contraction of the knee extensors at 20% of their maximal voluntary peak force, until exhaustion. Finally, 7 days of wrist-worn accelerometry were used to characterize physical activity levels.

RESULTS: The NASA TLX scale confirmed the greater demand for engaging in VGSS compared to ND ($p<.001$). Perception of fatigue increased ($p<.001$) to a similar level at the end of the cognitive tasks, with no difference between conditions ($p=.393$), and no decrease in cognitive performance ($ps>.416$). Participants' intention to engage in physical activity decreased ($p<.001$) regardless of the condition ($p=.663$). Time to exhaustion did not differ between both conditions (VGSS: 296±141s vs ND: 304±121s; $p=.479$).

CONCLUSION: While the participants perceived the VGSS as more demanding than ND, engaging in VGSS did not induce a specific state of mental fatigue compared to the ND. Our preliminary results failed to replicate previous observations from the literature suggesting a specific negative impact of VGSS on subsequent endurance performance and intention to engage in physical activity. As a high level of physical activity and fitness increases resistance to fatigue, an exploratory analysis considering these factors will be performed to further confirm our results.

References:

[1] Pageaux and Lepers. 2018. https://doi.org/10.1016/bs.pbr.2018.10.004

[2] Brown and Bray. 2018. https://doi.org/10.1093/abm/kay052

[3] Fortes et al. 2020. https://doi.org/10.1080/02640414.2020.1715181

Conventional Print Poster Presentations

CP-BM06 Running and jumping

ASSOCIATION BETWEEN VERTICAL AND LEG STIFFNESS DURING RUNNING AND THIGH MUSCLE SIZE IN NATIONAL-LEVEL DISTANCE RUNNERS

ANDO, R., OHNUMA, H., TANJI, F., IKEDA, T., YAMANAKA, R., SUZUKI, Y.
JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: We recently reported a positive correlation between distance running time and cross-sectional area (CSA) of the quadriceps femoris (QF), suggesting that larger QF is associated with lower distance running performance (Ando et al. 2022). It is well known that distance running performance is strongly influenced by running economy. Running economy is related to vertical stiffness (Kvert) and/or leg stiffness (Kleg) (Li et al. 2019; Zhang et al. 2022) that reflect the storage and the reutilization of the elastic energy. Taken these findings together, we hypothesized that distance runners with lower competitive level cannot use the elastic energy (i.e., stretch-shortening cycles of the muscle-tendon unit) well during running; therefore, they are forced to produce active force from the QF, which eventually became hypertrophied. The purpose of this study was to examine the relationship between Kvert/Kleg during running and QF CSA in national-level distance runners.

METHODS: Fifteen national-level male distance runners participated in the study (age: 25 ± 3 years; height: 171.6 ± 5.7 cm, body mass: 57.6 ± 3.5 kg, official personal best time for the 5000-m event: 13'45"11 ± 00'19"91). The participants were scanned in a supine position with a 3.0 T magnetic resonance image scanner and T1-weighted spin-echo transaxial images of the mid-thigh of the right leg were collected. The QF, hamstring (HM), and adductor (AD) muscles were identified and calculated their CSAs. The ratio of the muscle CSA to body mass to the two-thirds power was calculated as the relative muscle CSA (cm2/kg2/3). After individual warm-ups, the participants ran 60 m straight at an average velocity of their personal best time for 5000-m race on an all-weather track. The ground reaction force data were recorded using six force platforms. Kvert/Kleg were calculated from the maximal vertical ground reaction force during contact, running velocity, contact time, flight time, height, and body mass (Morin et al. 2005).

RESULTS: There was a significant negative correlation between Kvert (102.3 ± 18.6 kN·m−1) and QF CSA (4.64 ± 0.34 cm2/kg2/3) ($r = -0.593$, $P = 0.020$), while no significant correlation between Kleg (14.7 ± 2.9 kN·m−1) and QF CSA ($P > 0.05$). HM (2.10 ± 0.14 cm2/kg2/3) and AD (1.89 ± 0.29 cm2/kg2/3) CSAs did not significantly correlate with Kvert/Kleg ($P > 0.05$).

CONCLUSION: These results suggest that the QF is greatly hypertrophied in distance runners who do not use the elastic energy of the legs well during running. Coaching and/or training strategies to improve Kvert/Kleg during running may be useful to improve running economy, which may ultimately lead to smaller QF size.

REFERENCES:

Ando et al. (2022). J Hum Kineti, 81:65–72

Li et al. (2019). J Strength Cond Res, 35(6):1491–1499

Morin JB et al. (2005). J Appl Biomech, 21(2):167–180

Zhang et al. (2022). Front Physiol, 13:940761

SURFACE ELECTROMYOGRAPHY (SEMG) AND KINEMATIC COMPARES OF SWING LEG TECHNIQUE DURING SPRINT RUNNING AND ELASTIC BAND RESISTANCE TRAINING

JIE, Z., YING, Z., RURU, Z., LANJUAN, L., NIELS, B.J.V., DANIEL, K., MATTHEW, H.
DONGHUA UNIVERSITY;UNIVERSITY OF STIRLING

INTRODUCTION: Elastic band resistance training (EBRT) is beneficial for improving the specific strengths of sprinters(1). However, it is not clear whether the mode and working characteristics of the swinging leg muscle exertion while using swing technique are consistent with those during actual sprint performance. To achieve the optimal training effect, those specific strengths must be trained by using training methods that are specific to, and meet, or exceed the requirements of competitive contexts(2). In other words, the training effect of those specific strengths can be greatly affected by training regimens including motion range, movement speed, muscle exertion characteristics, working mode, and the extent to which the energy supply systems adapt to the requirements of specific movements and techniques(3). Therefore, the study aimed to use the synchronous testing methods of kinematics and sEMG to test the swing technique action in maximum sprint running(MSR) and the swing technique during the EBRT for Chinese elite sprinters. In addition, the study also explored the muscle sEMG characteristics of the swing leg in these athletes' response to sprint performance and specific strength training.

METHODS: Surface electromyography telemetry technology and high-speed camera were used to simultaneously test kinematics and muscle exertion characteristics of lower limb swing technique in high-level sprinters during EBRTand MSR.

RESULTS: The angle changes response to swing technique showed a significant difference in Maximum value of thigh angle(EBRT:183 ± 4,MSR:161±6,Deg;p=0.000), thigh flexion range(EBRT:160±9,MSR:99±6,Deg;p=0.000), and minimum value of knee angle(EBRT:40 ± 11, MSR: 30 ± 3, Deg;p=0.048) between EBRT and MSR . However, no significant difference

was shown in the values for knee flexion range(EBRT:110 ± 22,MSR :122 ±7,Deg;p=0.186). The angular velocity changes response to swing technique showed a significant higher for maximum value of thigh flexion angular velocity in EBRT than MSR (EBRT:1069 ± 168, MSR: 828 ±72 , deg•s-1;p=0.016).

When completing EBRT and MSR swing technique, each muscle group of the swing leg show distinct temporal sequence. The standardized mean value of Average EMG (AEMG) of FL(p=0.000) and SEM(P= 0.008)were shown in significant difference between EBRT and MSR.there was a significant difference in AEMG of RF(p=0.087), GM(p=0.012) ,TA(p=0.472) between EBRT and MSR . No significant difference was shown in AEMG of VMO(p=0.080),VLO(p=0.055),BF(p=0.187), Ta(p=0.472),LG(P=0.562) between EBRT and MSR.

CONCLUSION: In the practice of special strength training for sprinting running, we should know EBRT could effectively develop thigh forward swing speed and develop the special strength of single muscle groups such as RFandTA; however, the leg muscle activity sequence and muscle group coordination were not consistent with MSR swing technique. This may affect the training effect of the specific strengths of lower limb swing technique for optimal sprint performance.

ACUTE EFFECTS OF ASSISTED SPRINTING ON THE KINEMATICS AND PLANTAR LOADING OF SUBSEQUENT SPRINTING

YAMAZAKI, Y., MATSUI, S., NORO, H., HATA, K., ISHIKAWA, M., LEE, R.Y., YANAGIYA, T.

JUNTENDO UNIVERSITY

INTRODUCTION: The towing sprint is one of the assisted sprinting training methods. It can increase sprinting speed due to improved step frequency and step length1),2). Consequently, the kinematics and kinetics of assisted sprinting differ from normal sprinting, including shorter contact time2), smaller knee angle change during stance phase3), and larger impulse4).

Therefore, assisted sprinting improves sprint velocity by altering the kinematics of lower leg and resultant force. However, most of the previous research has compared assisted sprinting with normal sprinting, leaving the acute effects of assisted sprinting on subsequent sprint performance unexplored. Hence, this study aimed to determine the acute effect of assisted sprinting on kinematics and kinetics of subsequent sprinting.

METHODS: Nineteen male sprinters (age: 20.0 ± 1.7 years, height: 1.74 ± 0.06 m, weight: 66.0 ± 4.8 kg, world athletics score: 883.6 ± 96.2 score) performed maximal sprinting. Each sprinting sequence involved three trials: two unassisted 60-m sprinting before and after a single assisted sprinting using a motorized towing device with a 10% body weight load in isotonic mode. The sprinting motion from 50 to 60-m was recorded using two video cameras (240 fps). Sprinting speed, spatiotemporal and kinematic variables were calculated from the captured video in the sagittal plane. Plantar loading in the forefoot, midfoot, rearfoot and their total loading during sprinting were recorded using wireless, mobile insole sensor. Peak plantar loading and impulse during stance phase were calculated.

RESULTS: No significant differences were found in sprinting speed and spatiotemporal variables between Pre and Post. However, the mean values of hip flexion and extension angular velocities during the flight phase were significantly higher in the Post compared to the Pre (hip flexion: Pre 370.92 ± 38.20 deg/s, Post 405.41 ± 42.27 deg/s, hip extension: Pre 363.96 ± 35.88 deg/s, Post 389.60 ± 31.14 deg/s). Both peak total plantar loading and impulse were higher in the Post compared to the Pre, particularly in the rearfoot, although no significant differences were observed in plantar loading.

CONCLUSION: Sprinting speed was not significantly increased following the assisted sprinting, although the acute effect of increasing the thigh swinging velocity was observed.

【References】

1) Mero & Komi, Eur J Appl Physiol, 1986.

2) Clark et al., J Strength Cond Res, 2021.

3) Sugiura & Aoki, Advances in exercise and sports physiology, 2008.

4) Mero et al., Int J Sports Med, 1987.

EFFECTS OF DIFFERENT SAGITTAL POSTURAL ALIGNMENT ON FLOOR REACTION FORCE DURING SPRINT START

MURAKAMI, T., OKUDA, Y., FUJITA, K., YANASE, K.

DOSHISHA UNIVERSITY

INTRODUCTION: Human spine consists of cervical, thoracic, lumbar, and pelvis regions. In the sagittal plane, there are arranged physiological curvature, and each spine part interacts with one another (1). In general, the posture is believed to affect sports performance, for example, excessive anterior or posterior pelvic tilt postures have negative effects on sprint. However, there have been no studies examining the relationship between postures and sports performance, such as sprint. The purpose of this study was to clarify the effect of different sagittal postural alignment on floor reaction force during sprint start.

METHODS: Participants were 25 healthy young males (21.0 ± 0.8 years, 173.0 cm ± 5.2 cm, 50.2 kg ± 5.0 kg).

The participants were instructed to run as fast as they could a distance of 2.5m toward. They performed to step their right limb first, and kick the floor strongly with the left foot. The participants conducted three different postures at sprint start: the natural posture (NP), intentional maximum anterior tilt posture(AP), and intentional maximum posterior tilt posture (PP). Spine angles in sagittal plane were measured just before the sprint start using Spinal Mouse (Index Ltd., Tokyo, Japan). The order was performed randomly, and each trial was performed twice. Floor reaction forces of lift limb were measured

during the sprint start by a force plate. The peak forces of horizontal direction, vertical direction, and total force were measured. A one-way repeated measures analysis of variance (ANOVA) and Friedman test were used to compare spine angles in three postures. Additionally, these same tests were performed to compare for each peak force among the three postures.

RESULTS: The thoracic and sacral angles in sagittal plane were significantly different among postures. The thoracic extension angles were greater in the order of AP, NP, and PP, and the sacral anterior tilt angles were greater in the same order. The lumbar extension angles showed no significant differences among the postures. The ANOVAs showed main effects for all forces among the postures. Both the vertical and total forces of NP and PP were significantly greater than those of AP. The horizontal force of NP was significantly greater than that of AP.

CONCLUSION: Our results of this study suggest the NP are appropriate sprint start positions compared with AP. In near future, there is a need to analyze reaction times, sprint speeds, and other sprint factors between different postures.

References:

1) Kim et al, Clin Spine Surg. 2016

Contact:

cgtg0093@mail4.doshisha.ac.jp

KINEMATIC ANALYSIS OF TRAIL RUNNING PERFORMANCE: GENDER DIFFERENCES AND SECTIONAL VARIATION IN UPHILL AND DOWNHILL TERRAIN

BETTEGA, S., PELLEGRINI, B., BORTOLAN, L., VISCIONI, G., SCHENA, F., ZOPPIROLLI, C.

UNIVERSITY OF VERONA

INTRODUCTION: Classical determinants of endurance performance cant fully explain trail running since inter-individual differences in running economy and neuro-muscular capacities are greater than road or treadmill running due to challenging and varied terrain and slopes. While the physiology of athletes has widely been investigated, fewer data are available about running kinematics in ecological conditions. Thus, the aim here was to analyze gross kinematics among athletes of different performance levels along two uphill and downhill sections of similar incline during an actual race, hypothesizing that top-level athletes may exhibit less fatigue in both final sectors, with better maintenance of elevated speed, cycle length and reduced duty cycle.

METHODS: We filmed the athletes participating in the Dolomyhts trail running race (10km uphill (1750m D+) followed by 12km of continuous downhill terrain (1750m D-)) with high-frequency cameras, along four 15m track sections, at the start and end of both uphill and downhill segments, approximately. From the video analysis, we measured average sectional speed, cycle length and frequency, contact time, and duty cycle. Two groups for men and two for women were analyzed, including athletes who finished the race with a maximum +10% more time respect to the gender-relative winner, or between +10% and +15%, respectively. Male groups were created by matching all the females for performance index and age. Two-way ANOVA or ANCOVA statistical tests were used to analyze the differences between performance groups and sections, for both male and female athletes.

RESULTS: Among the male groups, a significant difference was observed in uphill running speed, with top men always running faster, through higher cycle length and lower duty cycle ($p<0.05$). Only a trend toward higher speed was shown in the downhill sections among men. Conversely, faster women revealed higher uphill and downhill speed ($p<0.05$) Moreover, the top-performing female group exhibited a higher cycle frequency and lower duty cycle during uphill running ($p<0.05$).

CONCLUSION: Kinematic data analysis suggests that the top-performing males demonstrated superior speed compared to competitors, particularly in the uphill section. In contrast, women's top trail runners were significantly faster throughout the entirety of the course. Top-male demonstrated augmented speed thanks to a reduced duty cycle and higher cycle length, on the other hand, top women's achieved greater speed through augmented cycle frequency. These differences may be due to different muscular strength capacities between genders.

THE EFFECTS OF DIFFERENT FOOT TORSIONAL STIFFNESS ON COUPLING ANGLE VARIABILITY DURING RUNNING

NAKATSUGAWA, T., YUYA, E., TAKEO, M.

TOKYO INSTITUTE OF TECHNOLOGY

INTRODUCTION: Greater coupling angle variability (CAV) which quantifies the variability of coupling motion that occurs in two segments, was reported to predict the incidence of overuse injuries [1]. Coupling motion is considered to be influenced by the soft tissue stiffness around the segments [2]. However, it is unclear how foot stiffness affects the foot CAV during running. The purpose of this study was to compare the CAV of intra-foot segment during running between groups with high and low foot torsional stiffness.

METHODS: Sixteen men running with mid- and forefoot strike participated in this study. Midfoot passive resistant torque and forefoot angle relative to rearfoot were measured simultaneously from maximum forefoot eversion to inversion. Foot torsional stiffness was calculated as the slope of the regression line in the range from 0° to 10° inversion of forefoot. Participants were divided into two groups based on foot torsional stiffness: high stiffness group (HSG; n = 8) and low stiffness group (LSG; n = 8). Participants ran barefoot at 3.3 m/s ± 10% on a 10 m runway, and we collected ground reaction force and kinematics of shank, rear-, mid-, and forefoot using a three-dimensional motion analysis system. CAV was calculated

as the circular standard deviation of the coupling angle quantified with modified vector coding technique [3]. The mean CAV in each phase was evaluated by dividing the stance phase into early (0~33%), mid (34~67%), and late stance (68~100%). The following couplings were investigated: 1) frontal rearfoot vs. sagittal midfoot, 2) frontal rearfoot vs. frontal midfoot, 3) frontal midfoot vs. sagittal forefoot, and 4) frontal midfoot vs. frontal forefoot. Independent t-tests or Mann-Whitney U tests were used to compare the CAV of each phase in two groups (α=0.05).

RESULTS: CAV of frontal midfoot vs. sagittal forefoot and frontal midfoot vs. frontal forefoot at mid-stance in LSG were significantly greater than in HSG. Additionally, CAV of frontal rearfoot vs. sagittal midfoot at late stance was also significantly greater for LSG compared to HSG.

CONCLUSION: Greater CAV indicates that the coordinated motion of two segments for shock absorption and propulsive force transmission differs among trials. Passive stabilizers including ligaments and fascia contribute to the restraint of foot motion [4]. In addition, LSG showed significantly greater mid- and rearfoot frontal ROM than HSG during gait [5]. Foot torsional stiffness reflects mechanical passive properties and low torsional stiffness foot may not control segmental motion well, resulting in increased CAV due to disruption of coordination patterns. Soft tissue stiffness such as foot torsional stiffness is considered noteworthy for detailed gait analysis.

1. Desai, G.A. et al., J Sports Sci 39: 38-47, 2021

2. Pohl, M.B. et al., Gait Posture 25: 295-302, 2007

3. Needham, R. et al., J Biomech 47: 1020-6, 2014

4. De la Portilla, et al., J Biomech 84: 183-90, 2019

5. Magalhães, F. A. et al., J Biomech 119: 110328, 2021

CHANGES IN MOVEMENT SPEED CONTROL CAUSED BY ACCURACY REQUIREMENT LEVEL USING A VERTICAL JUMP TASK

MURAKAMI, H., YAMADA, N.

CHUKYO UNIVERSITY

INTRODUCTION: Movement in humans is thought to be governed by a tradeoff between speed and accuracy (1, 2). However, studies that have examined whole-body movement (e.g. sports) have reported inconsistent findings regarding this relationship. Recently, we examined the relationship between speed and accuracy and its underlying mechanism by introducing a condition in which a control of the landing position was added to a vertical jump task (3). However, this phenomenon was only evaluated under a single condition, where the landing position was verbally instructed, and compared to regular trials. In the present study, the mechanisms underlying this speed–accuracy relationship were investigated by evaluating changes in jump height at required levels of accuracy when physically limiting the landing position accuracy.

METHODS: One healthy adult subject performed each 10 trials of vertical jumps on a force plate under the following four conditions: (1) normal condition (nc); (2) 100% adjustment condition (ad100); (3) 80% adjustment condition (ad80); (4) 60% adjustment condition (ad60). Signal outputs from the force plate were digitized at 1000 Hz. From the acquired force data, the corresponding mass and 3D acceleration vectors were calculated. Then, the 3D velocity and position vectors were calculated by the numerical integration of the accelerations. From these variables, the position vectors and distances of the takeoff and landing points, as well as the jump height, were calculated. In addition, the angle from the velocity vector of the takeoff and the landing was calculated, as well as deviation from the vertical direction.

RESULTS: Jump height decreased as the required landing accuracy condition increased (nc: 0.47±0.01 m, ad100: 0.46±0.01 m, ad80: 0.45±0.01 m, ad60: 0.43±0.01 m) ($p < 0.05$). The distance between the two points was calculated using the xz coordinates of the center of gravity of the landing and takeoff points for each condition (nc: 0.22±0.04 m, ad100: 0.18±0.08 m, ad80: 0.16±0.03 m, ad60: 0.10±0.04 m) ($p< 0.05$). These results indicate that the takeoff velocity was adjusted to improve the accuracy of the landing position, since the jump height is determined by the takeoff velocity. The deviation of the velocity vector of takeoff from the vertical direction decreased with conditions of higher required landing accuracy (nc: 3.30±1.08°, ad100: 3.75±1.73°, ad80: 2.17±1.00°, ad60: 1.75±0.90°) ($p < 0.05$). More vertical control of the takeoff may have improved the accuracy of the landing position.

CONCLUSION: Even in the vertical jump task, which is usually performed with maximal effort, when the landing position was made the target of control and the level of control was varied, it was shown that as accuracy increased, the velocity (jump height) decreased. Furthermore, it was shown that accuracy could be improved by controlling the velocity vector of the takeoff in a more vertical direction.

REFERENCES:

1)Fitts, 1954

2)Woodworth, 1899

3)Murakami & Yamada, 2024

THE ANALYSIS OF POSTURE STABILITY AND JUMPING PERFORMANCE ON INJURY RISK IN FEMALE ATHLETES

TSENG, P.C., HSIAO, H.W., LEE, H.J.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Female athletes have a high incidence of lower limb injuries, with injury risk being significantly greater than in males. Females are 3 to 5 times more likely to sustain unexpected non-contact leg injuries during the season compared to males, making pre-season screening critical. The purpose of this study was to examine potential differences in kinematic parameters, lower limb strength, and dynamic postural stability between healthy and previously injured female athletes during a single-leg drop jump landing. Variables assessed included reactive strength index (RSI), time to stabilization (TTS), and dynamic postural stability index (DPSI) measured during pre-season testing. Detecting differences between healthy and injured athletes on these metrics may help identify limb asymmetries and imbalance that could predispose female athletes to lower extremity injury.

METHODS: This study enlisted 43 Division I female athletes who had not sustained severe head or lower extremity injuries, nor undergone related surgery in the six months prior. A follow up post-season injury tracking categorized them into a healthy group (n=36) and an injury group (n=7), which included individuals with one anterior cruciate ligament (ACL) tear, three ankle ligament injuries, two quadriceps strains, and one patellar tendinopathy. During the experimental phase, 10 Vicon cameras (200 Hz) captured kinematic parameters, while kinetic data was gathered by Kistler force plates (1000 Hz) during the tasks. Measurements taken included jump height, RSI, impact force, DPSI, and TTS. A one-way ANOVA was conducted to analyze the differences between the healthy group and the injury group, considering both healthy and affected limbs.

RESULTS: The findings from this study indicate that during the single-leg drop jump, the TTS in the vertical direction (TTS_V) for the injured groups affected side was significantly higher than that for the uninjured side and the healthy group ($p<.05$). However, no significant differences were observed in jump height, landing impact force, RSI, TTS in anterior-posterior (TTS_AP) and medial-lateral (TTS_ML) directions, or DPSI. Additionally, the valgus angle on the affected side was significantly greater compared to the healthy side and the healthy group ($p<.05$).

CONCLUSION: Injuries during jumps are often associated with athletes landing on a single leg. The observed differences in TTS_V suggest that the injury groups affected side requires a longer duration to achieve post-landing stability. Poor dynamic postural stability is acknowledged as a risk factor for ACL injuries among athletes. Furthermore, a larger valgus angle has been identified in previous research as a significant risk factor for injuries, particularly in female athletes. Consequently, the disparities in TTS_V and valgus angle between the injured and healthy sides, as well as between the injured athletes and the healthy cohort of Division I female athletes, may indicate an increased potential for injury.

STUDY FOR DIFFERENCES IN JUMPING WHEN VOLLEYBALL PLAYERS WEAR MULTIPLE COMPETITION SHOES

HARA, Y., OZAWA, Y., FUJII, M., OZAWA, S., YAMADA, H.
TOKAI UNIVERSITY

INTRODUCTION: Volleyball players perform jump lots times in the game. Therefore, volleyball shoes (VS) are designed with emphasis on functionality such as cushioning, flexibility, and grip. For basketball shoes (BS), Brizuela et al. (1997) have suggested that increasing ankle support in vertical jumps leads to an increase in impact load upon landing and a decrease in performance. However, multiple competitions shoes have not been compared. The purpose of present study was to examine the effects of differences in multiple competition shoes on jumping performance.

METHODS: Subjects were 15 top-level Japanese college male volleyball players (180.6±6.9 cm, 72.3±4.1 kg, 20.7±1.3 years old). The group that usually practices with the VS (VSU group) had 8 subjects, and the group that usually practices with the BS (BSU group) had 7 subjects. They wore VS (ROTE JAPAN LYTE FF 3, ASICS, Japan), BS (GLIDE NOVE FF 3, ASICS, Japan) and control shoes (CS, school slippers, Achilles, Japan), and performed spike jumps on a force plate. The subjects performed a jump with a one-step run-up (one-step run-up jump) and a jump with a free run-up (free run-up jump). Jumping height (JH) were measured using a yardstick (Yardstick, S&C CORPORATION, Japan). Ground reaction force was captured using four force plates. The ground reaction force (GRF) of volleyball and basketball shoes were normalized by that of control shoes for excluding the effects of body weight and jumping height (nGRF). The obtained JH and GRF were compared between groups. One-way ANOVA was used for comparisons among VS, BS, and CS. T-test was used to compare VS and BS normalized by CS.

RESULTS: In free run-up jumps and single run-up jumps, there was no significant difference in jump height (cm) between the VSU and BSU groups when wearing the three shoes (VS, BS, CS). In the free run-up jump, there was no significant difference in the GRF during the landing phase between the VSU group and the BSU group when wearing the three shoes. However, in the BSU group for one-step approach jump, the GRF during the landing phase when wearing CS was significantly higher than that when wearing VS ($p=0.001$) and when wearing BS ($p=0.02$). In the BSU group during a one-step approach jump, nGRF during the landing phase when wearing VS was significantly lower than when wearing BS ($p=0.008$). On the other hand, in the VSU group during one-step approach jumps, nGRF during the landing phase when wearing VS showed a higher value compared to when wearing BS ($p=0.016$).

CONCLUSION: The results of this study can be attributed to the fact that VS and BS are primarily designed to prevent jumping injuries. Furthermore, it was suggested that both the VSU and BSU groups may use different strategies to control their jumps when wearing shoes that they do not normally use. The results of this study revealed that differences in multiple competition shoes have various effects on jumping performance.

Conventional Print Poster Presentations

CP-BM07 Sports Biomechanics

THE SHUTTLECOCK VELOCITY ADJUSTMENT STRATEGY IN BADMINTON BACKHAND SHOTS.

SHIMIZU, M., OZAWA, Y., YAMADA, H.
TOKAI UNIVERSITY

INTRODUCTION: Badminton is a popular racket sport and requires players to hit slow and fast shots to take advantage in rallies. One of the most important shots in badminton is the drive shot. To use the drive shot effectively, players must adjust the velocity of hitting the shuttlecock. Identifying the shuttlecock velocity adjustment strategy in backhand drive would provide coaches with knowledge to assist them in providing appropriate instruction, but no research has been examined from this perspective. Therefore, this study aimed to identify differences between skilled and unskilled players with regard to strategies for controlling shuttlecock velocity on the backhand drive.

METHODS: Ten male college badminton players (Age: 19.4 ± 1.0 year, height: 173.3 ± 4.5 cm, Weight: 64.2 ± 3.8 kg, Experience: 10.5 ± 1.4 year) and ten adult men with no experience in badminton (Age: 21.5 ± 0.6 year, height: 173.5 ± 5.0 cm, Weight: 64.5 ± 9.7 kg) are volunteered for this study. Participants performed backhand drives in the sitting position. Participants were instructed to control the shuttlecock velocity with effort (from 60% to 100%). Upper limb movement and shuttlecock trajectory were recorded with a motion capture system (Mac3D, Motion Analysis Co., USA). Shuttlecock velocity and upper limb joint (elbow extension, forearm supination, and wrist flexion) angular velocity were calculated for each effort level. Data were compared within each proficiency level using repeated measures of one-way analysis of variance (ANOVA) with effort level as a factor; when appropriate multiple comparison tests using Holms method were performed for items. The significance level was set at $p < 0.05$.

RESULTS: In skilled participants, shuttle velocity was significantly higher at the higher effort levels across all effort levels ($p < 0.05$) except between the 70%-80% ($p = 0.060$) and 80%-90% ($p = 0.060$) effort levels. Maximum angular velocity in the elbow and wrist were significantly higher depending on effort levels ($p < 0.05$). In contrast, shuttle velocity in unskilled participants was significantly higher at the higher effort levels across all effort levels ($p < 0.05$) except between 60%-70% ($p = 0.742$), 70%-80% ($p = 0.058$), and 60%-80% ($p = 0.233$). The forearm and wrist maximum angular velocity increased depending on shuttle velocity in unskilled participants ($p < 0.05$).

CONCLUSION: Skilled participants adjusted the shuttlecock velocity appropriately by adjusting the angular velocity of the elbow and wrist joints. Unskilled participants attempted to adjust the shuttlecock velocity appropriately by adjusting the angular velocity of the forearm and wrist joints. However, the unskilled could not properly control the joint angular velocity at low effort levels. As a result, the unskilled could not also control the shuttlecock velocity. In conclusion, it was found that skilled participants and unskilled participants swung with different shuttlecock velocity adjustment strategies.

UNCOVERING TWO EFFECTIVE SERVE STRATEGIES THROUGH CLUSTERING IN PROFESSIONAL TENNIS PLAYERS

DEGHAIES, K., LUSSIANA, T., TOUZARD, P., FOUREL, L., OZAN, S., GINDRE, C., BIDEAU, B., MARTIN, C.
RENNES 2 UNIVERSITY: UNIVERSITE RENNES 2

INTRODUCTION: The tennis serve can be divided into two dynamic distinct phases – loading and acceleration. Here we focus on the loading phase which may reflect style and individual tendency rather than substance (Kovacs & Ellenbecker, 2011) and where lower limb's inter-individual variability seems to be important (Fleisig et al., 2003). Contemporary approaches for profiling sport-specific movements are currently emerging and being utilized in sports biomechanics. This study aims to employ one of these approaches (clustering analysis) to objectively identify potential serve motion strategies among professional tennis players and compare serve kinematics and performance indicators across these strategies.

METHODS: Thirty-one male ATP ranked tennis players, using a foot-up serve technique, performed 5 successful flat serves in a target area. Three-dimensional marker trajectories were recorded at 300 Hz using a 23-camera Qualisys motion analysis system. A radar was positioned behind the baseline to measure ball speed. We performed a two-step cluster analysis. First, hierarchical clustering with Ward's method and squared Euclidean distance and then a k-means clustering in order to classify players' strategy according to several kinematic variables of the loading phase: downward center of mass (CoM) range of motion, maximum downward CoM velocity, and loading phase duration. The clustering models quality was assessed using the average silhouette coefficient, measuring both cluster cohesion and separation. Performance indicators (ball speed and impact height) and serve kinematics parameters were compared between clusters.

RESULTS: Two clusters (CL1: n = 17, CL2: n = 14) were identified with an average silhouette coefficient of 0.37 indicating a moderate to fair clustering model. No significant difference was found between clusters in height, weight, age, ATP ranking, impact height, or ball speed. Players of CL1 showed greater downward CoM range of motion (-7.87 ± 1.45 vs. -3.77 ± 1.31% of body height, $p < 0.001$), as well as greater maximum downward CoM velocity (-0.45 ± 0.13 vs. -0.25 ± 0.08 m.s-1, $p < 0.001$). However, players of CL2 showed greater horizontal maximal velocity during the loading phase (1.04 ± 0.24 vs. 0.76 ± 0.16 vs. m.s-1, $p < 0.001$). Moreover, the start of the loading phase relative to the instant of ball release (BR) (CL1: 78 ± 78 ms after BR, CL2: 39 ± 127 ms prior to BR, $p = 0.004$), as well as the duration between BR and ball-impact (CL1: 1032 ± 95 ms, CL2: 888 ± 170 ms, $p = 0.006$) were significantly different between the two clusters.

CONCLUSION: The observed differences between clusters highlight two distinct effective serve strategies in professional players. One is characterized by a higher, later, and faster downward CoM range of motion, while the other is characterized by an earlier and lower downward CoM range of motion, and a higher horizontal CoM velocity during the loading phase. Coaches should consider both these strategies to better individualize serve instructions.

THE NUMBER OF CRANK REVOLUTIONS REQUIRED TO ACHIEVE STABLE AERODYNAMIC CYCLING BIOMECHANICS OUTCOMES

WILLIAMS, D.1,2,3, DUNN, M.4, WORSFOLD, P.2,5, NEWTON, D.2,3, FAULKNER, S.H.3,6, D'ANDREA, F.1, WHEAT, J.1

1 SHEFFIELD HALLAM UNIVERSITY, UK; 2 UK SPORTS INSTITUTE, UK; 3 GREAT BRITAIN CYCLING TEAM, UK; 4 HERIOT-WATT UNIVERSITY, UK; 5 UNIVERSITY OF CHESTER, UK; 6 NOTTINGHAM TRENT UNIVERSITY, UK

INTRODUCTION: Cycling biomechanics and position optimisation research requires that an appropriate number of crank revolutions are collected to test hypotheses. Despite this, there are no evidence-based recommendations for a representative quantity for cycling experiments. The aim of this study was to determine the number of revolutions necessary to achieve stable sagittal plane cycling biomechanics outcomes whilst riders were in an aerodynamic position.

METHODS: Eighteen elite cyclists (10 females, 8 males, 22 ± 7 years, 1.74 ± 0.10 m, 69.0 ± 9.5 kg) completed a 3-min maximal bout on a cycling ergometer at a fixed cadence of 103 ± 2 rpm in their pursuit position. Lower-limb biomechanical data were captured using two-dimensional motion capture (100 Hz) and force pedals (200 Hz). Raw data were filtered using a 4th order Butterworth low-pass filter (6 Hz) and interpolated to 100 points per crank cycle using cubic splines. 37 discrete and 15 time-series kinematic, kinetic and inverse dynamics outcomes were calculated from the middle 60 crank revolutions. Sequential Averaging (SA)(1) and Iterative ICC (3, 1)(2) were performed to assess outcome stability.

RESULTS: SA showed that all discrete and time-series variables reached stability by at most 46 and 59 revolutions, respectively. However, the number of revolutions SA indicated were required for stability reduced with fewer reference revolutions (NREF) and greater standard deviation (SD) thresholds. ICC results showed that all 37 discrete variables, excluding peak knee flexion angular velocity (n = 32), reached maximum stability by 7 revolutions. In addition, all discrete variables achieved good stability (ICC ≥ 0.8) by 3 revolutions and 35 variables that reached excellent (ICC ≥ 0.9) did so by 4 revolutions. Despite this, the 95% confidence interval lower-bound did not reach ≥ 0.9 in 14 variables. Joint kinetics variables were found to be the least stable by both SA and ICC.

CONCLUSION: This study was the first application of SA and ICC to determine stability of cycling biomechanics outcomes. SA was most conservative and, as expected, results were affected by the SD threshold and NREF(2). However, SA allowed an indication of the stability of time-series data(3). In contrast, ICC did not require subjective inputs(2). The revolutions ICC indicated were required for stability were lower, but results did not exhibit a pattern of increased stability as NREF increased(4). It is possible that stability was assumed when the mean deviation (difference between the moving and cumulative mean) was still converging(3). The results of this study can be used to inform the design of future experiments in terms of the number of crank revolutions analysed, which might depend on the dependent variables included. In addition, the limitations of both stability methods should be considered in future applications.

REFERENCES:

1) Bates et al., J Biomech, 1983

2) James et al., J Sport Sci Med, 2007

3) Taylor et al., J Sport Sci, 2015

4) Chua et al., Sport Biomech, 2017

THE EFFECT OF TIME CONSTRAINTS AND THE KICKING FOOT ON THE VARIABILITY OF FOOTBALL PASS

SHIMOTASHIRO, Y., SHINYA, M.

HIROSHIMA UNIVERSITY

INTRODUCTION: Football players may change their passing location, even during a movement, depending on the movement of an opponent or team-mate. In such cases, the player is required to make a precise pass within a limited time, regardless of the dominant or non-dominant foot. As left and right foot is used in football, it is conceivable that the variation in passing may vary depending on the kicking foot. The purpose of this study was to determine the effects of time constraints and the kicking foot on passing precision.

METHODS: Six right-handed football players were recruited. Targets were placed 8 m in front of the ball and 4 m to the left and right of the ball, with LEDs placed 3 m in front of the ball. Participants performed an inside kick at the left and right targets according to the LEDs. We instructed participants to kick as fast and as accurate as possible on the grounders. In the time-constraint condition, participants were not informed of the direction in which the LEDs illuminated; thus, the direction of the pass was determined as soon as the LEDs were illuminated. This condition randomized the direction of the pass, with the right or left foot, on each of the 40 trials. In the no-time-constraint condition, participants were informed in a priori in which direction the LEDs would illuminate, and 20 trials were made in each condition. The x-coordinate (mediolateral) of the ball position in the plane that included the target was obtained from a video recording data using the two-dimensional DLT method. The variable error of the ball position was defined as the standard deviation of the ball position as an index of the passing precision. A three-way analysis of variance was performed to compare the variable error between the time constraint, the kicking foot, and the pass target conditions.

RESULTS: The significant main effect of the time constraints was observed on the variable error of the ball position. None of the other main effects nor the interactions were statistically significant. The variable error of the ball position was 104.8 ± 88.7 cm under the time constraint condition and 74.7 ± 76.6 cm under the no time constraint condition for passes by the right foot aiming at the right target. The similar results were observed for the other foot and target conditions.

CONCLUSION: Regardless of the kicking foot, immediate "decision-making" may reduce the precision of the pass. During football matches, quicker "decision-making" based on situational information may help to prevent a reduction in passing precision. Additionally, Training involving "decision-making" may also be effective.

RELATION BETWEEN MOTION CHARACTERISTICS AND EVALUATION OF SPLIT LEAP IN RHYTHMIC GYMNASTICS

SHIMIZU, K., KANKE, S., SASAKI, R.
KEIO UNIVERSITY

INTRODUCTION: Rhythmic gymnastics is an esthetic sport that emphasizes the elegance of movement and the precision of technique, evaluated and scored based on established criteria. One crucial aspect of performance is the "Difficulty Body", comprising elements, such as jumps, balance, and rotation1). In this study, we focused on the "split leap" which is frequently used in the performance structure at all age-groups2). We aimed to delineate the distinctive features of this movement by comparing its execution among gymnasts of varying competition levels, as well as to explore the movement methods that are highly evaluated.

METHODS: Six rhythmic gymnasts(20.7±1.4yrs, BMI 18.9±1.1) participated in this study, and performed split leap jump and two static anteroposterior leg-opening positions, one with pelvic rotation suppression and the other without. The angle of the hip joint and pelvic rotation in split leap and two static positions, and changing of angular velocity of hip joint during jump were measured. These measurements were compared based on the competition level of the participants. Furthermore, the jump movements were evaluated by internationally qualified judges, and these evaluations were compared with the measurement values obtained.

RESULTS: The results showed that the angle of the hip joint with pelvic rotation was the largest in the static condition without pelvic rotation suppression compared to the other static condition and split leap jump. Among the jumping movements, the more skilled participants maintained a larger angle during jumping, maintaining approximately 90% of the maximum split angle for 21% of the leap time. Notably, the angular velocity of the swinging leg exhibited a movement pattern that facilitated the maintenance of the large split angle. These movement characteristics were deemed to meet some of the high evaluation criteria set by judges.

CONCLUSION: The study suggested that jumps receiving high evaluations from judges necessitated maintaining a significant split angle above the default leg angle for an extended duration, with variations noted according to the competition level. While the indicators used in this study can be explained by the judges evaluation criteria, additional factors should also be considered.

REFERENCES:

1) Federation International de Gymnastique, 2022–2024 CODE of POINTS Rhythmic Gymnastics.

2) Niwa et al., The Relation between the Leg Split Angle and Flexibility for the Split Leap. Bulletin of Sendai College, 2005. 36(2): p.32-39.

EXPLORING THE SPEED-ACCURACY RELATIONSHIP IN OVERARM THROWING: MINIMIZING THE IMPACT OF BALL FLIGHT DYNAMICS

SUDO, Y., KAWAMOTO, Y., IINO, Y., YOSHIOKA, S., MURAI, A.
THE UNIVERSITY OF TOKYO

INTRODUCTION: The relationship between speed and accuracy in overarm throwing remains debated, with studies showing varied findings: faster throws may decrease accuracy (1), there may be an optimal speed for maximum accuracy (inverted-U relationship) (2), or no significant relationship between speed and accuracy at all (3). Previous research has highlighted task complexity and the throwers experience as key influences on the speed-accuracy relationship in throwing tasks. However, differences in the physical conditions of experiments should also play a role. By properly accounting for physical factors and subtracting their effects, a clearer understanding of human motor skills can be obtained. Previous research implies that a small, light ball or longer throwing distance might exhibit an inverted-U speed-accuracy relationship. This study aimed to reveal how different pitching conditions and ball flight physics affect throwing speed and accuracy and to clarify the characteristics of human motion relating to the throwing speed-accuracy relationship.

METHODS: Ball flight post-release of overarm throwing was simulated (4), targeting a vertical plane 0.9 m above the ground. The throwing speed was increased from 15 m/s to 33 m/s in 3 m/s increments. Constant white noise was added to the ball kinematic variables at ball release with respect to speed and throwing angle, centered on the combination of speed and throwing angle that would hit the center of the target. Accuracy was assessed by the vertical variability of the ball landing position across 1,000 simulations. Flight simulations were performed with two types of balls —a handball (mass: 0.45 kg, radius: 0.095 m) and a cricket ball (mass: 0.16 kg, radius: 0.036 m)— and two distances (short: 7 m and long: 20.14 m).

RESULTS: Simulations showed that for short distances, increased throwing speed led to a gradual decrease in landing variability—27.0% for handballs and 23.5% for cricket balls at 33 m/s compared to 15 m/s. At long distances, variability

dropped sharply with speed increases, with handballs and cricket balls seeing decreases of 69.3% and 74.3%, respectively. The difference in variability between ball types was minor, ranging from 1.89% to 6.36% for short distances and 10.6% to 17.7% for long distances at the corresponding speeds.

CONCLUSION: Throwing distance primarily affected the speed-accuracy relationships in overarm throwing tasks, while the type of ball had little effect. Contrary to the hypothesis, accuracy monotonically increased with higher throwing speeds, not replicating the anticipated inverted U-shaped relationship for the long distance. It was assumed that the variability of ball motion at release would remain constant regardless of the throwing speeds, but it is possible this variability might increase at faster throwing speeds.

REFERENCES:

1) Etnyre, Percept Mot Skills, 1998

2) Freeston et al., Eur J Sport Sci, 2007

3) Vila & Ferragut, Int J Perform Anal Sport, 2019

4) Clanet, Annu Rev Fluid Mech, 2015

SAGITTAL FOREFOOT STRIKE PATTERNS AND ITS ASSOCIATIONS WITH 100-M SPRINT PERFORMANCE IN MALE SPRINTERS

HARUTO, A., TADASHI, S., MASAFUMI, T., YUKI, K., KEISHI, K., TADAO, I.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: Foot strike patterns during running in long-distance runners have typically been classified into three patterns based on sagittal foot positionings at the initial contact and are related to their running performance [1]. In contrast, few studies have explored the usage trends of foot strike patterns in sprinters because most sprinters employ the forefoot strike pattern. To the best of our knowledge, no study has investigated the classification of forefoot strike patterns in sprinters. Utilizing the forefoot strike pattern classification may provide insights into understanding of how sprint performance varies among sprinters. Therefore, in this field study, we examined the usage trends of forefoot strike patterns based on sagittal foot motion during the stance phase of a 100-m sprint in male sprinters and explored their associations with 100-m sprint performance.

METHODS: Sagittal videos were recorded for 296 male sprinters who completed a 100-m sprint race during a track and field event, using high-speed cameras positioned at points corresponding to the acceleration (31.14 m) and maximum sprint phases (60.00 m). Out of these, 248 sprinters exhibiting the forefoot strike pattern and achieving a corrected 100-m sprint time (as desecribed below) of less than 12.00 seconds were included in the analyses of this study. The sagittal forefoot strike patterns were classified into the heel contact (HC) and non-heel contact strikes (NHC). HC was defined as a pattern in which the heel contacted the ground during the stance phase, whereas in NHC, it did not contact the ground. The corrected 100-m sprint time was computed by adjusting the official 100-m sprint time for the effect of wind speed and direction [2]. An unpaired t-test was used to compare the corrected 100-m sprint times between the two groups.

RESULTS: The usage rates during the acceleration phase were comparable between HC and NHC (48.0 and 52.0%, respectively). In contrast, during the maximum sprint phase, the rate was 2.2-fold higher for HC than for NHC (68.1 vs. 31.9%, respectively). When classified during the maximum sprint phase, the corrected 100-m sprint time was significantly faster in NHC group than in the HC group ($P = 0.030$); however, this difference was not observed during the acceleration phase.

CONCLUSION: We found that classifying forefoot strike patterns based on sagittal foot motion during the stance phase into two patterns may be associated with the 100-m sprint time in male sprinters. Therefore, we propose that sagittal forefoot strike patterns could be an important biomechanical factor contributing to superior 100-m sprint performance in sprinters.

REFERENCES:

[1] Bovalino SP, Kingsley MIC. Foot Strike Patterns During Overground Distance Running: A Systematic Review and Meta-Analysis. Sports Med Open. 2021;7(1):82.

[2] Moinat M, Fabius O, Emanuel KS. Data-driven quantification of the effect of wind on athletics performance. Eur J Sport Sci. 2018;18(9):1185-1190.

Conventional Print Poster Presentations

CP-PN10 Strength body composition and fatigue

LOCAL VIBRATION: ACUTE EFFECTS OF THE TONIC VIBRATION REFLEX AND THE ILLUSION OF MOVEMENT ON MAXIMUM WRIST FORCE PRODUCTION

AMIEZ, N., MARTIN, A., PAIZIS, C.

UNIVERSITÉ DE BOURGOGNE

INTRODUCTION: The acute application of local vibration (LV) leads to the projection of Ia afferents to the alpha motor neurons pool and sensorimotor areas of the cortex. Depending on the conditions under which the LV is applied, two phenomena may occur: the tonic vibratory reflex (TVR) and the illusion of movement (1, 2). This study aimed to understand the

role of these two phenomena, whose presence is rarely controlled in studies, on the ability to produce maximum voluntary isometric contraction (MVIC).

METHODS: The LV was applied to the flexor carpi radialis muscle (FCR) of 16 participants (6 minutes, continuous, 80 Hz, 2mm amplitude) in two separate sessions to test both conditions: one favoring the presence of TVR (visual attention focused on the vibrating wrist, no electromyographic muscle feedback), the other favoring ILLUSION (hand hidden, focus on kinesthetic feedback, electromyographic feedback from the FCR muscle). Illusion perception was measured subjectively, and electromyographic activity (EMGa) of the FCR muscle and the extensor carpi radialis (ECR) antagonist muscle recorded during LV was compared with EMGa recorded at rest. MVIC with superimposed and potentiated doublet electrical stimulations at 100Hz were performed in isometric flexion and extension. Assessments were performed 10 minutes before (PR1), and just before (PR2) the LV protocol, and then 0 (P0) and 30 minutes (P30) after the end of the protocol. In addition, voluntary activation level (VAL) and maximal EMGa of the FCR and ECR muscles during MVIC were studied.

RESULTS: Compared to rest, EMGa increased during LV for vibrated muscle only in TVR condition ($P < 0.001$). The illusion of movement was greater in the ILLUSION condition than in the TVR condition ($P < 0.001$). The repeated measures ANOVA showed an interaction only for MVIC performed in flexion. While the ILLUSION condition showed no change ($P > 0.472$), MVIC in the TVR condition was lower at P0 ($P < 0.027$) and P30 ($P < 0.034$) compared with PR1 and PR2. In addition, the MVIC at P0 was lower than that observed in the ILLUSION condition ($P = 0.001$). Moreover, the amount of TVR was negatively correlated with the decrease in MVIC. Other variables remained unchanged.

CONCLUSION: The ability to produce maximal force is reduced only when the six minutes of LV induces TVR, and the amount of TVR recorded on the vibrated muscle is negatively correlated with force loss. Consequently, the conditions under which LV is applied (i.e., EMGa of the vibrated and antagonist muscle and the presence of illusion) should be better controlled to ensure reproducibility of results accros studies.

References:

1. Burke D, et al., J Physiol, 1976. doi: 10.1113/jphysiol.1976.sp011580.

2. Taylor MW, et al., Multisens Res, 2017. doi: 10.1163/22134808-00002544.

THE INFLUENCE OF PHOTOBIOMODULATION ON UPPER BODY MUSCULAR PERFORMANCE

DAMICO, A., BOURANIS, C., NICOLAY, K., SILVA, K., GALLO, J.
SALEM STATE UNIVERSITY

INTRODUCTION: Photobiomodulation (PBM), sometimes referred to as low-level laser therapy, has been shown to improve aerobic endurance performance, along with muscular endurance during single joint resistance exercises targeting smaller muscles. It is unclear whether this benefit extends to compound exercises targeting larger muscles, such as the barbell bench press.

METHODS: In a within-group design, 10 collegiate athletes (mean±sd; age 20.1±1.1 yrs; BMI 25.3±3.9 kg.m-2) received PBM or a sham treatment both six hours prior and then immediately preceding a bench press protocol. Photobiomodulation dosage was 30 Joules per site using an 850 nm wavelength nine diode cluster applicator with five infrared laser diodes (6 J/diode) at 200 milliwatts each and four 650 nm wavelength LED diodes at 10 milliwatts each. Two treatment sites each on the pectoralis major, triceps, and deltoids were irradiated. Bench press one repetition maximum (1RM), volume load (VL) lifted during five sets to failure at 60% 1RM, and soreness immediately after and in the three days following were compared between PBM and sham conditions. Testing was conducted over three sessions separated by a week each, with a baseline testing day occurring first, and the PBM and sham condition testing days following in a counterbalanced fashion to control for order effects. Two-tailed paired t-tests were used to compare the change from baseline between conditions (alpha level = 0.05). Cohen's d was used to calculate effect size.

RESULTS: No significant differences were observed between groups for bench press 1RM ($p=0.48$), VL ($p=0.19$), or soreness ($p=0.90$). No effect was observed for 1RM ($d=.18$) or soreness ($d=.08$). A moderate effect ($d=.50$) was observed for VL, where sham condition change from baseline was 710±518 lbs versus 459±484 lbs in the PBM condition.

CONCLUSION: These findings suggest that muscular performance during compound, large muscle group exercises such as the bench press may not benefit from PBM at moderate loads relative to 1RM. Photobiomodulation is thought to exert its effects via mitrochondrial biogenesis and increased electron transport chain activity; therefore, ergogenic benefits may be limited to longer-duration exercise. Further, while a significant result was not observed, the moderate effect observed in the volume load assessment, where more weight was lifted over five sets in athletes in the placebo condition versus the PBM condition, suggests that the specific treatment used in this study may have inhibited performance. It is unclear whether there is an upper limit at which point PBM becomes ergolytic, but the findings of this study may indicate that such a threshold exists.

THE EFFECT OF SUPERIMPOSED LOCAL VIBRATION ON ISOMETRIC SUBMAXIMAL KNEE CONTRACTIONS

TIMBERT, T., AMIEZ, N., MARTIN, A., COMETTI, C., PAIZIS, C.
UNIVERSITY OF BURGUNDY

INTRODUCTION: While the acute application of localised vibration (LV) at rest induces a loss of strength in most cases, it would appear that its application during contraction can prolong the duration of fatiguing exercise with a potential in-

crease in motor unit recruitment (2). Therefore, this study investigated the effect of superimposed local vibration (SLV) to enhance strength production on submaximal knee extension.

METHODS: Following a warm-up, 10 participants performed maximal voluntary isometric contractions (MVIC) and Rate of Force Development (RFD) contractions before (PRE) and after (POST) one fatiguing protocol. The protocol consists of alternating isometric contractions at 50% of the MVIC in an intermittent format (15 ON/ 5 OFF). The fatiguing task was stopped when the force produced was below 40% of the MVIC. A control condition (CON) and a condition with SLV (VIB, 100Hz, 2-3mm, quadricipital tendon) were performed in the same session, randomised, and interspersed with 45 minutes of rest. The Time Torque Integral (TTI), electromyographic activity (EMGA) of the Vastus Medialis (VL), the Vastus Lateralis (VL), and the Rectus Femoris (RF) were used to compare both fatiguing protocols.

RESULTS: The fatiguing task induces a decrease in the MVIC for both conditions ($p = 0.079$). Similar TTI values ($p = 0.100$) were found for both conditions (CON: 2.38×107 ± 0.9×107 Nm.s-1 and VIB: 2.68×107 ± 1.0×107 Nm.s-1). RFD was unchanged between conditions ($p = 0.913$). For EMGA, no significant differences were found between conditions for either the MVIC ($p > 0.070$) or the fatiguing task ($p > 0.184$).

CONCLUSION: Our study shows no change in the work produced by the two conditions or in EMGA for the quadriceps muscles. Although various studies have shown a positive effect on strength for a weak submaximal contraction (1) or sustained maximal contraction (2), our results do not support that SLV affect the ability to repeat isometric submaximal knee contractions.

(1) Grande et al., "Ia afferent input alters the recruitment thresholds and firing rates of single human motor units", Exp Brain Res, 2003.

(2) Bongiovanni, et al., "Tonic vibration reflexes elicited during fatigue from maximal voluntary contractions in man". J Physiol, 1990.

BODY COMPOSITION AND MUSCULAR STRENGTH: EFFECTS OF DEPLOYMENT IN THE PORTUGUESE AIR FORCE FLIGHT SQUADS

MATIAS, C.N.1, BORGES, H.1, VALAMATOS, M.J.V.2,3, CAVACA, M.L.2,3, JOÃO, F.2, CARDOSO, J.5, REIS, J.F.2,3, MORGADO, J.P.1, VAZ, J.6, BAPTISTA, F.2, MONTEIRO, C.P.2, FERNANDES, T.M.4, CURTO, D.2, NICOLAU, M.2, JESUS, F.2, CARLOS, R.7, ESPADA, M.8, PARDAL, M.9, VITORINO, S.9, NUNES, T.9, RIBEIRO, H.9, SILVA, C.9, ROSÁRIO, I.9, LOPES, M.9

1CIDEFES - UNIVERSIDADE LUSÓFONA, LISBOA, PORTUGAL; 2CIPER; 3FPF; 4FMRP-USP; 5UMAIA; 6CIIEM; 7UATLA; 8ESSE-IPS; 9FORÇA AÉREA PORTUGUESA

INTRODUCTION: Most armed forces are involved in national and international deployments where fine motor skills, mental acuity, and physical performance are simultaneously required. Portuguese Air Force crews deployed on search and rescue missions are multidisciplinary teams of 5 elements comprising these different tasks.

Body composition and strength are significant factors in the military, as effective performance in their duties is crucial for mission success. However, research on the effects of military deployments is limited. In terms of physical fitness, there is some consistency in the findings: a decrease in aerobic capacity and an increase/maintenance of muscular strength, power, and endurance. In terms of body composition, the only consistent result is a reduction in weight.

Bioelectrical impedance analysis (BIA) allows a non-invasive, economical, and practical field evaluation of body composition and phase angle (PhA). Moreover, PhA has been suggested as an indicator of cellular integrity and muscle quality and a predictor of physical performance, as it represents the synergistic effect of physical activity, recovery (e.g.sleep) and nutrition.

This study evaluates the effects of a 15-day deployment for search and rescue missions on the body composition, PhA and strength of the airmen of the Portuguese Air Force flight squads.

METHODS: Healthy military males (N=23, 9 pilots, 5 co-pilots, 2 systems operators and 7 rescue workers) were evaluated the day before and immediately after deployment. Body composition (fat and fat-free mass (FM and FFM), total-body, intra and extracellular water (TBW, ECW, ICW) and PhA were assessed through BIA (BIA-101, Akern). Maximal strength and rate of force development (RFD) were evaluated through 3 maximal voluntary isometric contractions in different conditions: (i) hand grip, using a portable dynamometer (Jamar); (ii) dominant knee extensors and flexors test, using a HUMAC isokinetic dynamometer (HUMAC NORM, CSMI Medical Solutions); and (iii) isometric mid-thigh pull (IMPT), performed on a homemade force plate.

Paired sample t-test was performed, and significance was set at $p<0.05$.

RESULTS: Participants presented differences in body composition and strength variables after deployment. ECW increased from 19.1 ± 2.2 to 19.9 ± 2.3 kg ($p=0.008$), while a decrease in PhA (from 7.1 ± 0.8 to 6.9 ± 0.6°, $p=0.038$), FM (from 14.8 ± 4.6 to 13.6 ± 4.1 kg, $p=0.024$), flexors peak torque (from 143.0 ± 25.9 to 134.0 ± 23.2 Nm, $p=0.043$), and IMTP RFD (from 11.6 ± 2.4 to 9.9 ± 2.3 N/ms, $p=0.004$) was observed.

CONCLUSION: Our findings indicate that, after a 15-day deployment, members of the flight squads in the Portuguese Air Force experienced a decrease in PhA and in the ability to generate lower limb maximal and explosive force, even though a slight (non-significant) increase in FFM was observed. Therefore, the observed decline in phase angle and strength may be attributed to factors such as nutritional status, recovery time (including sleep), and overall fatigue.

EFFICACY OF INTERVAL TRAINING IN IMPROVING BODY COMPOSITION AND ADIPOSITY IN ADULTS: AN UMBRELLA REVIEW WITH META-ANALYSIS

POON, E.T.C., LI, J., LITTLE, J., WONG, S., HO, R.
THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: This study aimed to synthesize the available evidence on the efficacy of interval training compared to moderate-intensity continuous training (MICT) and non-exercise control (CON) in reducing body adiposity in adults.

METHODS: An umbrella review with meta-analysis was performed. A systematic search was conducted in seven databases (MEDLINE, EMBASE, Cochrane Database, CINAHL, Scopus, SPORTDiscus, and Web of Science) until October 2023. Systematic reviews with meta-analyses of randomised controlled trials (RCTs) comparing interval training and MICT/CON were included. Literature selection, data extraction, and methodological quality assessment (AMSTAR-2) were conducted independently by two reviewers. Meta-analyses were performed using a random-effects model. Sub-group analyses were conducted based on the type of interval training (high-intensity interval training [HIIT] and sprint interval training [SIT]), intervention duration (<12 weeks or ≥ 12 weeks) and body mass index (normal range or overweight/obesity).

RESULTS: Sixteen systematic reviews, including 78 RCTs and 2,447 unique participants, met the inclusion criteria. Most systematic reviews had a critically low (n=6) or low (n=6) AMSTAR-2 score. Interval training demonstrated significantly greater reductions in total body fat % (BF %) compared with MICT (weighted mean difference [WMD] = -0.72; 95% confidence interval [CI] =-1.14 to -0.29) and CON (WMD = -1.50; 95% CI = -2.40 to -0.60). Significant reductions in fat mass, visceral adipose tissue, subcutaneous abdominal fat, and android abdominal fat were also observed following interval training compared to CON. Sub-group analyses indicated that both HIIT and SIT resulted in superior BF% loss than MICT, with greater benefits observed in individuals with overweight/obesity and with longer duration interventions (i.e., ≥ 12 weeks).

CONCLUSION: This novel umbrella review with large-scale meta-analysis provides an updated synthesis of evidence with implications for physical activity guideline recommendation. The findings support interval training as a viable exercise strategy for reducing adiposity in the general population.

BODY COMPOSITION ASSESSMENT AS A KEY INDICATOR OF OPTIMIZED STRENGTH PERFORMANCE FOLLOWING AN 8-WEEK HIGH-VOLUME TRAINING REGIMEN

IRIT, M., ALTMAN, A., GEPNER, Y.
TEL-AVIV UNIVERSITY

INTRODUCTION: This study aimed to elucidate the association between body composition and strength performance improvements following 8 weeks of high-volume training regimen among young males.

METHODS: Thirty young males (23.5±1.96 years, 75.5±5.9 kg) participated before (T0) and after 8 weeks of high-volume training regimen (T2). Measurements days included blood markers, anthropometric and strength evaluations, such as hand grip (HG), maximal voluntary contraction (MVC), isometric mid-thigh pull (IMTP), pull-ups and bench presses. In a sensitivity analysis, the participants were stratified using k-means clustering based on their differences in body composition at baseline. Lower skeletal muscle mass and free-fat mass (LSMFF, n=20) and higher skeletal muscle mass and free-fat mass (HSMFF, n=10) conditions were analyzed using an independent sample T-test.

RESULTS: We observed two clusters with significant ($p<0.001$) differences, based on changes in skeletal muscle mass and fat-free mass at baseline. HSMFF significantly ($p<0.001$) improved muscle mass in the right hand, both legs and torso at T2 compared to LSMFF. Changes in bench press, push-ups, and IMTP were significantly ($p<0.05$) higher in HSMFF compared to LSMFF. Eosinophils were significantly ($p<0.05$) lower among the HSMFF at T2 compared to LSMFF. No changes were found in other blood measurements.

CONCLUSION: Our study revealed distinct body composition clusters among young males at baseline which are associated with changes in performance. These findings indicate that higher levels of muscle mass and fat-free mass serve as key indicators of enhanced strength performance following such a high-volume exercise training protocol.

EFFECTS OF ELECTRICAL MUSCLE STIMULATION AND RESISTANCE EXERCISE TRAINING ON MUSCLE STRENGTH AND HYPERTROPHY

ANDO, S., HASHIMOTO, Y., KANNO, I., KANO, K., ANJIKI, K., OGAWA, M., FUJIBAYASHI, M., SUDO, M., OKAMOTO, T.
UNIVERSITY OF ELECTRO-COMMUNICATIONS

INTRODUCTION: Electrical muscle stimulation (EMS) has the potential to be an alternative modality to voluntary exercise [1]. However, less is understood how EMS applied to the lower limb muscles using belt electrodes influences quadriceps muscle strength and hypertrophy. Previous studies suggested that EMS activates mostly superficial motor units. Thus, we tested the specific hypothesis that changes in muscle strength and hypertrophy following EMS training are different from those following resistance exercise training. The purpose of this study was to examine effects of EMS and resistance exercise training on muscle strength and hypertrophy, and to compare the effects.

METHODS: Thirty-six healthy male participants were divided into three groups; EMS training group (EMS group), resistance exercise training group (Resistance group), and control groups. In the EMS group, EMS was applied bilaterally to the abdomen, glutes, thighs, and lower legs with an electrical stimulator three times per week for eight weeks. The stimulator

current waveform was set at 20 Hz with a pulse width of 0.25 ms. The cycle consisted of a two sec stimulation and a two sec pause. In the Resistance group, participants performed dynamic leg press training [2] for eight weeks. In the control group, participants maintained their lifestyle. Before and after the trainings, maximal isometric/isokinetic knee extension torque was measured using the Biodex dynamometer. Quadriceps muscle volume was assessed using magnetic resonance imaging.

RESULTS: EMS training increased maximal isometric/isokinetic torque ($p < 0.01$), while leg press training only increased maximal isokinetic torque ($p < 0.05$). In the EMS group, muscle hypertrophy was observed at the distal part of the quadriceps muscle ($p < 0.05$). In the Resistance group, muscle hypertrophy was prominent around the muscle belly ($p < 0.001$).

CONCLUSION: The present results indicate that EMS training has the potential to increase muscle strength. The lack of increases in isometric torque in the Resistance group suggests that the training effects were not transferred to isometric strength. The regional hypertrophy of the quadriceps muscle in the EMS group is presumably ascribed to current flows from knee to hip in the present experimental setup. The present results suggest that effects of EMS training using belt electrodes on muscle strength and hypertrophy are different from dynamic resistance exercise training.

[1] Akagi et al. (2024) J Sports Sci

[2] Neves et al. (2022) PLoS One

INFLUENCE OF THE ELECTRODE PLACEMENT ON THE NATURE OF RESPONSES EVOKED BY TRANSCUTANEOUS SPINAL CORD STIMULATION

SORDET, J., MARTIN, A., AMIEZ, N., VITRY, F., QUENOT, J.P., PAPIORDANIDOU, M.

INSERM U1093

INTRODUCTION: Transcutaneous spinal cord stimulation (tSCS) has experienced a clinical interest over the last years especially in patients undertaking locomotor recovery (1). This stimulation technique elicits responses in all muscles of the lower limb, called Posterior Root Muscle (PRM) reflexes (2). Although these responses seem of reflex nature, the electrode placement during tSCS can influence the type of recruited fibers (3). The purpose of this study was to evaluate the homosynaptic post-activation depression mechanism (HPAD) when tSCS was applied at two different levels of the spinal cord.

METHODS: 20 subjects participated in one experimental session and 10 out of them accepted to take part in a second experiment. For the first experiment tSCS was delivered at the lumbar level (L1-L2), while for the second experiment PRM reflex was elicited by stimulating at the thoracic level (T11-T12). For both experiments, these responses were compared with the H-reflex, elicited by stimulating the posterior tibial nerve. EMG activity was recorded from the right soleus (SOL) and vastus lateralis (VL) muscles. Recruitment curves in paired-pulse stimulations were built for the two types of stimulation. The amplitude of PRM and H-reflexes were matched and the HPAD phenomenon was tested by delivering paired-pulse stimulations at 1s inter-stimulus interval, by changing the test and the conditioning stimulation. The degree of HPAD was assessed by the amplitude of the second response expressed as a percentage of the amplitude of the first response (HCOND/HTEST, PRMCOND/HTEST, HCOND/PRMTEST and PRMCOND/PRMTEST).

RESULTS: For both experiments, results of the SOL recruitment curves showed that the amplitude of the second PRM-reflex was significantly decreased ($P<0.05$) compared to the first one for all stimulation intensities. Concerning the VL muscle, the amplitude of the second response was not significantly decreased during the first experiment while during the second one, a decrease of the second response was observed, indicating VL afferents solicitation during tSCS. Regarding the conditioning stimulations of the first experiment, no difference was observed between the different conditioning ratios ($P=0.99$), suggesting that the degree of HPAD was identical between tSCS and nerve stimulation. During the second experiment, where the VL afferents were solicited by tSCS, the PRMCOND/PRMTEST was significantly lower ($P<0.05$) compared to the other conditioning ratios.

CONCLUSION: Although PRM reflex and H-reflex seem to be sensitive in the same way to the HPAD phenomenon, the influence of the heteronymous contribution of VL afferents on SOL PRM reflex seems to have an impact on the degree of HPAD that can be evoked by tSCS. The electrode placement plays an important role in the nature of the elicited responses and should be taken into account when comparing the responses evoked by tSCS and peripheral nerve stimulation.

1. Hofstoetter et al., 2013

2. Minassian et al., 2007

3. Sayenko et al., 2015

STRESS FACTORS ASSESSED BY HEART RATE VARIABILITY, HORMONAL LEVELS, AND PERCEIVED EXERTION DURING MILITARY FIELD TRAINING

KYRÖLÄINEN, H., SEPPÄNEN, J., OJANEN, T.

UNIVERSITY OF JYVÄSKYLÄ; 2NATIONAL DEFENCE UNIVERSITY

INTRODUCTION: Stress causes changes in the functions of the autonomic nervous system as well as in the endocrine and metabolic systems. In military field training, there are often multiple stressors, including physical strain, environmental factors, sleep deprivation, energy deficit, and psychological factors. The main aim of this study was to determine stress factors utilizing heart rate variability, hormone levels, and perceived exertion during three weeks of a military field training.

The second aim was to investigate how the changes in the selected subjective and objective measures were related to each other, and whether aerobic fitness and body composition were related to these changes.

METHODS: A total of 49 men (age 20 ± 1 years; height 179 ± 7 cm; body mass 73.0 ± 8.8 kg) participated in the study. The three-week military training was divided into a shooting training period (5 days), combat training period I (8 days), and combat training period II (7 days). Nocturnal and morning heart rate variability (HRV), anabolic and catabolic hormone status, physical activity, ratio of perceived exertion (RPE), and amount of sleep were investigated before the military field training, periodically during the training, and 4-5 days after the end of the military field training. In addition, aerobic fitness (12-min running test) and body composition were measured.

RESULTS: During the three-week military field training, nocturnal and morning heart rate, cortisol (COR), RPE, and NASA-Task Load Index (TLX), which assesses the level of stress experienced by an individual while performing a task, increased statistically significantly during the training. Respectively, testosterone (TES) and insulin-like growth factor-1 (IGF-1) levels decreased statistically significantly. Only a few statistically significant changes were observed in the HRV variables. The observed stress, caused by the military field training, seems to recover to its initial levels or close to them within 4-5 days after the end of the training. There were weak associations between the changes in the subjective and objective measures but, however, RPE was associated with TES ($r=-0.30$, $p<0.05$) and NASA-TLX with COR ($r=0.49$, $p<0.01$).

CONCLUSION: The stress caused by military field training caused changes in the functions of the autonomic nervous system as well as the endocrine and metabolic systems. The changes indicate that the training increased the participants' physiological and / or psychological stress, leading the body to a more catabolic state. It was, however, challenging to interpret the results while the changes in the studied variables varied individually. It can be concluded that the present study can provide interesting data about the workload of military field training. In addition, it seems that different measurement methods and tools are needed for obtaining better quality data and thus, improving the reliability and reproducibility of the study. Finally, individual responses and adaptations should be taken into considerati

THE EFFECT OF MENTAL FATIGUE ON BOXING PERFORMANCE

SALAM, H., FARAJ, S.
UNIVERSITY OF SULAYMANIYAH

INTRODUCTION: Mental fatigue has been shown to reduce physical performance in endurance sports (Marcora, 2009a). Recent studies have demonstrated a negative effect of cognitive tasks involving response inhibition on perception of effort during self-paced endurance tasks (Marcora et al., 2009b; Salam et al., 2017). By comparison, there is a paucity of research investigating the effects of mental fatigue on high intensity intermittent sports, such as boxing, which, even though shorter in duration, has been shown to effect psychological states in boxers (Slimani et al., 2002). Therefore, the aim of this study was to investigate the effect of mental fatigue on boxing physical performance.

METHODS: Sixteen elite boxers completed 3 laboratory visits, the first was to familiarize participants with the experimental protocol. During the experimental visits, each boxer completed three rounds of boxing performance. In the first round, boxers performed 1000 jab and cross punches, in second round 1000 left and right hooks, and in final round 1000 left and right uppercuts punches. There was a 60 second rest period between each round. Prior to these exercise bouts boxers completed either mentally fatiguing task (MF) or a control condition (CC). Within the MF condition, undertook a 30-min incongruent Stroop Task designed to induce perceptions of MF. Within the CC condition participants spent 30-min reading a magazine, and the Brunel mood scale (BRUMS) questionnaire were assessed before and immediately after each condition. During rest periods between rounds, blood lactate, heart rate, and RPE were taken. Data were analysed by two-way (2 condition x 3 time points) repeated-measures ANOVAs.

RESULTS: The MF task induced negative change in boxing performance duration, so the comparison of 1000 punch time expenditure were: the first round (CC 392 ± 8 sec vs. MF 446 ± 3 sec), second round (CC 370 ± 14 vs. MF442 sec ± 6 sec) and third round (CC 338 ± 12 sec vs. MF385 ± 7 sec) (Boxers spent longer time in MF condition compare to CC ($P<0.05$) RPE was significantly higher in the MF compared to CC (($P<0.05$).BRUMs was no significant difference in pre –conative task perception of mental fatigue between MF (5.9±1.32) and CC (6.1±1.21), however, post rating of MF(11.8±1.3) were significantly higher than CC(6.7±0.8) ($P<0.05$). There was no significant different in HR between conditions ($P>0.05$). However, the BL accumulation was significantly lower in MF condition ($P < 0.05$).

CONCLUSION: The results of this study demonstrate that MF has a direct negative effect of boxing performance duration, RPE, and perception of mental fatigue.

Marcora S (2009a). Salam, H, Marcora, S & Hopker (2018). J.G.Eur J Appl Physiol 118, 85–92. Marcora SM, Staiano W & Manning V (2009b). J ApplPhysiol 106, 857-64. Eur J ApplPhysiol 114, 1095-105. Slimani M, Miarka B,Teixeira R, Znazen H,Tod D& Nikolaidis P (2022) Medicina dello Sport10.23736-S0025.

Conventional Print Poster Presentations

CP-MH16 Exercise and medical conditions

THE GUT MICROBIOTA AND CARDIORESPIRATORY FITNESS IN MULTIPLE SCLEROSIS PATIENTS

NECHALOVÁ, L., PENESOVÁ, A., HRIC, I., BABICOVÁ, M., HLAVÁCOVÁ, V., BIELIK, V.
FACULTY OF PHYSICAL EDUCATION AND SPORT, COMENIUS UNIVERSITY IN BRATISLAVA

INTRODUCTION: Despite the progressive decreases in the physical function and mobility of the lower extremities in multiple sclerosis (MS) patients, the evidence indicates the positive impact of physical activity on the development of this disease. Furthermore, emerging research has shown the crucial role of gut microbiota in maintaining overall health in MS patients, including its potential influence on the immune system, chronic inflammation, or neurological conditions. However, there is still limited data on the potential negative shifts in the gut bacteria due to reduced physical activity, as well as the convincing positive relationship between cardiorespiratory fitness and the gut microbiota in MS individuals. Therefore, the purpose of this study was to compare active MS women with active healthy women and investigate the associations between gut microbiota and cardiorespiratory fitness.

METHODS: This prospective cross-sectional study involving 17 active MS women (MS) and 17 active healthy women (controls) was carried out. The gut microbiota was categorized using specific primers targeting the V3–V4 region of 16S rDNA; the body composition was measured by bioimpedance; and the cardiorespiratory fitness was quantified by an incremental test on a bicycle ergometer.

RESULTS: We observed significant negative shifts in body composition (e.g., BMI, waist circumference, and body fat percentage) and significantly lower cardiorespiratory fitness (e.g., VO2max/kg, Loadmax/kg, RER, and VE) in MS compared to controls. Furthermore, we detected significant negative shifts in gut microbiota, e.g., a decreased alfa diversity (Chao1), a decreased relative abundance of short-chain fatty acid producers (e.g., Blautia spp., Coprococcus spp., Eubacterium spp.), and a decreased relative abundance of physical fitness-associated bacteria (e.g., Veillonella spp.) in MS compared to controls. Notably, a significant positive association was found between health-related bacteria (e.g., Faecalibacterium prausnitzii, Lactobacillaceae, Veilonella magna, and Veilonella rogosea) and cardiorespiratory fitness (e.g., Vo2max/kg, Loadmax/kg).

CONCLUSION: The main findings of our study were inferior body characteristics and cardiorespiratory fitness, as well as negative shifts in gut microbiota in MS compared to controls. Moreover, our study clearly showed a strong association between several gut microbes and cardiorespiratory fitness. We believe that increased physical activity can be effective in stimulating changes in bacteria linked to health in MS patients.

FUNDING: This study was supported by the Grant No. APVV-22-0047 of the Slovak Research.

EFFECTS OF AEROBIC EXERCISE IN ALPHA-SYNUCLEIN EXPRESSION IN ANIMAL MODEL OF PARKINSON'S DISEASE. A SYSTEMATIC REVIEW.

MORALES-ÁLAMO, D.1,2,3, TORRES-REYES, S.3, MARTÍN RODRÍGUEZ, S.1,2,3
1.DEPARTMENT OF PHYSICAL EDUCATION, ULPGC; 2.RESEARCH INSTITUTE OF BIOMEDICAL AND HEALTH SCIENCES , ULPGC; 3.FACULTY OF PHYSICAL ACTIVITY AND SPORTS SCIENCES, ULPGC

INTRODUCTION: Parkinson's disease (PD) is characterized by the aggregation of toxic cytoplasmic inclusions called Lewy bodies (LBs) and Lewy neurites (LNs), leading to dopaminergic loss in the substantia nigra. The primary component of LBs and LNs is the protein alpha-synuclein (alpha-Syn). Exercise has been shown to be effective as a complementary therapy for PD, resulting in the alleviation of some motor symptoms and improvements in quality of life. However, despite numerous physiological mechanisms proposed to explain the neuroprotective effect of physical exercise, only a growing body of animal research aims to determine if physical exercise can modulate alpha-Syn expression under PD conditions. This systematic review investigates whether endurance exercise reduces alpha-Syn levels in the substantia nigra in animal models of PD.

METHODS: PRISMA Guidelines were strictly followed. We systematically searched relevant articles in Web of Science, Medline/PubMed, Scopus, and Cochrane Library from inception to January 2024. The total sample size across the 8 included studies was 356 mice (i.e., only 116 received exercise intervention). To evaluate the risk of bias, the SYRCLE's RoB tool for animal studies was used.

RESULTS: 343 articles were identified from the databases (55 in PubMed; 6 in Cochrane Library; 115 in Web of Science and 167 in Scopus). Out of 247 articles (without duplicates) that were screened, 27 studies met the inclusion criteria for the first and 10 studies for the second screening review. All studies showed a decrease in alpha synuclein levels following aerobic exercise intervention. The exercise led to significant reductions in alpha-Syn in all models treated with intraperitoneal injection of MPTP. The mouse models of Parkinsons disease induced by triacetyl-6-OHDA injection also experienced a reduction in alpha-Syn expression with resistance exercise intervention.

CONCLUSION: Animal experiments consistently showed a clear downregulation in alpha-Syn expression in response to aerobic exercise compared to sedentary control groups. Nevertheless, caution is warranted in interpreting these findings

due to inherent limitations and inconsistencies in standardization and reporting quality within the domain of animal research.

FEASIBILITY OF A MULTISPORT, LAND- AND WATER-BASED OUTDOOR PROGRAM FOR MANAGING MOTOR AND NON-MOTOR SYMPTOMS IN MILDLY-DISABLED PERSONS WITH PARKINSON'S DISEASE: A SINGLE-GROUP PILOT STUDY

NATALE, D., MELONI, M., CARIA, A., PORCO, I.G., BANDIERA, P., PAULUS, K., SOLLA, P., DELLA CROCE, U., MANCA, A., CUGUSI, L.

1. UNIVERSITY OF SASSARI; 2. UNIVERSITY OF VERONA

INTRODUCTION: Outdoor land- and water-based activities are considered non-conventional, promising activities for individuals with motor disorders deriving from neurological conditions. The aim of this pilot study was to investigate the anthropometric, body composition, functional and psychological effects of a 10-week, multisport outdoor program (i.e., hiking, surf, kayak, and sailing) in mildly disabled individuals with Parkinsons disease (PD).

METHODS: The research design was set as a single-group pre-test/post-test interventional study. Ten subjects (9M:1W; median Hoehn-Yahr: 2; range: 1-3) were recruited from those referring to the neurology unit and volunteered to participate in a 10-week outdoor program consisting of 8 hiking sessions (2/week), and 12 sessions of different water-sports activities (i.e., surf, kayak, and sailing; 2 sessions/week). Main outcomes (anthropometrics, body composition, balance, muscular strength, flexibility, cardiorespiratory fitness, quality of life) were assessed at baseline (PRE), end of the hiking sessions (MID), at the completion of the water-sports intervention (POST) and at three months from the program completion (follow_up, F_UP).

RESULTS: Repeated-measures ANOVA and adjusted post-hoc comparisons revealed significant changes in body weight (PRE-POST: -3%; p=0.014; MID-POST: -2.4%; p=0.008; POST-F_UP: +3.4%; p=0.005) and in Body Mass Index (PRE-MID: -2%; p=0.014; PRE-POST: -2.7%; p=0.014), waist circumferences (POST-F_UP: +5.3%; p=0.033), and Waist-to-Hip Ratio (PRE-POST: -2.5%; p=0.029; POST-F_UP: +5.8%; p=0.005). A significant decrease was observed in the time to complete the Five-Times-Sit-to-Stand Test (PRE-MID: -17.2%; p=0.005). Flexibility was found changed both in the Back Scratch (PRE-POST: +24.6%; p=0.042) and Sit-and-Reach Tests (PRE-POST: +87%; p=0.015). Regarding cardiorespiratory fitness, as estimated by distance covered during the 2-Minute and 6-Minute Walk Tests (2MWT, 6MWT), data showed a significant increase in distance both for the 2MWT (PRE-POST: +9.7%; p=0.035), and 6MWT (PRE-POST: +9.4%; p=0.011; MID-POST: +4.9%; p=0.032). Wilcoxon U-tests run on clinical scores revealed significant changes in UPDRS-1 (mentation/behavior/mood sections: PRE-POST: -29.5%; p=0.008), UPDRS-3 (motor sections: PRE-POST: -6.1%; p=0.05), and Beck Depression Inventory (PRE-POST: -33.5%; p=0.028).

CONCLUSION: Preliminary data showed that a 10-week program combining land- and water-based outdoor activities proved safe and feasible in mildly disabled individuals with PD, also showing potential for improving mood as well as selected anthropometrics, motor-functional and cardiorespiratory outcomes. However, the significant drops in performance detected at the 3-month F_UP should be taken into proper account as they may suggest the need for involving people with PD in longer-term interventions to induce a stable behavioral change in lifestyle.

AEROBIC AND COGNITIVE TRAINING DURING DIALYSIS TO MITIGATE DECREASED FUNCTIONAL AND PHYSIOLOGICAL STATUS IN HEMODIALYSIS PATIENTS

BOGATAJ, S., ROELANDS, B., PAJEK, M., PAJEK, J.

UNIVERSITY MEDICAL CENTRE LJUBLJANA

INTRODUCTION: Hemodialysis (HD) patients are at risk of frailty, sarcopenia, and cognitive decline, which affect their overall quality of life (QoL) and increases the risk of morbidity and mortality. One important blood parameter inducing this, and that has been shown to be affected by HD, is brain-derived neurotrophic factor (BDNF). BDNF plays a vital role in neuronal survival, synaptic plasticity, and energy metabolism. This study aimed to determine the impact of sequential physical and cognitive intradialytic training on functional and physiological status of HD patients.

METHODS: Thirty-two HD patients were randomly divided into an experimental (EXP) and control (CON) group. The EXP group underwent 12 weeks of intradialytic cycling and cognitive training three times a week, while the CON group received standard care. Outcome measures (serum BDNF concentrations, subjective feeling of mental fatigue, frailty score, QoL (Physical Component Summary (PCS) and Mental Component Summary (MCS)) were assessed before and after the intervention.

RESULTS: A significant between-group difference was found for subjective feeling of mental fatigue ($F(1,29)=9.74$, $p=0.004$) and frailty score ($F(1,29)=12.26$, $p=0.002$) favoring the EXP group, whereas no significant differences were observed for BDNF ($F(1,29)=2.15$, $p=0.153$), PCS ($F(1,29)=1.52$, $p=0.227$) and MCS ($F(1,29)=1.27$, $p=0.270$). BDNF concentrations were preserved in the EXP group, while a significant decrease was observed in the CON group ($p=0.006$). There was a significant correlation between the change in BDNF and change in mental fatigue ($r=-0.554$; $p=0.001$). The frailty score significantly increased in the CON group ($p=0.011$), while it remained stable in the EXP group. PCS was improved within the EXP group ($p=0.040$).

CONCLUSION: The study provides evidence for the effectiveness of a novel non-pharmacological intervention for HD patients. By targeting both physical and cognitive aspects, this intervention holds promise for improving their functional status. Further research is needed to explore the long-term benefits of such interventions and understand their potential impact on QoL.

FEASIBILITY AND ACCEPTABILITY OF A PHYSICAL ACTIVITY AND NUTRITION INTERVENTION FOR HOSPITALIZED ADULTS UNDERGOING HEMATOPOIETIC STEM CELL TRANSPLANTATION

VEJBY, S., HENRIKSSON, A., JOHANSSON, B., ROBELIUS, A., WETTERGREN, L.
DISCIPLINARY DOMAIN OF MEDICINE AND PHARMACY

INTRODUCTION: Hematopoietic stem cell transplantation (HSCT) is a well-established procedure with the potential to cure a variety of conditions. As patients are hospitalized for a long time, special considerations regarding physical activity (PA) and nutrition are required. Malnutrition during HSCT may impact on relapse rate, fatigue, infection rate, engraftment and survival. In a previous study, we found that it is possible to increase PA levels using behavior change techniques such as individualized goal-setting, daily follow up and a self-monitoring PA diary. The present study aimed to investigate the feasibility and acceptability of a nurse-led combined physical activity and nutrition support program directed to patients undergoing HSCT at a Swedish university hospital.

METHODS: In this single arm longitudinal intervention study, 20 adults planned for HSCT (14 males, mean age 56 (SD 13.2)) participated in an individualized intervention regarding PA and nutrition. The intervention started pretransplant with a nurse led information and encouragement about PA, web-based diet diary and a dietitian consultation. During hospitalization, intervention included PA goal-setting (walking, bicycling, rubber bands), activity diary, energy/protein intake monitoring, dietitian consultation, daily follow-ups by the study nurse and a PA prescription at discharge. After discharge, the study nurse had additional follow-up by phone. Six minutes walking test was assessed pretransplant, at admission and at discharge. Feasibility and acceptability were assessed by the number of patients participating, adherence to the intervention and retention. Semi-structured interviews were conducted with a sub sample of participants (n=14) two weeks after discharge. Interviews were transcribed and analyzed using qualitative content analysis.

RESULTS: Twenty eight of 52 eligible patients were approached, 22 patients consented to participate in the study. As for adherence; 95% completed the diet diary pretransplant (30% during hospitalization), 100% formulated PA goals, 97% completed the activity diary daily, 70% met their PA endurance goals, 75% reached calculated energy intake and 10% reached calculated protein intake (they reached 76% of their calculated intake on a group level). All participants completed the 6MWT and no one terminated their participation prematurely. The qualitative analysis resulted in three main categories: Intervention factors (follow-ups, visible goal-setting, positive effects e.g.), individual factors (coping, previous experiences e.g.) and context factors (environment and routines). Generally, participants described the intervention as helpful and that they became motivated to achieve their personal PA goals.

CONCLUSION: The intervention appears to be feasible as most patients fulfilled both the PA and nutrition parts and no adverse effects were reported. A revised version of the intervention will be implemented in clinical care.

PHYSICAL AND PSYCHOLOGICAL BENEFITS OF PHYSICAL ACTIVITY INTO CANCER CACHEXIA MANAGEMENT

PEYRACHON, R., RICHARD, C., LIÈVRE, A., ANDRÉ, N., GELEIN, B., CHAORY, K., RÉBILLARD, A.
UNIVERSITY OF RENNES, M2S-EA7470, F-35000 RENNES, FRANCE

INTRODUCTION: Physical Activity (PA) is known to either maintain or enhance the physical and psychological conditions of early-stage cancer patients (Campbell et al. 2019). However, the effectiveness of PA in patients with cancer cachexia, a syndrome characterized by severe physical deconditioning and losses in appetite, weight, lean mass, and fat mass, remains uncertain. Consequently, it is unclear whether the established PA guidelines are suitable for cachectic cancer patients (CCP) or if engaging in PA could potentially worsen symptoms of cachexia. The objective of our study was to evaluate the impact of a PA program on CCP.

METHODS: 19 CCP participated in a supervised PA program combining endurance and resistance training. Throughout a 3-month period, CCP could engage in exercise sessions twice a week, each lasting for 1 hour. The number of exercise sessions was recorded. Physical condition assessments, including body composition, strength, and endurance, were conducted. Psychological condition included quality of life and cancer-related fatigue.

RESULTS: CCP realized 17.42±3.90/24 sessions over the 3-months program. 19 patients completed physical assessments and 14 responded to questionnaires. PA program led to significant increases in lean mass ($p<0.001$), endurance ($p<0.001$) and lower limbs strength ($p<0.001$) among the CCP. Concerning the patients reported outcomes, PA program led to significant reduction of cancer-related fatigue through general fatigue ($p=0.015$) and physical fatigue reductions ($p=0.042$). Also, PA program counteracted cancer cachexia symptoms, loss of appetite ($p=0.006$), constipation ($p=0.035$), reduction of activity ($p=0.039$) and motivation ($p=0.006$) and improved role functioning ($p=0.005$) and social functioning ($p=0.019$).

CONCLUSION: CCP engage in the PA program and experience benefits on physical and psychological condition. PA program improves lean mass, appetite, endurance, strength, cancer-related fatigue, and quality of life. These findings highlight the importance of incorporating PA into cachexia management. According to our results, a frequency of 1.5 to 2 sessions per week for 3 months seemed sufficient to yield positive outcomes. According to patients reported benefits, PA program could create virtuous circle for restarting activities and regaining motivation beyond the PA program. Two main limitations emerge from our study: the results are based on a small sample of CCP, and the absence of a non-exercise control group makes it difficult to assess the impact of the exercise on the patients health. Further studies are needed to specify the dose-response relationship between program characteristics and the resulting effects. Moreover, larger studies are needed to refine the effects of PA program according to patient characteristics (e.g. type of tumor, treatment).

THE EFFECT OF STRENGTH TRAINING ON THE GUT MICROBIOME OF CHILD CANCER SURVIVORS

HLAVÁCOVÁ, V., BABICOVÁ, M., NECHALOVÁ, L., HRIC, I., SMAHOVÁ, S., KOLENOVÁ, A., BIELIK, V.
COMENIUS UNIVERSITY IN BRATISLAVA, FACULTY OF PHYSICAL EDUCATION AND SPORT

INTRODUCTION: The human gut microbiome is an important factor in the genesis and progression of many diseases. Acute lymphoblastic leukemia (ALL) is the most common cancer in children and the most common cause of cancer-related death in childhood. Oncological treatment negatively affects the composition of the intestinal microbiome, which is reflected in the overall physical and psychological health of the patient. The aim of this study was to determine the influence of strength training on the composition of the intestinal microbiome.

METHODS: This study was aimed at detecting changes in the composition of the intestinal microbiome in cured pediatric oncology patients (1-3 years after being cured of acute lymphoblastic leukemia) after an 8-week, 3-times-a-week intervention focused on sports activity. The composition of the gut microbiome was analyzed using the Illumina sequencing method. We sequenced the hypervariable V3-V4 regions of the 16S rRNA gene, which enable the identification of relative bacterial abundance in stool samples.

RESULTS: Based on the results, we found that, due to the exercise intervention, there was no convincing shift in the composition of the intestinal microbiome in the patients. Also, we did not notice positive results at microbial α-diversity. However, we reported a significant increase in beneficial bacteria producing short-chain fatty acids (SCFA) in the bacterial species Blautia obeum ($p = 0.0397$) and Butyricicoccus faecihominis ($p = 0.0499$).

CONCLUSION: The results of this study showed a minimal effect of strength training on the bacterial composition of the intestinal microbiome in cured pediatric oncology patients. There was no increase in the diversity and richness of the composition of the gut microbiome. There was no increase in beneficial bacteria compared to pathogenic bacteria, except for the bacterial species Blautia obeum and Butyricicoccus faecihominis.

THE EFFECT OF AN EXERCISE PROGRAM ON PHYSICAL FITNESS IN CHILD CANCER SURVIVORS

BABICOVÁ, M., NECHALOVÁ, L., HRIC, I., HLAVÁCOVÁ, V., SMAHOVÁ, S., KOLENOVÁ, A., BIELIK, V.
FACULTY OF PHYSICAL EDUCATION AND SPORT, COMENIUS UNIVERSITY IN BRATISLAVA

INTRODUCTION: Pediatric individuals with acute lymphoblastic leukemia (ALL) undergo extensive chemotherapy treatment and, as a result, suffer from fatigue and, therefore, a decrease in their daily physical activity level. The symptoms of the treatment thus disable the participation of the children in sports and games, which play a major role in childhood and adolescence. Lack of physical activity induces impaired balance, strength, cardiovascular function, and mobility. Many of the negative effects persist even after the treatment. Exercise training is considered a safe and, at least partly, effective option for the improvement of overall health as well as for an increase in physical activity levels in child cancer survivors. The aim of this study was to determine the effect of an 8-week exercise program on physical fitness in child cancer survivors and evaluate the effectiveness of the program.

METHODS: This study is focused on the effect of home-based exercise program on child cancer survivors with ALL. Pediatric individuals who participated in this study were divided into two groups: a group that underwent an 8-week exercise program (EG, n=13) and a control group (CTRL, n=9). Hand grip strength (HGS) test, vertical jump (squat jump and countermovement jump) and psychomotor vigilance task (PVT) test were measured before and after 8 weeks of exercise program.

RESULTS: We found a significant increase in the hand grip strength (HGS) test ($p = 0.037$) after

an 8-week exercise program in experimental group. Furthermore, we received positive feedback from parents and reported an 81.1 % rate of completion of the exercise program by child cancer survivors.

CONCLUSION: The main findings from our study were positive changes in the hand grip strength (HGS) test after 8-week exercise program in child cancer survivors. The exercise program is a key tool for child cancer survivors to regain their physical fitness after medical treatment, making it easier to resume their activities of daily living.

AN EXERCISE (SPECIALIST) TO FACILITATE DIALYSIS PATIENT'S INTRODUCTION TO EXERCISE: A PRAGMATIC NON-RANDOMIZED CONTROLLED TRIAL

CARUSO, L., PIVA, G., STORARI, A., CREPALDI, A., BATTAGLIA, Y., LOPEZ-SOTO, P.J., ALEJANDRO, M.M., MANFREDINI, F., LAMBERTI, N.
UNIVERSITY OF FERRARA

INTRODUCTION: Despite the recommendations of the international guidelines, the adherence to physical exercise programs by patients with end-stage kidney disease (ESKD) is very low, with only 20 to 40% of patients physically active. In this pragmatic nonrandomized trial (ClinicalTrials.gov NCT04282616) we set up an exercise facilitator in a dialysis unit, to facilitate the introduction of patients to exercise.

METHODS: A total of 262 patients were contacted for eligibility at the University Hospital of Ferrara (Italy) and Cordoba (Spain) dialysis facilities. After excluding patients with absolute contraindication to exercise (e.g. amputation, unstable angina, etc.), the exercise physiologist proposed advised participation in one of the four different 3-month options related to physical function: 1) a supervised program (SUP) before each dialysis session (30-minute of aerobic walking combined to strengthening and flexibility exercises); 2) a structured home-based low-intensity interval walking program lasting 16

minutes daily (SHB); 3) training advice to increase physical activity according to the available guidelines (AD); or 4) a periodic assessment overtime of their exercise capacity (CO).

RESULTS: A total of 76 patients were ineligible for inability to ambulate even assisted (52%) or to communicate in Italian language (24%). Within the 186 eligible patients, 45 (24%) declined to participate due to: low interest in physical activity (n=30, 67%); satisfaction with the current level of functional ability (n=10, 22%); lack of time (n=5, 11%). The remaining 141 people decided to participate, leading to an adherence of 76% of the eligible patients or 54% of the entire dialysis population.

The most chosen training programs were SUP (n=57, 40%) and SHB (n=61, 43%), while 19 (13%) patients chose to perform periodic assessments (CO), and 4 people (4%) asked for advice on physical activity (AD).

Concerning the choice of the different exercise options, significant differences were observed for age (SUP: 73±11 years; SHB: 65±13; CO: 61±11; AD: 56±10; p<0.001), dialysis vintage (SUP: 6±3 years; SHB: 4±2; CO: 3±3; AD: 2±2; p<0.001), Charlson comorbidity index (SUP: 8±3; SHB: 7±3; CO: 5±2; AD: 4±2; p<0.001) and mobility as assessed by the 6-minute walking distance (SUP: 243±112 meters; SHB: 311±125; CO: 378±106; AD: 235±122; p<0.001). A significantly lower quality of life was also reported for SUP and SHB patients compared to the other two groups.

No differences were noted for sex, distance from the dialysis center, or means of transportation.

CONCLUSION: the presence of an exercise specialist inside the dialysis center was crucial for improving and facilitating adherence to physical activity in ESKD patients. The preliminary results indicated that tailored supervised training sessions are preferred by the most frail participants, and home-based programs remained a valuable option for this population.

EFFECT OF RESISTANCE EXERCISE TRAINING ON WORRY AND ANXIETY SYMPTOMS AMONG YOUNG ADULT WOMEN WITH SUBCLINICAL GENERALIZED ANXIETY DISORDER: PRELIMINARY RESULTS OF A RANDOMIZED CONTROLLED TRIAL

RICE, J., O'SULLIVAN, D.T., GORDON, B.R., LINDHEIMER, J.B., LYONS, M., HERRING, M.P.

UNIVERSITY OF LIMERICK

INTRODUCTION: Previous randomized controlled trials (RCT) have shown significant reductions in worry and anxiety symptoms after as little as eight weeks of moderate intensity resistance exercise training (RET) compared to non-active comparisons. The pilot RCT reported here quantified the effects of eight-weeks of guidelines (WHO & ACSM) based moderate-to-high intensity RET compared to low intensity RET among young women with subclinical Generalized Anxiety Disorder (AGAD).

METHODS: Twenty participants (mean age (y): 21.68±2.6) were randomized to either moderate-to-high or low intensity RET. Participants completed an 8-week, fully supervised, one-on-one moderate-to-high intensity RET intervention following a two-week familiarisation period, beginning at 75% predicted one-repetition maximum or low intensity RET, beginning at 20% predicted one-repetition maximum. AGAD status was confirmed using validated cut-scores for both the Penn State Worry Questionnaire (≥45) and the Psychiatric Diagnostic Screening Questionnaire-GAD subscale (≥6). The 16-item, self-reported Penn State Worry Questionnaire (PSWQ) and the trait subscale of the State Trait Anxiety Inventory (STAI-Y2) measured worry and anxiety symptoms, respectively, at baseline, end of familiarization (pre-week 10, week 4, 8 and 1-month follow-up. A 2 (group) x 5 (timepoint) RM-ANOVA examined differences between low and moderate-to-high intensity RET. Hedges' d effect sizes (95%CI) quantified the magnitude of differences in change between groups across time. Cohen's d effect sizes (95%CI) quantified the magnitude of within-group change.

RESULTS: No significant group X time interaction was found for worry (F(2.5,45)=1.47, p=0.240, d=0.74 [95%CI: -0.18 to 1.67]) or anxiety (F(1.8,32)=0.52, p=0.62, d=0.39 [95%CI: -0.51 to 1.29). A significant main effect for time was found for worry (F(2.5,45)=4.54, p=0.011) and anxiety (F(1.8,32)=7.10, p=0.004), such that both moderate (worry: d=0.82 [95%CI: -0.02 to 1.65]; anxiety: d=0.94 [95%CI: 0.10 to 1.80]) and low (worry: d=0.32 [95%CI:-0.66 to 1.31]; anxiety: d=0.54 [95%CI: -0.45 to 1.54]) intensity RET reduced worry and anxiety. Improvements in worry and anxiety persisted at the one-month follow-up for moderate-to-high intensity (worry: d=1.10 [95%CI: 0.17 to 1.96]; anxiety: d=1.20 [95%CI: 0.25-2.06]) and low (worry: d=0.73 [95%CI: -0.28 to 1.73]; anxiety: d=0.70 [95%CI: -0.31 to 1.71]).

CONCLUSION: Eight-weeks of moderate-to-high intensity resistance exercise training induced stronger reductions in worry and anxiety symptoms compared to low intensity; however, the reductions were not significantly different compared to low intensity, likely due to the small, preliminary sample size. These preliminary findings suggest that both moderate-to-high and low intensity RET induced potentially clinically meaningful, moderate and large magnitude [within-group] reductions in worry and anxiety symptoms, that persisted at one-month follow-up.

AEROBIC EXERCISE TRAINING REDUCES RED BLOOD CELL DISTRIBUTION WIDTH IN INDIVIDUALS WITH SPINAL CORD INJURY

ELY, M., BURNS, K., YATES, B., TAYLOR, A.

PROVIDENCE COLLEGE

INTRODUCTION: An elevated red blood cell distribution width (RDW, >14%) is associated with cardiovascular disease and mortality. Individuals with spinal cord injuries (SCI) are reported to have an elevated RDW, and in non-injured populations aerobic exercise training has been shown to decrease RDW. However, a direct RDW comparison between those with SCI and non-injured individuals has not been completed, nor has a longitudinal assessment of RDW following aerobic exercise training. Therefore, the purpose of this investigation was to 1) cross-sectionally compare RDW in individuals with SCI

and anthropometrically matched non-injured individuals and 2) longitudinally monitor changes in RDW in individuals with SCI performing 6-months of aerobic exercise training.

METHODS: In the cross-sectional comparison, hematological parameters including red blood cell number, volume, hematocrit, hemoglobin, and RDW were measured in twenty-five individuals with SCI and a cohort of 22 non-injured individuals that were anthropometrically matched for sex, age, and body mass index. In the longitudinal portion, thirty-seven individuals with SCI performed 6-months of hybrid functional electrical stimulation rowing (FES) aerobic exercise. Hematological assessments as well as measures of aerobic fitness (VO2peak) were performed prior to participation as well as following 3- and 6-months of FES. Exercise was performed 2-3 times per week for >20 minutes. Exercise intensity increased from 60-70% to 75-90% of heart rate peak as obtained during VO2 testing. Exercise intensity was additionally adjusted at 3-months based on VO2 testing.

RESULTS: Individuals with SCI displayed an elevated RDW (13.5±1.4%) compared to matched non-injured individuals (12.5±0.4%, P=0.005). Additionally, in individuals with SCI (n=37), RDW decreased following 6-months of aerobic exercise training (Pre:14.2±0.3%, Post:13.6±0.2%, P=0.009). Aerobic capacity increased with 6-months of aerobic training in all individuals (1.22±0.07 to 1.37±0.07 L·min-1, P<0.001) but the magnitude of increase was greater in those with pre-training RDW <14% (n=18, +0.19±0.03 L·min-1) compared to those with elevated RDW >=14.0% (n=19, +0.11±0.02 L·min-1, P=0.040).

CONCLUSION: RDW is elevated in individuals with SCI and was reduced with 6-months of aerobic exercise training. An elevated RDW at the initiation of aerobic exercise training may limit cardiorespiratory gains with training. Although it is unknown if an elevated RDW is the cause or consequence of disease, routine clinical assessment of RDW appears to be a useful biomarker to monitor cardiovascular health in individuals with SCI.

Conventional Print Poster Presentations

CP-SH08 History, Sociology, Sport management and law

COMPARATIVE ANALYSIS OF GRASSROOTS RUNNING INITIATIVES: UNVEILING DYNAMICS, POLICIES, AND SOCIETAL IMPACTS IN THE UK AND TAIWAN

JIANG, R.S.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION

This research explores and compares the dynamics of grassroots running initiatives in the UK and Taiwan, focusing on the prominent "Parkrun" model in the UK and the prevalence of running as a nationwide sport in Taiwan. Investigating the interplay of government policies, private sector initiatives, and voluntary sector engagement, the study seeks to uncover insights that can inform strategies for enhancing community-based physical activities and fostering a healthy/active lifestyle.

METHODS

Two interrelated theoretical frameworks, governance theory and a strategic-relational approach, are adopted. This dual perspective enables us to discern the mediation and shaping of outcomes, specifically highlighting the involvement of distinct sets of interests, the exercise of power, and whose interests were ultimately fulfilled. The empirical investigation utilizes a qualitative case-study methodology, relying on documentary materials and conducting semi-structured interviews.

FINDINGS

Parkrun, a volunteer-driven event in the UK, has shaped public health policies and increased physical activity since the early 2000s. Operating in 768 locations, it emphasizes running and walking in local green spaces. In UKs 2016-2021 "Towards an Active Nation" phase, Parkrun notably boosted the active population. In Taiwan, where 80.2% engage in sports, walking/jogging/running prevails, featuring monthly marathons even in extreme conditions. Pre-pandemic, Taiwan hosted 500-600 yearly events, with over 400 in 2023 post-pandemic, contributing to a significant sports and event consumption market.

DISCUSSION

Parkrun earns praise for significantly contributing to health policies and encouraging widespread physical activity through volunteer-driven events in green spaces, aligning with broader public health goals. However, the volunteer-based model raises concerns about sustainability, resource allocation, and potential event disparities. In Taiwan, diverse marathons showcase a commitment to providing rich participation experiences, reflecting a cultural inclination toward enjoyable and social exercise. Yet, the emphasis on varied formats may pose challenges such as logistical complexities, potential quality dilution, and varying safety standards, despite the high engagement of the Taiwanese population in regular physical activities. Both models share the goal of promoting physical well-being, but contrasts are crucial to recognize. The UKs health-oriented model emphasizes regular exercise, but drawbacks may include over-reliance on volunteers and disparities in community access. Taiwans participation-oriented approach caters to diverse motivations but faces challenges like standardization and event quality control. In conclusion, the comparison shows how running adapts to unique societal

needs, contributing to healthier communities. On the other hand, both models need critical assessment to address potential shortcomings and ensure sustained positive impacts.

INTERGENERATIONAL TRANSMISSION AND REPRODUCTION OF CULTURAL CAPITAL IN THE FAMILYA SOCIOLOGICAL STUDY OF FAMILY BASKETBALL

WANG, Z., SUN, Z.
BEIJING SPORT UNIVERSITY

Intergenerational career mobility has always been a social issue of great concern to scholars, and the phenomenon of class solidification, such as "like father,like son", has attracted widespread attention. Similarly, intergenerational transfer of careers has been occurring in the field of sports. In addition to the role of parental predisposition differences, family cultural capital, as an important means of maintaining class status, has also become a key concern of sociological scholars in recent years. The study takes Bourdieus capital theory as the basic theoretical support, starts from the perspective of "intergenerational inheritance" and "reproduction", and employs the research methods of literature, field survey and interviews to study the dynamic process of intergenerational inheritance and reproduction of the familys sports and cultural capital, and to find out the relationship between sports experience and career. The study was conducted to find out the influencing factors and mechanisms of intergenerational transmission of sports experiences and careers, to explore the internal logic and external influencing factors, and to comprehensively analyse and explore the contents, links and characteristics of the process of transferring and reproducing the familys cultural capital. The study found that, firstly, parents who have rich family cultural capital and benefit from it tend to have stronger motives for transferring family cultural capital out of the importance they attach to family and education, and the concern about their own status and the future development of their children. Secondly, the mechanism of intergenerational transmission and reproduction of family cultural capital is expressed through two fields: the primary transmission in the family and the indirect transmission in the school. Third, the transmission of family cultural capital is a dynamic process, including three stages: transmission, reproduction and conversion. Fourthly, the intergenerational transmission and reproduction of family cultural capital is uncertain, lengthy and persistent.

ATHLETIC FOOTPRINTS OF BANGABANDHU SHEIKH MUJIBUR RAHMANS FAMILY AND THEIR IMPACT ON BANGLADESHS SPORTING LANDSCAPE

ISLAM, M.Z., FERDOUS, J.
JESSORE UNIVERSITY OF SIENCE AND TECHNOLOGY

Purpose of the present study was to delve into the sports culture within the family of Sheikh Mujibur Rahman, the founding father of Bangladesh, covering three generations.

Using a historical research method, primary sources such as official records, personal documents, and pictorial records were analyzed alongside secondary sources like books and journals. The three generations of the family are examined, focusing on key members such as Sheikh Lutfur Rahman, Bangabandhu Sheikh Mujibur Rahman, Sheikh Kamal, Sultana Kamal, Sheikh Jamal, Sheikh Rehana, and Sheikh Hasina.

The involvement of Sheikh Lutfur Rahman, Bangabandhus father, in sports as both a participant and organizer played a pivotal role in shaping the sporting interests of his son, Sheikh Mujibur Rahman. Bangabandhus commitment to sports continued post-independence, including initiatives like declaring Kabaddi as the national sport, forming the Bangladesh Women Sports Control Board, and establishing the Bangladesh Institute of Sports. Sheikh Mujibs eldest son, Sheikh Kamal, emerged as a visionary sports organizer, contributing to modern football in Bangladesh and establishing the Abahani Krira Chakra (a multifaceted sports club). Sultana Kamal, his wife, achieved acclaim as a national champion in athletics, advocating for development of womens sports in Bangladesh. The familys influence extended beyond playing fields, as they actively engaged in sports administration, leadership, and organizational roles. Despite the tragic events of 1975, their legacy endures, with numerous awards and honors recognizing their contributions to Bangladeshs sports landscape.

MULTIPLE CORRESPONDENCE ANALYSIS ON ELDERLY SPORTS INTENSITY OF ENGAGEMENT IN CHINA: CATEGORY, RELATIONSHIP, PREDICAMENT, COUNTERMEASURES

KANG, J., ZHU, L.
ZHEJIANG NORMAL UNIVERSITY

Introduction

Participation in sports appropriately has a positive effect on improving the physical and mental health of the elderly, which clarifying the non-competitive and intensity adaptability characteristics of the elderlys sports participation. For promotion of elderly physical activity in appropriated intensity, further research should pose attention on situation tracing and mechanism analysis of the elderlys sports participation intensity, especially in China. With Chinese economic soaring in decades, there was development gap between urban and rural, which make difference on elderly sports habits. It's important to outline the portrait of the sports participation intensity of the elderly in China for different group.

Methods

Based on China Health and Retirement Longitudinal Study (CHRALS) data base, cluster analysis elderly sports participants into several groups according to sport participant intensity. Based on these, find out relationships between these groups and their demographic characteristics throughout multiple correspondence analysis.

Results

According to sport participant intensity, clustered elderly sports participants into three 3 groups: mild participants, mild and moderate participants, all-round serious participants. What's more, the first two groups participate sports shortly each time with high frequency, and don't prefer vigorous-intensity sports, strongly associated with high income, urban dwellers, live with spouse, several obstacles with body function; all-round serious group participate with vigorous-intensity, long time and high frequency, strongly associated with low income, without spouse, rural area, no obstacle with body function.

Discussion

Non-metropolitan area is the main location for elderly sports participants, which is contrary to the common sense that citizen prefer sports in China than villagers. In metropolitan, sports facilities don't match with soaring population. In addition to the lack of consumption habits of Chinese aging people, caused by their youth daily life, elderly have less opportunity to participate sports. While in rural and fringe area, ger rid out of contradiction between people and land, villagers cost less, almost to zero, to exercise, which cultivate them to participate more frequently and more intensity. Those are the main part of all-round serious participants. Caused by conventional culture of filial piety, considering number of elderly people believe that living in elderly service institution means no offspring or unhappy family, which shamed themselves. So most aging people, living in institution lost their mobility, were divided into mild participants, which pose high demand of sports rehabilitation and prescription for elderly service institution.

SPORTS PRESENTATION IN LARGE-SCALE ATHLETICS EVENTS IN CHINA

JIANG, R.1, YANG, J.2

1.CHINA UNIVERSITY OF GEOSCIENCES (WUHAN) 2.WUHAN UNIVERSITY OF ENGINEERING SCIENCE

INTRODUCTION: Athletics sports presentations are stage-shows through combination of a series of essential elements, including broadcasting, music, video, lighting and performance, which provide a unique experience to the audience and participating athletes. Therefore, athletic sports presentations can be considered as the packaging of sports competition site, which plays avital role in promoting athletics events and spreading culture of the host place. As a segment of the sports industry, sports presentations have been gradually become a certain industrial ecology, and especially got great development after a series of a large-scale comprehensive sports events.

METHODS: This study used literature methods to address the development history and characteristics of sports presentations in China; an expert interview method was used to conduct in-depth interviews with teachers engaged in sports presentations to clarify working processes on the field of competition in domestic track and field events. In addition, questionnaire method and other research methods (such as on-site referees and spectators) were employed to address the current situation of the sports presentations in the 2020 National Athletics Championships field. To investigate the mainstream groups of these three types of competitions on the display of the various panels for real feelings and suggestions, sorting out the status quo and the existence of the problem, it has finally been put forwarded the corresponding counter measures for the future development of the track and field events sports display.

CONCLUSIONS:

Our study found that the progress towards the concept of the event organizers, the interoperability of the organizing structure, the refinement of the related technology and the improvement of the professional quality provide the practitioners' necessary support and guarantee for the development of the sports presentation in track and field events. However, there are loopholes in the sports presentation, such as its popularity is still low in China; the communication between sports presentation and other business sectors is insufficient; sports presentation is limited by the objective conditions such as budgets and venues.

RECOMMENDATIONS:

Considering the problems facing the development of sports presentation in China, we proposed the following suggestions: positive work attitude and high cognition are necessary; promoting talent training and setting up industry norms; strengthening the supervision of events and promoting brand building. Careful implementation of these suggestions will ultimately bring a new advancement in the current development of sports presentations in China.

VERIFICATION OF EMPOWERMENT EVALUATION INDEX FOR COMPREHENSIVE COMMUNITY SPORTS CLUBS IN JAPAN

YAMADA, N.1, OSAKI, T.1, KAWANISHI, T.2, KOZAKAI, R.3, KAWANISHI, M.3

1.GRADUATE SCHOOL OF LIFELONG SPORT, HOKUSHO UNIVERSITY, 2.CHUBU GAKUIN UNIVERSITY, 3.HOKUSHO UNIVERSITY

(Introduction) There are approximately 3,600 Comprehensive Community Sports Clubs (CCSCs) in Japan. Japan Sports Agency has identified strengthening the organization and expanding the role of CCSCs as one of the measures to be taken by 2026. In order to further improve the quality of CCSCs, it is important to strengthen their empowerment (EP) as a social group. In the study of EP in integrated clubs, the authors research (Yamada et al., 2020) suggests that Japanese CCSCs lack the ability to collaborate with external organizations, and that it is necessary to develop an organizational structure that integrates with the community and related organizations in the future.

(Purpose) The purpose of this study was to clarify the factor characteristics that constitute the EP of CCSCs and to obtain basic data for the future development of EP evaluation indexes focusing on the simplicity of CCSCs.

(Methods) An Internet survey was conducted on sixty registered clubs in Hokkaido for one month from September 2023, with responses obtained from forty clubs. The survey content was developed based on the EP concepts of Oakley (2000) and other researchers. Each item was rated and measured on a 5-point Likert-type scale ranging from "agree" to "disagree.

(Results) The comparison of the mean values of the twenty items used in the survey revealed that the internal EP, which is the basic organizational structure of CCSC, such as "membership management" and "organizational management," tended to be high. On the other hand, external EP, which is related to cooperation with external organizations such as exchanges with "private sports organizations" and "other CCSCs," tended to be low. The following six factors were extracted from the results of the factor analysis of EP. Each factor was named "compliance," "school collaboration," "financial management," "private sector collaboration," "membership management," and "human resource management. The contribution rate of these factors was 68.3%. Cronbach's coefficient was α=.818, indicating stable reliability for each factor and the entire rating scale. There was no significant relationship between the factor scores and the basic attributes of the CCSC.

(Conclusion) The EP evaluation indices of CCSC were found to consist of compliance, financial management, membership management, and human resource management for the internal EP, and school collaboration and private-sector collaboration for the external EP. These factor structures are similar to those of the EP scale in the authors previous study, and further study is needed to examine the validity of the scale while simplifying it.

(References)

Oakley Peter, and Clayton Andrew. (2000) THE MONITORING AND EVALUATION OF EMPOWERMENT, INTRAC, RESOURCE DOCUMENT, Occasional Papers Series No.26,1-69.

Yamadam, N (2019) Empowerment evaluation of comprehensive community sports clubs, Masters thesis, Hokusho University,1-75.

Conventional Print Poster Presentations

CP-PN05 Nutrition IV

5KM TIME TRIAL PERFORMANCE AND RUNNING ECONOMY AFTER 7 DAYS OF NEW ZEALAND BLACKCURRANT SUPPLEMENTATION IN TRAINED MALE AND FEMALE RUNNERS

MANDERS, R., HUNT, J., KING, D.

UNIVERSITY OF SURREY

INTRODUCTION: New Zealand Blackcurrants (NZBC) have been well described as ergogenic aids. It has been postulated that the NZBC related performance effects could be the result of a better oxygen delivery to the muscles, which in turn could lead to an improved running economy (RE) and substrate utilisation. We aimed to investigate the effects of 7-day NZBC supplementation on 5km running performance, running economy and substrate utilisation in trained male and female runners.

METHODS: 9 males (31.8±10.3y, BMI:23.4±2.3 kg/m2, VO2max:52.1±6.5 mL/kg/min) and 9 females (31.2±9.5y, BMI:21.8±2.1 kg/m2, VO2max:47.2±5.8 mL/kg/min) were recruited. Using a double-blind, randomised, placebo controlled, cross-over design, participants received 600 mg/day NZBC extract (containing 210 mg anthocyanins) or a placebo (PLA) for 7 days prior to assessing RE and metabolic responses at 75%, 85% and 95% of LT2 followed by a 5km time trial (TT). RE and metabolic parameters were determined via breath-by-breath analysis and TT performance by completion time.

RESULTS: The 5km TT was completed in 1355±147s and 1191±100s for females and males resp. in PLA. NZBC supplementation did not have significant effects on TT performance in males (1215±118s, P=0.2). In the female group there was a strong trend toward improved TT performance with a completion time of 1335±158s (P=0.051). RE was lower at the higher (95% and 85%LT2) intensities compared to 75%LT2 at a group level for both PLA (184.0±12.61, 188.3±14.13 and 198.0±17.02 mL/kg/km, resp. P<0.05) and NZBC (180.1±14.56, 181.1±15.82 and 190.2±15.52 mL/kg/km, resp. P<0.05). No significant differences were found in RE between trials at group level for females and males at the different intensities (P>0.05). NZBC did not alter total energy expenditure at 75%, 85% or 95%LT2 when compared to PLA at a group (11.2±2.31, 12.7±3.04, 14.2±3.54 kcal/min vs. 11.9±2.44, 13.3±2.77, 14.9±3.21kcal/min resp. (P>0.1) or gender specific level. Carbohydrate and fat oxidation also did not differ between PLA and NZBC (P>0.1).

CONCLUSION: 7 Days of New Zealand Blackcurrant supplementation did not significantly improve running economy, performance or substrate use in trained runners but there was a strong trend towards improved performance for female athletes. These results underline the differences between male and female physiology and the need for more gender specific research.

EFFECTS OF 6-WEEK MEDIUM-CHAIN TRIGLYCERIDE SUPPLEMENTATION ON GUT MICROBIOTA AND THEIR METABOLITES IN FEMALE UNIVERSITY FOOTBALL PLAYERS

ISHIBASHI, A.1,2,3, KATAYAMA, Y.4, YASUMATSU, M.4, KOJIMA, C.5, ISHIKAWA, H.6, KOJIMA, K.6, TAKAGI, T.6, TERADA, S.1
1. THE UNIVERSITY OF TOKYO, TOKYO; 2. JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE; 3. TOYO UNIVERSITY 4. RIKKYO UNIVERSITY; 5. RITSUMEIKAN UNIVERSITY ;6. THE NISSHIN OILLIO GROUP, LTD.

INTRODUCTION: Accumulating evidence suggests that each person has an immensely diverse and stable gut microbiota whose composition influences the health of the host through their metabolites. Diet and nutritional status are key factors in determining gut microbiota composition and their metabolites. Medium-chain triglycerides (MCTs), which are more quickly metabolized than long-chain triglycerides (LCTs) in the body, are widely known to lose body mass and fat mass. Recent studies have reported that MCTs-enriched diets could affect gut microbiota composition and gut health in obese individuals [1] . However, it remains unclear whether the intake of MCTs exerts a beneficial effect on gut health in athletes as well. Therefore, the purpose of the present study was to investigate the effects of MCTs supplementation on gut microbiota composition and gut health in female university football players.

METHODS: Seventeen female university footballers were enrolled and randomly assigned to receive either MCTs (MCT group, n = 9) or Rapeseed oil (LCT group, n = 8). They consumed jelly sticks containing 18 g MCTs or LCTs every day for 6 weeks. We evaluated energy intake, energy expenditure, body composition, gut microbiota and its metabolite before and at the end of the intervention. In addition, self-reported bowel movement frequency was surveyed.

RESULTS: Energy intake and energy expenditure before and during the 6-week intervention did not differ between both groups. In the MCT group, the percentage of total body fat after the intervention was significantly lower than before the intervention ($p = 0.03$), whereas no significant change was observed in the LCT group. A significant decrease in Firmicutes/Bacteroidetes ratio, which is known to have an important role in maintaining normal intestinal homeostasis, was observed in the MCT group ($p < 0.05$), but not in the LCT group. In addition, the total fecal short-chain fatty acid concentration, which is reported to stimulate colonic motility and accelerate colonic transit, significantly increased in the MCT group ($p < 0.05$), while such effect was not observed in the LCT group. Self-reported bowel movement frequency was significantly increased after the intervention in the MCT group, but not in the LCT group ($p < 0.01$).

CONCLUSION: Six-week intake of MCTs supplementation may cause changes in the composition of gut microbiota and their metabolites, leading to improved bowel movements in female university football players.

REFERENCE:

1. Rial SA. et al. Gut microbiota and metabolic health: the potential beneficial effects of a medium chain triglyceride diet in obese individuals. Nutrients, 2016. 8(5): 281.

EFFECTS OF TRAINING AND POST-EXERCISE PROTEIN SUPPLEMENTATION ON BODY COMPOSITION IN UNTRAINED FEMALES

REHRER, N., MURRAY, M., BEST, A., SIMS, S., LOEHR, J.
UNIVERSITY OF OTAGO

INTRODUCTION: The aim of the study was to investigate effects of 12 wk training with post-exercise protein supplementation on body composition in untrained, healthy females.

METHODS: Participants (n = 27, 33.1 ± 9.2 y, mass 69.5 ± 13 kg, BMI < 30, VO2max 27.3 + 3.7 ml/kg/min) undertook upper-body resistance training (2 x/wk) and HIIT cycling (3 x/wk). Participants were told this is not a weight loss programme and they should adjust dietary intakes to maintain weight.Dietary intakes (3-day record) were measured at wk 0,4,8,12, body composition (DXA) at wk 0 and 12. Participants consumed either a high- (24 g, N = 15 ,P) or equicaloric low- (3 g, N = 12, C) protein post-exercise supplement (510 kJ).

RESULTS: Average daily intakes of total energy wk 4-12 in P and C (7.2 ± 1.1 , 7.9 ± 1.1 MJ, resp. P = 0.17) and protein (90 ± 14 , 85 ± 12 g., resp. P = 0.28) were similar. There was little change in body mass with training (P =0.56) and no significant difference between P and C (Δ 0.04 ± 2.2 kg, 0.38 ± 1.3, resp. P=0.64).

There was a large variability in change in fat mass such that the change over time was not significant (P = 0.12). There was no difference between P and C (Δ -0.5 ± 1.9 , - 0.5 ± 1.2 kg, resp. P = 0.98). Participants gained lean mass (P = 0.008) but there was no difference between P and C (Δ 0.6 ± 1.4 , 0.8 ± 0.8 kg, resp. P = 0.56).

CONCLUSION: Post-exercise protein supplementation (24 g) appears not to impact body composition changes in normal weight, healthy, untrained women who undergo 12 wk of mixed aerobic and resistance training. The fact that total dietary intakes of protein did not differ between groups and that protein was likely in excess of needs (~1.2 g/kg) likely account for the lack of effect of protein supplementation on body composition.

INCREASED GREEK YOGURT CONSUMPTION VERSUS WHEY PROTEIN SUPPLEMENTATION IN ATHLETES

BELL, M., RETSIDOU, I., SAABNI, S., STEARS, H., KLENTROU, P.
BROCK UNIVERSITY

INTRODUCTION: High-impact sports induce a persistent skeletal load, positively influencing bone mineral properties among athletes. However, extended periods of intense training may exacerbate inflammation, potentially leading to an imbalance in bone remodelling, favouring increased bone resorption. While current nutritional strategies for athletic youth

predominantly emphasize whey protein (WP) supplementation, this study explores whether there are potentially comparable benefits of Greek yogurt (GY), a nutrient-dense wholefood dairy product rich in bone-supporting elements such as protein, calcium, and phosphorus.

METHODS: A total of 31 University athletes of various high-impact sports (aged 17-22 years; 13 males, 18 females), participated in this study which employed a randomized controlled, parallel design including an initial 8-week control phase, followed by an 8-week intervention period. During the control phase, participants maintained their typical diet and training routines. During the intervention period, participants were randomly assigned to consume either 175 g GY (1 serving: flavoured, 0%, 130 calories, 17 g protein, 225 g calcium) twice a day or ⅔ of a scoop of commercially available WP powder twice a day (morning and night; flavoured, ~29 g, 120 calories, 19 g protein, 112.5 g calcium). Body composition and bone properties were measured at the studys commencement (week 0), at the end of the control period (week 8) and after the intervention (week 16). Morning blood draws were also collected during weeks 0, 8, and 16 to measure bone biomarkers (osteocalcin, P1NP, OPG, CTX, RANKL, sclerostin) and inflammatory cytokines (CRP, IL6, IL10, TNFα).

RESULTS: Although statistical significance was not attained, negligible alterations in relative body fat were noted during the control weeks 0 to 8 (Δ<1%) while both the GY and WP groups exhibited increases in relative body fat during the intervention weeks 8 to 16 (Δ=1-2%). No changes in body mass (kg), or upper/lower bone speed of sound (s) were observed irrespective of intervention group or sex.

CONCLUSION: By comparing the effects of Greek yogurt consumption with whey protein supplementation, this research aims to provide valuable insights into the potential benefits of incorporating wholefood dairy products into athletes diets.

RECOVERY WITH VISTULA TART CHERRY SUPPLEMENTATION FOLLOWING A MARATHON.

SQUIRES, E., WALSHE, I.H., KEENAN, A., HAYMAN, O., LOMAX, I., WOOD, J., BROWNSON-SMITH, R., MCHUGH, M.P., HOWATSON, G.

NORTHUMBRIA UNIVERSITY

INTRODUCTION: Long distance running induces marked increases in inflammation and symptoms associated with muscle damage. Tart cherries (TC) have become a popular nutritional strategy for recovery, particularly for attenuation of markers associated with muscle damage. The aim of this study was to explore the effect of a different cultivar (Vistula) TC supplement on recovery following a marathon.

METHODS: Thirty-five recreationally active volunteers (the mean ± SD age, stature and mass were 40 ± 10 years old, 176.5 ± 10.2 cm and 78.8 ± 13.8 kg, respectively) participated in the Kielder marathon. Participants were randomised to receive either a freeze-dried TC powder or calorie-matched placebo (17 TC, 18 placebo) for 7 days, with the marathon occurring on day 5 of the supplementation period. Maximal voluntary contractions (MVC), counter movement jumps (CMJ), muscle soreness (DOMS), circulating creatine kinase (CK) and high-sensitive C-reactive protein (hs-CRP) were assessed directly following, as well as 24- and 48h post marathon. A 2 x 4 (condition x time) ANOVA was used to determine differences. MVC and CMJ were expressed as percentage change from baseline to account for individual variation.

RESULTS: There were significant changes over time for all variables ($p < 0.001$) indicating the presence of muscle damage. There were no significant differences between the conditions for MVC, CMJ and DOMS ($p > 0.05$). However, there was a difference between the groups for hs-CRP ($p < 0.05$), and post-hoc analysis revealed lower levels in the group supplemented with Vistula TC at 24 (10.4 vs. 16.1 mg/L, $p < 0.05$) and 48 h (5.4 vs. 8.9 mg/L, $p < 0.05$).

CONCLUSION: This study provides initial insights into the potential use of a powdered Vistula TC supplement following strenuous exercise. The marathon caused changes in indices of muscle damage and inflammation in both groups. Despite there being no evidence of functional changes and soreness measures, the TC group experienced lower levels of inflammation following a marathon, compared to the placebo group.

EFFECT OF ACUTE DIETARY INTAKE OF BEET ROOT JUICE ON METABOLIC FUNCTION, SKELETAL MUSCLE OXYGENATION, AND CARDIOVASCULAR FUNCTION DURING ENDURANCE SUBMAXIMAL EXERCISE IN HEALTHY MEN

HO, C.J., HUN-YOUNG, P.

KONKUK UNIVERSITY, SEOUL, REPUBLIC OF KOREA

INTRODUCTION: In the sports field, the supplementation of beet root juice (BRJ) is recognized as a popular nutritional supplement that can enhance the bioavailability of nitric oxide (NO) during exercise, leading to improved athletic performance [1, 2]. However, considering the diverse characteristics of various research groups, there is a lack of conclusive evidence regarding the impact of acute dietary dietary intake of BRJ on endurance exercise performance [2]. Therefore, the purpose of this study is to examine the impact of acute dietary intake of BRJ on metabolic function, skeletal muscle oxygenation levels, and cardiovascular function during endurance submaximal exercise in healthy men.

METHODS: Ten healthy men (aged 25.2 ± 2.3 years) completed 30-minute submaximal cycle ergometer exercise trials corresponding to 70% maximal heart rate (136.4 ± 1.5 bpm) with either placebo or BRJ in a random order. Participants visited a total of three times, with the first visit involving a familiarization process. During the second and third visits, they were instructed to consume a placebo or BRJ on 2.5 hours before exercise. During exercise, average exercise load, rate of perceived exertion, heart rate, stroke volume, cardiac output, minute ventilation, oxygen uptake (VO2), carbon dioxide excretion, respiratory exchange ratio, oxygen pulse (O2pulse), oxygenated hemoglobin, deoxygenated hemoglobin, total hemoglobin, tissue oxygenated saturation, systolic blood pressure, diastolic blood pressure (DBP), mean arterial pressure

(MAP), and total peripheral resistance were measured. The brachial–ankle pulse wave velocity (baPWV) and flow-mediated dilation (FMD) were measured before and after exercise.

RESULTS: BRJ intake resulted in an increased average exercise load ($p = 0.035$, $\eta p\ 2 = 0.406$) during submaximal exercise, accompanied by an elevation in corresponding increases in VO2 ($p = 0.048$, $\eta p\ 2 = 0.367$) and O2pulse ($p = 0.033$, $\eta p\ 2 = 0.413$). Additionally, it resulted in a decreased DBP ($p = 0.001$, $\eta p\ 2 = 0.699$) and MAP ($p = 0.007$, $\eta p\ 2 = 0.574$) during submaximal exercise and a reduced baPWV ($p = 0.049$, $\eta p\ 2 = 0.365$) while increasing FMD ($p = 0.001$, $\eta p\ 2 = 0.723$) before and after exercise.

CONCLUSION: The study confirmed that acute dietary intake of BJR resulted in an improvement in O2pulse during endurance exercise at 70%HRmax, leading to an increased exercise load and corresponding VO2. Furthermore, it has been established that it is effective in enhancing cardiovascular function. Therefore, the present study established that acute dietary intake of BJR has greater potential than placebo intake in enhancing endurance exercise capacity.

EXOGENOUS LACTATE TREATMENT IMMEDIATELY AFTER EXERCISE PROMOTES GLYCOGEN RECOVERY IN TEPY-2 MUSCLE IN MICE

KIM, T., KIM, J.

KONKUK UNIVERSITY - SEOUL CAMPUS

INTRODUCTION: A recently published study described lactate function in three keywords : lactate as an energy source, as a precursor of gluconeogenesis, and a signaling molecule, especially during exercise, when lactate moves into or out of the cell (1). A previous study showed potential that lactate upregulates the expression level of catalytic enzymes in the process of glucose production (2). However, it is difficult to conclude that lactate alone was responsible for these effects, as most previous studies used combined treatments, such as lactate and glucose. Therefore, this study aimed to examine the effects of exogenous lactate intake immediately after exercise on glycogen synthesis at 1, 3, and 5 h post-administration, and on energy metabolism at rest.

METHODS: Eight-week-old male Institute of Cancer Research mouse were randomly grouped in standard laboratory animal cages: post-exercise group with oral administration of lactate or saline immediately after exercise (LAC, SAL; n = 24 per group), Lactate or saline (3 g/kg) were orally administered to the LAC and SAL groups immediately after the treadmill exercise (speed: 25 m/min, slope: 15 °, duration: 50min). Mice were sacrificed at different times (1, 3, and 5 hours). Glycogen concentration was measured using plantaris muscle. Additionally mRNA of four main enzymes that are relevant to the glycogen synthesis in the plantaris muscle (hexokinase 2, glycogen synthase 1, phosphoglucomutase 1, pyruvate dehydrogenase E1 alpha 1), and lactate transporter (monocarboxylate transpoter-1,4), was measured by qPCR method. Moreover, energy metabolism was measured after exercise for 5hours.

RESULTS: As a result of mRNA analysis of four main enzymes relevant to the glycogen synthesis process in skeletal muscle, significantly higher levels of hk-2 and gs-1 were found in the LAC group at 5 hours. In addition, we observed that pgm-1 and pdh-a1 were significantly higher in the LAC group at 3 hours. And mct-1 was significantly higher in the LAC group at 5 hours, and mct-4 analysis results showed that it remained high in the LAC group for up to 3 hours. In the results of measuring resting metabolic rate for 5 hours after lactate ingestion after exercise, we observed that the LAC group had lower respiratory exchange rate up to 1 hour. The amount of carbohydrate oxidation was observed to be lower in the LAC group until the 30 minutes.

CONCLUSION: We observed that lactate intake after exercise increased glycogen synthase in skeletal muscle for up to 5 hours. Additionally, exogenous lactate intake after exercise increased glycogen resynthesis and decreased carbohydrate utilization. Overall, these results suggest that lactate supplementation post-exercise can improve glycogen synthesis and recovery in skeletal muscles, and can be developed as a novel supplements to enhance energy recovery after exercise.

LOWER CALCIUM AND IRON INTAKE IN ADOLESCENT HANDBALL PLAYERS: IS A NEW TREND EMERGING?

SZIRAKI, ZS., NYAKAS, CS., SZMODIS, M.

UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: An adequately composed diet plays a particularly important role in the proper development and sports performance of adolescent athletes. The purpose of the study was to determine whether young female handball players consume adequate amounts of nutrients, especially calcium and iron.

METHODS: 32 elite youth female athletes (age 15.34 ± 1.89 y, body height 166.7 ± 5.81 cm, body weight 60.61 ± 9.47 kg, BMI 21.81 kg/m2) were included in our cross-sectional study (2020-2021). Anthropometric measurements (Inbody 770, skinfold measurements) were performed on the athletes, and they also filled out a 3-Day Food Record (Analysis software: Nutricomp DietCAD 5.0). The statistical analysis was performed with the JAMOVI 2.4.14 program. The significance level was $p < 0.05$.

RESULTS: The daily total energy intake (TEI) was 1994 ± 569 kcal. Of the TEI, 17.5%, 34%, and 48.5% were comprised of protein, fat, and carbohydrates, respectively. The average daily consumption of calcium and iron was 624 ± 200 and 10.58 ± 4.21 mg, and folic acid and vitamin B12 intake was 179 ± 99.8 mg and 2.61 ± 1.97 mcg, which are all below the recommended values for the age group ($p < 0.001$). The average intake value of vitamin C was 238 ± 437 (M=112) mg, which exceeded the required values.

CONCLUSION: The macronutrient ratios of the surveyed athletes are disadvantageous: a shift can be observed in favor of fat intake compared to carbohydrates, which are more important in terms of sports performance. Furthermore, the intake amount of micronutrients is unfavorable, which is worrisome from the point of view of both proper development and long-term health preservation and sports performance. This deplorable intake deficit is in line with the results of both Hungarian youth people with an average level of physical activity and international elite youth athletes.

THE EFFECTS OF SHORT-TERM ORAL CURCUMIN SUPPLEMENTATION ON INFLAMMATORY MARKERS FOLLOWING EXERCISE: A RANDOMISED PLACEBO-CONTROLLED TRIAL

ALHEBSHI, A., THORLEY, J., JAMES, L., CLIFFORD, T.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Unaccustomed, highly strenuous, or prolonged exercise, triggers an acute phase inflammatory response, characterized by an increase in several inflammatory markers such as the pro-inflammatory tumor necrosis factor alpha (TNF-α) and interleukin-6 (IL-6). While an inflammatory response appears necessary for long-term muscle repair, and adaptation, if excessive or uncontrolled, it could damage cells and evoke symptoms of gastrointestinal stress, fatigue, delayed-onset muscle soreness (DOMS), and increase the risk of upper respiratory illness. Hence, there is a growing interest in nutritional strategies that could modify the transient but potentially deleterious effects of post-exercise inflammation. While the (poly)phenol, curcumin, has exhibited anti-inflammatory effects in cell and animal studies, there remains limited data in humans. Therefore, this study examined whether curcumin could modify markers of inflammation after intense exercise.

METHODS: Twenty-six healthy recreationally active males and females (25±6 years; 68±10 kg; 170±8 cm) completed the study. All females were tested in the early follicular phase of their menstrual cycle. Participants were randomly assigned to receive either 1000 mg/day of curcumin or 1000 mg/day of inulin (placebo control), for 3 days before, and 30 min prior to 100 drop jumps, followed by 50 squat jumps. Blood samples were collected pre, post, 1-h, and 2-h post-exercise and analysed for IL-6, interleukin 2 (IL-2), interleukin 4 (IL-4), interleukin 10 (IL-10), interleukin 12 (IL-12), TNFα, interferon gamma (IFNγ), monocyte chemoattractant protein-1 (MCP-1), granulocyte colony stimulating factor (G-CSF), matrix metalloproteinase (MMP-9) and vascular cell adhesion molecule 1 (VCAM-1). $P < 0.05$ was considered statistically significant; hedges g effect sizes were calculated for Holm-Bonferroni post-hoc comparisons.

RESULTS: No significant time, treatment, and interaction effects were found for IL-6, TNFα, IL-12, IL-2, and IL-4. IL-10 increased 1 h-post exercise ($P<0.001$; g=1.12). IFNγ concentrations decreased 1 hr (-44%; P=0.004; g=0.45) and 2 hr (-17%; $P<0.001$; g=0.16) post exercise and MCP-1 increased 1 hr post exercise (~62%, $P = 0.004$; $g = 0.64$). G-CSF and VCAM-1 concentrations were higher in curcumin vs. placebo (treatment; $P\leq0.021$; $g\geq0.26$). MMP-9 levels increased immediately post exercise by 79% ($P<0.001$; g=0.26). There were no significant interaction effects for curcumin vs. placebo.

CONCLUSION: Four days of curcumin supplementation did not modify inflammatory markers pre and post-exercise, suggesting that curcumin has limited effects on inflammation in humans. Further studies with different markers in different tissues are required to support these findings.

Conventional Print Poster Presentations

CP-PN12 Cardiovascular Physiology

CARDIOVASCULAR EFFECTS OF DARK CHOCOLATE SUPPLEMENTATION DURING HIGH-INTENSITY RESISTANCE EXERCISE THROUGHOUT THE MENSTRUAL CYCLE IN HEALTHY WOMEN

WANG, C.W.1, FANG, S.H.1, WANG, S.C.2, HE, C.S.2

NATIONAL CHUNG CHENG UNIVERSITY 1, NATIONAL TAIWAN UNIVERSITY OF SPORT 2

INTRODUCTION: Previous research has shown that high-intensity resistance exercise has been associated with adverse effects on cardiovascular function, including rapid elevation of blood pressure and unfavorable release of cardiac markers [1]. The secretion of female hormones varies across different menstrual phases, with estrogen known to inhibit the activity of the sympathetic nervous system (SNS) and induce the release of nitric oxide (NO), promoting vasodilation [2]. Moreover, dark chocolate, rich in cocoa flavanols, contributes to mechanisms preventing cardiovascular disease, including improvements in vascular endothelial function and reductions in blood pressure [3, 4]. This study aims to investigate whether adverse cardiovascular effects induced by high-intensity resistance exercise can be mitigated through estrogen secretion and dark chocolate supplementation.

METHODS: Thirty-one healthy adult women (with regular menstrual cycles) were recruited as participants. During a consecutive two-month period, conducting a total of four experiments (Early Follicular-DC, Early Follicular-MC, Mid Luteal- DC and Mid Luteal- MC). On the day of the experiment, resting values (Rest) of finger-toe pulse wave velocity (ftPWV), blood pressure, Arterial Velocity Pulse Index (AVI), and Arterial Pressure Volume Index (API) were collected. Participants were then provided with a standard breakfast along with either 85% dark chocolate or milk chocolate (1 g/kg). After a 2-hour rest period following breakfast, baseline measurements after supplementation (baseline-C) were taken. Subsequently, participants engaged in warm-up exercises followed by a single high-intensity resistance exercise session (5 sets of 6

repetitions) at 75% of 1RM, which included squats, bench presses, and deadlifts. Measurements were also taken immediately post-exercise (T0) and 1 hour post-exercise (T60). The data were analyzed using two-way repeated measures analysis of variance (ANOVA).

RESULTS: The Early Follicular-MC group exhibited significantly higher values in ftPWV and API at both baseline-C and T0 compared to the Mid Luteal-DC, Mid Luteal-MC, and Early Follicular-DC groups ($p < .05$). Moreover, the Early Follicular-MC and Early Follicular-DC groups demonstrated significantly elevated SBP and API at rest compared to the Mid Luteal-MC and Mid Luteal-DC groups ($p < .05$). Additionally, the Early Follicular-MC group exhibited significantly higher SBP at baseline-C compared to the Mid Luteal-DC group ($p < .05$). However, no significant differences were observed in DBP and AVI among the groups.

CONCLUSION: The findings of the study indicate that women demonstrate significantly lower SBP and arterial stiffness during the mid-luteal phase in comparison to the early follicular phase. Additionally, the consumption of dark chocolate leads to a notable reduction in blood pressure and arterial stiffness. Furthermore,it serves to attenuate the swift elevation in blood pressure and arterial stiffness induced by high-intensity resistance exercise.

EXPLORING TRPV4 MODULATION IN ANGIOGENESIS: IMPLICATIONS FOR ENHANCING AEROBIC CAPACITY AND MUSCLE PERFUSION

MALKA, G., BERGDAHL, A.
CONCORDIA UNIVERSITY

INTRODUCTION: Angiogenesis is a physiological process resulting in the formation of new capillaries from existing vascular networks. Through exercise, this process occurs as an adaptive response to improve blood-tissue exchange properties by increasing surface area for oxygen diffusion, nutrient uptake, and elimination of waste products. Thus, angiogenesis is often associated with improvements in cardiovascular hemodynamics and metabolic activity through changes in capillary density. Calcium ions ($Ca2+$) play a crucial role as signal transducers in several cellular processes, including cell proliferation and cell migration. Transient Receptor Potential cation channel subfamily Vanilloid member 4 (TRPV4) is moderately permeable to $Ca2+$ and highly expressed in endothelial cells, which comprise the inner lining of blood vessels. The activation of TRPV4, thus inducing angiogenesis through a channel-specific agonist (GSK1016790), remains relatively unexplored in current research. This study aimed to solidify the link between TRPV4 and angiogenesis using an Aortic Ring Assay (ARA) thereby providing implications for enhancing aerobic capacity and muscle perfusion during exercise.

METHODS: Three-day-old C57Bl/6 pups were euthanized, and their thoracic aortas were surgically removed. The vessels were cleaned, cut into 1mm wide rings, and randomized into a control group with standard growth media, and 2 agonist groups (3nm, 10nm). Over 12 days, the length and number of new sprouts were recorded to assess the degree of penetration/perfusion and measure angiogenic activation, respectively. Statistical analysis included running a two-way ANOVA as well as recording the mean and standard deviation for sprout length and number.

RESULTS: A significant increase in sprout length (pixel units) was observed 8 days onwards after the rings were exposed to the agonist compound at both the 10nm (196.21 ± 23.06) and 3nm (195.22 ± 38.90) concentrations when compared to control conditions (148.53 ± 27.98) ($p< 0.01$).

CONCLUSION: This study provides pertinent information on TRPV4s role as a mediator for intracellular signalling where stimulation of the ion channel can potentially be a target for vascular remodelling and capillary growth, offering valuable insights into further research aimed at advancing cardiovascular function and exercise physiology. Current research in vivo is examining the synergistic potential between aerobic exercise and the TRPV4 cation channel on angiogenesis.

RELATIONSHIP BETWEEN CALF VENOUS VASCULAR PROPERTIES AT REST AND CALF VENOUS RETURN DURING LEG EXERCISE

IIMURA, Y., OUE, A.
TOYO UNIVERSITY

INTRODUCTION: Great venous capacitance refers to the large amount of blood contained in veins at rest. Venous return from the calf to the heart during leg exercise is increased by muscle pump (Folkow et al. 1970), which depends on the force of muscular contraction and the amount of blood in venous vessels (Barendsen and van den Berg 1984). Based on these factors, improved venous vascular properties (capacitance and compliance) at rest are expected to increase venous return during exercise, but this relationship has not yet been investigated. Therefore, the purpose of this study was to clarify the relationship between calf venous vascular properties at rest and calf venous return during leg exercise.

METHODS: Twenty-two healthy young volunteers (15 men, 7 women; age, 22 ± 1 years; height, 166.3 ± 7.9 cm; weigh, 60.2 ± 11.8 kg; BMI, 21.6 ± 3.1 kg/m2) participated in this study. First, the change in calf volume in the supine position was measured using a cuff deflation protocol (Halliwill et al. 1999) by venous occlusion plethysmography in order to evaluate the capacitance and compliance in the calf veins at rest. Next, the participants rested in the supine position and then stood up and performed a tiptoe exercise. The change in calf volume was measured using strain-gauge plethysmography through this protocol. The change in calf volume during the postural change from supine to standing was calculated as the index of venous volume (VV), and the change in calf volume during the tiptoe exercise was assessed as the ejection volume (EV), which was used the index of venous return from the calf (Stewart et al. 2004).

RESULTS: Calf venous capacitance at rest showed a significant positive correlation with VV (P = 0.027, r = 0.470), but not with EV (P = 0.793, r = -0.059). There was no significant correlation between calf venous compliance at rest and VV (P = 0.392, r = 0.192) or EV (P = 0.387, r = -0.194).

CONCLUSION: These results suggest that the capacitance and compliance of calf veins at rest might not be correlated with calf venous return during leg exercise.

References

Barendsen and van den Berg, Angiology 35: 163-172, (1984).

Folkow et al., Acta Physiolo Scand 80: 61-72, (1970).

Halliwill et al., J Appl Physiol 87: 1555–1563, (1999).

Stewart et al., Am J physiol Heart Circ Physiol 286: H1216-H1222, (2004).

Contact: iimura0403@gmail.com

THE EFFECTS OF ACUTE NITRATE-RICH BEETROOT POWDER INGESTION ON CARDIOVASCULAR FUNCTION AND ENDURANCE EXERCISE PERFORMANCE DETERMINANTS IN HEALTHY ADULTS: A DOSE-RESPONSE INVESTIGATION

MCLELLAN, A., ROWLAND, S., ODONNELL, E., JAMES, L., CLIFFORD, T., BAILEY, S.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: The dose-response effect of acute dietary nitrate supplementation on brachial systolic blood pressure and exercise capacity has been well documented. However, there is a paucity of data exploring the dose-response effects of nitrate on central blood pressure, pulse wave variables, flow mediated dilation, and endurance exercise performance determinants. Thus, the purpose of the current study was to investigate the acute effects of ingesting three doses of nitrate rich beetroot powder on various cardiovascular function and endurance performance markers.

METHODS: Eighteen normotensive, healthy participants (mean ± SD: age 23 ± 4 yr, BMI 24 ± 3 kg/m2, systolic blood pressure 119 ± 4 mmHg, VO2Peak 46 ± 13 mL·kg-1·min-1) completed four experimental conditions in a double-blind, randomized design. The conditions were: control with no supplement, and beetroot powder providing 200 mg, 400 mg, or 800 mg nitrate. During each trial, brachial and central blood pressure, pulse wave variables, and flow mediated dilation were measured, and a venous blood sample was collected prior to and 2.5 h following supplement ingestion. A ramp incremental cycling test to exhaustion was completed post supplement ingestion for assessment of exercise economy (VO2-WR slope), gas exchange threshold (GET), respiratory compensation point (RCP), peak aerobic power (PAP) and VO2peak. All data were assessed using one-way linear mixed models.

RESULTS: Plasma nitrate and nitrite significantly increased (P ≤ 0.001) from control after ingesting 200 mg, 400 mg, and 800 mg nitrate. There were significant main effects of supplement for central systolic blood pressure (P = 0.043), but post-hoc analyses revealed no significant between-condition differences (P ≥ 0.066). There were significant main effects for pulse wave parameters (P ≤ 0.048), with augmentation index and augmentation pressure lower than control following ingestion of 200 mg (Δ: -4 ± 7 % and -2 ± 3 mmHg), 400 mg (Δ: -7 ± 8 % and -2 ± 3 mmHg), and 800 mg (Δ: -6 ± 6 % and -2 ± 2 mmHg) nitrate. There were main effects of supplement for the absolute and percentage changes in artery diameters during flow mediated dilation assessment (P ≤ 0.046), with an increased artery diameter from control after ingesting 400 mg nitrate (Δ: 0.002 ± 0.069 mm, P = 0.048), but not 200 mg or 800 mg (P ≥ 0.05). There were no significant effects on peripheral blood pressure variables or VO2-WR slope, GET, RCP, PAP and VO2peak during the ramp incremental exercise test (P ≥ 0.05).

CONCLUSION: Acute supplementation with a nitrate-rich beetroot powder improved pulse wave variables and endothelial function, but these variables exhibited different dose-response effects. Brachial blood pressure and determinants of endurance performance were not altered by nitrate ingestion. These findings improve our understanding of the effects of nitrate supplementation on cardiovascular function and exercise capacity in healthy adults.

THE EFFECT OF PHLEBOTOMY ON NEUROMUSCULAR FATIGUABILITY AND CARDIORESPIRATORY, METABOLIC, AND PERCEPTUAL RESPONSES TO PROLONGED EXERCISE

KONTRO, H., JENSEN, M., CASWELL, A., ABOODARDA, S.J., MACINNIS, M.J.

UNIVERSITY OF CALGARY

INTRODUCTION: An acute loss of blood volume is known to affect maximal aerobic capacity (VO2max), but its influence on prolonged submaximal exercise remains unclear. The objective of this study was to investigate the effect of acute phlebotomy on physiological responses to 60 minutes of submaximal exercise in the heavy domain and its subsequent impact on maximal exercise performance.

METHODS: After baseline testing and a control trial, using a double-blind design, 17 moderately trained participants (5 female) underwent either phlebotomy (PHLE) to withdraw 7% of total blood volume, or a sham procedure (SHAM). Physiological, metabolic, perceptual, and neuromuscular responses were assessed during 60 minutes of submaximal exercise in the heavy domain (71 [6] % of VO2max) and during a subsequent severe intensity time-to-task failure trial.

RESULTS: Phlebotomy significantly affected ventilation (+9 [11] % vs. control trial), ventilatory equivalent (+8 [7] %, heart rate (+6 [5] %), O2 pulse (-7 [6] %), and lactate (+34 [26] %) during submaximal exercise (p < 0.05). Maximal exercise was impaired, with a -30 [30] % reduction in time-to-task failure (P = 0.018) and a non-significant reduction in VO2max (-6 [8] %, P

= 0.09). Submaximal VO2, RER, substrate oxidation, RPE, and neuromuscular fatigability were unaffected. The ventilatory and lactate responses in PHLE became progressively exacerbated during the 60-minute exercise bout with the greatest deviations compared with the control trial observed at the end of exercise.

CONCLUSION: These findings highlight the role of circulating vascular volumes in mediating resilience against time-dependent disturbances in homeostasis during prolonged exercise. Blood volume and/or hemoglobin mass have a role in the regulation of ventilation and blood lactate even in steady state conditions.

ACUTE EFFECTS OF SLOW-PACED BREATHING ON CARDIAC AUTONOMIC CONTROL FOLLOWING SPRINT INTERVAL TRAINING: A RANDOMIZED CONTROLLED TRIAL

RAIDL, P., LAISTER, S., CSAPO, R.

UNIVERSITY OF VIENNA

INTRODUCTION: Relaxation techniques are assumed to benefit sports and exercise performance and recovery. However, direct evidence in support of specific strategies is limited. One promising approach is slow-paced breathing (SPB), given its influence on autonomic control, vagal activity, and cardiac regulation. Multiple studies demonstrated its positive effects on acute measures of heart rate (HR), HR variability (HRV), and well-being [1, 2].

METHODS: To explore the acute effects of SPB on cardiac control following exercise, healthy and physically active participants underwent a sprint interval training (SIT) session. Participants were stratified by sex and randomly allocated to either an SPB or a control group. Both groups performed a SIT protocol (4 × 30s with 4min active rest) on a non-motorized treadmill against a resistance of 5% of body weight, followed by 4min of active recovery. Subsequently, participants either followed a 10-minute SPB protocol or sat quietly. HR, HRV-derived Root Mean Square of Successive Differences (RMSSD) and low frequency (LF-) power as measures of vagal tone, as well as subjective exertion on a 100mm visual analog scale (VAS100) at 5 time points.

HR, log-transformed RMSSD and log-transformed LF-power were analyzed using mixed (group × time) ANOVAs and multiple comparison-adjusted post-hoc tests. A continuous ordinal regression (COR) was performed for VAS100 ratings. Model fit was evaluated through log-likelihood ratio tests, including group, time, and group × time interactions in consecutive order.

RESULTS: A sample of n = 25 (18 females, age = 25.7 ± 3.2) was analyzed for this study, with four datasets excluded due to a malfunctioning HR monitor.

HR decreased over time of recovery from 177 ± 10 bpm to 112 ± 13 bpm ($p = 0.019$), with no differences between groups. Also, no significant differences in RMSSD were found between groups.

LF-power showed significant time and interaction effects ($p < 0.05$). Post-hoc analysis revealed a reduction in LF-power between the active recovery phase and the subsequent SPB phase for the intervention group ($p < 0.001$). No significant reduction in LF-power ($p = 0.088$) was found in the control group.

The COR model for VAS100 did not improve with the inclusion of group × time interactions ($p = 0.088$).

CONCLUSION: The exercise session resulted in the expected increase in HR and decrease in HRV measures, with both gradually recovering within 14 minutes after exercise. Post-exercise SPB did not expedite the recovery of HR or RMSSD. Nevertheless, SPB was associated with a decrease in LF-power, indicating a reduction in sympathetic tone. These findings suggest that the SIT session strongly increased sympathetic nervous system activity, thereby potentially limiting the observable benefits of SPB on cardiac vagal control.

Literatur

[1] Russo et al. (2017), Breathe (Sheff), 13(4):298-309

[2] Laborede et. al. (2022), Neurosci Biobehav Rev., 138:104711

HEART RATE RESPONSE TO CONSTANT LOAD BELOW AND ABOVE THE VENTILATORY THRESHOLD 1: A PILOT STUDY IN TRAINED CYCLIST

OPAZO, E., CESPEDES, C., ACEITUNO, H., TORRES, M.

UNIVERSIDAD DE CÁDIZ

INTRODUCTION: Recent research reveals varying internal load responses across exercise intensity domains, notably about heart rate (HR). Controversy has emerged in distinguishing the behavior of HR responses between moderate and heavy-intensity domains. This study aims to evaluate the HR response during a constant load test and compare the slope of the HR between below and above ventilatory threshold 1 (VT1) loads.

METHODS: Five participants (four males) with a mean age of 30.6 years (± 6.5), BMI of 22.8 (± 3.92), and maximal oxygen consumption of 59.8 ml/min/kg (±11.54) were evaluated. Participants completed two assessment sessions on different days: one session consisted of a maximal oxygen consumption test on a cycle ergometer, and the other day included two constant load tests. These constant load tests consisted of two 7-minute stages of a 10% peak power output difference, with one below and the other above VT1. A self-selected cadence was maintained during the test, with a 12-minute rest between evaluations. A cycle ergometer was adjusted according to each participants anthropometry, along with a heart rate band and a gas analyzer were used. The slope of heart rate during minutes 2-7, 3-7, 4-7, and 5-7 was analyzed, comparing below and above VT1 stages with the Wilcoxon test and significance of 95%.

RESULTS: The HR median (min; max) slope for 2-7 min was 0.291(0.116;0.411) for below and 0.389 (-0.029;0.564) for above, for 3-7 min: 0.157 (0.088;0.500) and 0.350 (-0.215;0.410), for 4-7 min: 0.257 (0.072;0.469) and 0.331 (-0.422;0.478), and for 5-7 min: 0.258 (0.210;0.440) and 0.298 (-0.925;0.514) beats per min/min. There was no significant difference between the below and above VT1 comparisons (p>0.05).

CONCLUSION: We found no stabilization of the HR response even below VT1 in trained cyclists. Among the cyclists analyzed, one consistently exhibited a negative slope of HR above VT1 during the windows examined. The median HR slope comparison below and above, calculated across various time windows, indicates an increase at 2-7, 3-7, and 4-7 minutes, but not at 5-7 minutes, albeit without significant differences. Additional volunteers are needed, and more complex analyses are required to enhance the reliability of our conclusions.

EFFECT OF INTERMITTENT BREAKING-UPS OF PROLONGED SITTING ON CENTRAL AND PERIPHERAL ARTERY STIFFNESS IN YOUNG ADULTS

PARK, J., SON, J.S., KIM, D.Y., HWANG, M.H.

INCHEON NATIONAL UNIVERSITY

INTRODUCTION: Prolonged sitting is a common lifestyle in the advanced countries with automated industrial structures and developed service industries. As amount of time spent sitting during the day increases, the risk of arterial stiffness, an independent predictor of cardiovascular disease, is increased. Thus, a lifestyle of prolonged sitting is considered a risk factor for cardiovascular disease in modern society. Intermittent breaking-ups of prolonged sitting can be an effective behavioral intervention to offset the negative influence of that. However, it is difficult to discover studies investigating the effects of intermittent breaking-ups of prolonged sitting on both central and peripheral artery stiffness. Therefore, the purpose of this study was to investigate the effect of intermittent breaking-ups of prolonged sitting on aortic and leg artery stiffness in young adults.

METHODS: Nine healthy young adults (24 ± 1 yrs) were recruited for this study. By randomized crossover design, study participants performed both conditions: 3 hours of prolonged sitting (PS) and 3 hours of prolonged sitting with intermittent breaking-ups by 5 minutes of very slow, brisk walking every hour (BPS). Central artery stiffness measures such as aortic pulse wave velocity and augmentation index were evaluated by SphygmoCor Xcel system, Non-dominant leg pulse wave velocity as peripheral artery stiffness was measured by Doppler Flowmeters connected with PowerLab data acquisition system. Central artery stiffness measures were assessed at baseline and after the interventions. Peripheral artery stiffness was measured not only at baseline and after the intervention but also every hour during the interventions.

RESULTS: There was no significant condition by time interaction for central artery stiffness measures and peripheral artery stiffness (P > 0.05). Additionally, BPS with very slow, brisk walking for 5 minutes every hour also had no effect on peripheral artery stiffness.

CONCLUSION: In conclusion, one bout of prolonged sitting for 3 hours does not negatively influence on central and peripheral artery stiffness, and intermittent breaking-ups of prolonged sitting by very slow, brisk walking do not seem to play a positive role in central and peripheral artery stiffness measures in healthy young adults.

EFFECT OF HORMONAL STATUS AND PHYSICAL ACTIVITY LEVEL ON CARDIAC AUTONOMIC MODULATION IN YOUNG HEALTHY WOMEN

DELPECH, N., DOUMENC, C., LAFFETAS, P., ENEA, C.

UNIVERSITY OF POITIERS

INTRODUCTION: Heart rate variability (HRV) and baroreflex sensitivity (BRS) are indexes of cardiac autonomic modulation, which are influenced by a number of factors including gender, physical activity and ageing [1, 2]. In women, HRV and BRS also appears to be affected by hormonal variations specific to womens lives (menstrual cycle, hormonal contraception or menopause) [3, 4]. On the other hand, physical activity is known to have a beneficial effect on cardiac autonomic regulation. The aim of this study was to investigate the effect of hormonal status on these indexes and to determine whether regular physical activity can modify this effect.

METHODS: A total of 29 young women were divided into two groups, according to their hormonal status: oral contraceptives (CO+, n=17) or natural menstrual cycle (CO-, n=12). The Global Physical Activity Questionnaire was used to assess moderate-to-vigorous physical activity (MVPA) and sedentary time. Non-invasive measures of beat-to-beat arterial pressure and heart rate (Finapres) were used to assess baroreflex sensitivity and heart rate variability. The mean values of systolic blood pressure (SBP), diastolic blood pressure (DBP), HRV parameters (LF, HF, LF/HF, SDNN, RMSSD and RR) and BRS of the two groups were compared using Students unpaired t-test. A Pearson correlation matrix was used to test for an association between the amount of weekly MVPA and SBP and DBP in women.

RESULTS: SBP and DBP were significantly higher in CO+ than in CO- women (CO+: 121.8 ± 9.9 and CO-: 109.3 ± 9.8 mmHg, p<0.05; d=1.2; CO+: 73.2 ± 9.5 and CO-: 64 ± 9.5 mmHg, p<0.05; d=1). However, neither BRS nor HRV differed between CO+ and CO- (BRS CO+: 19.8 ± 9.7 and CO- 22.7 ± 8.7 mmHg/ms p>0.05; d=-0.3). MVPA did not correlate with better cardiovascular regulation or lower blood pressure in either group.

CONCLUSION: Despite higher SBP and DBP in oral contraceptive users than natural menstruating women, our results suggest that neither hormonal status nor MVPA levels influence cardiac autonomic regulation in young healthy women. Further studies are needed to determine whether older women are affected by these both factors.

REFERENCES:

[1] Zhou et al., (2023). Cardiovagal baroreflex sensitivity, blood pressure and blood pressure variability - the Maastricht study. Journal of hypertension, 41(2), 254–261.

[2] Barnes et al., (2012). Association of cardiac baroreflex sensitivity with blood pressure transients: influence of sex and menopausal status. Frontiers in physiology, 3, 187.

[3] McKinley et al., (2009). The impact of menstrual cycle phase on cardiac autonomic regulation. Psychophysiology, 46(4), 904–911.

[4] Mascone et al., (2023). Naturally menstruating women exhibit lower cardiovagal baroreflex sensitivity than oral contraceptive users during the lower hormone phase. Experimental physiology, 108(12), 1481–1489.

PALPATORY, PHOTOPLETHYSMOGRAPHIC AND 1 LEAD ELECTROCARDIOGRAPHIC HEART RATE MONITORING VALIDITY DURING VARIED INTENSITY AEROBIC AND RESISTANCE EXERCISE

PANAYIOTOU, G., DIAMANTI, V., LADAS, A., METHENITIS, S., DOULIGERIS, A., FEIDANTSIS, K., BELLALI, T.

EUROPEAN UNIVERSITY OF CYPRUS

INTRODUCTION: Heart rate recording is essential for determining acute and chronic exercise responses during rest and exercise and can be utilised as an internal load metric for exercise load monitoring. The present study examined the validity of different heart rate measurement methodologies during aerobic and resistance exercise under different intensities: 60% - 100% HRmax and 1 RM during aerobic and resistance exercise, respectively.

METHODS: Thirty male sports science students, aged 22.7+1.6 years, with body mass 74.0±9.2 kg and height 1.77.4±6.8 m, participated in the study. After initial familiarisation, aerobic capacity (VO2max) and maximal strength (1RM) were measured seven days apart during two laboratory visits. Through a cross-over design, participants took place in an interval, incremental, multistage maximum aerobic and resistance exercise separated by one week. Aerobic exercise consisted of five stages of three minutes of treadmill running at 60%, 70%, 80%, 90% and 100% of HRmax, whereas resistance exercise involved five maximal repetition sets at 60%, 70%, 80%, 90% and 100% of 1 RM. Two minutes rest interval between stages/sets allowed recovery and simultaneous monitoring of HR through photoplethysmograph (PPG -hand finger pulse oximetry and wrist smart watch), electrocardiographic activity (one lead chest heart rate band and 12 lead ECG) and wrist palpation of the radial artery. All HR monitoring methods were compared against the criterion method of 12 lead ECG. Pearson correlation coefficient (r) was determined using IBM SPSS Statistics v29 software. The level of significance (p) was set at 0.05.

RESULTS: Pearson correlation coefficient (r) of different methods and intensities concerning the criterion method of 12 lead ECG during endurance and resistance exercise ranged from r=0.075 (p>0.05) to r=0.923 (p<0.001) and r=0.28 (p>0.05) to 0.958 (p<0.001) respectively. In particular, higher correlations with 12 lead ECG during aerobic exercise were observed during moderate (70% HRmax) intensities with the one lead chest heart rate band (r=0.923, p<0.001). At the same time, the exact method revealed the lowest correlation during maximal (100% HRmax) intensity (r=0.075, p>0.05). In contrast, during resistance exercise, the highest correlations were shown during high (80% 1RM) intensity with the one lead chest heart rate band (r=0.028, p>0.05) and the lowest with the PPG (wrist smart watch) (r=0.923, p<0.001).

CONCLUSION: An inversely dose-dependent validity pattern of heart rate recording emerged among different heart rate recording methods during aerobic and resistance exercise, likely to arise from technical and hemodynamic issues. Specifically, the validity of HR recording methods during aerobic exercise tends to decrease with increasing exercise intensity. In contrast, it increases during resistance exercise, with the reverse being the case with reducing exercise intensity.

Conventional Print Poster Presentations

CP-SH03 Cognition and Psychobiology

ATHLETE AND EXERCISER BARRIERS AND ENABLERS TO MENSTRUAL CYCLE COMMUNICATION IN SPORT

FORREST, L., KIEMLE-GABBAY, L., MARTIN, D., VALENTIN, S.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: The impact of the menstrual cycle (MC) on athlete wellbeing and performance is highly individualised, with athletes often reporting difficulties communicating their MC experiences to their coaches and support staff. However, less is known with respect to facilitating MC communication in sport settings. Therefore, the aim of this study was to explore athletes' lived-experiences of the barriers and enablers to MC communication in sport.

METHODS: Self-identifying female athletes (N=379; age 30 ± 9 years; range = 18-63 years) from 85 sports/exercise activities and 30 different nationalities, completed an online survey consisting of quantitative and short answer qualitative questions regarding their MC communication practices and comfort in communication. A mixed-method analytic approach was utilised, with descriptive statistics summarising quantitative data and qualitative content analysis conducted on open-text responses.

RESULTS: Athletes' comfort in communicating with others about their MC was variable; general practitioners, teammates and friends/family were deemed most approachable (75%, 69% and 69% of participants respectively). Athletes perceived people as being more approachable if they had underpinning medical/physiological/psychology knowledge (82%), they were female (80%) and had a lived-experience of MC (71%), whilst being male (3%), having a similar cultural background (5%) and having a lack of familiarity (7%) were reported the least. Just under one half of participants were extremely (7%), very (12%), or somewhat (27%) satisfied with the support they received pertaining to their MC. More than one half (51%) experienced situations in which they found communicating about their MC in a sporting context challenging, however 48% had experienced positive/supportive situations or attitudes towards menstruation/MC. Content analysis of open-text responses showed that the most commonly reported challenges to communication in sport included coaches being male, participants feeling awkward and embarrassed to discuss it, a perceived lack of relationships with coaches, and considering menstruation a personal/private topic. The most commonly reported positive MC-related experiences included open discussions with training partners/groups, training groups/partners/competitors being sympathetic and understanding, other women providing period products and support, and male coaches being supportive and receptive to discussions/altering training if needed.

CONCLUSION: This study reinforces that athletes and exercisers can experience challenges in MC communication. However, protective/enabling factors such as having supportive teammates and coaches and having underlying MC knowledge helps develop period positive environments in sport.

ELITE ADULT AND ADOLESCENT SOCCER PLAYERS EXPERIENCES AND PERCEPTIONS OF THE MENSTRUAL CYCLE AND ATHLETIC PERFORMANCE

DONNELLY, J., VALENTIN, S., EASTON, C., WHITE, A., FORREST, L.
UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Female soccer players report health, wellbeing, and performance implications as a result of their menstrual cycle (MC). Previous research has focused on the adult population with little focus on the adolescent athlete experiences. Thus, this study aimed to investigate the experiences of the MC and performance implications in adult and adolescent soccer players and explore athlete communication with coaches pertaining to the MC.

METHODS: Female elite adult (n = 44, age 25.0 ± 5.3) and adolescent (n = 80, age 15.0 ± 1.2) soccer players completed an online questionnaire consisting of quantitative and short answer qualitative questions on experiences of the MC and hormonal contraception (HC), and perceptions of communication and support received pertaining to their MC. A mixed-method analytic approach was utilised, with descriptive statistics and Chi-square test for association evaluating quantitative data, and qualitative content analysis for open-text responses.

RESULTS: Over one quarter (n = 12; 27.3%) of adults reported currently using HC, compared to 10.3% (n = 7) adolescents with the oral contraceptive pill (OCP) as the majority choice (83.3% adults vs 100.0% adolescents). Irregular bleeding was experienced by 80.7% (n = 25) and 89.3% (n = 58) of naturally menstruating adults and adolescents, respectively. A total of 43.6% (n = 17) adults and 35.3% (n = 24) adolescents described their bleeding as "Heavy' or 'Very Heavy'. Eight players were pre-menarcheal (10.0%), and 88.0% (n = 7) believed it would negatively impact soccer performance, due to MC symptoms experienced and inconvenience of menses. Adult players were significantly more likely to perceive the MC negatively affected performance (96.3% (n = 26)) than adolescents (78.3% (n = 36)) ($x^2 = 1, 62) = 4.32$, $p = 0.038$). Qualitative analysis highlighted a fear of leaking and symptoms experienced as key reasons for the MC negatively impacting performance in both cohorts. Players, especially adolescent players, had difficulties in discussing their MC. Communication strategies differed, with significantly more adult players reporting speaking to a player regarding their MC (82.5%, n = 2) than adolescents (34.5%, n = 19) ($x^2 = 1, 43) = 22$, $p<0.001$). A significant association was also identified in athlete perception of coach gender impacting communication, as 84.5% (n = 49) of adolescents believed it was influential compared to 72.5% (n = 29) of adults ($x^2 = 2, 78) = 6.95$, $p = 0.031$). A perceived lack of knowledge, ability to relate and awkwardness were all cited as key reasons from both adults and adolescents.

CONCLUSION: Soccer players report wellbeing and performance impacts due to their MC, highlighting the need for individual understanding and support. Furthermore, understanding the experiences of adolescents allows support structures to develop their practice and enhance comfort in communication, in turn aiming to normalise the conversation.

A SIX-WEEK COORDINATIVE MOTOR TRAINING PROGRAM IMPROVES SPATIAL ABILITY PERFORMANCES IN HEALTHY CHILDREN

MORAWIETZ, C., WISSMANN, A.M., MUEHLBAUER, T.
UNIVERSITY OF DUISBURG-ESSEN

Overall academic achievements are decreasing, which poses a risk for cuts in physical education time in favor of other subjects [1]. At the same time, recent research on the association between physical activity, cognitive function and academic achievement in children reveals promising findings [2]. Spatial abilities as one aspect of complex cognitive functions are encountered frequently in everyday life [3] and have been associated with higher academic achievements, particularly in STEM-subjects [4]. Making use of this positive interaction could open new possibilities to address several problems of today's society at once. The aim of the present study therefore is to investigate the effects of a six-week coordinative motor training on spatial ability performances in healthy children.

A total of 53 healthy secondary school students (f/m: 30/23, mean age: 11.3 ± 0.6 years) participated in either a six-week coordinative motor training with spatial ability elements (intervention group [IG]; 2x/week, 45 minutes/session) or attended regular PE-class (active control group [CG]). Pre- and post-intervention measurements included the Paper Folding Test (PFT), the Mental Rotation Test (MRT), the Water Level Task (WLT), the Corsi Block Test (CBT), and the Numbered Cones Run (NCR).

Pretest values did not differ significantly between groups at baseline. Repeated measures ANOVA revealed significant main effects of test but not of group and significant test × group interactions. Precisely, significant medium- to large-sized improvements in spatial abilities were observed for all but one (i.e., PFT) measures in the IG but not in the CG as indicated by the post-hoc analysis (MRT: $p < 0.001$, Cohen's $d = 0.66$; WLT: $p < 0.001$, Cohen's $d = 0.51$; CBT-span: $p < 0.001$, Cohen's $d = 0.99$; CBT-CS: $p < 0.001$, Cohen's $d = 1.00$; NCR: $p < 0.001$, Cohen's $d = 0.76$).

Spatial abilities of the IG improved significantly from pre- to posttest compared to the CG indicating that the coordinative motor training had a positive effect on spatial ability performances in healthy children. These findings are in line with previous research evaluating the effect of motor training on spatial abilities. Future research might also take gender specific differences in spatial abilities into account and evaluate the effect of coordinative motor training on spatial abilities in different age groups.

References

1. Hardman, K., A. Routen, and S. Tones, UNESCO-NWCPEA: world-wide survey of school physical education; final report. 2014.

2. Alvarez-Bueno, C., et al., Aerobic fitness and academic achievement: A systematic review and meta-analysis. Journal of Sports Sciences, 2020. 38: p. 1-8.

3. Fernandez-Baizan, C., J. Arias, and M. Méndez, Spatial orientation assessment in preschool children: Egocentric and allocentric frameworks. Appl. Neuropsychol. Child, 2019. 10(2): p. 171-193.

4. National Research Council, Learning to Think Spatially. 2006, Washington, DC: The National Academies Press. 332.

ATTENTION AND MEDITATION LEVEL OF ARCHERY, YOGA AND DANCESPORT BASED ON ELECTROENCEPHALOGRAM (EEG) SIGNAL ANALYSIS

HE, Z., LI, F., CHEN, H.

PEKING UNIVERSITY

INTRODUCTION: Electroencephalograms (EEG) signals depict the electrical activities of neurons and consist of psychological and cognitive information. Alpha brainwaves are associated with meditation and Beta brainwaves are associated with attention. EEG signals transform brainwaves into attention and meditation values. Both attention and meditation reveal psychological movement of athletes. Attention is related to concentration ability while meditation indicates relaxation level. The study aimed to compare attention and meditation level in archery, yoga and dancesport, so as to explore psychological training method for corresponding sport.

METHODS: The study was conducted in an academically prestigious university in China. Yoga group included 16 college students sampled from yoga courses. There were two phases for yoga research: the review phase and the teaching phase. Archery group consisted of 4 members from campus archery team and 50 ordinary students. Archery actions were divided into three phases: preparation, arrow releasing, and relaxation. Dancesport group included 10 students who played rumba and cha-cha dance. EEG signal was processed during different phases in each group. Data were analyzed by One-way ANOVA with R 4.3.1.

RESULTS: First, for yoga group, attention in review phase was significantly higher than that in teaching phase ($F(1,19)=4.68$, $p<0.05$). However, there was no significant difference in meditation between two phases ($p=0.7$). Second, in archery group, significant difference was observed in attention among ordinary students between arrow releasing and relaxation phases ($F(2,15)=4.31$, $p=0.033$). Regarding meditation, significant difference was observed between preparation and arrow releasing phases, and between preparation and relaxation phases ($F(2,15)=5.26$, $p=0.019$). For archery team members in arrow releasing phase, their meditation level was lower and their attention level was higher than ordinary students. Third, for dancesport group, however, there was no significant difference observed in both attention and meditation in rumba and cha-cha dance.

CONCLUSION:Attention and meditation level fluctuated in different phases of different groups. First, yoga practice can improve students' attention level, particularly during the review phase when students reflected and consolidated yoga moves. Second, attention of archery group increased during preparation and releasing phases, indicating that a high level of concentration was required for archery athletes, so that attention should be emphasized in psychological training. Third, results indicated that attention and meditation training were not among top priorities in dancesport, as dancesport required various high-demanding skills.

ISOLATING THE EFFECTS OF PERIPHERAL AD CENTRAL FATIGUE ON INHIBITORY CONTROL, SKILLED MOTOR PERFORMANCE, AND GAZE BEHAVIOUR IN TEAM SPORT ATHLETES

HAUSENDORF, J., GONZALEZ, C., RAKOBOWCHUK, M.

THOMPSON RIVERS UNIVERSITY

Introduction

Central fatigue (CF) and exercise-induced peripheral fatigue (PF) have a detrimental effect on cognitive and sport-specific performance [1,2]. Yet, in past research, the exercise stimulus was based on relative intensities related to VO2peak or maximal heart rates, which often induce vastly different muscle metabolic stresses between participants [3].The purpose of this study was to control the metabolic stress within the heavy exercise domain across participants whilst assessing whether the concomitant mental fatigue potentiates sport performance and inhibitory control declines, and whether these declines relate to changes in gaze behaviour.

Methods

In 10 varsity soccer players, we initially identified ventilatory thresholds using a ramp incremental protocol to individually tailor the 45 minute of cycling within the heavy exercise domain. Participants simultaneously performed four continuous blocks of a modified Stroop task which causes subjective mental fatigue with deteriorating task performance after 45 minutes [4]. Before and after exercise, participants completed a Flanker task, measuring response-inhibition accuracy and reaction time. They also performed an interceptive soccer task (ball control) wearing a mobile eye-tracking device to measure gaze. Two external cameras were used to assess qualitative performance of the soccer-specific task.

Results

There was no significant difference in response-inhibition accuracy on the Flanker task before compared to after exercise (Pre: 117, SD=3; Post: 116, SD=3, p=.32). Also, reaction time before exercise did not differ significantly from reaction time after (Pre: 612, SD=100; Post: 567, SD=25, p=.22). Accuracy on the Stroop task was maintained throughout the exercise bout (F (3,24)=1.31, p=.295). Reaction time on the Stroop task did also not change significantly (F(3,24)=0.07, p=.971). Performance on the interceptive soccer task significantly worsened after compared to before mental and physical exercise (Pre: 0.80, SD=0.35; Post: 0.68, SD=0.29, p=.012, d=0.856). Whereas, with exercise only, performance did not decline (Pre: 0.74, SD=0.31; Post: 0.75, SD=0.24, p=.506).

Conclusion

This study effectively induced a similar metabolic stress and similar peripheral fatigue magnitudes across participants. This reduced performance of the interceptive task when combined with a CF stimulus suggesting CF as an important factor contributing to sport performance deterioration. Subsequent, analysis of kinematics and gaze behaviour may explain underlying mechanisms.

References

Dambroz et al. (2022) PLOS ONE 17(7): e0270099

Kunrath et al. (2020) Revista Brasileira de Medicina Do Esporte, 26(2): 172–178

Rossiter, H. B. (2011) Comprehensive Physiology 1:203-244

Van Cutsem et al. (2020) Medicine & Science in Sports & Exercise, 52(1), 120–130

THE EFFECT OF ATTENTIONAL FOCUS STRATEGY ON MOTOR LEARNING OF DROP JUMP

FURUHASHI, Y., MURATOMI, K., YOSHIDA, T., TANIGAWA, S., MAEMURA, H.

UNIVERSITY OF TSUKUBA

INTRODUCTION: Attentional focus strategy (AFS) can promote a neutral (NEUT), internal (INT), or external focus of attention (EXT) and improves various sports performance. Drop jump (DJ) is a plyometric training that enhances the stretch-shortening cycle in lower limb muscles and is commonly used by S&C coaches and athletes. Furuhashi et al. 1) showed that DJ performance can be improved by NEUT for DJ experienced athletes and EXT for DJ inexperienced athletes. Thus, it is clear that AFS can be effective coaching method in DJ. However, all these studies are limited to examining the immediate effects of AFS on DJ, and the effects of AFS on motor learning of DJ have not yet been clarified. These findings provide the necessary knowledge for DJ inexperienced athletes to use DJ as training.

METHODS: 24 DJ inexperienced female college student were randomly divided into 3 groups (NEUT, INT, and EXT). They performed 6 sets of 5 DJ trainings (total 30 trials) using each focus of attention. Pre-test and post-test were performed before and after training, followed 3 days later by Retention-test 1 and 7 days later by Retention-test 2 to perform 2 trials DJ without instruction. The instructions for each condition were as follows: NEUT: "Perform the jump to the best of your ability", INT: "Step off the box, land on the balls of your feet, then fully and explosively extend your ankles, knees, and hips to jump as high as possible", EXT: "Step off the box, jump fast, imagine the ground is hot, get off the ground quickly, imagine you are a stiff spring, and focus on jumping to the roof." Three-dimensional coordinates of the 12 retroreflective markers fixed on each subject's body were obtained using a Vicon T20 system (Vicon Motion Systems Ltd.) with 10 cameras operating at 250 Hz. Ground reaction force was measured by a force platform at a rate of 1000 Hz. From the measured data, reactive strength index (RSI), contact time (CT), jump height (JH), joint torque, joint power, angular of the lower leg joints were calculated.

RESULTS: In all groups, DJ performance improved from Set 1 to Set 6 during the training session. All groups also improved DJ performance from Pre-test to Post-test. On the Retention-test, the EXT group showed higher DJ performance than the other groups. In addition, EXT group performed rational force exertion and movement to improve DJ performance.

CONCLUSION: These results showed that AFS is effective for DJ motor learning. In particular, it has been shown that EXT can be used by DJ inexperienced athletes to effectively learn reasonable force exertion and movement to improve DJ performance. S&C coaches may benefit from using plyometrics instruction with AFS to improve the performance of athletes at a wide range of levels.

REFFERENCES:

1) Furuhashi Y, Hioki Y, Yoshimoto S, and Hayashi R. Effect of Neutral, Internal, and External Focus on Drop Jump Performance: Is Drop Jump Performance Affected by Plyometric Training Experience? J. Strength Cond. Res. 36: 3319-3323, 2022.

EXAMINING THE IMPACT OF COOPERATIVE JOINT ACTION EXERCISE ON COGNITIVE FUNCTIONING AMONG COLLEGE STUDENTS

AMISHIMA, R., NAKAJIMA, T., MORITA, N.

北海道教育大学

Backgrounds

Joint actions are common in daily activities, such as handshakes and playing sports together. Research indicates that synchronous exercises involving two individuals can enhance cooperative behaviors in children (Rabinowitch et al., 2017), suggesting that synchronized activities among multiple individuals promote prosocial behaviors in children. Conversely, higher-order cognitive functions, like executive function, play a crucial role in goal-oriented human behaviors and social interactions (Diamond, 2013). Studies have demonstrated that acute exercise can improve executive functions (Ishihara et al., 2021). However, most prior research has focused on individual exercise without joint action conditions, leaving it unclear whether there are additional benefits when combining acute exercise with joint actions among peers in terms of cognitive/executive functions. In this study, we aimed to examine the effect of synchronous joint actions on cognitive/executive function responses to different exercise conditions.

Methods

Thirty-two college students participated, forming 16 pairs of same-sex individuals. The study involved four experimental conditions: 1) simultaneous synchronous exercise by two participants (synchronous condition), 2) simultaneous asynchronous exercise by two participants (asynchronous condition), 3) solo exercise by each participant (solo condition), and 4) resting control (rest condition). Participants engaged in 20 minutes of moderate-intensity bicycle exercises (at 50% of their maximum heart rate) in the exercise conditions, while they remained seated for the same duration in the rest condition. Cognitive/executive functions were assessed using a calculation task and the Trail Making Test (TMT). Participants reported their rate of perceived exertion (RPE) after the exercises.

Results

The number of correct answers increased after the bicycle exercise session in the solo condition ($p < 0.05$), but not in the synchronous condition, where there was only a slight, non-significant increase ($p = 0.25$). Similarly, the number of TMT tasks tended to increase only in the synchronous condition ($p = 0.08$), with no exercise-induced increase observed in the other conditions. RPE scores were the lowest after the synchronous condition and the highest after the solo condition (13.2 ± 1.1 vs. 14.2 ± 1.1; $p < 0.01$), respectively.

Conclusion

These findings suggest that while synchronized joint action exercises with peers may not yield clear additive effects on cognitive and executive functions following a moderate-intensity exercise, synchronous joint action exercises may facilitate the execution of the exercise program.

Reference

- Rabinowitch TC, J Exp Child Psychol. 2017;160:21-32.
- Diamond A. Annu Rev Psychol. 2013; 64: 135-168.
- Ishihara T, et al. Neurosci Biobehav Rev. 2021; 128: 258-269.

RELATIONSHIPS BETWEEN PERFORMANCE ON GENERIC COGNITIVE TESTS AND A SPORT-SPECIFIC DECISION-MAKING TASK.

ROLLEY, T., SAUNDERS, N., FOX, A.S.

DEAKIN UNIVERSITY

Introduction

Optimal sporting performance relies on a complex interplay of an athlete's sporting abilities, including cognitive function (1). Poor cognitive performance (e.g. slower reaction times) in athletes has been associated with compromised-making processes, resulting in poor execution of athletic tasks impacting performance or safety (1). Generic cognitive tests are typically used to assess cognitive function in athletes, which may be lack ecological validity and therefore misrepresent sport-specific cognitive performance. The aim of this study is to assess relationships between generic cognitive tests and a sport-specific decision-making task.

Methods

Twenty (elite: n=6; sub-elite n=14) (mean±SD, age=24.11±5.64years; height=169.15±6.21cm; mass=66.50±7.92kg) women's Australian-rules football players participated in this study. Correct response reaction time (i.e. time taken in accurate responses to stimulus) and performance accuracy (i.e. percentage of accurate responses) were assessed across tests targeting various cognitive parameters: (i) Deary Liewald task (i.e. simple reaction time); (ii) one-, two- and three-back tasks

(i.e. working memory); (iii) four-choice reaction time task (i.e. choice reaction time); (iv) one-card learning task (i.e. visual learning). Sport-specific reaction time was determined through a specifically developed decision-making task which required responding to an attacking player's movement cues. Relationships between the generic cognitive tests and the sport-specific decision-making task were assessed using Pearson's r correlations (α=0.05).

Results

No statistically significant relationships were found between the generic cognitive tests to the sport-specific decision-making task for either correct response time or performance accuracy ($p>0.05$). A non-statistically significant moderate correlation ($r=0.42$, $p=0.065$) was found between the four-choice reaction time task and the sport-specific decision-making task.

Conclusion

The lack of relationship between the generic cognitive tests and sport-specific decision-making task may be explained by task complexity. It is possible that the generic cognitive tests do not accurately assess an athlete's cognitive ability to read-and-react to cues in a sport-specific context (e.g. reading an opposition player's body cues). The moderate correlation between the four-choice reaction time task to the sport-specific decision-making task could suggest this generic test appropriately measures an athlete's ability to selectively attend to and filter relevant cues. With the generic cognitive tests demonstrating no relationship to performance on a sport-specific cognitive task, future research to improve the ecological validity of cognitive testing in sport is warranted.

References:

(1) Mori et al., Hum. Mov. Sci., 2002

THE IMPACT OF PHYSICAL ACTIVITY ON THE DEVELOPMENT OF EXECUTIVE FUNCTIONS IN HEALTHY CHILDREN: A BIOECOLOGICALLY-ORIENTED NARRATIVE REVIEW

SCHAERZ, S.

LETHBRIDGE COLLEGE

INTRODUCTION: From planning to regulating emotions to problem-solving, executive functions are important for a wide range of activities [1]. They are crucial for children's success in school, particularly in subjects like math and language [2]. An expanding body of evidence suggests that the development of executive functions in healthy children is associated with regular engagement in physical activity [3]. However, there is a noticeable gap in research that seeks to untangle this link within the broader context of human development [4]. The purpose of this narrative review is to advocate for an expanded perspective on understanding how physical activity contributes to the development of executive functions in healthy children, urging for the exploration of physical activity as a developmental process within the context of a complex and ever-evolving bioecological system.

METHODS: Database searches (i.e., ERIC, SPORTDiscus, PubMed, MEDLINE) were conducted to gather theoretical and empirical literature pertaining to the effects of physical activity on healthy childrens executive functions. Evidence was organized based on the domains of the bioecological model (i.e., person, process, context, time) [5]. Bioecologically-oriented hypotheses were then generated for the purpose of further empirical testing.

RESULTS: Analysis of the literature yielded the following hypotheses: (I) The developmental impact of physical activity on executive functions varies based on quantity and quality. Optimal benefits are achieved through frequent, prolonged engagement in moderate-to-vigorous intensity physical activity, encompassing a range of complex motor skills that increase in complexity over time. (II) The quantity and quality of physical activity is largely a function of a child's physical literacy and gender. Physical activity quantity and quality are further impacted by contextual factors including peer and parental support, school and competitive sporting environments, as well as socioeconomic status. (III) Temporal factors such as the child's chronological age and long-term persistence of developmentally disruptive events, such as the recent COVID-19 pandemic, further affect the quantity and quality of physical activity.

CONCLUSION: The developmental impact of physical activity on executive functions emerges from the dynamic interplay between the developing child and the context and time in which the child is situated. This narrative review advocates for increased emphasis on bioecologically-oriented research aligned with the hypotheses herein presented.

REFERENCES:

[1] Diamond, Annu. Rev. Psychol., 2013.

[2] Cortés Pascual et al., Front. Psychol., 2019.

[3] Haverkamp et al., J. Sports Sci., 2020.

[4] Shi et al., Brain Sci., 2022.

[5] Bronfenbrenner & Morris, Handbook of Child Psychology, 2006.

Conventional Print Poster Presentations

CP-SH07 Physical activity promotion

IDENTIFICATION OF PROFILES OF JAPANESE JUNIOR HIGH SCHOOL STUDENTS USING LATENT CLASS ANALYSIS BASED ON AWARENESS OF EXERCISE AND ACTUAL LIFESTYLE HABITS

SANO, T., KANO, H., MIYATA, H., GOTO, A., NAKANO, T.
CHUKYO UNIVERSITY

INTRODUCTION: The Japan Sports Agency conducts a national survey on physical fitness, motor ability, and exercise habits among elementary and junior high school students. Most analyses based on this data focused on tracking changes in single variables or correlations between single variables. Consequently, there have been no studies that express the characteristics of each students exercise and lifestyle habits as profiles based on combinations of multiple variables. Therefore, we aimed to identify diverse groups reflecting differences in the profiles of junior high school students exercise and lifestyle habits by applying latent class analysis to questionnaires on exercise awareness, opportunities, and lifestyle.

METHODS: We used questionnaire data provided from Aichi Prefecture, involving 39,050 2nd-grade junior high students (19,853 males, 19,197 females). The items included exercise preference, exercise importance, motivation to exercise after graduation, weekly exercise time, breakfast consumption status, daily sleep hours, daily screen time, membership status in sports clubs, exercise habits on holidays. To clarify groups reflecting differences in exercise and lifestyle habits profiles, latent class analysis based on items was conducted. The number of groups was determined by ensuring each classs composition ratio exceeded 5% and minimizing information criteria (AIC, BIC). Utilizing the conditional response probabilities, we interpreted each groups profiles.

RESULTS: As a result of latent class analysis, 7 groups were derived reflecting differences in exercise and lifestyle habits profiles. Among the three groups with positive attitudes toward exercise, C1 (composition ratio: 28.8%) exercised a lot with good lifestyle habits. C2 (11.7%) had plenty of exercise time and opportunities but excessive screen time. C3 (5.1%) did not belong to any sports clubs and exercised <60 minutes/day. Among the two groups with slightly positive attitudes toward exercise, C4 (24.6%) belonged to clubs with plenty of exercise time. C5 (11.5%) did not belong to any sports clubs and exercised <60 minutes/day. Among the two groups with negative attitudes toward exercise, C6 (9.1%) belonged to sports clubs and had a lot of exercise time but had few opportunities for exercise on holidays. C7 (9.3%) did not belong to any sports clubs and exercised <60 minutes/week.

CONCLUSION: The exercise and lifestyle habits profiles among junior high school students can be classified into 7 groups. While attitudes towards exercise generally align with exercise time and opportunities, some students who have limited exercise opportunities despite having a positive attitude towards exercise, or students who have plenty exercise time despite having a negative attitude towards exercise. These findings underscore the need to provide sufficient opportunities for exercise in daily life and enhance activities to ensure the enjoyment of exercise according to each groups challenges.

IMPACT OF A 6-MONTH SIT-STAND DESK-BASED INTERVENTION ON MUSCULOSKELETAL DISCOMFORT AND POST-WORK FATIGUE IN OFFICE WORKERS: A CLUSTER RANDOMIZED CONTROLLED TRIAL

SILVA, H., TENO, S.C., JÚDICE, P.B.
UNIVERSIDADE LUSÓFONA: UNIVERSIDADE LUSOFONA DE HUMANIDADES E TECNOLOGIAS

Background: Sedentary behavior (SB) is a major concern in developed countries, as adults spend over 60% of their potential waking time in this behavior, primarily due to work. To reduce SB at work, sit-stand desks have been proposed as an alternative. Many companies are using them to mitigate worker's health problems, but their impact on musculoskeletal discomfort and post-work fatigue is still unclear.

Purpose: This study aims to evaluate the impact of a 6-month intervention with a sit-stand desk on office workers musculoskeletal discomfort and post-work fatigue in comparison to a control group.

Methods: This study used a two-arm (1:1) clustered randomized controlled trial design, where participants were randomly assigned to either the intervention or control group. The intervention included a psychoeducation session, motivational prompts, and a contextual modification (i.e., sit-stand desk) in the workplace for 6 months. The control group continued to work as usual and only attended the psychoeducation session. The Nordic Musculoskeletal Questionnaire was used to measure musculoskeletal discomfort, while the Need for Recovery Scale was used to measure post-work fatigue. Repeated-measures ANOVA was used with the group as between-subject factor, and the time*group interaction was evaluated considering a 5% significance level.

Results: The study involved 38 participants with an average age of 43.8 years (±8 years). The intervention group significantly reduced musculoskeletal discomfort (total score reduction of 4.89; p=0.018) from baseline to 6 months, while the reduction in the control group was non-significant (4.00; p=0.070). A similar trend was found for post-work fatigue, with the intervention group showing a significant reduction (-1.68; p=0.013), whereas the control group showed a non-significant reduction (-1.05; p=0.128). Regardless, no time*group interactions were found (p>0.05) for both outcomes.

Conclusion: Our 6-month intervention based on sit-stand desk proved to be effective in reducing musculoskeletal discomfort and post-work fatigue of office workers, although the psychoeducation session alone seemed to have some favorable effect on these outcomes. These findings suggest that reducing SB in the workplace can benefit workers musculoskeletal discomfort and post-work fatigue, among other proven health benefits.

ENHANCING PHYSICAL ACTIVITY AND LIFESTYLE HABITS IN ADOLESCENT GIRLS: THE IMPACT OF FITSPIRIT SCHOOL-BASED INTERVENTIONS IN CANADA

MATHIEU, M.E., GILBERT, J., AHMADI, S.

UNIVERSITÉ DE MONTRÉAL: UNIVERSITY OF MONTREAL

INTRODUCTION: The benefits of adopting healthy lifestyle habits are manifold for adolescents. However, only about 24% of Canadian adolescents adhere to physical activity (PA) guidelines, with girls being less active than boys [1]. FitSpirit, a non-profit organization, strives to enhance the motivation and enjoyment of regular PA among adolescent girls in Canada, thereby increasing their awareness of the advantages of an active lifestyle [2]. This study aimed to (1) compare lifestyle habits between adolescents who participated only for a few weeks (Average 5-10 weeks) in FitSpirits interventions (Intervention group) and those who registered but had yet to participate (Control group), and (2) to evaluate the extent to which FitSpirit enhances PA enjoyment and whether this enjoyment is further linked to lifestyle habits among adolescents who terminated their participation (former participants).

METHODS: Questionnaires used in this study assessed adherence to recommendations for PA levels, recreational screen time, sleep duration, and eating habits regarding vegetable and fruit intake. These assessments used the Canadian 24-Hour Movement Guidelines and Canadas Food Guide. Former participants were divided based on whether FitSpirit participation increased their enjoyment of PA (Enjoyed and Not Enjoyed).

RESULTS: For our first study aim, 364 girls in the intervention group (age= 14.8±1.4 years) and 215 girls in the control group (age= 14.8±1.4 years) participated. The results indicated only a significant difference in PA levels between groups; the intervention group met PA guidelines significantly more than the Control group (27.5% vs 19.1%, p= 0.023). However, there were no significant differences in the rest of the lifestyle habit variables between groups. Among former participants, 143 girls in the Enjoyed group (age= 18.1±1.6 years), and 298 girls in the Not Enjoyed group (age= 17.5±1.6 years), the Enjoyed group adhered more to recreational screen time guidelines than the Not Enjoyed group (35.7% vs 24.2%, p= 0.012). The enjoyment of PA was not associated with other adherence to recommendations.

CONCLUSION: The FitSpirit program appears promising in encouraging adolescent girls to adopt a more active lifestyle soon after the beginning of FitSpirit. Also, enjoyment of PA helped to manage screen time more effectively. These findings underscore the importance of continued efforts in similar interventions that aim not only to increase PA but also to cultivate a lasting appreciation for active lifestyles among adolescent girls.

REFERENCES:

1. Roberts KC, Yao X, Carson V, Chaput JP, Janssen I, Tremblay MS. Meeting the Canadian 24-hour movement guidelines for children and youth. Health Rep. 2017;28(10):3–7.

2. Sardin V. FitSpirit Annual Report 2021–2023: A Year of Action. Available online: https://www.fitspirit.ca/about/publications/annual-reports.

PHYSICAL ACTIVITY IN GERMAN CRAFTSPEOPLE

HOFMANN, H.S., GORGES, J., BIALLAS, B.

GERMAN SPORT UNIVERSITY COLOGNE

Introduction: Craft occupations are often associated with physically and psychologically stressful work demands (Blasczyk, 2018). As a result, German craftspeople often experience musculoskeletal pain (IKK, 2023). However, physical activity (PA) is an important health determinant and should be promoted to maintain the work capacity of craftspeople (WHO, 2020). Therefore, the aim of this study was to conduct a comprehensive analysis of PA in the German craft sector.

Method: A study with a stratified sample including employees and employers from different trades of n= 1830 participants was conducted. Data were collected by computer-assisted telephone interviews using the EHIS-PAQ to assess PA, including work-related PA, transport-related PA and leisure-time PA. Design and adjustment weights were calculated to increase representativeness.

Results: The majority (52.7%) performed work tasks of moderate physical effort, with a notable gender difference in physically demanding tasks (men: 16.2%; women: 5.2%). Age-related findings highlighted an increase in sedentary occupational PA and a decrease in physically demanding tasks. Specific occupations such as construction and building were characterised by high physical demands, while health care, personal hygiene and cleaning and food-related occupations were predominantly sedentary. In addition, health-enhancing physical activity (HEPA) averaged M = 222.27 minutes per week (95% CI [212.27; 232.16]), with 56.6% of craftspeople exceeding the WHO recommendation of 150 minutes per week. 32% engaged in muscle-strengthening PA (MSPA) during leisure time. In addition, male tradespeople spent more time doing HEPA and MSPA compared to women, as did young tradespeople compared to older individuals.

Conclusion: The findings underline the importance for targeted interventions to address PA, particularly in the context of MSPA, which is crucial for the prevention of musculoskeletal pain and injury. In addition, the findings highlight the unique

physical demands and individual patterns of physical activity among German craftspeople and provide a basis for tailored prevention strategies and further research.

References: Blasczyk, S. A. (2018). Ensuring sustainable employment for older workers and workers with health problems in the craft sector: From concern to good solution? (Working Paper Research Funding Nr. 103). Düsseldorf: Hans-Böckler-Stiftung. Available from https://www.econstor.eu/handle/10419/216028.

IKK-Classic (2023). Health in the trades. Available from https://www.ikk-classic.de/assets/594/8594_ikkc_web_pdf.pdf.

World Health Organization (2020). WHO Guidelines on Physical Activity and Sedentary Behaviour. Available from https://www.ncbi.nlm.nih.gov./books/NBK566045/

APPLYING A DETERRENCE NUDGE STRATEGY FOR PROMOTING STAIR USE IN A UNIVERSITY SETTING

LEE, C.G.

SEOUL NATIONAL UNIVERSITY

Purpose: The aim of this study was to examine whether indirectly deterring elevator use through time targetted Point-of-Decision Prompts (PODPs) efficiently increases stair usage in a university setting.

Methods: A quasi-experimental design was employed over a period of two weeks during September 2023. Baseline observations were conducted for one week prior to the placement of signage at two locations. The intervention in this study lasted for one week immediately following the baseline observations. Logistic regression was employed to examine the increase in ascending stair use.

Results: Our intervention focusing on time-related messages effectively increased stair usage among individuals in a university setting. Furthermore, women and individuals aged 30 years or older were notably more likely to be influenced by our intervention compared to men and individuals aged less than 30 years, respectively.

Conclusion: Indirectly discouraging elevator use through time-targetted PODPs may amplify the impact of previously employed time-related messages. Our findings also suggest that a deterrence nudge should primarily be directed towards promoting stair use among women or individuals aged 30 years or more.

HEALTHCARE PROFESSIONALS' KNOWLEDGE, ATTITUDE, AND PRACTICE OF PHYSICAL ACTIVITY PROMOTION IN DIABETES CARE WITHIN PRIMARY HEALTH CARE SETTINGS IN KUWAIT.

ESKANDARANI, D., KIRK, A., LENNON, M., ALWEQAYYAN, A.

UNIVERSITY OF STRATHCLYDE

Introduction

Diabetes mellitus, particularly type 2 diabetes (T2D), continues to be a significant public health concern worldwide, presenting a considerable burden on healthcare systems. One crucial aspect of managing diabetes involves the promotion of physical activity (PA) among individuals with the condition. Healthcare professionals play a crucial role in promoting PA within diabetes care. Understanding healthcare professionals knowledge, attitudes, and practices (KAP) towards PA is essential for developing targeted interventions for T2D patients. This study aims to assess the KAP of healthcare professionals towards PA recommendation and promotion in diabetes care within public primary health care in Kuwait.

Methods

A national quantitative cross-sectional survey was conducted among healthcare professionals working at primary healthcare centres in Kuwait between the 13th of December 2023 and 31st of January 2024. The data collection tool was an online 36-item self-administered questionnaire which was validated in a pilot study. The respondents' overall KAP was categorized using the modified Bloom's cut-off point as high (80-100%), moderate (60-79%) and low (<60%) knowledge.

Results

Out of the total 294 healthcare professionals who consented to participate in the survey, 250 were included for analysis as they were either partially or fully completed. Most participants were female, comprising 64% (n=161) of the respondents. The most prevalent specialty among the respondents was family physicians (n=97; 39%). A significant proportion of healthcare professionals (65%; n= 125), demonstrated awareness of PA guidelines for patients with T2D. Regarding overall knowledge levels, 41% (n=80) of participants exhibited a moderate level of knowledge, while 29% (n=56) displayed a low level of knowledge. However, the overall mean score for attitude was 4.1 out of 5 (82%) indicating a positive attitude. In terms of practice, the average score was 3.7 out of 5 (74%), suggesting an average level of adherence to recommended practices. There was a statistically significant difference amongst specialization categories in terms of knowledge ($p = 0.043$), attitude ($p = 0.040$), and practice scores ($p = 0.001$).

Conclusion

Overall, healthcare professionals who participated in this study displayed moderate levels of knowledge, positive attitudes, and an average practice of PA promotion. While this study sheds light on healthcare professionals KAP regarding PA promotion within diabetes care, further research is needed to identify barriers and facilitators in primary care settings. Understanding these factors will be crucial in developing tailored interventions to effectively promote PA among individuals with T2D in Kuwait, ultimately improving their management and overall health outcomes.

EFFICACY OF A SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTION ON IMPROVING PRESCHOOLERS' HEALTH-RELATED QUALITY OF LIFE - RESULTS OF A CLUSTER RANDOMIZED CONTROLLED TRIAL DURING COVID-19 PANDEMIC

AU, W.Y., LIN, S., LEUNG, C., FONG, D., WONG, S., CHAN, D., CAPIO, C., YU, C., WONG, S., CHEN, Y., THOMPSON, W., SIU, P.
THE UNIVERSITY OF HONG KONG

INTRODUCTION: Health-related quality of life (HRQOL) is an important indicator of overall wellbeing by measuring one's perception towards his/her physical and mental state despite objective functioning. While the World Health Organization (WHO) recommends children and adolescents aged 5-17 to engage in 60-minute moderate-to-vigorous physical activity (PA) daily for health, physical inactivity is highly prevalent in this population, including preschoolers. Social isolation policies during COVID-19 pandemic not only accelerated physical inactivity, but worsened HRQOL in children. Effective interventions to curb physical inactivity and improve HRQOL are urgently needed. Positive relationship between PA and HRQOL is profound in older populations, but few rigorously-designed studies with clear intervention methodology and adequate PA dose examined the effect of PA on improving HRQOL in young children. Limited evidence in preschoolers suggested no effect of PA on HRQOL, but reliance on parent-report to assess HRQOL, and parents' role to motivate children PA might have diminished certainty of findings, and none of them specifically investigated effectiveness during COVID-19 pandemic. Given that improving HRQOL of preschoolers has significant impact on their overall wellbeing, this study evaluated the effect of a school-based PA intervention with exercise dose benchmarked with the WHO PA guidelines, on improving self-reported HRQOL in preschoolers grown during the pandemic period of COVID-19.

METHODS: This is an on-going cluster randomized controlled trial involving 3300 children aged 4-6 from 110 Hong Kong preschools. The first-year batch was conducted under social isolation policies of COVID-19 (9/2022-6/2023). Children were randomized into intervention or control groups according to attended schools. Control preschools continued with the usual curriculum with 2.5 hours PA/week. Intervention schools received an additional twice weekly 75-minute game-based PA class (+2.5 hours), making up to 5 hours PA/week, meeting the WHO-recommended PA levels on weekdays. HRQOL was assessed by the Kiddy-KINDL instrument in 6 aspects: 1) physical & 2) psychological well-being; 3) self-esteem; 4) family; 5) friends, and 6) daily functioning. Generalized estimating equations adjusted for baseline values was used to assess treatment effects.

RESULTS: The first-year batch included 207 children from 10 schools [116 intervention, 91 control; mean age=5.27 years (SD 0.38); 103 girls]. Significant intervention effect was found on HRQOL over a school year (intervention +0.5%; control -4.6%; p=0.004).

CONCLUSION: These preliminary findings suggested that kindergarten-based PA intervention might have attenuated the general decline in HRQOL during COVID-19 pandemic, showing the importance and potential of PA to improve preschoolers' overall wellbeing. Results in the coming years will substantiate whether positive effect of PA on HRQOL can be sustained in post-COVID years.

WANTS AND NEEDS TO NAVIGATE SPORT PARTICIPATION AND MOTHERHOOD: A MIXED METHODS EVALUATION OF ENABLERS AND BARRIERS FOR ATHLETES DURING PREGNANCY AND POSTPARTUM RETURN TO SPORT

CARO, C., TROW, S., BELL, Z., RENARD, M., KLOSKOWSKA, P., BROWN, E., EDWARDS, L., FLYNN, A.C., LAVELLE, F.
KINGS COLLEGE LONDON

Purpose:

An increasing number of female athletes navigate an athletic career alongside pregnancy. The role of nutrition and physical activity during pregnancy is well documented, however, evidence and recommendations are predominately based on the general population. Considering the high energetic demands and increased nutritional requirements of pregnant and postpartum athletes they may be vulnerable to low energy availability and wider health implications. The aim of this study was to evaluate the experiences, nutritional needs and wants of pregnant and post-partum athletes in the United Kingdom and Ireland.

METHODS: Due to the exploratory nature of this research a mixed – method approach was adopted. Semi-structured online interviews were conducted in elite athletes ≥ 18 years old, who trained and/or competed at the highest level of their sport prior to and/or during pregnancy and reside in the UK. The topic guide explored athletes' experiences in elite sport, specifically during preconception, pregnancy and the postpartum period. The interviews were recorded, transcribed verbatim and analysed by thematic Analysis. An exploratory cross-sectional online survey assessing sociodemographic characteristics, sport involvement, women's health, pregnancy and postpartum support, nutritional knowledge, diet quality and supplement behaviours was developed and disseminated across the UK and Ireland.

RESULTS: Eleven UK athletes (mean age 31 ± 3 years) from nine team and individual sports participated in the interviews. Six key pregnancy and postpartum themes were generated; (1) The identity shift: athlete to mother, (2) From podium to parenthood: preconception and pregnancy planning, (3) Is that my career over?: upon becoming pregnant, (4) Navigating the bump: elite training and pregnancy, (5) Back in the game: returning to sport postpartum and (6) "I'm not going through that again": Lack of pregnancy and postpartum specific advice and support. The participants discussed the intrinsic and extrinsic challenges, decisions and considerations related to maternal health and elite sport.

Discussion

This study highlights the challenges athletes encounter in balancing an athletic career with motherhood and highlights a need for improved access to physical and mental health support, tailored nutrition guidance, and increased women's

health awareness to better support athletes during pregnancy and postpartum. The survey findings highlight areas that need future research.

PHYSICAL ACTIVITY MITIGATES METABOLIC HEALTH RISK AMONG YOUNG WOMEN

CASTELLI, D., CORRAL, C., RAMOS SANTIAGO, T., HALEY, A.
UNIVERSITY OF TEXAS AT AUSTIN

Background: Metabolic syndrome (MetS) has been implicated as mitigating health risk (Pasha et al., 2018), but is understudied in young Latina women. MetS is the clustering of high values of blood pressure, blood glucose, abdominal fat, waist circumference, and blood lipids to increase the risk of cardiovascular disease, stroke, and Type II diabetes. Approximately 1 in 3 Americans have MetS risk, which is preventable. Purpose: The purpose of this preliminary study was to determine the association between moderate to vigorous physical activity (MVPA) and MetS risk. Methods: As part of the first wave of a large-scale study examining MetS risk among young women, ages 18-40, 32 individuals (40% Latina) consented to complete a health questionnaire, biometric data collection, finger prick blood sample for lipids panel analysis, and wearing a Fitbit Inspire for 14 days. Results: After data were cleaned and inspected for normality, participants were categorized as healthy/unhealthy based on a composite of risks from the survey, biometric data, and blood assays. We used the odds ratio package in R Studio to analyze low MVPA (less than 20 min per day, based on the median of the sample) and metabolic factors. Those with < 20 min daily MVPA were 1.72 times more likely to have unhealthy LDL levels (95%CI: 1.1289, 2.652535), and 3.89 times more likely to have unhealthy HDL levels (95%CI: 1.78940, 9.469539), and 2.29 times more likely to have an unhealthy body fat % (95%CI: 1.213306, 4.575957). Conclusions: Since MetS is preventable with behavioral change, MVPA should be a primary focus of intervention among young women to mitigate risk. Future research should examine the cultural and contextual differences in the determinants of MVPA and how this risk may influence brain vulnerability to inflammation.

Pasha, E. P., Birdsill, A. C., Oleson, S., Haley, A. P., & Tanaka, H. (2018). Physical activity mitigates adverse effect of metabolic syndrome on vessels and brain. Brain imaging and behavior, 12, 1658-1668.

THE PREVALENCE OF SEDENTARY BEHAVIOR AMONG SAUDI FEMALE UNIVERSITY STUDENTS STUDYING SPORT SCIENCE AND PHYSICAL ACTIVITY AT TAIBAH UNIVERSITY

AL-HARBI, A., ALAHMADI, M.A.
TAIBAH UNIVERSITY

Background:

In 2018, for the first time Saudi Arabia launched a new Sport Science and Physical Activity (SSPA) major for Saudi females at several Saudi Universities, including Taibah University in Madinah city, western Saudi Arabia. Evidence from studies strongly suggests that the amount of time being sedentary should be decreased. Just recently, the Arabic version of the Sedentary Behavior Questionnaire (SBQ) became available with acceptable levels of validity and reliability to assess sedentary behavior (SB) among Saudi males and females aged between 15 to 30 years old (Alahmadi, MA et al, 2023). Therefore, the current study aimed to explore the prevalence of SB and its patterns in a sample of SSPA female students at Taibah University in Saudi Arabia.

Methodology:

A sample of 109 female university students from the College of Education at Taibah University (mean ± standard deviation age of 21.7 ± 1.3 years) was recruited for this study. The original English version of the SBQ was previously translated into Arabic. Then, the validated Arabic version of the SBQ was used to assess SB. The Arabic SBQ included 9 types of SB (watching television, playing computer/video games, sitting while listening to music, sitting and talking on the phone, doing paperwork or office work, sitting and reading, playing a musical instrument, doing arts and crafts, and sitting and driving/riding in a car, bus or train) on weekdays and weekends. Descriptive statistics were reported as mean values and standard deviation. A paired t-test was used to compare SB between weekdays and weekends.

RESULTS: The total time of SB indicated by the Arabic SBQ was 677.8 ± 209.7 and 679.8 ± 244.0 (minutes/day) during weekdays and weekends, respectively. Overall, the average total sitting time of SBQ (min/day) was 483.5 ± 239.9 (min/day) and the majority of students (90%) spent ≥ 7 hours/day sitting. Sedentary time did not differ between weekdays and weekends (P= 0.91). Results also showed that, on average, participants dedicated most of their time during the weekday to completing office/paperwork (172.8 ± 108.3 minutes/day), followed by sitting and talking on the phone (161.5 ± 97.6 minutes/day) and reading (133.80 ± 109.8 minutes/day). The most time spent during the weekend was sitting and talking on the phone (173.9 ± 109.5 minutes/day) followed by completing office/paperwork (133.7 ± 99.4 minutes/day).

CONCLUSION: It is concluded that the total mean length of SB in minutes/day for female students was considerably high. Our findings also highlight the need to raise awareness of the importance of adopting an active lifestyle and reducing time spent in SB.

References:

Alahmadi, M.A., Almasoud, K.H., Aljahani, A.H. et al. Validity and reliability of the Arabic sedentary behavior questionnaire among university students aged between 18–30 years old. BMC Public Health 23, 128 (2023). https://doi.org/10.1186/s12889-023-15030-1

Conventional Print Poster Presentations

CP-AP04 Power and Strength II

ESTIMATING POWERLIFTING 1RM USING ISOMETRIC MID-THIGH PULL AND SKELETAL MUSCLE MASS INDEX: A PILOT STUDY

WANG, C.K., YU, T.A., HE, C.S.

NATIONAL CHUNG CHENG UNIVERSITY

INTRODUCTION: The three main movements in free weight training, known as "the big 3," are the squat (SQ), bench press (BP), and deadlift (DL). These are commonly incorporated in strength and bodybuilding routines, offering significant benefits in muscle strength, explosive power, and hypertrophy. Exercise science emphasizes the use of the 1RM (One-repetition Maximum) to base training intensity, noting that 1-5RM can significantly enhance muscle strength, while 6-12RM is more effective for muscle hypertrophy. This approach is often considered the "gold standard" for assessing dynamic strength. However, accurate 1RM testing presents high-intensity muscular challenges and a relatively higher risk of injury, particularly due to increased blood pressure and muscle damage during maximal effort[1]. Prior research has shown a highly correlated relationship between isometric strength, muscle mass, and muscle strength[2,3]. Therefore, this study aims to use the isometric mid-thigh pull (IMTP) and the skeletal muscle mass index (SMI) to predict 1RM for SQ, BP, and DL. This approach could help mitigate injury risks and reduce the time cost associated with testing.

METHODS: Following IRB approval, 45 student athletes (11 males, 34 females; mean age 21±0.9 years, height 167.9±7.3 cm, weight 66.1±11.3 kg) from taekwondo, archery, and volleyball were recruited on campus. In laboratory environment, portable force plates (9260AA, Kistler, CH) and a body composition analyzer (H20B, InBody, KR) were used to measure SMI and IMTP, while barbell was used to measure parameters such as SQ, BP, and DL. The Shapiro-Wilk test was utilized to assess the normality of SMI distribution. Pearsons product-moment correlation was used to determine the interrelationships among the parameters, and multiple regression analysis was applied to identify strong predictors.

RESULTS: The SMI was normally distributed (W=.992, p=.991). Significant correlations were observed between SMI and IMTP (r=.721, p<.001), DL (r=.745, p<.001), BP (r=.795, p<.001), and SQ (r=.57, p<.001). Significant correlations were also noted between IMTP and DL (r=.819, p<.001), BP (r=.783, p<.001), and SQ (r=.643, p<.001). Multiple regression analysis revealed that IMTP and SMI could explain 72.1% of the variance in DL 1RM (p<.001), 72.4% of the variance in BP 1RM (p<.001), and 43.7% of the variance in SQ 1RM (p<.001).

CONCLUSION: This study discovered that SMI and IMTP together exhibit significant linear relationships with the 1RM for DL, BP, and SQ, enabling the establishment of reliable regression models. Further experimental validation is required to verify the discrepancies between the formulas and real-world scenarios. The formulas are as follows:

DL = -14.928 + .459 * IMTP + 7.801 * SMI

BP = -38.147 + .205 * IMTP + 6.964 * SMI

SQ = 46.531 + .322 * IMTP + 4.62 * SMI

[1]Niewiadomski et al. (2008). J Hum Kinet, 19, 109-120.

[2]DAntona et al. (2006). J. Physiol, 570(Pt 3), 611-627.

[3]De Witt et al. (2018). J. Strength Cond. Res, 32(2), 528-533.

6RM AND 10RM BACK SQUAT PROTOCOLS PROMOTE DIFFERENT BRAIN OXYGENATION RESPONSES

LEITAO, L., PAREJA-BLANCO, F., MARINHO, D., NEIVA, H.

SUPERIOR SCHOOL OF EDUCATION OF POLYTECHNIC INSTITUTE OF SETUBAL; UNIVERSIDAD PABLO DE OLAVIDE; UNIVERSITY OF BEIRA INTERIOR

INTRODUCTION: Coordination and strength are essential to perform technical gestures during training and competition. These motor tasks are connected to the prefrontal cortex (PFC) response since the decision to maintain exercise is affected by sufficient blood flow and oxygenation supply for brain function. Cerebral hemoglobin consumption during high loads in strength exercises may change until failure in response to fatigue. Our study goal was to analyze cerebral hemoglobin consumption during two maximal protocols in the back squat exercise.

METHODS: Twelve men (29.2 ± 4.3 years; 81.5 ± 2.2kg; 1.72 ± 0.19m) performed 6 (6RM) and 10 (10RM) repetitions until failure in back squat, with 72h of rest between. PFC response was analyzed by NIRS to measure the concentration of oxygenated hemoglobin (O2Hb), deoxygenated hemoglobin (HHb), total hemoglobin (tHb), and tissue oxygenation index (TOI). The first and last repetitions were analyzed in both protocols (6RM and 10RM) to understand the PFC responses up to failure (last repetition of both protocols) and non-failure (first repetition of both protocols) efforts.

RESULTS: O2Hb was higher in 6RM than in 10RM in the first (8.12 ± 2.5 vs 5.41 ± 3.3 µmol/L) and last repetition (16.5 ± 5.5 vs 7.7 ± 4.5 µmol/L). No differences were observed in HHb and TOI between protocols. tHB incresed in both protocols from the first until the last repetition (6RM: 6.53 ± 2.2 µmol/L - 14.93 ± 5.27 µmol/L; 10RM: 3.41 ± 2.16 µmol/L - 6.01 ± 2.77 µmol/L). O2Hb was higher in the last repetition than in the first one for both protocols (p<0.05).

CONCLUSION: Increasing fatigue during 6RM and 10RM promoted a progressive increase in HbO2 and tHB response until failure being higher with heavier loads.

COMPARISON OF THE EFFECTS OF BARBELL HIP TRUST AND BARBELL GLUTE BRIDGE RESISTANCE TRAINING ON JUMP, SPRINT AND CHANGE OF DIRECTION IN FEMALE HANDBALL PLAYERS

XUAN, Q., MANYING, R., JIANG, Y., XINYI, W.
BEIJING INSTITUTION OF SPORTS SCIENCE

INTRODUCTION: Barbell Hip Thrust (BHT) and Barbell Glute Bridge (BGB) are training methods that primarily rely on external loads to develop the hip extensor muscles [1]. Insufficient development of the hip extensors can lead to poor performance, increased risk of knee injuries, or low back pain [2]. Both BHT and BGB utilize the active deficiency principle of multiarticulating muscles [3], but they differ in terms of support position. Previous studies have shown that changes in body and limb positions can affect muscle activation [4]. The aim of this study is to compare the effects of explosive power, sprint,and change of direction ability on lower limb performance using BHT and BGB.

METHODS: 24 members of the Beijing womens handball team (had no lower limb fractures and back injury within half a year; without undergone surgical procedures within the past year or absent from training or failed the test) were recruited and randomly divided into BGB group,BHT group and control group.The 5RM values of BHT and BGB were measured conventionally before the experiment, and the experimental group was intervened with a 5*5 training method with a training load intensity of slightly less than 5RM, with intervals of no more than 2 minutes between sets [5], twice a week for 8 weeks.

Smart speed & Smart jump (Fusion Sport, Australia) was used to measure the 10m, 30m, 60m, Illinois, the SJ, CMJ and Jump Test before and after the experiment. A 20-minute standardized exercise preparation was performed by coach before each intervention with the training load of both groups consistent and included in the daily physical training plan (without any other gluteal bridge training mode).Two-way ANOVA was used for statistics. Significance was set at $P<0.05$. When ANOVA used the partial Eta square to represent the effect size, the cut-off points for small, medium, and large effect sizes were 0.01, 0.06, and 0.14, respectively.

RESULTS: There was a significant difference in maximum strength before and after between the BHT group ($p=0.004$) and the BGB group ($p=0.000$). No significant differences were observed in the interaction of time and intervention for CMJ, Jump Test, 10m, 30m, and 60m sprints. The interaction between time and intervention in SJ showed significance ($F2, 42=2.53$; $p=0.015$, ES=0.132), with post-hoc tests demonstrating a significant difference between the BGB group and the control group ($p=0.03$). Similarly, the interaction between time and intervention in Illinois was also significant ($F2, 42=3.89$; $p=0.028$, ES=0.156), with post-hoc tests showing a significant difference between the BHT group and control group ($p=0.01$).

CONCLUSION: BGB training can enhance SJ performance while BHT can improve change of direction ability in female handball players; however, neither training method demonstrated improvements in sprint performance. 1.Contreras et al.(2017) 2.Lane et al.(2017) 3.Schoenfeld et al.(2002) 4.Paoli et al.(2009) 5.Friedman et al.(2016)

CHANGES IN VARIOUS STRENGTH ATTRIBUTES IN MALE COLLEGIATE RUGBY SEVENS PLAYERS AFTER A UNIFORM RESISTANCE TRAINING PROGRAM

LEE, H.J., CHEN, M.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Rugby sevens is a high-intensity team sport played on a field, where certain physical capabilities, particularly acceleration and countermovement jump (CMJ) height, are crucial as they have shown correlations with game statistics. The dynamic strength index (DSI), which is derived from the relative peak force of the CMJ and the isometric mid-thigh pull (IMTP), serves as a tool for guiding diagnostic training focused on maximal strength or ballistic exercises. Thus, this study aims to investigate the relationship between 10-meter sprint speed and various strength qualities, and to evaluate the impact of the same resistance training regimen on athletes with differing DSI and EI values.

METHODS: Ten male collegiate rugby sevens athletes completed a 3-week training intervention consisting of sprint drills, weightlifting derivatives, combined free-weight resistance, and ballistic training. Athletes were tested on the 10-m sprint, squat jump (SJ), countermovement jump (CMJ), and isometric mid-thigh pull (IMTP) before (PRE) and after (POST) the intervention. Participants were ranked based on dynamic strength index (DSI) and elastic index (EI) then split into high and low groups (DSI-H vs DSI-L; EI-H vs EI-L). Independent t-tests compared mean differences in variables between the high and low DSI and EI groups. Statistical significance was set at $p < .05$.

RESULTS: After the 3-week training, 10-m sprint velocity significantly increased in both DSI-H and DSI-L (5.16 ± 0.18 vs 5.48 ± 0.63 m/s, and 5.85 ± 0.38 vs 6.06 ± 0.30 m/s, respectively, $p<.05$), and EI-H and EI-L (5.64 ± 0.55 vs 5.88 ± 0.45 m/s, and 5.36 ± 0.35 vs 5.62 ± 0.46 m/s, respectively, $p<.05$). DSI significantly decreased in DSI-H and DSI-L (1.19 ± 0.14 vs 0.89 ± 0.09, and 0.94 ± 0.10 vs 0.79 ± 0.17, respectively, $p<.05$), and EI-H and EI-L (0.98 ± 0.11 vs 0.79 ± 0.17, and 1.15 ± 0.20 vs 0.90 ± 0.08, respectively, $p<.05$). Relative IMTP peak force significantly increased in DSI-H and DSI-L (21.37 ± 2.13 vs 28.58 ± 3.22 N/kg, and 26.83 ± 3.96 vs 33.25 ± 6.96 N/kg, respectively, $p<.05$), and EI-H and EI-L (24.43 ± 1.84 vs 31.92 ± 6.59 N/kg, and 23.77 ± 5.93 vs 29.91 ± 5.15 N/kg, respectively, $p<.05$). SJ height significantly increased in EI-L after training (38.57 ± 6.85 vs 42.41 ± 7.93 cm, $p<.05$).

CONCLUSION: The key finding from study was that high and low dynamic strength index (DSI) and elastic index (EI) groups displayed differential responses to the same training program, indicating athletes may possess different baseline strength qualities. Examining multiple test variables is crucial, as using just one outcome or index to guide training could lead to misinterpretation. It is important to select appropriate testing batteries that identify distinct physical attributes in order to develop optimized, individualized training programs tailored to each athletes unique strength qualities.

COMPARING UNIMODAL AND BIMODAL COUNTERMOVEMENT JUMP FORCE PROFILES IN MALE COLLEGIATE ATHLETES: A PILOT STUDY

CHEN, M.Y., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The countermovement jump (CMJ) is commonly used to assess jumping ability in athletic testing batteries. The force-time (F-T) curve produced during a CMJ can reveal different jumping strategies employed by collegiate athletes. Some studies have found that a bimodal F-T curve may indicate inefficient use of the stretch-shortening cycle (SSC) in male rugby players, due to greater braking center of mass displacement. However, other research found the bimodal F-T curve was associate with a more effective CMJ compare to a unimodal curve, in both male and female collegiate students. The percent pre-stretch augmentation, calculated as the difference in jump height between CMJ and squat jump (SJ). Therefore, the aim of this pilot study was to compare unimodal and bimodal F-T curves in the CMJ and their relationship to elastic index (EI) in male collegiate athletes.

METHODS: Ten male collegiate rugby sevens athletes performed 10-m sprint, SJ, and CMJ tests. Each test was performed twice. After testing, four separate case study comparisons were conducted by selecting athlete pairs who had similar heights and who consistently displayed either a unimodal (UNI) or one of three bimodal (BI) CMJ force-time (F-T) curves: bimodal with a higher first peak (BI-F), bimodal with a higher second peak (BI-S), or bimodal with equal peaks (BI-E).

RESULTS: The unimodal (UNI) curve was associated with the lowest jump height, takeoff velocity, relative peak power, countermovement depth, and propulsion duration (30.61 cm, 2.49 m/s, 24.31 N/kg, 24.31 cm, and 212 ms, respectively). Additionally, the EI for UNI was -7%, indicating a lower CMJ height compared to squat jump (SJ) (32.74 vs. 30.61 cm). The bimodal curve with the second peak higher (BI-S) exhibited the lowest relative braking peak forces (22.49 N/kg). In contrast, the bimodal curve with the first peak higher (BI-F) showed the lowest relative propulsion peak forces (23.47 N/kg). The bimodal curve with equal peaks (BI-E) demonstrated the greatest jump height, takeoff velocity, relative peak

power, and countermovement depth during CMJ (50.39 cm, 3.14 m/s, 68.85 N/kg, and 35.79 cm). However, BI-F had the largest EI, not BI-E (24% vs 10%).

CONCLUSION: Assessing an athletes use of the SSC based solely on the CMJ force-time (F-T) curve may be insufficient. A more comprehensive evaluation examining individual test variables is necessary. We recommend practitioners compare variables such as the EI or SJ metrics. The unimodal or bimodal F-T curve exhibited during CMJ could be influenced by many factors including population demographics and training background. Rather than just the F-T curve, a multifaceted approach assessing SSC utilization through CMJ variables, SJ comparisons, and biomechanics is advised. Further research using electromyography and motion analysis to examine differences in muscle activity and kinetics between F-T curve types is suggested.

FEMALE SNATCH TECHNICAL INDEX UTILIZING AI SKELETON MODEL AND BARBELL TRAJECTORY ON LIGHTWEIGHT CATEGORY

CHEN, J.S., BAN, Y., HSU, C., HO, W.

UNIVERSITY OF TAIPEI

INTRODUCTION: In this paper, we create a novel snatch technical index considering the relation between the lifters body and barbell trajectory from a competition video. Snatch processes lifters coordination skills in continuous movement, hence we observe the relation between body information and barbell kinematic parameters. We utilize our novel technical index to indicate the lifters performance of elite and ordinary athletes, respectively and further verify the precision of our snatch technical index by independent sample t-test.

METHODS: The novel snatch technical index is established with the body information and barbell trajectory from the video, which reflects the real situations in the snatch movement. We capture these competition videos from the 2019 and 2020 National Intercollegiate Athletic Games (Taiwan) womens weightlifting lightweight categories (45-59kg). The lifters body information is obtained by Intel OpenVINO with the Microsoft COCO model. Barbell trajectory is gathered by our previous barbell tracking algorithm (Hsu, C. T., Ho, W. H., & Chen, J. S., 2018). Then we calculate the area between the lifters upper extremity and the barbell from each frame and further gather the mean of these areas of the snatch movement. Finally, an independent sample t-test verifies the lifters performance of two groups (elite and ordinary).

RESULTS: We gather the snatch technical index of elite and ordinary lifters, respectively. The elites mean area is less than the ordinary (912.945 cm2 < 1176.164 cm2) and there are significant differences from the independent sample t-test (p=0.003*).

CONCLUSION: The proposed female snatch technical index indicates the weighting lifters sports performance both considering the mean area of the lifters body and barbell trajectory. According to the results, the mean area of the elite group is significantly less than the ordinary group. This observation shows that our snatch technical index can efficiently estimate the lifters sports performance.

A NOVEL FEMALE SNATCH PERFORMANCE INDEX BY UTILIZING OPEN AI SKELETON FOR WOMAN 55KG AND 59KG CATEGORY

HSU, C.T., BAN, Y.R., CHEN, J.S., CHANG, Y.H, CHIU, T.Y., HO, W.H.
UNIVERSITY OF TAIPEI

INTRODUCTION: A novel female snatch performance index is proposed and verified in this paper. Many successful snatch measure indexes such as horizontal displacement and vertical displacement have been observed, however, these indexes need experts utilizing kinematic analysis software to gather. Hence, in this study, an open AI skeleton is considered to obtain the skeleton information automatically and further compose the 2D skeleton information to our proposed snatch performance index.

METHODS: Intel OpenVino with Microsoft CoCo skeleton model is considered in this paper. We gather woman 55Kg and 59Kg categories snatch competition videos from 2019 IWF weightlifting world championship and 2021 Tokyo Olympic games. These videos are separated into elite and general groups. Skeleton model is utilized to obtain the lifter's joint coordinate from the videos We refer to the snatch phases (Ikeda, et al, 2012; Musser, Garhammer, Rozenek, Crussemeyer, & Vargas, 2014) and further consider the joint passing time in each phase as our novel female snatch performance index. Finally, independent sample t test verifies our proposed index.

RESULTS: From independent sample t test, the passing time of snatch phase III and phase IV are significant difference. Elite lifters consume less time in phase I and phase II than general lifters. Furthermore, the most-high level of the barbell of the elite lifters is lower than general lifters.

CONCLUSION: In this paper, we proposed a novel female snatch performance index to indicate the female weightlifting lifters' performance. From the results, we can obtain that our proposed index indicates that elite lifters consume less time in phase III and phase IV and utilize less most-high level of the barbell. These observation shows that our proposed female snatch performance index can efficiently and precisely indicate lifters' performance.

RATE OF FORCE DEVELOPMENT OF HEEL-RISE MOVEMENT WAS ASSOCIATED WITH SPATIOTEMPORAL GAIT PARAMETERS IN COMMUNITY-DWELLING OLDER ADULTS

SAKAMOTO, M., KAMIDE, N., ANDO, M., SATO, H., SHIBA, Y., SHIMIZU, S., SUGAWARA, H., TADANO, C.
SCHOOL OF ALLIED HEALTH SCIENCES, KITASATO UNIVERSITY

INTRODUCTION: The decline in neuromuscular function and loss of skeletal muscle mass associated with aging leads to a change in gait ability (Tavakkoli Oskouei et al. 2021). As an index of instantaneous muscle force development, rate of force development (RFD) indicates neuromuscular function. It has been reported that RFD of the plantar flexor (PF) muscle, analyzed by a rapid heel-raise movement on a portable force plate, contributes to walking speed (Clark et al. 2013, Hester et al. 2021). However, these studies evaluated no spatiotemporal gait parameters other than walking speed. The aim of this study was to examine the association of PF RFD, measured by the heel-raise test using a portable force plate, to spatiotemporal gait parameters in older adults.

METHODS: The participants were 193 older adults aged 65 years and older (mean age, 74.2 ± 5.2 years, 140 females) who were living independently in the community. Maximum gait speed, step length, and cadence were recorded by a pressure-sensitive walkway system (MW-1000; Anima, Tokyo, Japan). Sampling frequency of the system was set at 100 Hz. RFD of PF was evaluated by vertical ground reaction force data measured during a rapid heel-raise task performed on a portable force plate (Clark et al. 2013, Hester et al. 2021). The vertical force data were sampled at 100 Hz and analyzed by LabChart software. In this study, RFDpeak was defined as peak force divided by the time to peak force (Hester et al. 2021), and RFD50 as force at 50 msec divided by 50 msec. As these RFD values were the mean slope of each interval, we also calculated the maximum slope value (RFDmax) during the heel-raise movement (Clark et al. 2013), analyzed by LabChart software. RFDmax was calculated from the peak of the first derivative of the force signal (Thompson et al. 2014). As a marker of muscle strength, handgrip strength was measured on a dynamometer. The associations between each gait parameter and each of RFD and handgrip strength were analyzed using multivariate regression analysis, with each gait parameter as the dependent variable and RFD and handgrip strength as the independent variable, adjusted for age and sex as confounders. Step length was normalized by height in the analysis. Significance was set at $p < 0.05$.

RESULTS: Gait speed was positively related to RFDpeak ($p < 0.01$), RFDmax ($p<0.01$), and handgrip strength ($p < 0.01$). Step length was positively related RFDmax ($p=0.014$) and handgrip strength ($p=0.047$). Cadence was positively related to all RFD parameters of RFD50 ($p=0.03$), RFDpeak ($p=0.02$), and RFDmax ($p=0.02$), but not to handgrip strength.

CONCLUSION: PF RFD measured by the heel-raise test was associated with spatiotemporal gait parameters in older adults. These results suggest an association of neuromuscular function with spatiotemporal gait parameters, and particularly with cadence.

THE EFFECTS OF SINGLE- AND MULTI-JOINT RESISTANCE EXERCISES ON THE LOSS OF SUBCUTANEOUS ADIPOSE TISSUE

ICHINOSE, H., MAEO, S.1, KINOSHITA, M.1, KOBAYASHI, Y.1, EIHARA, Y.1, NISHIZAWA, N.1, KUSAGAWA, Y.1, SUGIYAMA, T.1, KANEHISA, H.2, ISAKA, T.1

1 FACULTY OF SPORT & HEALTH SCIENCE, RITSUMEIKAN UNIVERSITY, JAPAN 2 DEPARTMENT OF PHYSICAL EDUCATION, NATIONAL INSTITUTE OF FITNESS & SPORTS IN KANOYA, JAPAN

INTRODUCTION: Spot reduction refers to the conception of localized loss of subcutaneous adipose tissue (SAT) due to exercise of muscles in the same area [1]. Although the common belief is that the spot reduction does not occur as a result of an exercise program, the evidence is insufficient and thus this common belief is controversial. Resistance training can be classified into either single- or multi-joint exercises, and exercise-dependent muscle activation and muscle hypertrophy has been reported [2]. However, the effects of these exercises on the loss of SAT have not been well studied, and little is known about whether the localized loss of SAT occurs after each exercise. This study aimed to investigate the quantitative changes in the SAT of the hip and thigh areas resulting from each of single- (knee extension; KE) and multi-joint (leg press; LP) resistance exercises.

METHODS: Seventeen untrained healthy young adults (11 males and 6 females) performed single-joint KE in one leg and multi-joint LP in the other leg at 70% of one repetition maximum (1RM) of the corresponding task. Each leg performed 5 sets of 10 repetitions per session, 2 sessions per week for 12 weeks. Before and after the intervention, the following variables were measured using magnetic resonance images from both KE and LP sides: the cross-sectional area (CSA) of the muscles in the hip (the total area of 4 individual muscles) at the level of the upper end of the greater trochanter and those in the midthigh (the total area of 12 individual muscles), and the SAT CSA at the same two levels.

RESULTS: The muscle CSA in the hip significantly increased after the LP ($p < 0.01$) but not after the KE ($p = 0.17$), and the muscle CSA in the thigh significantly increased after both KE and LP ($p < 0.01$). The %change in the muscle CSA in the hip was greater for the LP than the KE (LP vs KE, +10.8% vs +3.6%, $p < 0.01$). In the thigh, no difference was observed in %change in the muscle CSA between LP and KE (+5.3% vs +4.2%, $p = 0.14$). The SAT CSA of the hip and thigh did not change in either training ($p = 0.85$-0.89), and no difference was observed in the %change in the SAT CSA between the two training tasks in either the hip (-0.3% vs -0.4%, $p = 0.94$) or thigh (-1.1% vs -0.3%, $p = 0.56$).

CONCLUSION: After the intervention in this study, the exercise-dependent muscle hypertrophy was presented (LP: the hip and thigh, KE: the thigh only), but the SAT area did not significantly change in any exercise or site. This suggests that resistance training, inducing muscle hypertrophy, does not reduce the SAT at the trained area, and the localized loss of SAT due to resistance training does not occur.

[1] Kostek, M.A. et al. (2007) Sci Sports Exerc, 39(7): 1177-1185. [2] Gentil, P. et al. (2017) Sports Med, 47(5): 843-855.

Conventional Print Poster Presentations

CP-AP07 Team Sports

PRACTICAL CONSIDERATIONS FOR THE USE OF PRE-SESSION SUBJECTIVE WELLNESS AS A TOOL FOR INJURY RISK MITIGATION IN AMATEUR RUGBY UNION

GRIFFIN, A., KENNY, I., COMYNS, T.M., TIERNAN, C., LYONS, M.

ATLANTIC TECHNOLOGICAL UNIVERSITY, GALWAY; UNIVERSITY OF LIMERICK

INTRODUCTION: Rugby Union is a high-intensity contact invasion sport with an inherent risk of injury. Monitoring training has become integral to the injury risk management practices of coaches in recent years [1]. Evidence is emerging supporting the use of Likert and visual analogue scales as a method of monitoring wellness with studies [2] supporting their ecological validity. The purpose of this study was to explore (1) associations between various subjective self-reported measures of wellness and injury occurrence in amateur Rugby Union and (2) the influence of various lag periods (time between the dose and injury) on these associations.

METHODS: Forty-three male players (mean ± SD; age 24.8 ± 4.1 years; height 184.1 ± 7.2 cm; body mass 100.4 ± 16.8 kg; playing experience 13.7 ± 4.7 years) from six teams participated in the study over one competitive season. Participants recorded six subjective wellness measures (fatigue, muscle soreness, sleep duration, sleep quality, mood, and readiness to train) on a chromatic coloured 1 – 5 Likert scale immediately prior to each training session and match. An overall daily wellness score was also calculated by summating all 6 scores (i.e. minimum score = 6, maximum score = 30). Injury data were collected by each team's physiotherapist. Multilevel logistic regression was used to analyse any associations between injuries and the wellness variables across 0, 3 and 7 day lag periods.

RESULTS: The logistic regression found significant weak to strong associations between the occurrence of injury and the six individual measures of wellness, resulting in odds ratios (OR) ranging from 1.642 - 4.870 ($p < 0.001$ - 0.01) with 0-days lag. A strong association (OR = 6.172, $p < 0.001$) between the occurrence of injury and the summative score of overall wellness was found (0-day lag). No associations were found when lag periods of 3 and 7 days were examined.

CONCLUSION: The findings of this study support the positive association between injury and subjective wellness. Practitioners should see subjective wellness measures as simple yet highly informative for monitoring players' training with the aim of promoting positive adaptations while simultaneously mitigating injury risk. If players experience a negative overall

wellness, it is likely their risk of injury is increased. Practitioners should act on the data instantaneously, which may be challenging, but conversing with the said player regarding their wellness data and subsequent training prescription may be good practice.

REFERENCES:

1. West, S.W., et al., Training load and injury risk in elite rugby union: the largest investigation to date. Int J Sports Med, 2020. 42(08): p.731-739.

2. Cullen, B.D., McCarren, A.L. and Malone, S., Ecological validity of self-reported wellness measures to assess pre-training and pre-competition preparedness within elite Gaelic football. Sport Sci Health, 2021.17: p.163-172.

APPLICATION OF IMU SENSORS TO THE FUNCTIONAL ANALYSIS OF SHOOTING IN PARALYMPIC WATER POLO.

FRONTUTO, C., BONAIUTO, V.

UNIVERSITÀ DI ROMA TOR VERGATA

INTRODUCTION: In recent years, there has been a growing interest in Paralympic sports, aiming to ensure fair competition through a system that evaluates athletes residual abilities. According to the current classification present in Paralympic Water Polo (1), the lowest score is given to athletes who are unable to perform movements with their hands, so the study focused on the most typical movement in Water Polo that involves the use of at least one hand, i.e. shooting (2).

METHODS: The study was conducted on 5 subjects of which 4 belonged to a Paralympic team, with different types of disabilities, and 1 competitive athlete belonging to a water polo team with no degree of disability for data comparison. Two IMU sensors synchronized with each other (Movella DOT, 120Hz) were placed on the body of the athletes. One sensor on the forearm to monitor degrees of movement (ROM) of the dominant upper limb during shooting, and one at the C7 vertebra to derive information on torso rotation (3). Athletes were asked to perform 7 shots at 5 m from the goal with the purpose of hitting a target. Two GoPro cameras (240 Hz) filmed aligned to the athletes shooting position from side and rear perspectives, to determine the height of the ball during the shot (instant of release) on the water surface. Kinovea free-license software was used for video analysis.

RESULTS: The average values of player 5 were taken as a reference, which were trunk rotation of 60°, a forearm angle of 80° and a shooting height of 1.25m. It was considered the best performance of each Paralympic athlete. In terms of ROM of the dominant upper limb, athlete 1 had no limitation, athletes 2 and 3 had a limitation of 5°, and athlete 4 of 3°. Athlete 1 showed a limited trunk rotation of 20° and a lower shot height of 54.4%. Athlete 2 had a limitation of 10° in torso rotation, and a 48% lower jump height. Athlete 3 had no limitation in torso rotation, and a 51.2% lower jump height. Athlete 4 performed 6° less torso rotation, and 52.8% lower jump height.

CONCLUSION: This preliminary study showed how the proposed assessment system using inertial sensors can detect the residual abilities of Paralympic athletes in specific sports actions. Subsequent studies on a large number of subjects could allow percentile tables and reference values to be drawn up, so as to provide an aid to classifiers of a more fair and objective classification.

REFERENCES:

1) Italian Swimming Paralympic Federation, CLASSIFICATION RULES WATER POLO DISCIPLINE, 2022

2) Marion A. et al., Sport Biomechanics Lab, 2010

3) Tupling, S. G. et al., Med. Biol. Eng. Comput. 1987

SESSION OF RATING OF PERCEIVED EXERTION(SRPE) LOAD IS STRONGLY CORRELATED TO GPS-DERIVED MEASUERES OF EXTERNAL LOAD IN CFA WOMEN'S SUPER LEAGUE PLAYERS

LI, N., TAN, Z.Z., YU, T.H.

SHANGHAI RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: The purpose of this study was to determine whether session rating of perceived exertion (sRPE) derived training load correlates with GPS-derived measures of external load in Chinese Football Association (CFA) women's super league football player.

METHODS: Twenty-two CFA women's football athletes took part in this study. Total distance, distance covered at high speed zone (19-23 km·h−1), times of acceleration and deceleration, and times of turn left and turn right and PlayerLoadTM were collected as external load during the match in 2021 CFA women's football season by GPS systems. Within 30 minutes after the end of match, athletes were promoted to complete a questionnaire reporting their perceived exertion using BorgCR-10 scale. sRPE was calculated at the end of season by multiplying perceived exertion by respective session duration.

RESULTS: There were strong correlations between sRPE and total distance (r=0.721, P<0.01), sRPE and PlayerLoadTM(r=0.584, P<0.05).. There were moderate correlations between sRPE and times of acceleration and deceleration(r=0.384, P<0.05). There were weekly correlations between sRPE and high speed running distance(r=0224, P<0.05) and times of turn left and turn right（r=0.227, P<0.05）.

CONCLUSION: In CFA football players, sRPE were strongly correlated with total distance, PlayerLoadTM. sRPE as low cost, easy to learn tool is a good way to monitor players internal workload. Combination of internal and external workload is best way to know player workload.

THE EFFECTS OF BODY-BLADE TRAINING ON SHOULDER FUNCTION IN ADOLESCENT MALE VOLLEYBALL PLAYERS

REN, X.

SHANGHAI RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: This study explores the effect of four weeks BodyBlade exercise training on shoulder joint proprioception and muscle strength of adolescent male volleyball players. Through an experimental study on 16 young male volleyball players, it was found that after four weeks of BodyBlade exercise, the players shoulder joint proprioception and muscle strength had changed.

METHODS: 16 male volleyball players, with average age of (17.21±1.36) years, average height of (193.07±4.44) cm, average weight of (77.93±8.03) kg, were included in the study. BodyBlade exercise training Protocol: The training involved the use of a primary shoulder joint vibration rod exercise, with one-minute sets, three sets per session, and a frequency of twice a week. The following parameters were assessed: Maximum peak torque of the dominant shoulders external rotation at 90 degrees using the Isomed2000 test at a velocity of 60°/s. Assessment of proprioception involving the dominant shoulder, positioned at 90 degrees of abduction and internal rotated to 60 degrees and external rotated to 30 degrees, using the Isomed2000 test at a velocity of 2°/s. Evaluation of strength perception for replicating 25% of the maximum isometric strength of the dominant shoulder using the Isomed2000. Changes in upper limb dynamic balance before and after intervention were assessed using the Upper Limb Y Balance Test.

RESULTS: The results showed significant changes in various measures before and after the intervention. The average internal rotation isokinetic muscle strength before the intervention was (47±14.04) Nm, which increased to (50.44±16.09)Nm after the intervention. The maximum peak external rotation moment decreased from (35.06±10.04) Nm to (33.63±12.27) Nm. The sense of position errors for external rotation at 30° and internal rotation at 60° also improved significantly. The force sense difference for internal rotation increased from (1.72±1.6) Nm to (2.30±1.68) Nm, while the force sense difference for external rotation increased from (2.56±3.04) Nm to (3.61±3.22) Nm. The upper limb Y balance test scores on the dominant side also improved from 90.25±15.44 to 96.65±12.02.

CONCLUSION: Four weeks of BodyBlade exercise training resulted in significant improvements in shoulder joint proprioception and muscle strength in teenage male volleyball players. These findings suggest that this type of training can be beneficial for enhancing the performance of these athletes.

CONTEXTUAL INTERFERENCE AND SOCCER SHOOTING PERFORMANCE: AN APPLIED RANDOMIZED STUDY

SOUGLIS, A.G.1, TRAVLOS, A.K.2, KALIARNTAS, K.3, ANDRONIKOS, G.3, APOSTOLIDIS, A.1, NOUTSOS, K.1, BOURDAS, D.I.1, GELADAS, N.D.1, BOGDANIS, G.1

1SCHOOL OF PHYSICAL EDUCATION AND SPORTS SCIENCE, NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, ATHENS, GREECE. 2DEPARTMENT OF SPORTS ORGANIZATION AND MANAGEMENT, FACULTY OF HUMAN MOVEMENT AND QUALITY OF LIFE SCIENCES, UNIVERSITY OF PELOPONNESE, GREECE. 3SCHOOL OF APPLIED SCIENCES, DEPARTMENT OF SPORT, EXERCISE AND HEALTH SCIENCES, EDINBURGH NAPIER UNIVERSITY, EDINBURGH, UK

INTRODUCTION: Coaches teach technical skills using practice scheduling with higher rather than lower amounts of contextual interference (CI) [1]. Learning outcomes are greater when motor skills are practiced in a random order (high CI) than blocked practice (low CI) [2]. This study explored the effects of practice scheduling (random, serial, blocked) on soccer shooting performance.

METHODS: Forty-two male players (age: 22.7 ± 2.2 y, experience: 14.3 ± 2.6 y) were randomly assigned into 3 groups (random, serial, blocked) and undertook 216 acquisition trials over six consecutive days (36 trials/day). During the acquisition phase, the three groups performed the shots on random, serial, and blocked practice schedules with verbal directional quantitative knowledge of results (KR). The practice schedule included 3 targets (lower left/right corners, upper middle of the goal). The random and serial groups per-formed 36 trials each day to all targets. The blocked group performed 36 trials on a different target each day. Targets consisted of concentric circles with a radius of 15, 30, 45 and 60 cm from the target's center, scoring 4 points in the center and 3, 2, 1 points towards the outer target circles and 0 when there was no-contact of the ball with the target. Testing included 24 shots (20-meters distance from the middle of the goalposts) in a serial order on two targets placed at the upper left/right corners of a standard goal, at baseline and at the transfer phase (48-hour delayed retention interval) without additional KR. Groups by time (3x8) mixed repeated measures ANOVA was used for main and interaction effects followed by Bonferroni post hoc tests.

RESULTS: Analysis showed significance for group ($p < 0.001$, $\eta2 = 0.4$), time ($p < 0.001$, $\eta2 = 0.8$) and group by time interaction ($p < 0.001$, $\eta2 = 0.8$). Bonferroni pairwise comparisons for the interaction showed: (a) no between groups differences at baseline ($p > 0.05$), (b) at the acquisition phase, the random and serial groups improved significantly from day 1 to day 6 ($p < 0.05$), while the blocked group improved significantly from day 1 to day 3 ($p < 0.05$), and from day 4 to day 6 performance returned to baseline ($p > 0.05$), and (c) at the transfer phase, the random group performed significantly better than the serial and blocked groups, which also differed (1.8 ± 0.1 vs. 1.5 ± 0.1 and 1.1 ± 0.1, respectively, all $p < 0.05$). At the transfer phase blocked group's performance returned to baseline (1.1 ± .08).

CONCLUSION: These findings agree with studies estimating the ecological validity of the CI hypothesis [3] and support the predictions of CI effect, indicating better performances when practicing with an increasing CI arrangement (random practice) compared to serial or blocked schedules. To improve long-term learning in mastering technical soccer skills, coaches are encouraged to implement random scheduling in their training programs.

1. Magill & Anderson (2021), 2. Makaruk et al. (2024), 3. Travlos (2010)

A SUCCESSFUL FIRST SEASON IMPLEMENTATION OF VAR IN FOOTBALL: THE NORWEGIAN STORY

BYRKJEDAL, P.T., ERIKSTAD, M.K., JOHANSEN, B.T.

UNIVERSITY OF AGDER

INTRODUCTION

Since its inclusion in the laws of the game handbook by the International Football Association Board before the 2018-2019 season, it has been found that the Video Assistant Referee (VAR) system has improved the accuracy of referees decisions from 92.1% to 98.3% (1). Despite its effectiveness, VAR continues to spark significant debate, including concerns over match flow and delays (2). Prior to the 2023 season, the Norwegian Premier League (NPL) adopted VAR for the first time. This study aims to explore and detail the NPL's inaugural season utilizing VAR.

METHODS

This study investigates the number of situations checked by VAR and associated time use. According to the laws of the game, VAR may only intervene in four specific situations: goals, penalties, direct red cards, and cases of mistaken identity. A total of 240 matches from the 2023 NPL season were included. Data utilized for analysis is provided by official reports from the Norwegian Football Federation (NFF) and gives an overview of all situations investigated by VAR. Time delay was noted from when the referee halted play for VAR checks.

RESULTS

A total of 1662 incidents were reviewed by VAR, covering 748 goals, 694 yellow cards, 60 direct or potential red cards, and 160 penalty situations. Out of these, 1304 were quickly resolved (no delay of match play), while 358 required further investigation. VAR upheld the initial decision in 303 cases but altered the decision in 55 instances. Of these, 25 were factual checks (e.g., ball in/out, offsides), with an average match delay of 48 sec. The remaining 30 necessitated on-field reviews by the match official, with match delay averaging 2 min and 2 sec. Notably, 9 of 303 decisions upheld by VAR were later identified as incorrect by NFF, missing critical calls with 2 red cards, 2 goals, and 5 penalties. Maximum time to complete VAR checks was 6 min and 10 sec.

CONCLUSION

The introduction of VAR in the NPL led to 55 overturned decisions, marking, to the best of the authors knowledge, the lowest known VAR intervention rate across European leagues with 1 intervention every 4.36 matches. Despite this, certain oversight incidents (such as kick to the head) and single cases of prolonged delays have drawn criticism towards VAR, also from Norwegian fans. Such incidents and other learning effects prompted adjustments to the VAR protocol throughout the season, improving the effectiveness of VAR. Our findings indicate that VAR improved the correctness of match officials' decisions by lowering the number of mistakes from 3.9 to 0.5% in the NPL during the 2023 season. However, previous findings, including 795 VAR checks in other European leagues, reported a median of 22 sec for factual checks and 62 sec for on-field reviews (1). Thus, there is room for improvement in reducing VAR-review time in the NPL.

1. Spitz et al., (2021), Journal of Sports Sciences.

2. Scanlon et al., (2022) Soccer & Society

EFFECTS OF INTERVAL CRYOSTIMULATION ON THE SOLES OF THE FEET DURING A FOOTBALL PRACTICE GAME IN A HOT ENVIRONMENT ON THERMOREGULATION AND AMOUNT OF CHANGE IN RUNNING SPEED AND DISTANCE

KANATANI, K., NAKAGAWA, Y., XY, H., TAKAGI, T., KAWABATA, T.

ENVIROMENT PHYSIOLOGY FOR EXERCISE

INTRODUCTION: It is important to prevent hyperthermia and heatstroke, and to control dangerous increases in body temperature in order to safely enjoy exercise and sports activities in hot enviroment. We have shown that brief (2minute) cryostimulation(whole body and lower limbs: -120°C, sole of the feet:-50°C) decrease of esophageal temperature during the recovery period after exercise in a hot environment. In this study, the effects of interval the soles of the feet cryostimulation during a football practice game in a hot environment were examined from exercise physiological and biomechanical perspectives.

METHODS: Twenty-two subjects were selected into two groups: sole of the feet cryostimulation (SC) and a control (CON) group. Both groups participated in a football training session followed by three sets of 15-minute games with 10-minute breaks in between, in a temperature of approximately 32℃ and 45% relative humidity. After training and each game, the SC underwent cryostimulation(-50℃) on the soles of the feet for 2 minutes. Both groups were measured for body weight (BW) and Therm scale before and after training. After training, the tympanic temperature (Ttym) was measured. In the game session, measurements were taken for BW, Therm scale, and Ttym immediately after the game ended. And Ttym was also measured after 2 minutes end of the game. Continuous measurements were taken of running speed and distances and heart rate (HR). Water debt during exercise was calculated by multiplying body weight (in 10g units) by water consumption. The Thermal scale was used to measure 10 levels of subjective temperature sensation.

RESULTS: Dehydration levels per training and per game increased with exercise duration, with slightly lower levels in the SC. There was no significant difference in Ttym compared to the CON. However, the SC showed a tendency to suppress the increase in Ttym. HR during the game showed an increase with each game in both groups. Post-training and post-game SC significantly suppressed the HR. Additionally, HR during exercise also showed a tendency to be suppressed compared to CON. Subjective thermal sensation was found to be suppressed in resting values due to the effect of the SC.

There was no difference in the total running distance per game between the two groups in the SC and the CON. However, during the third game, the total distance covered at high speed running (HSR; < 20km/h) was higher in the SC(6.57 ± 1.66 m) compared to the CON(4.87 ± 0.77 m).

CONCLUSION: It was found that cryostimulation of the sole of the foot suppresses dehydration and decreases Ttym and HR during exercise. Subjective thermal sensation was also suppressed. It is thought that cooling the arteriovenous anastomosis area (AVA) of the sole effectively returned venous blood that had dissipated heat. There was no difference in the total running distance between games 1, 2, and 3. However, it is worth noting that the SC maintained a significantly higher value of HSR distance in game 3 without any decrease. The Sole of the feet cryostimulation can be easily administered in the field and can suppress the rise in body temperature in a short time. This may be an effective measure to prevent heat stroke caused by environmental (physical) stress from the hot and humid summer environment and exercise (physiological) stress from physical exercise and sports.

EFFECTS OF EARLY SLEEP RESTRICTION ON PHYSICAL PERFORMANCE, MOTIVATION, TESTOSTERONE/CORTISOL RATIO, INFLAMMATION AND MUSCLE DAMAGE MARKERS IN HIGHLY-TRAINED FEMALE SOCCER PLAYERS: PRELIMINARY RESULTS

KOMAREK, Z., WIECEK, M., SOKULSKA, N., LIPOWSKA, M., SPIESZNY, M., HOLDA, M., FILIP-STACHNIK, A.
UNIVERSITY OF PHYSICAL EDUCATION IN KRAKOW

INTRODUCTION: Strong evidence indicates that sleep deprivation and chronic sleep restriction has a negative impact on athletes performance. However, little is known about the effect of sleep restriction on female athletes. The aim of this study was to analyze the effects of 3-hour early sleep restriction on physical performance, motivation, testosterone/cortisol ratio, inflammation, and muscle damage markers in highly-trained female soccer players.

METHODS: Eight female soccer players participated in a randomized, counterbalanced, and crossover experiment. Each athlete performed two identical experimental sessions in two conditions: a) after habitual sleep (HS) and b) after 3-hour sleep restriction (SR) and performed the following tests: a) countermovement jump; b) sprint test (0-30 m); c) Zig Zag Test without ball; d) Zig Zag Test with ball and d) Yo-Yo intermittent recovery test level 1. Each experimental session was preceded by an evening standardized soccer training (ST). Blood was collected: a) before ST (T0); b) after ST (T1) and c) before physical tests (T2) to evaluate the activity of creatine kinase and lactate dehydrogenase, concentration of myoglobin, C-reactive protein, cortisol, and testosterone.

RESULTS: T-test showed a significant increase in the 10-m sprint time in SR condition in comparison to HS condition (1.905 ± 0.080 vs 1.890 ± 0.089 s, respectively; p=0.036), without significant changes in other physical tests (p>0.05). In addition, a significant decrease in subjective reports on "physical strength" (2.8 ± 0.7 vs 3.8 ± 0.7 a.u., respectively; p= 0.017) and "muscle soreness" (6.1 ± 0.9 vs 5.0 ± 1.6 a.u, respectively; p=0.044) was observed in SR condition in comparison to HS condition. There were no statistically significant differences between HS and SR conditions in level of any biochemical markers (p>0.05).

CONCLUSION: The present study indicates that a 3-hour restriction on early sleep can negatively affect some aspects of physical performance and motivation in highly trained female soccer players, but has no effect on testosterone/cortisol ratio, inflammation, and muscle damage markers. Nevertheless, athletes and coaches should take into consideration the potential effects of one night with sleep restriction.

SLEEP, PHYSICAL ACTIVITY AND SEDENTARY TIME IN TEAM SPORT ATHLETES IN THE NORTHEAST OF ICELAND

ÝR ARNARDÓTTIR, N., TAEHTINEN, R.
UNIVERSITY OF AKUREYRI

INTRODUCTION: Sports have been associated with various health benefits, however when it comes to the highest level, they become physically and mentally demanding for the athlete [1] and occasionally affects sleep [2]. The aims of the study were to examine whether insomnia affects team sport athletes in the Northeast (NE) of Iceland, and to compare the amount of physical activity and sedentary time of these athletes with comparable groups of people in the same region.

METHODS: Sleep, physical activity and sedentary time were measured using a questionnaire for team sport athletes in NE of Iceland and a general population sample in comparison. The Insomnia Severity Index was used to diagnose insomnia. In total, 84 athletes from team sports, men (57.1%; Mean age=22.2, SD=4.1) and women (42.9%; Mean age=23.8, SD=5.9) participated. Participants were aged 18-45 years and competed with a team at the highest level in their sport (football, n=34, 40.5%; handball, n=18, 21.4%; basketball, n=15, 21.4%; volleyball, n=10, 11.9% and ice hockey, n=7, 8.3%). The general population consisted of 189 participants, men (32.8%, Mean age=36.9, SD=6.1) and women (67.2%, Mean age=38.8, SD=5.65) living in the NE of Iceland.

RESULTS: In total, 85.6% of the athletes slept 7 to 9 hours per night on weekdays, compared to only 61.5% of the general population. On weekends, 92.7% of the athletes slept 7 to 9 hours per night, compared to only 76.9% of the general population. For the athletes, 36.1% had subthreshold insomnia compared to 48.1% of the general population. Also, 9.6% of the athletes had clinical insomnia compared to 16.9% of the general population. Sedentary time was generally higher among the general population, with 28.8% spending an average of 8 to 10 hours per day sedentary, compared to 27.7% of the athlete group. 11.0% of the general population spent 11 to 13 hours per day sedentary, but only 3.6% of the athlete group. A high proportion of the general population did not meet the recommendations for physical activity, only 26.1% were physically active for 30 minutes per day at least five days per week, while 80.8% of athletes met the recommendations.

CONCLUSION: Team sport athletes in NE of Iceland are generally healthy in terms of sleep, physical activity and sedentary lifestyle compared to the general population.

Conventional Print Poster Presentations

CP-AP10 Performance and body composition

MUSIC IMPROVES PERFORMANCE BUT NOT PERCEIVED EXERTION DURING HIGH-INTENSITY ROWING

KOCH, L., SCHITTENHELM, A., BRANDT, T., ANDRES, D., ADLER, P., FAIRHURST-MENUHIN, M., SCHMIDT, A.
UNIVERSITY OF THE BUNDESWEHR MUNICH

INTRODUCTION: The aim of the present study was to investigate how exposition to slow compared to fast music during high-intensity rowing intervals affects performance, heart rate (HR), lactate, relative perceived exertion (RPE), and recovery.

METHODS: The study followed an A/B crossover design where participants (N = 21) performed 5 x 500 m rowing intervals under 2 different conditions, fast and slow beat music. Primary endpoint was the difference in total rowing time between conditions. Differences in average heart rate (HR), average RPE as well as rowing interval times, RPE, and HR per interval between the fast and slow music conditions were secondary endpoints. For exploratory purpose, the drop of HR and lactate during the first 5 min after completion of the rowing intervals were analyzed.

RESULTS: Participants had significantly shorter total rowing times while listening to fast compared to slow music ($p = .009$, $rB = .59$) with the greatest difference found during the 1st interval. Further, the 1st interval was significantly faster than the intervals 2–5 ($p < .001$). The largest drop in performance occurred during the fast music condition between the 1st and 2nd interval. While average HR in the slow music condition was significantly lower compared to the fast music condition ($p = .03$, $rB = .48$), no significant difference was found for average RPE ($p = .47$, $rB = .02$). Lactate values after completion of interval 5 differed significantly between groups with lower values in the slow music condition ($p = .05$, $rB = .41$) whereas no significant difference was found for lactate drop ($p = .21$, $rB = .21$). Contrary, participants showed a higher HR drop rate when listening to slow music ($p = .05$, $rB = .42$).

CONCLUSION: While fast music improved performance without elevating RPE, slow music was superior in terms of recovery. Systematically tailoring music to the intended training stimulus offers broad potential for competitive sports as well as the fitness and health sector.

THE RELATIONSHIP BETWEEN RUNNING ECONOMY, VO2,MAX AND RUNNING PERFORMANCE; A SYSTEMATIC REVIEW

O SULLIVAN, I., FRANCIS, P.
SOUTH EAST TECHNOLOGICAL UNIVERSITY, IRELAND

INTRODUCTION: Running Economy (RE) and VO2,max are measures of the aerobic demand of running and have been described as useful predictors and critical components of running performance (P) [1, 2]. The purpose of this systematic review is to illustrate the relationship between VO2max, RE and P whereby all P measures have been converted to points using the World Athletics (WA) scoring tables.

METHODS: A database search was carried out in Web of Science, Scopus and SportDiscus between the years 2007 and 2023. In accordance with a PRISMA checklist 33 studies providing 61 VO2max and P data sets (n = 694) and 27 RE and P data sets (n = 348) were included in this review. The relationships between VO2max and P and RE measured at 12 km/h (RE12km/h) and P were determined using linear regression analysis.

RESULTS: There is a statistically significant correlation between VO2max and P ($R2 = 0.80$, $p \leq 0.001$, $alpha = 0.05$) and no statistically significant correlation between RE12km/h and P ($R2 = 0.08$, $p = 0.15$, $alpha = 0.05$). These relationships were further broken down to observe potential differences between performances measured using distances < 5000m or ≥ 5000m. VO2max appears to demonstrate a stronger correlation with performance in distances ≥ 5000m ($R2 = 0.83$, $p \leq 0.001$, $alpha= 0.05$). RE12km/h is not correlated with P at distances < 5000m or ≥ 5000m.

CONCLUSION: This review suggests that VO2max is the dominant factor in the prediction of endurance running performance in events ranging from 800m to the marathon. Sub-divided into studies which measured performance over distances < or ≥ 5000m, VO2max appears to play an even stronger role in the prediction of longer distance performance. RE12km/h demonstrates no correlation of statistical significance with performance.

References

[1] J. T. Daniels, "A physiologists view of running economy," (in English), Medicine and Science in Sports and Exercise, Article vol. 17, no. 3, pp. 332-338, 1985.

[2] C. Foster, J. Daniels, and R. Yarbrough, "Physiological and training correlates of marathon running performance," Australian Journal of Sports Medicine, no. Nov/Dec, p. 5, 1977.

EXERCISE-INDUCED PERFORMANCE IMPAIRMENT AND RECOVERY FOLLOWING A TYPICAL DOSE OF NORDIC HAMSTRINGS EXERCISE: ELECTRICAL IMPEDANCE MYOGRAPHY ASSESSMENT

LONGO, S., CORATELLA, G., TONINELLI, N., BORRELLI, M., RAMPICHINI, S., DORIA, C., LIMONTA, E., CÈ, E., ESPOSITO, F.
UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Electrical impedance myography (EIM) is a painless technique deriving from the classical bioelectrical impedance analysis. In EIM, the electrodes are applied locally over a body segment to describe its bioelectrical tissue properties (i.e., impedance, Z) by resistance (R), reactance (Xc), and phase angle (PhA) analysis. EIM components seem to change in response to different level of muscle contraction, fatiguing tasks, and eccentric exercise. However, there is still a lack of studies about its potential use to assess the recovery following potential eccentric exercise-induced performance impairment. Therefore, the aim of this study was to measure changes in EIM components induced by a typical dose of Nordic hamstring exercise (NHE) and the time-course of recovery.

METHODS: Thirteen men (mean±SD; age=25.2±2.9 years; body mass=77.5±11.3 kg; height=176.4±8.4 cm) were recruited. Knee flexors maximum voluntary isometric contraction (MVC), muscle soreness by visual-analogue scale of 100 mm (VAS), 50-kHz EIM components (i.e., Z, R, Xc, and PhA), echo intensity (EI), and anatomical cross-sectional area (ACSA) of the posterior thigh were assessed at baseline (PRE). Then, 4 sets of 6 repetitions of NHE were performed. The participants were subsequently assessed on day 1 to day 4 (Day1, Day2, Day3, Day4) after the NHE. Data were analysed by repeated-measure ANOVA and non-parametric Friedman tests with $p<0.05$.

RESULTS: After the NHE protocol, MVC decreased at Day1 (-14%, $p<0.01$), Day2 (-17%, $p<0.01$), and Day3 (-17%, $p<0.01$), recovering at Day4 (-7%, $p>0.05$) compared to baseline. VAS increased at Day1 (16±13 mm, $p<0.01$), Day2 (22±16 mm, $p<0.01$), Day3 (19±14 mm, $p<0.01$), and was still higher than baseline at Day4 (11±8 mm, $p<0.05$). Conversely, EIM components (Z, R, Xc, and PhA) did not change significantly from baseline throughout the protocol ($p>0.05$). Similarly, hamstrings EI and ACSA did not change significantly from baseline throughout the protocol ($p>0.05$).

CONCLUSION: These results showed that the proposed NHE protocol induced an impairment in muscle function, which recovered within 4 days. Muscle soreness increased and persisted up to Day4. However, muscle impedance and structural characteristics were not affected by 4 x 6 NHE. Therefore, further research with different eccentric exercise-induced performance impairment is needed to assess the potential use of EIM to monitor muscle-performance recovery.

Freeborn T.J., Regard G., Fu B. Localized Bicep Tissue Bioimpedance Alterations Following Eccentric Exercise in Healthy Young Adults. 2020. IEEE Access, vol. 8, pp. 23100-23109

ESTIMATION OF ELECTROMYOGRAPHY THRESHOLD (EMGT) CONSIDERING FREQUENCY AND THE RELATIONSHIP BETWEEN EMGT AND ENERGY METABOLISM RESPONSE

NAKANO, H., HIROSE, K., KONDO, A., MIYAMOTO, N., KAJIWARA, W., ONODERA, K., UDA, S., TAKEDA, M.
DOSHISHA UNIVERSITY

INTRODUCTION: A golden standard for EMGT (EMG Threshold) determination has not been established. This study examined methods for determination for EMGT in incremental exercise test on a bicycle ergometer (12 discrimination methods described below), and evaluated the correlation between the 12 detected EMGTs and LT1 (Lactate Threshold), LT2 (Onset of Blood Lactate Accumulation), VT1 (Ventilatory Threshold) and VT2 (Respiratory Compensation Threshold).

METHODS: Seventeen adult male subjects (25.6 ± 9.3 years) with exercise habits were subjected to incremental exercise test on a bicycle ergometer (LC4, Monark, Sweden). The workload at the beginning of exercise was set at 30 watts (constant 60 rpm), and the workload was increased by 30 watts every 2 minutes. Wireless electromyography (DSP EMG sensor, Sports sensing, Japan) sensors were attached to the rectus femoris and vastus lateralis muscles, and EMG were obtained during exercise. Exhaled gas exchange was measured with an exhaled gas analyzer (AE-310s, Minato, Japan). Blood lactate concentration (Lactate pro 2, Arkley, Japan) was measured before the start of exercise, every 2 minutes during exercise, and immediately after the end of exercise. An accelerometer was attached to the crank of a bicycle ergometer to calculate the pedaling angle from the angular acceleration. The obtained EMG data was analyzed based on FFT, and divided by low frequency band (10-130 Hz), high frequency band (130-420 Hz), and all bands (10-420 Hz). By considering elements of 2 pedaling angles (180° or 360°) and 3 frequency bands based on the FFT analysis (Low, High or All), 6 EMGs (360°-EMG (Low), 360°-EMG (High), 360°-EMG (All), 180°-EMG (Low), 180°-EMG (High), 180°-EMG (All)) were obtained from raw EMG data. The EMGTs were determined by visual inspection, using the point at which the magnitude of the EMGTs began to rise sharply, first (EMGT1) and second (EMGT2) respectively. Total 12 EMGTs (6 EMGT1 and 6 EMGT2) were detected and evaluated the correlation between LT1, VT1, LT2, and VT2.

RESULTS: EMGT was detected in all 12 EMGT detection methods in both the rectus femoris and vastus lateralis muscles from all subjects. The validity of the analyzed segment for pedaling (360° or 180° is preferable) was similar for the rectus femoris muscle ($r = 0.83$-0.92, $p < 0.05$) and for the vastus lateralis muscle ($r = 0.80$-0.97, $p < 0.05$). The correlation coefficient was slightly higher with 180° analyzed segment. The combinations of highest correlation among pedaling angles and frequency bands were 180°-EMGT1 (Low) in the vastus lateralis ($r = 0.84$, $p < 0.05$) for LT1, 360°-EMGT2 (High) of the vastus lateralis ($r = 0.97$, $p < 0.05$) for LT2, 180°-EMGT1 (Low) in the vastus lateralis ($r = 0.82$, $p < 0.05$) for VT1, and 180°-EMGT2 (Low) in the vastus lateralis ($r = 0.86$, $p < 0.05$) for VT2.

CONCLUSION: It was desirable to use the vastus lateralis muscle as the target muscle for detecting EMGT. EMGT considering both pedaling angle and frequency band might be highly correlated with LT and VT.

AN ASSESSMENT OF THE QUALITY OF LIFE, WELLBEING AND STRESS LEVELS OF FOOTBALL REFEREES IN HONG KONG

OREILLY, J., HUI, S.C., SIT, C.H.P., LU, Y.J.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: In recent years, there has been an enhanced awareness in relation to the emotional wellbeing of professional sportspeople (Henriksen et al. 2020). As a result, updated guidelines have been produced by sporting and scholarly organisations to assist practitioners identify issues that previously may have went overlooked (Gouttebarge et al. 2021). Football referees are subject to significant physical and psychological requirements, although little is known about the impact of these demands on their emotional health (Loghmani et al. 2021). This study aimed to conduct an assessment of various emotional wellbeing markers on football referees in Hong Kong.

METHODS: Referees from the Hong Kong Football Association (HKFA) training programme participated in this study. A questionnaire containing 28 items was conducted at the beginning, mid-way, and end of the year, covering aspects of general information, basic health, quality of life, nutrition knowledge, psychological evaluation, and information on quitting the profession. All questionnaires were prepared in bi-lingual.

RESULTS: A total of 106 participants (mean age 25.4 y) across 3 years took part in this study. Table 1 illustrates the change in the level of quality of life (QoL), which was assessed in years 2 and 3. In year 2, the overall level of QoL dropped significantly in both the mid- and post-programme stage (p=0.024), while the situation the following year was the opposite, whereby QoL increased by 4.5 and 5.4 points at the latter two stages, respectively (p=0.005).

The mean level of self-perceived state of well-being significantly dropped at the end of the programme in each year (p=0.022 & 0.034). The percentage of those who regarded themselves in a "good" state of well-being, or even better, also decreased by 18.5 points (p=0.05) at the post-programme stage after year 3. 66%, 82% and 86% of referees regarded their well-being as "good" or better at the pre-programme stage of the 3 years respectively, which dropped to 60%, 70% and 68% at the end of each year. See table 2.

According to the degree of the sources of stress rated by young referees, there was no source that was regarded as "strong" by a high percentage of referees while less than 30% of referees never thought about quitting.

CONCLUSION: The current study shows that the state of well-being of young referees decreased at the end of the programme, as did the level of QoL in year 2. Some sources of stress were alleviated due to the increased opportunities of learning and practicing provided by the programme. This research can provide useful information for Football Associations in South-East Asia in relation to the recruitment and retention of professional referees, as well as leading to the potential enhancement of refereeing performance.

Henriksen et al. 2020. J. Sport Exerc. Psychol. 18(5):553–560.

Gouttebarge et al. 2021. Br J Sports Med. 55(1):30–37.

Loghmani et al. 2021. Sport Manag Rev. 1–26.

BODY COMPOSITION AND BONE MINERAL DENSITY IN HIGH PERFORMANCE RUNNERS

CHOLP, J., STRELECKÝ, M., CUPKA, M., BUZGÓ, G., ORESKÁ, L., CERNÁCKOVÁ, A., HAMAR, D., KERN, H., PAYER J., KILLINGER, Z., SEDLIAK, M.

FACULTY OF SPORTS AND EDUCATION OF COMENIUS UNIVERSITY BRATISLAVA

INTRODUCTION: The endurance running is nowadays the subject of interest not only in sport science and competitive sport, but also the general population, as it is one of the most natural movements of human. However, the effect of endurance running activity on changes in the body composition and bone mineral density in performance endurance runners are still not sufficiently examined. The aim of the study was to determine the differences in body composition (BC) and bone mineral density (BMD) variables between young performance runners and the non-sporting general population. From our results, we wanted to find out the extent of the impact of endurance training in runners on their body composition and bone density parameters and thus show the important issues related to performance and elite sports.

METHODS: The monitored selection of young performance runners (YPR) consisted of 11 subjects (age 26.5 ± 2.7 yrs; body mass index (BMI) 22,0 ± 1,1 kg.m-2) and the monitored group of non-sporting population (NSP) consisted of 8 probands (age 26.8 ± 2.5 yrs; body mass index (BMI) 28,7 ± 5,8 kg.m-2) of slovak nationality. Both groups were males. YPR were defined by a training volume of < 240 minutes of running activity per week, age (20-30 years old) and by their personal records on 10 km run in endurance running competitions. NSP were defined by their age (20-30 years old) and history of no regular physical activity or practice < 30 minutes per week in the last 5 years. A dual energy X-ray absorptiometry (DXA) was used where all the necessary anthropometric BC and BMD variables were estimated. To evaluate the differences in the monitored parameters between groups we used the Mann - Whitney U test and ES (Cohen r). All data are expressed as means ± SD.

RESULTS: The endurance running group had a significantly lower value of total body weight (73,3 ± 4,4 kg vs 94,7 ± 21,1 kg, p = 0.017; ES = 0.549), total fat mass (18,4 ± 1,5 % vs 28,3 ± 6,7 %, p = 0.002; ES = 0.701), android fat mass (19,6 ± 1,9 % vs 33,1 ± 9,4 %, p = 0.002; ES = 0.720), gynoid fat mass (21,1 ± 2,6 % vs 30,5 ± 6,4 % , p = 0.005; ES = 0.644), the ratio of android to gynoid fat mass (0,9 ± 0,1 vs 1,1 ± 0,2, p = 0.047; ES = 0.455) and a significantly higher value of lean mass (77,5 ± 1,5 % vs 68,7 ± 6,3 %, p = 0.007; ES = 0.616), total BMC (4,1 ± 0,2 % vs 3,0 ± 0,4 %, p = 0.000; ES = 0.833). Young runners had significantly higher values only in the Z-score of the total BMD (0,75 ± 0,40 SD vs - 0,21 ± 0,61 SD, p = 0.001; ES = 0.749). The Z-scores of the proximal femur and lumbar spine were not significantly different between the groups.

CONCLUSION: Endurance running activity has a significant effect on improving body composition parameters and overall bone mineral density in the group of young performance runners, however, no specific significant effect on increasing bone mineral density in the proximal femur and lumbar vertebrae was found, even though it is a type of activity with impact forces on these body parts.

EFFECTS OF 12-WEEK VARIED MODES OF CIRCUIT TRAINING ON INHIBITORY CONTROL PERFORMANCE AND BODY COMPOSITION IN POSTMENOPAUSAL WOMEN

WEN, H.J.1, CHEN, Y.Z.1, HUANG, P.Y.1, WANG, H.L.2

1TZU CHI UNIVERSITY, TAIWAN, 2MENNONITE CHRISTIAN HOSPITAL, TAIWAN

INTRODUCTION: The prevalence of dementia and obesity rises among women following menopause. Regular exercise has shown benefits in enhancing cognitive function and improving body composition. Both aerobic exercise and resistance training are recommended for adults and the elderly. Hydraulic resistance circuit training offers a safe and convenient option for sedentary women. However, the effects of different circuit training modes on inhibitory control performance and body composition in postmenopausal women (PMW) remain uncertain. This study aimed to investigate the effects of various modes of circuit training on inhibitory control performance and body composition in PMW.

METHODS: Thirty-one healthy PMW (mean age 68.6 ± 5.6 years) with no regular exercise habits were recruited. The mean weight of participants was 58.6 ± 6.3 kg, and the mean height was 155.6 ± 4.9 cm. Participants were randomly assigned to either the hydraulic resistance circuit training group (RG) or the aerobic combined hydraulic resistance circuit training group (ARG), with training sessions scheduled three times per week, lasting 60 minutes each, over a period of 12 weeks. Stroop task performance and body composition (measured using the ACCUNIQ BC380, SELVAS Healthcare Inc.) were assessed before (week 0) and after the 12-week training period.

RESULTS: Significant improvements were observed in the reaction time (RT) of the Stroop task for both congruent (RG: 549.5 ± 76.2 vs. 533.0 ± 58.2 ms; ARG: 591.0 ± 85.5 vs. 559.0 ± 65.6 ms, $p = 0.018$) and incongruent conditions (RG: 599.1 ± 102.3 vs. 575.9 ± 73.3 ms; ARG: 643.1 ± 98.2 vs. 607.3 ± 88.2 ms, $p = 0.022$) in both the RG and ARG groups ($p < 0.05$). However, there were no significant changes in the accuracy rate (RG: 98.3 ± 1.6 vs. 98.40 ± 1.1%; ARG: 98.8 ± 1.2 vs. 99.1 ± 0.8%, $p = 0.38$). The percentage of lean body mass (LBM, %) significantly increased in the RG group (36.0 ± 3.3% vs. 36.6 ± 3.1%, $p = 0.013$) compared to the ARG group (36.3 ± 1.9 vs. 36.8 ± 1.9%, $p = 0.081$). However, fat mass significantly decreased in the ARG group rather than the RG group after the 12-week training (CoFM0-23.4 kg, ARG 19.7 kg vs. RG 22.8 kg, $p = 0.005$). Additionally, the total body fat percentage (BF%) and fat mass in the trunk, upper body, and lower leg improved significantly in both groups after the 12-week training period ($p < 0.05$).

CONCLUSION: Both modes of 12-week circuit training effectively improved reaction time in inhibitory control performance. However, hydraulic resistance circuit training demonstrated greater benefits for percentage of lean body mass, while aerobic combined hydraulic resistance circuit training provided more benefit for fat mass in PMW. This study was supported by the National Science and Technology Council (NSTC112-2410H320-0010MY2).

Conventional Print Poster Presentations

CP-AP11 Children, Talents and Young athletes

THE RELATIONSHIP BETWEEN 2D:4D RATIOS, ACCELERATION ABILITY, AGILITY, AEROBIC ENDURANCE, AND SPECIFIC SOCCER PERFORMANCE IN YOUNG MALE SOCCER PLAYERS

SANPASITT, C., YONGTAWEE, A., NOIKHAMMUEANG, T., WOO, M.

CHULALONGKORN UNIVERSITY

INTRODUCTION: The ratio between the lengths of the index and ring fingers (2D:4D) defined as a biological indicator for athletic performance; it is considered a potential marker for prenatal testosterone exposure. The aim of this study was to investigate the association between 2D:4D ratios, physical fitness, and specific soccer skill in young male soccer players.

METHODS: One hundred and thirty-two young male soccer players aged 13-15 years old were recruited for participation and categorized according to three distinct playing positions: defenders, midfielders, and forwards. Anthropometric profiles, including height, weight, body fat percentage, and 2D:4D finger length ratio, were evaluated. Furthermore, acceleration ability; 10m, 20m, and 30m sprint; VO2max; Yo-Yo intermittent level-1 test; and change of direction; arrowhead agility tests were assessed. We used the Loughborough soccer passing and dribbling protocol to measure each player's soccer-specific performance.

RESULTS: A significant positive correlation between the right and left digits' ratios ($r = 0.644$, $p < 0.001$) was observed, indicating a strong linear relationship. The analysis revealed that the 2D:4D ratio of both hands demonstrated no significant differences between playing positions. Furthermore, arrowhead agility tests showed a weakly positive, correlation with right 2D:4D ($r = 0.251$, $p = 0.004$). Moreover, we detected strong significant correlations between agility and acceleration ability (10m; $r = 0.750$, 20m; $r = 0.763$, and 30m; $r = 0.760$). The associations between both right and left 2D:4D and 10m, 20m, and 30-m sprint times were statistically insignificant. We observed that the VO2max had a weakly negative

correlation with dribbling time (r = –0.257, p = 0.003) and a positive correlation with long passing capacity (r = 0.312, p < 0.001).

CONCLUSION: Our results provide strong evidence regarding the utility of the 2D:4D ratio in the identification of talent and performance optimization of young male soccer players. Our detection of the strong correlation of the 2D:4D ratio with change of direction ability and aerobic endurance can also ultimately serve as a key predictor of passing and dribbling performance in young male athletes.

HOW TALL WILL THEY BE? RELIABILITY OF ADULT HEIGHT PREDICTION IN FEMALE AND MALE YOUTH BASKETBALL PLAYERS

RÖSCH, D.1, HÖNER, O.1, HUTH, M.2,3, ADELT, T.4, MAERZ, A.4, LEYHR, D.1

1 UNIVERSITY OF TÜBINGEN; 2 GERMAN BASKETBALL FEDERATION ; 3 ALBA BERLIN BASKETBALLTEAM; 4 BASKETBALL ASSOCIATION OF BADEN-WÜRTTEMBERG

INTRODUCTION: Recent studies highlight the impact of outcomes related to biological maturation on talent identification and development processes in youth basketball [1]. As height is regarded a contributing factor to performance in basketball, methods for predicting adult height are of particular interest in this context. While there is evidence on the reliability of biological maturity status assessments, knowledge on the reliability of methods to predict adult height is still lacking [2]. Thus, the aim of this longitudinal study was to analyze the reliability of methods for adult height prediction.

METHODS: The samples consist of N=27 female U14/U15 (Mage[T1]=13.87; Mage[T2]=14.16) and N=37 male U14 (Mage[T1]=13.26; Mage[T2]=13.56) players of two different institutions of the German talent development system (youth academy or regional selection team). Players' predicted adult height (PAH) was assessed at two different time points (T1 and T2) by the method of Khamis & Roche [KR; 3] and via the BAUs Sport Sonic Bone ultrasound (US) device. (i) The methods' test-retest reliability was investigated via correlation analyses. Additionally, one-sample t-tests were used to analyze absolute differences in adult height predictions between T1 and T2. The reference value was set to Mdiff=0, as height predictions were not expected to change. (ii) Paired-samples t-tests examined differences in predictions of the two methods at both time points. Cohen's d served as effect size.

RESULTS: (i) Reliability analyses revealed high correlations between T1 and T2 for both methods in females (r≥.99) and males (r≥.94). However, the analyses of absolute differences between time points indicated significant differences in PAH estimates in both samples for PAH by KR (females: Mdiff=0.53, p<.001, d=1.29; males: Mdiff=0.58, p<.01, d=.53) and PAH by US (females: Mdiff=0.80, p<.001, d=.95; males: Mdiff=1.21, p<.001, d=.89). (ii) Significant differences were found between PAH by KR and by US at T1 (p<.001, d=.73) and T2 (p<.01, d=.62) in females, whereas no differences in PAH predictions were present in males at either time point (p≥.10).

CONCLUSION: While results of the correlation analyses support the reliability of both investigated PAH estimation methods, analyses of differences between time points revealed distinct inconsistencies in the agreement. Thus, results reinforce the need for regular monitoring of maturation-related outcomes to decrease potential measurement errors. The discrepancies in accuracy between the two methods in females, together with the advanced maturation of the analyzed sample, require further investigations. Further measurements in this project may provide insights, as may future validation studies of PAH methods in basketball and other sports where height is considered just as important.

REFERENCES:

[1] Albaladejo-Saura et al. (2021). Int J Environ Res Public Health, 18(1), 328.

[2] Leyhr et al. (2020). Front Sports Act Living, 2, 587861.

[3] Khamis & Roche (1994). Ped, 94(4), 504-507.

LIMITING FACTORS OF AEROBIC ABILITY OF MALE ADOLESCENTS IN DIFFERENT AGES

ZHAO, K.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Aerobic capacity can comprehensively reflect the bodys ability to uptake, transport, and utilize oxygen, providing an indication of the overall level of human health. However, the understanding of the limiting factors in the development of aerobic capacity in different age groups is not very clear. This study intends to investigate the limiting factors of aerobic capacity in male adolescents across different age groups from three aspects: oxygen uptake, oxygen transport, and oxygen utilization.

METHODS: 386 male adolescents aged 11-18 were selected as participants. They are grouped into three age categories based on their chronological age: 11-13 years old, 14-15 years old, and 16-18 years old. Their VO2peak was tested using a ramp-type incremental load exercise. Oxygen uptake indicators (pulmonary function indicators: FVC, FEV1, FEV1/FVC, PEF, FEF25, FEF50, FEF75, FEF25-75, IC, PIF), oxygen transportation indicators (cardiac structure and function indicators: IVSd, LVPWd, LVIDd, LVIDs, AoD, Las, E, DT, s', e', EDV, ESV, SV, LVM, EF, FS), and oxygen utilization indicators (muscle oxygen utilization capacity indicators: SmO2, tHb, BLA) were measured. Through factor analysis, principal components of indicators related to oxygen uptake, oxygen transport, and oxygen utilization capacity are extracted. Using the extracted principal components as independent variables and VO2peak as the dependent variable, a multiple regression analysis was conducted to explore the potential physiological mechanisms influencing aerobic capacity in male adolescents across different age groups.

RESULTS: Found that the main limiting factors of aerobic capacity of 11-13 years old male adolescents are pulmonary function and cardiac structure. The adjusted R square is 0.520, among which pulmonary function index accounts for 83.06%, and cardiac structure index accounts for 16.94%. The main limiting factors of aerobic capacity of 14-15 years old male adolescents were cardiac structure and pulmonary function, with the adjusted R square of 0.603, among which pulmonary function index accounted for 69.26%, and cardiac structure index accounted for 30.74%. The main limiting factors of aerobic capacity of 16-18 years old male adolescents were pulmonary function, cardiac structure, cardiac function and muscle oxygen utilization ability, with the adjusted R square of 0.666, among which pulmonary function index accounted for 41.00%, cardiac structure and function index accounted for 23.54%, and muscle oxygen utilization ability index accounted for 18.36%.

CONCLUSION: In the early stages of adolescence, the VO2peak of male adolescents is primarily influenced by pulmonary function and cardiac structure, with the impact of pulmonary function being particularly significant. With increasing age, the influence of cardiac structure, function, and muscle oxygen utilization capacity on VO2peak becomes more prominent, while the proportion of the impact of pulmonary function on VO2peak gradually decreases. This may be attributed to the delayed growth of the lungs compared to overall body growth.

EXPLORING FACTORS INFLUENCING SUCCESS WITHIN THE WELSH RUGBY UNION DEVELOPMENTAL PATHWAY: A MULTI-DISCIPLINARY, LONGITUDINAL APPROACH.

LOWE, G., GOTTWALD, V., JONES, E., OWEN, J.

BANGOR UNIVERSITY

INTRODUCTION: The constraints faced by sports organisations due to limited resources reinforce the need for effective talent identification (TID) and selection protocols. Despite previous studies revealing the complex, dynamic, and multidisciplinary nature of TID, there is a prevailing tendency to concentrate on cross-sectional, linear, and unidimensional methods. Subsequently, it is not surprising that practitioners and academics have a poor track record of successful TID systems. More recent scientific approaches have begun to adopt more sophisticated machine learning techniques, which allow for a much more comprehensive exploration of the multifaceted factors likely involved in the identification of talent. Nevertheless, research investigating important determinants of expertise for athletes performing at the highest levels in the UK high-performance systems has adopted what is an arguably flawed 'one-size-fits-all' approach. However, there is robust evidence supporting the notion that factors influencing expertise development are almost certainly sport specific. Thus, the purpose of this two-fold study was to apply a machine learning approach to examine the factors influencing progression and success within the Welsh Rugby Union (WRU) pathway.

METHODS: Attributes from five distinct themes based on underpinning theoretical hypotheses (i.e., anthropometrical, physical, psychological, socio-demographic, skill acquisition, technical and tactical) were assessed across five age-grades during a 3-year collection. An athlete psychosocial survey was employed to measure constructs of behaviours, personality traits, and psychological factors. Overall, 41 constructs were measured. A socio-demographic and skill acquisition questionnaire were used to obtain information about relative age, place of development, family information, education, practice and training factors and sport history. Physical testing included anthropometrical measures, grip strength, isometric mid-thigh pull, countermovement jump, 10-40m sprint, 505 agility, and bronco test. Players' technical and tactical ability were collected from the coaches using a bespoke tech-tac measure. The study adopted machine learning analysis by way of increasing predictive power. The analysis was used to analyse large numbers of features and find which features best distinguish between two different classes of objects, in relation to progression and success.

RESULTS: Based on over 87 variables, we were able to identify key features across psychosocial, physiological, and skill acquisition-related domains that could be used to discriminate progression and success within the WRU pathway.

CONCLUSION: Despite recent encouragement of multidimensional approaches in TID, many sporting organisations still exhibit a bias towards physical and anthropometrical factors. The model can help support the efficaciousness of talent systems and assist key stakeholders in implementing identification and selection protocols.

DIFFERENCES IN FRONT CRAWL PERFORMANCE BETWEEN BOYS AND GIRLS AT 12 YEARS OF AGE

LJØDAL, I., WORTELBOER, M.W., GONJO, T., OLSTAD, B.H.

NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Compared with actual performance, load-velocity profiles have proven to be good predictors of swimming performance in front crawl (Gonjo et al., 2021). The use of load-velocity testing remains underexplored in adolescent populations, only one age-group comparison of girls (Wettengl et al., 2024). The application of this method within an adolescent age group, from amateur to elite, can provide valuable insight into the development of swimming performance among adolescents who are currently in their early developmental stages of puberty.

METHODS: This was a cross-sectional study within a longitudinal study, including 113 male and female swimmers (age 12.28 ± 0.46 y, height 159.11 ± 7.51 cm and weight 47.91 ± 7.90 kg). The 50-meter race was recorded using the AIM race analysis system (AIMsys Sweden AB, Lund, Sweden). Swimming velocity (V50m) excluded the first and last stroke on each lap. The data for the load-velocity profiles was collected using 1080 Sprint (1080 Motion, Lidingö, Sweden). Participants performed three semi-tethered 25 m swims with progressively increasing loads (~ 1 - 2 - 3 kg) in front crawl with maximum effort. A 5 m range between 10 m and 15 m from the wall was used to calculate the average swimming velocity of the semi-tethered swimming and a regression line predicted the maximum swimming velocity (Vmax). The Shapiro-Wilk

test was used to check the data distribution. One-way ANOVA (parametric data) and the Kruskal-Wallis test (non-parametric) were used to analyse the differences between boys and girls. Pearson's correlation coefficient was used to analyse covariation.

RESULTS: There were significant differences between male and female swimmers in time in seconds for 50 m (T50m, males 34.83 ± 3.67 s, females 36.41 ± 3.27 s, $p < 0.027$), V50m (males 1.37 ± 0.14 m/s, females 1.29 ± 0.12 m/s, $p < 0.005$), and Vmax (males 1.25 ± 0.18 m/s, females 1.17 ± 0.15 m/s, $p < 0.010$). The correlation between T50m and Vmax was $r = 0.459$, $p < 0.001$.

CONCLUSION: The differences found for T50m, V50m, and Vmax show that boys have a faster swimming time, a higher swimming velocity, and a higher estimated maximum velocity based on the load-velocity profile. This suggests that the pubertal change in body composition is progressed enough to show the physical benefits for male swimmers at this age. The moderate correlation between T50m and Vmax also supports the use of load-velocity testing for predicting performance in young adolescent swimmers.

Gonjo, T., Njøs, N., Eriksrud, O., & Olstad, B. H. (2021). The relationship between selected load-velocity profile parameters and 50 m front crawl swimming performance. Frontiers in Physiology, 12, 625411. https://doi.org/10.3389/fphys.2021.625411

Wettengl, C., Karlsson, R., Olstad, B. H., & Gonjo, T. (2024). Load–Velocity Profile and Active Drag in Young Female Swimmers: An Age-Group Comparison. International Journal of Sports Physiology and Performance, 19(1), 44-52. https://doi.org/10.1123/ijspp.2022-0213

RELATIVE AGE EFFECT OF ADOLESCENT'S PARTICIPATION IN CLUB ACTIVITIES: A CROSS-SECTIONAL STUDY IN WIDE-SPREAD JAPAN AREAS

MORI, T., AOKI, T., OISHI, K., IKEUE, K., YAMAGUCHI, H., HANANO, H., YAMAMOTO, Y., HIROE, Y., ISHII, K.
DOSHISHA UNIVERSITY

INTRODUCTION: Relative age effect (RAE) explains that the relatively younger (those who were born later among the same grade) tend to have disadvantage in physique and player selection. Previous studies have reported that the relatively younger are underrepresented in professional sports. RAE is often seen in competitive sports, such as soccer and baseball. Conversely, opposite RAE has been reported in advantageous sports for petite athletes, such as table tennis. However, no study has examined RAE of adolescents' participation in club activities. Therefore, we investigated the RAE of adolescent's participation in club activities to clarify the clubs that the relatively younger are more likely to participate.

METHODS: We targeted 18876 adolescents aged 10–18 years (10722 boys and 8154 girls from 76 schools in Japan) for the analysis. We obtained adolescent's information about birth month and asked adolescents the kinds of club activities (school club activity, neighborhood group activity, or private lesson) they participate. Moreover, we categorized sports (soccer, basketball, tennis) and culture clubs (music, art, science). Furthermore, we focused on the popular descriptions of club activities. To examine the association between adolescent's birth month and participation in club activities, we used logistic regression analysis by sex, adjusted for adolescent's grade and body mass index.

RESULTS: Relatively younger boys were less likely to participate in sports clubs (OR=0.98, $p<0.01$) but were more likely to participate in culture clubs (OR=1.02, $p<0.05$). However, no RAE was seen for girls' sports and culture club activities. For the description of club activities, we showed that the relatively younger adolescents were less likely to participate in "soccer" (OR=0.98, $p<0.05$), "baseball" (OR=0.96, $p<0.01$), and "track and field"(OR=0.96, $p<0.01$) club activities but were more likely to participate in "table tennis" (OR=1.03, $p<0.05$), "badminton" (OR=1.04, $p<0.05$), "kendo (Japanese-style fencing)" (OR=1.04, $p<0.05$), and "science" (OR=1.05, $p<0.05$) club activities. Conversely, the relatively younger girls were less likely to participate in "Japanese archery" (OR=0.95, $p<0.05$) club activities but were more likely to participate in "tennis" (OR=1.04, $p<0.01$) club activities.

CONCLUSION: Although RAE of adolescents' participation in club activities certainly existed, it depended on the sports type. The relatively younger selected racket sports, which are activities favorable for them.

References

1. Musch, J, Grondin, S. Unequal competition as an impediment to personal development: A review of the relative age effect in sport. Dev Rev. 2001;21: p147–67.

2. Romann, M, Fuchslocher, J. The need to consider relative age effects in women's talent development process. Percept Mot Skills. 2014;118: p651–62.

RELIABILITY OF DRY-LAND JUMPS FOR YOUNG FIGURE SKATERS.

MYKLEBUST, H., KJELLSTADLI, B.
UNIVERSITY OF STAVANGER

INTRODUCTION: Figure skaters can improve performance in multi-revolution jumps by increasing the speed of rotation during the flight phase and/or increasing the height of the jumps [1]. Further, skaters spend a lot of time practicing on multi-rotational jumps both on ice and on dry-land, and manufacturers claim that training with rotational and harness training systems can enhance performance [2]. Hence, a non-invasive testing method is needed to quantify the possible effects of rotational and harness training. Therefore, the aim of the present study was to evaluate test-retest reliability and

inter-rater reliability of jump height (flight time) in counter-movement jumps (CMJ) and maximal rotational jumps (RJ) performed by young figure skaters.

METHODS: Nineteen female figure skaters (age: 10-16 years, height: 151.2±6.2 cm, bodymass: 52.5±6.2 kg) were recorded performing two CMJ trials with free arms and three RJ trials using a non-invasive smart-phone APP "My Jump 2" (v.6.1.7 by Dr. Balsalobre-Fernández). Thereafter, two independent experienced scientists analyzed all jumps using the APP, which estimates jump height from flight times. The method has been found valid compared to contact mat [3]. The inter-rater reliability was assessed using typical error (TE) between raters analyzing the same jumps, and test-retest reliability was assessed using TE within skaters repeating the same type of jump. Additionally, coefficient of variation (CV) between skaters was included as a reference of homogeneity of the group. The results are presented as mean ± standard deviation (SD) and the accepted level of TE was set to be < 6 % as previously reported for CMJ [3].

RESULTS: The results from rater one was CMJ = 29.1 (4.8) cm and 485 (40) ms for jump heights and flight times, respectively, and for RJ was jump heights 23.1 (5.0) cm and flight times 431 (46) ms. Hence, CV between skaters were 17 %, 8.3 %, 21 % and 11 % for CMJ height, CMJ flight time, RJ height, and RJ flight time, respectively. Test-retest reliability showed TE of 3.8 %, 1.9%. 3.7 % and 1.8 % for the same parameters.

Rater two showed 1.4 (1.2) cm higher CMJ height and 3.1 (1.7) cm higher RJ height ($p<0.01$). This corresponds to 12 (11) ms and 29 (17) ms longer flight times for CMJ and RJ, respectively. The inter-rater TE was 3.9 % and 2.0 % for CMJ height and CMJ flight time, respectively. For RJ the inter-rater TE was 8.9 % for jump height and 4.8 % for flight time.

CONCLUSION: Inter-rater TE for CMJ was comparable with TE within skaters and of acceptable magnitude. To our knowledge, inter-rater variability for RJ has not been reported previously and was unacceptably high. Hence, using the same rater to analyze RJ is essential for reliability.

References:

1 Mazurkiewicz, A. (2021). https://doi.org/10.2478/pjst-2021-0007

2 Panfilov, V. (2023). https://hdl.handle.net/11250/3078285

3 Gallardo-Fuentes et al. (2016). https://journals.lww.com/nsca-jscr/toc/2016/07000

BODY COMPOSITION, ANTHROPOMETRIC PARAMETERS, AND STARTING AGE MAKE A DIFFERENCE BETWEEN ELITE LEAD CLIMBERS AND BOULDERERS – A RETROSPECTIVE STUDY

GINSZT, A., ZIELINSKI, G., BYS, A., ZIEBA, E., ZABOREK, M., LYCZBA, J., GAWDA, P., GINSZT, M.

MEDICAL UNIVERSITY OF LUBLIN

INTRODUCTION: Previous research studies suggest that the success of the sport climber is primarily determined by variables that can be improved through training, such as strength, power, or endurance, rather than anthropometric variables. However, there is a lack of research assessing differences in body composition and anthropometric parameters between the two most common sport climbing sub-disciplines – lead climbing and bouldering.

METHODS: This study analyzed the relationships between age, climbing experience, body mass, body height, and body mass index, and the best result in sport climbing among male lead climbers and boulderers. The data of the 422 best male sport climbers based on 8a.nu world ranking were an-alyzed in two categories: "Route Ranking: Top-10 climbs last 12 months" for lead climbers and "Boulder Ranking: Top-10 climbs last 12 months" for boulderers.

RESULTS: The comparison of the lead climbers and boulderers (collectively, in groups Elite and Higher Elite) showed that the lead climbers started climbing at a younger age, had a lower body mass and lower height, and had a longer period to achieve the hardest route in comparison with the boulderers. Lower height and lower body mass were also observed among "Higher Elite" lead climbers compared to "Elite" lead climbers. When comparing the "Elite" and "Higher Elite" groups in both lead climbing and bouldering, the "Higher Elite" group started climbing at a younger age and had a longer period to achieve the hardest route.

CONCLUSION: This retrospective study suggests that lower body mass and height are more crucial for lead climbing performance than for bouldering. Younger starting age and longer sporting experience are the key points in the "Higher Elite" level in both subdisciplines.

Conventional Print Poster Presentations

CP-AP12 Sports Technology

EXPLORATORY RESEARCH AND ANALYSIS OF THE PHYSICAL FITNESS TEST SYSTEM ON MOTION CAPTURE AND BODY TRACKING

YANG, P.C., CHIU, Y.2,3, CHUANG, Y.4, CHEN, I.3

1CHANG JUNG CHRISTIAN UNIVERSITY. 2CHANG JUNG CHRISTIAN UNIVERSITY. 3KAOHSIUNG MEDICAL UNIVERSITY. 4KAOHSIUNG MEDICAL UNIVERSITY.

INTRODUCTION: Physical fitness encompasses the bodys capacity to adjust comprehensively. More workforce and material resources must be put into the fitness assessment, which can lead to inconsistent data quality due to different exam-

iners or assistants. The data collected from the assessment tends to be fragmented or singular, needing continuous process records and analysis of dynamic motion. With the advancement of science and technology and the growing trend of sports technology, scientific data is collected and measured conveniently through innovative computer vision technology.

METHODS: This study aims to establish the necessary technological framework for motion capture and body tracking to analyze the landmark data of human bodies in a video and to develop computer vision technology to design and develop the physical fitness detection system for college students. This research designed an image data collection environment, developed a computer vision-based physical fitness test system using Googles MediaPipe framework to measure and validate data of physical fitness testing items, and enhanced Physical Fitness Testing procedures.

RESULTS: The dimensions of the experimental space are 300 centimeters in length, 380 centimeters in width, and 250 centimeters in height. We analyzed data from 6 participants. The data collection sessions were conducted individually and were stored for later analysis. The preliminary result shows that the sit-ups, sit and reach, and standing long jump is high as large, more than 0.9; the correlation via logistic regression models suggests that the relationship between the traditional method and the computer vision-based technology beliefs is very strong.

CONCLUSION: AI imaging technology brings benefits to physical fitness testing. The system can capture human body motion via pose detection and pose tracking. The studys overall architecture is feasible and practical.

THE REAL-TIME TABLE TENNIS SWING CLASSIFICATION SYSTEM BASED ON TINYML

SHEU, Y.H., CHEN, T., WU, S.

NATIONAL FORMOSA UNIVERSITY

INTRODUCTION: With the rise of sports technology and Artificial Intelligence (AI), the integration of sensors with AI is gaining popularity in the sports industry. The emerging technology of Tiny Machine Learning (TinyML), developed in recent years to address the limited computational resources of devices, is being widely adopted. This study introduces a cost-effective The Real-time Table Tennis Swing Classification System Based on TinyML. The system aims to reduce the training burden on table tennis coaches or players and enhance the interest of beginners in learning professional techniques.

METHODS: The system is primarily comprised of two main components: the hardware, known as the embedded AI smart table tennis racket, and the software, referred to as the computer application. The hardware aspect, the embedded AI smart table tennis racket, includes the racket itself and an RF wireless receiver for receiving measurement signals. The software component, the Computer Application, is responsible for displaying the classification results. This combination establishes a real-time table tennis swing posture classification system based on TinyML technology.

After collecting the swing data, it is transmitted to the AI-MCU (Microcontroller Unit) on the Embedded AI Smart Table Tennis Racket. The AI-MCU uses its TinyML model for real-time swing posture classification. The classified swing data is then wirelessly transmitted via Radio-Frequency (RF) to the computer-side application for display. The embedded AI smart table tennis racket utilizes the STM32F7 component as the main control chip. The STM32F7 component is responsible for communication and control of 6-axis sensorts and performs processing and calculations for the TinyML model.

RESULTS: In the data analysis, real-time classification is achieved using AI deep learning theory. By collecting swing data from our schools players, four different AI deep learning models are tested for data segmentation and classification accuracy of swing data. The experimental results show that Convolutional Neural Networks (CNN) have the best capability for waveform segmentation and swing classification accuracy. In practical swing tests, the converged training data and optimized CNN model achieve an average classification accuracy of approximately 98.3% for actual table tennis player swings. Through the development of the Embedded AI Smart Table Tennis Racket, it not only enables swing posture classification but also corrects the swing postures of typical table tennis beginners, achieving the intelligent training goal for table tennis.

CONCLUSION: Through the development of the Real-time Table Tennis Swing Classification System Based on TinyML, it not only enables swing posture classification but also corrects the swing postures of typical table tennis beginners, achieving the intelligent training goal for table tennis. In the future, this research can also be combined with AR/VR related applications.

VARIATION IN MIDSOLE STIFFNESS, INDEPENDENT OF ENERGY RETURN, DOES NOT AFFECT RUNNING ECONOMY IN TRAINED MALE DISTANCE RUNNERS

PAGE, D., AUDET, A., LOCKE, C., MELVIN, A., LEPLEY, A., KOZLOFF, K.

UNIVERSITY OF MICHIGAN-ANN ARBOR

INTRODUCTION: Advances in running shoe technology focus on combining embedded carbon fiber plates with novel midsole foams to improve running performance. Variations in midsole stiffness and energy return (ER) across brands have been shown to influence running economy (RE) [1,2]. Differences in shoe last, foam composition, plate stiffness, and other specific design features make it difficult to attribute the importance and interaction between midsole stiffness and ER. The purpose of this study was to assess changes in RE in response to different midsole mechanical properties within a singular brand's line.

METHODS: This study examined three shoes of a singular brand's line (M1, M2, M3) (Mass = 218, 210, 210g respectively [3.7% difference]), heel stack (42, 36, 33mm respectively [27.3% difference]) featuring nitrogen infused EVA foam midsoles. Only M1 contained a carbon fiber plate. Stack height was measured at the heel with sock liner intact under a load of 5N.

The shoes were uniaxially loaded over 100 cycles (687N; 70kg body mass [BM] equivalent). Force was applied separately at the heel and midfoot regions, and stiffness and ER were obtained. 8 trained male runners (Age: 22.3 +/- 2.3yr, BM: 63.9 +/- 2.0kg, World Athletics Score: 904.9 +/- 159.0 pts) of the same shoe size (US9) completed a 10-min warm-up (12.39kph) followed by two, 3-min trials in each shoe (14.86kph). Shoes were tested in a randomized and mirrored order. Blood lactate was measured at rest, and after trials 1, 4, and 6 to ensure participants were below aerobic threshold (defined as an increase in blood lactate >1.5mmol/L above resting). RE was calculated using a 5 breath moving average of VO2 from the last minute of each trial and averaged between both trials run in the same shoe per subject. A repeated-measures ANOVA was used to assess differences between heel and midfoot stiffness and RE.

RESULTS: Shoes differed in stiffness at the heel (M1=63.3; M2=64.3; M3=79.1 kN/m [25% max difference]) and midfoot (M1=54.4; M2=81.4; M3=72.0 kN/m [49.6% max difference]). ER was similar across all three models at the heel (M1=73.1; M2=72.8; M3=72.6% [.7% max difference]) and midfoot (M1=74.4; M2=72.2; M3=73.0% [3% max difference]). RE was not significantly different (p=0.057) between shoes, which differed up to 1.61% (M1=186.3 +/-13.1ml/kg/km, M2=188.3 +/-10.9ml/kg/km, M3=189.3+/-11.9ml/kg/km).

CONCLUSION: In the present sample of trained men of similar body mass, RE did not significantly differ in shoes whose midsole foams differed in stiffness but not ER. A more diverse subject pool and greater variations in ER between shoes may be needed to identify the magnitude of ER necessary for significant improvements in RE. Maximizing ER may be more impactful than altering midsole stiffness when determining foam properties that maximize distance running performance.

REFERENCES:

1. Burns et al, 2023 ECSS.

2. Joubert et al, 2023 Int J Sport Phys Perf.

COMPARISON OF VENTILATION AT VARIOUS EXERCISE INTENSITIES WITH SMART-GARMENT HEXOSKIN VS A WEARABLE METABOLIC SYSTEM IN HEALTHY YOUNG PARTICIPANTS

FRIOCOURT, M., SHEEL, A.W., ALIVERTI, A., BERTIN, D., MAIGNANT, G., BOUGAULT, V.

UNIVERSITÉ CÔTE DAZUR

INTRODUCTION: In sports and health sciences, the assessment of minute ventilation (V Ė) is needed to determine ventilatory thresholds, to identify some abnormal breathing patterns, but also to quantify the inhaled dose of a pollutant during exercise. However, V Ė measurement is currently not routinely available in the field. The smart Hexoskin T-shirt (Carré Technologies, Canada) is a promising tool in this regard, but validation studies are still conflicting, especially for ventilations above the first ventilatory threshold (VT1). Our aim is to investigate the validity of the V Ė measurements provided by the Hexoskin T-shirt at different intensities in healthy active participants.

METHODS: Healthy subjects (6 W, 6 M, age 24±7 yrs, height 172±10 cm, body mass 68±12 kg, V Ȯ2max 51±9 ml.min-1.kg-1, mean ± SD) underwent a cardiopulmonary exercise test (CPET) with 2-min increments on a cycle ergometer (Saris H3, Saris, USA). After a 20-min of rest, a time to exhaustion (TTE) test was performed at 95% of maximal aerobic power or greater to add high intensity V Ė data set. V Ė was measured continuously using a metabolic system (Metamax 3B, Cortex, France) and Hexoskin. The tidal volume of Hexoskin was adjusted a posteriori for each subject by multiplying the values by a conversion factor, as specified by the manufacturer. This factor was obtained thanks to a spirometric forced expiratory manoeuvre before exercising, allowing to obtain the volume per signal amplitude. The V Ė obtained by the two techniques were then synchronised in time and compared breath by breath. The VT1 was determined by the respiratory equivalent method.

RESULTS: 8 subjects completed the TTE test. When considering V Ė during both CPET and TTE, the Pearson correlation coefficient (r) between both methods varied from 0.72-0.98. Individual mean differences vary between 3 l.min-1 and 54 l.min-1, with a total mean difference of 34 l.min-1. The coefficients of variation (CV) varied from -160 % to 310%. In CPET alone (n=12), r varied from 0.92-0.99 and mean differences between -3 l.min-1 and 71 l.min-1. In TTE alone (n=8), r varied from 0.54-0.98 and mean difference vary between 2 l.min-1and 88 l.min-1. When we compared V̇E values below the VT1 only, r varied between 0.77 and 0.98 and mean differences between -4 l.min-1and 34 l.min-1. Above VT1, r varied from 0.59-0.97 and mean differences from -3 l.min-1 to 105 l.min-1. Except for one subject, Hexoskin overestimates V Ė values.

CONCLUSION: We found poor agreement between V Ė as measured with Hexoskin and the Metamax. Despite good correlation coefficients, the mean differences and CV are high, with very dispersed values around the mean difference, whatever the intensity. It seems the validity is better in some subjects compared with the others, and the explicative variable remain to be investigated.

DEVELOPMENT AND CONSTRUCTION OF AN ISOKINETIC DEVICE FOR ECCENTRIC HIP ADDUCTION EXERCISES

CVJETICANIN, O., MARUŠIC, J., ŠARABON, N.

FAKULTETA ZA VEDE O ZDRAVJU, UNIVERZA NA PRIMORSKEM

INTRODUCTION: The hip adductor muscle group plays an important role in mobility and stability of the hip joint during various athletic activities [1]. In sports characterized by high-speed movements and frequent changes of directions (e.g., football, ice hockey), injuries to the hip adductor muscles are common. Eccentric training has shown promising results in preventing muscle damage and reducing injury risk [2]. Given that commercially available devices for eccentric training of

hip adductor muscles are often expensive and complex to use, thus limited in practical application, the objective of this study, i.e. project, was to introduce optimized training device, better suited for everyday use.

METHODS: The development of the optimized training device (OTD) for eccentric hip adduction was split into two distinct phases. The initial phase centered on developing an adjustable sensory device (ASD) tailored specifically to validate functional requirements. During this phase, 12 subjects performed eccentric hip adduction with the ASD, providing insights into expected maximum torque produced across various exercise variations. Specifically, comparisons were made between long-lever (support above the ankle) and short-lever (support above the knee) variations, unilateral versus bilateral exercise, and different angles of hip flexion (0, 45, and 90 degrees). The data collected during this phase was used to optimize the design process for the first OTD prototype developed in the second phase of the project.

RESULTS: The initial measurements conducted with an ASD provided crucial input parameters for the development of the first OTD prototype. The determined maximum peak torques from these measurements enabled the selection of an appropriate electric motor as the primary driving source for the device. Results of the measurements also revealed that maximal torque development occurred at hip flexion angles of 0 or 45 degrees, with a notable decrease in maximal torque observed at a 90-degree angle. Furthermore, we observed comparable torque production between long-lever (support above the ankle) and short-lever (support above the knee) variations of the exercise. Notably, the use of the short-lever variation allowed for the design of a more compact device in the initial prototype development process. Ultimately, the unilateral version of the exercise proved less viable, attributed to reduced torque output and the requirement for uncomfortable fixation methods. The aforementioned findings played a crucial role in the successful design of an optimized training device for eccentric hip adduction training.

CONCLUSION: A novel solution for eccentric hip adduction training has been introduced. The initial prototype of the OTD was developed based on insights from measurements using the ASD. This developed OTD prototype stands out for its affordability, robustness, and user-friendly design, offering potential contributions to injury prevention across various athletic activities.

VRODEL – LEARN TO LUGE IN A VIRTUAL WORLD

HOLLAUS, B., KEINER, J., GALLINAT, M., KRANHOLDT, S., MIKULIC, D., VOLMER, J.

MCI INNSBRUCK

INTRODUCTION: Luge is a low-cost and accessible recreational activity, which is popular in alpine regions. However, the risk of injury is high, especially for beginners or tourists according to ÖKAS [1]. Therefore, promoting luge safety is important to minimized the amount of accidents and deaths in luge. In most cases the reason behind an accident is the lack of skill in steering the luge [2]. Hence, it would be ideal, to have the skill to steer already before luging on a slope. How can the skill be learned in a safe way without luging on a slope? In cooperation with the luge federation of Austria (Rodel Austria), the project VRodel was realized, that answers this question.

METHODS: In a first step of the VRodel project, a requirement analysis was realized. It was important to answer the question, what users would expect and want from a luge safety experience. The outcome showed, that a virtual and immersive game is of interest, that appears as real as possible. Additionally, it should train the steering and other skills in luge which can be transferred to a real luge experience. In a second step, the luge slope of Kühtai was virtualized by means of photogrammetry. The three-dimensional model was then cleaned, polished and set into the virtual Stubai vally. In a third step, a game was developed in the virtual world, to create a virtual training. The focus was on the correct physical behavior of the luge in the virtual world. Based on measurements, physical properties like friction coefficients & the effect of body movement on steering have been adjusted. The safety training uses gamification aspects to be as immersive as possible. As a fourth step, the game was tested by experts of Rodel Austria and some beta-testers.

RESULTS: The project resulted in a virtual reality safety training for the sport of luge, that excels the current luge simulation games in terms of appearance, realness and transferability of skills into the real sport. This was underlined by the feedback of the experts of Rodel Austria and some beta-testers.

CONCLUSION: Le Noury et al. mention the potential of extended reality for training a skill in sports in their review. They also outlined that this field showed low efficacy on improving motor skills in the past and more research is needed [3]. This project is addressing the needs from society for safer luging and at the same time used an approach that needs more research according to Le Noury.

Reference:

[1] ÖKAS, Österreichisches Kuratorium für Alpine Sicherheit. (2021, April). Der Zwischenbericht Winter. https://alpinesicherheit.at/wp-content/uploads/2022/05/PA-2022-Winter-2021_22_12042022.pdf

[2] Regina Sterr, Österreichisches Kuratorium für Alpine Sicherheit. (2019, January 29th). Rodeln in Zahlen. https://www.alpinmesse.info/de/Rodeln-in-Zahlen/

[3] Le Noury, P., Polman, R., Maloney, M. et al. A Narrative Review of the Current State of Extended Reality Technology and How it can be Utilised in Sport. Sports Med 52, 1473–1489 (2022). doi: 10.1007/s40279-022-01669-0

ROBUST GOLF SWING ANALYSIS: A MACHINE LEARNING APPROACH WITH INTEGRATED BODY DYNAMICS

HONG, E.

WASHINGTON UNIVERSITY IN ST. LOUIS

INTRODUCTION: Artificial intelligence has found widespread application across various domains, including sports education where machine learning (ML) techniques are applied to analyze players movements thereby offering valuable insights for enhanced performance.

We introduce a golf swing analysis system that harnesses the power of machine learning while addressing critical shortcomings commonly encountered in existing ML-based AI tools. In our work, a ML-model is deployed on a comprehensive dataset comprising diverse golf swings and discerns correlations between the trajectory of the golfers shoulders and the resulting ball flight. The acquired data serves as the foundation for predictive analytics to offer actionable insights into the quality of the swing. Notably, the rotational angles derived from the players motion serve as invaluable indicators of the golf swings dynamics.

METHODS: Most state-of the art AI tools rely on ML-based pose detection to extract coordinates of crucial body points, but these tools often yield inaccurate results, particularly when analyzing movements of high-level players. This can be due to the fact that these tools are typically trained on datasets comprising predominantly of data from average individuals. For instance, professional players fully turn their shoulders up to 180 degrees during their swings, a rarity among non-professionals.

We can either re-train the tool with datasets containing instances of abnormal poses or selectively rectify inaccurate results based on body dynamics to address the problem. Our approach adopts the latter strategy and uses a formula to determine the horizontal rotation angle by comparing shoulder widths at setup and follow-through positions as follows.

shoulder_turn (°) = arccos (shoulder width at follow-through/shoulder width at setup position) x 180/π

In case that the tool fails to accurately detect shoulder positions, we identify the last correct shoulder coordinates during the swing and project the correct shoulder positions for the remainder of the swing based on body dynamics analysis.

RESULTS: In our experimentation, player's swings are analyzed by MediaPipe, a ML-based pose detection tool, and the subsequent ball trajectories are measured using TopTracer, a commercial ball tracing system. Their comparisons reveal a compelling correlation between the shoulder rotation angle and the flight path of the ball.

We also confirmed that MediaPipe generated occasional errors in pose analysis. Our post-processing tool automatically detected them and corrected such errors. The amount of error recovery ranges from 36° to 42° in shoulder rotational angle. This ensures that the data obtained is reliable and reflective of the true dynamics of the golfers swing.

CONCLUSION: While expanding the dataset holds promise, its effectiveness in rectifying errors requires further investigation and validation. Also, exploring the impact of augmenting the dataset on error reduction can be a promising direction for future work.

THE INFLUENCE OF A SPORTS VISION TRAINING PROGRAM ON PERFORMANCE OF RELATED TASKS OF VISUAL PERCEPTION IN VARSITY ATHLETES

STEWART, T., DALTON, K., CINELLI, M.

WILFRID LAURIER UNIVERSITY

INTRODUCTION: Sports Vision Training (SVT) is an emerging field in athlete development with the goal of improving visual abilities in athletes to improve sport performance. Athletes exhibit heightened visual abilities such as dynamic visual acuity (DVA) [1], multiple object tracking (MOT), and peripheral awareness [2] when compared to non-athletes. These visual abilities are also found to be correlated with sports performance [3]. Visual abilities such as choice reaction time, go/no-go, and visual memory can also be enhanced through SVT, with improvements observed in strategic sports (i.e., hockey) [4,5]. Training using SVT modalities has led to improvements in on-field decision making [6], however, this is not the consensus, as other research found no improvements in visual abilities or in-game statistics [7]. Previous findings suggest that the influence of SVT on enhancing the visual system is still not fully understood. Therefore, the aim of this study is to evaluate the influence of a novel SVT intervention on visual perception in strategic sport athletes.

METHODS: Strategic sport athletes (n=3 completed; n=9 in progress) completed 10 sessions of visual software (i.e., visual perception) SVT, with visual abilities being assessed at pre- and post-training. The one-hour training sessions consisted of various SVT modalities including Neurotracker, Senaptec Strobe Glasses, SwitchedOn, and Fitlights, with the goal of enhancing visual perception and utilization of vision for action. The visual assessment consisted of three measurement tools to assess 13 visual and sensorimotor abilities, including DVA, MOT, anticipation timing, and go/no-go. The tools included are: DVA task (moV& V&MP Vision Suite), Bassin Anticipation Timer, and Senaptec Sensory Station. Athletes were assessed pre- and post-training and the data were analyzed using a paired-samples t-test, with significance set at $p<.05$.

RESULTS: Following the training, there was a significant improvement in the go/no-go task (total score) (mean diff. = -5.00, t =-8.660, p=.013), MOT (composite score) (mean diff. = -0.1579 t=-15.830, p=.004), and absolute error of anticipation timing (msec) at 40mph (mean diff. = 6.67, t=6.995, p=.02). No significant changes in the scores from pre- to post-training were found in the other visual abilities, however many approached significance and data collection is ongoing.

CONCLUSION: The findings suggest that the novel visual software SVT program can lead to improvements in visual abilities including go/no-go, multiple object tracking, and a reduction in anticipation timing error. Overall, a visual software-

specific SVT program can improve some measures of visual perception in strategic sport athletes that are known to be correlated with sports performance.

1. Yee et al. (2021) 2. Faubert (2013) 3. Poltavski & Biberdorf (2015) 4. Poltavski et al. (2021) 5. Schwab & Memmert (2012) 6. Romeas et al. (2016) 7. Liu et al. (2020)

BREAST HEALTH INTERVENTIONS HAVE A POSTIVE IMPACT IN ELITE FEMALE SOCCER MATCH OFFICIALS

ERRINGTON, C., TARNOWSKI, C.A., ROLLO, I., QAQAYA, N.Y., HELSEN, W.F., PAINES, E., JONES, M., BURBAGE, J.
GATORADE SPORTS SCIENCE INSTITUTE

INTRODUCTION: Many elite female athletes (83%) report below-average breast and bra knowledge. Interventions in elite female athletes, including education sessions and individual bra assessments, can improve breast and bra knowledge, as well as breast pain and comfort. This can subsequently improve sport performance. However, to date, there is no information regarding interventions in elite match officials, despite being exposed to similar training and competition demands as athletes, whilst also wearing additional devices on their upper body. Therefore, the aim of this study was to understand the breast/bra knowledge and breast comfort of female soccer officials, and evaluate the impact of an education session and individual bra assessment.

METHODS: Nineteen elite female soccer match officials (age: 38 ± 5 y) attended a 1 h online breast/bra health education session, followed by an individual bra assessment with a trained professional. Each match official was then provided with a new high-support sports bra. A questionnaire was administered before the intervention (PRE) and four weeks after the intervention (POST). The PRE questionnaire assessed variables such as previous sports bra fitting experience, interaction of wearable devices with sports bras, breast/bra knowledge (1=extremely poor, 5=excellent) and breast pain (0=no pain, 10=worst possible pain). The POST questionnaire repeated the assessment of breast/bra knowledge, and compared their old vs. new sports bra in terms of fit (0=does not fit at all, 10=perfect fit), support (0=very unsupportive, 10=very supportive) and breast pain. PRE and POST data were compared using a paired samples t-test, with statistical significance set at $p < 0.05$. Data are shown as (mean ± SD, range).

RESULTS: Breast/bra knowledge increased from PRE (3 ± 1, 1-5) to POST intervention (4 ± 1, 3-5) ($p < 0.05$). PRE data found that 32% of elite match officials experience breast pain, with a pain severity rating of 4/10, and that 37% experience problems with wearing a sports bra due to interference from upper body wearable devices. 74% of match officials had never been fitted professionally for a sports bra prior to the intervention. POST data demonstrated a 30% improvement in fit of the new sports bra (8.5 ± 1.7) vs. their old sports bra (6.6 ± 1.9) and a 28% improvement in support (6.7 ± 2.0 to 8.6 ± 1.0, respectively, all $p < 0.05$). The new sports bra reduced breast pain by 20% vs. the old sports bra (2.6 ± 2.5 vs. 1.1 ± 1.7, respectively, $p < 0.05$).

CONCLUSION: The education session and individual bra assessment successfully improved the breast/bra knowledge of the elite female soccer match officials. Provision of a new high-support sports bra improved fit and support, subsequently reducing breast pain. The finding that upper body wearable devices interfere with sports bra comfort in this population warrants further investigation to identify potential solutions.

Conventional Print Poster Presentations

CP-MH07 Health and Fitness/Exercise interventions

ENERGY EXPENDITURE AND COGNITIVE RESPONSES DURING ACUTE HIGH-INTENSITY FUNCTIONAL EXERCISE IN SUB-HEALTHY OLDER ADULTS

LEE, C.L.1, CHANG, N.J.2
NATIONAL SUN YAT-SEN UNIVERSITY 1, KAOHSIUNG MEDICAL UNIVERSITY 2

INTRODUCTION: According to the American College of Sports Medicine [1], an annual survey of fitness trends worldwide showed that high-intensity interval training (HIIT) has been one of the main trends for the past ten years. An alternative to HIIT is high-intensity functional training (HIFT), a relatively new training modality that emphasizes multi-joint functional movement that can be adapted to any fitness level and lead to higher muscle recruitment than more traditional forms of exercise [2]. HIFT is a form of intense exercise prescribed in various modalities and durations; however, little is known about the influence of acute HIFT on older adults.

METHODS: Eighteen sub-healthy older adults were randomly selected and conducted in a balanced order to four trials after a maximum oxygen consumption test with the incremental load on an ergometer. We tested the acute effects of HIIT vs. HIFT vs. HIFT followed by HIIT [HIFT+HIIT] vs. HIIT followed by HIFT [HIIT+HIFT] on energy expenditure (EE), excess post-exercise oxygen consumption (EPOC), and cognitive performance. The HIIT technique consists of 30 seconds of exercise for 12 movements with a 30-second rest between interval movements; the HIFT and HIIT sessions are similar, except for the 8 movements combined with free weight lifting.

RESULTS: The EE during exercise in the HIIT was significantly higher than that in the HIFT+HIIT, HIIT+HIFT, and HIFT (5.41 vs. 4.60 vs. 4.59, and 3.71 kcal/hour/kg, $p < .05$). The EPOC during recovery in the HIFT+HIIT was significantly increased by 143%, 177%, and 246% compared to the HIIT+HIFT, HIIT, and HIFT conditions, respectively ($p < .05$); however, the HIIT+HIFT

did not differ from HIIT or HIFT condition (p > .05). The Stroop test was not significantly different between exercise intervention among four conditions, but the cognitive abilities of Memory Sweep and Problem-Solving after 30 minutes of exercise among four conditions were significantly better than pre-exercise (p < .05).

CONCLUSION: Integrating vigorous, interval cardio with strength training activities, regardless of the sequence, may dampen the anticipated surge in energy burn typically brought on by the cardio alone. Nevertheless, pairing resistance exercise followed by aerobic exercise might be advantageous for heightening the EPOC throughout the recovery phase. Moreover, all four types of exercise were found to improve partial cognitive function for aging adults with sub-healthy issues.

References:

[1] Thompson, W. R. (2022). Worldwide survey of fitness trends for 2022. ACSMs Health & Fitness Journal, 26(1), 11-20.

[2] Rivas-Campo, Y., García-Garro, P. A., Aibar-Almazán, A., Martínez-Amat, A., Vega-Ávila, G. C., Afanador-Restrepo, D. F., ... & Hita-Contreras, F. (2022, April). The effects of high-intensity functional training on cognition in older adults with cognitive impairment: A systematic review. Healthcare, 10 (4), 670.

EFFECTS OF REDUCED TRAINING FREQUENCY ON LOWER BODY MUSCLE STRENGTH AND MASS, AFTER 12 WEEKS OF SYSTEMATIC CONCURRENT TRAINING

MPAMPOULIS, T., STASINAKI, A., ZARAS, N., BOGDANIS, G., TERZIS, G.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Systematic concurrent resistance and aerobic training results in substantial increases in muscle strength and mass as well as major improvements in various health indices. Yet, sports enthusiasts are often forced to reduce their training frequency or completely abstain from training for certain periods due to lack of time or mild injuries. Nevertheless, it remains unclear whether reducing training frequency, without reducing training intensity, might result in preservation of muscle strength and mass achieved during the systematic training period. The purpose of this study was to investigate the effect of concurrent resistance and aerobic training once per week or once every two weeks, on muscle strength and mass, after a period of 12 weeks of systematic concurrent resistance and aerobic training performed twice per week.

METHODS: Twenty young moderately-trained women (height 164±4.8cm, mass 60,9±6.1kg), with no experience in systematic resistance exercise, followed 12 weeks of lower body resistance training [leg press, 4 sets X 6 repetitions, 80% of maximal strength (1-RM), 2/week] and high intensity interval bicycling (10X1min, at 100% aerobic power, with 1 min rest between bouts). After this 12-week training period, participants were equally assigned into 2 groups: one group trained once per week (G7), while the other group trained once every two weeks (G14), for another 12 weeks, with the training intensity and volume used at the last training session of the initial 12 weeks. Leg press 1-RM and quadriceps muscle cross sectional area (CSA, via ultrasonography) were evaluated before (T1), at the end of 12 weeks of systematic training (T2), after 6 weeks (T3) and after 12 weeks (T4) of reduced training frequency. Data were treated with repeated measures ANOVA and Tuckey post-hoc test (statistical significance was set at $p \leq 0.05$).

RESULTS: Leg press 1-RM and quadriceps CSA increased after systematic training (G7: 29.6±13.8% and 14.2±4.9%, respectively; G14: 29.9±7.9% and 14.5±3.6%, respectively, $p<0.05$). Leg press 1-RM remained unchanged for both groups after 6 weeks of reduced training frequency. Leg press 1-RM and quadriceps CSA decreased only in G14 after 12 weeks of reduced training frequency compared to T2 (2.9±2.5% and 5.9±1.7% respectively, $p<0.05$).

CONCLUSION: These results suggest that muscle strength of the lower extremities is well preserved with only 3 training sessions in 6 weeks (once every 14 days), after a period of systematic concurrent training. If this bimonthly training frequency is continued for 6 more weeks both muscle strength and mass decrease significantly, yet most of the resistance training-induced improvements are preserved. Therefore, performance of one training session every 2 weeks for 3 months after cessation of systematic concurrent training may preserve up to 90% of the muscle mass and strength adaptations achieved, if the training intensity and volume are sufficient.

SIMILAR IMPROVEMENT IN AEROBIC PERFORMANCE FOLLOWING EITHER NORMOXIC, HYPOXIC, BLOOD FLOW RESTRICTION, OR ECCENTRIC CYCLING TRAINING IN ELDERLY INDIVIDUALS.

CITHERLET, T., MOTA, G., CARLETTA, M., HAYOZ, K., SILVA PEREIRA, D., MILLET, G.

UNIVERSITY OF LAUSANNE

INTRODUCTION: The elderly population is growing worldwide and has an increased risk of non-communicable diseases such as cardiovascular diseases. It is crucial to find efficient strategies to manage the associated health and financial burden. Hypoxic (HYP), blood flow restriction (BFR), and eccentric (ECC) training have emerged as training modalities of interest to counteract aging effects. Nevertheless, these interventions have never been compared. Thus, this study aimed to evaluate whether moderate-intensity intermittent training (MIIT) combined with HYP, BFR, or ECC in the elderly can induce greater effects on aerobic fitness than traditional cycling training (CON).

METHODS: Fifty-five elderly completed four weeks of MIIT on a bicycle (3 sets of 5 min of exercise followed by 5 min of rest, with an additional set each week) in one of four conditions: HYP (fraction of inspired oxygen ~14%), BFR (cuffs pressure ~350 mmHg), ECC, and CON. For all groups, the pedaling cadence was set at 60 rpm, and exercise intensity was determined by a perceived exertion level of 14 on the 6-20 Borg scale. Aerobic fitness was assessed through a 6-min cycling test, with concomitant oxygen consumption, heart rate, stroke volume, cardiac output, and muscle oxygenation (TSI)

measurements using indirect calorimetry, impedance cardiography, and near-infrared spectroscopy, respectively. Muscle oxidative capacity was evaluated through TSI measurement during repeated occlusions after exercise cessation.

RESULTS: Post-training, all groups exhibited a significant increase in average relative power during the 6-min cycling test (CON 20±23%; HYP 7±9%; BFR 10±10%; ECC 4±24%; P<0.0001); however, these increases were not significantly different between the training modalities (P=0.071). Post-intervention, TSI decreased by -3±5% (P=0.001) and oxygen consumption increased by 9±17% (P=0.001), with no group differences. No training or group effects were found for muscle oxidative capacity, heart rate, cardiac output, and stroke volume.

CONCLUSION: Aerobic performance was enhanced in all groups to a similar extent, highlighting the relevance of these training modalities for improving exercise capacity. Nonetheless, there were no differences between the groups in performance or physiological responses, indicating similar effectiveness across these strategies. Performance increase can be attributed to improved oxygen extraction at the muscular level rather than improved convection. The commonly claimed superiority of ECC or BFR training for muscle adaptations, along with the HYP condition for cardiovascular fitness, was not confirmed by our findings. The results rather support a personalized approach to training prescriptions, considering medical status and individual preferences.

FEASIBILITY AND EFFICACY OF A 6-MONTHS, HOME-BASED RESISTANCE TRAINING IN HEALTHY OLDER ADULTS.

BOCHICCHIO, G., FERRARI, L., BOTTARI, A., CAVEDON, V., MILANESE, C., LUCERTINI, F., POGLIAGHI, S.

UNIVERSITY OF VERONA

INTRODUCTION: Aging is characterized by a natural decline in muscle mass, physical function, muscle strength, and power. Home-based resistance training interventions have gained increasing attention from scientists and healthcare system operators, but their efficacy is yet to be fully determined (1). Among the innovative solutions that have been proposed by the industry, the Kari® system combines a web-based prescription platform with a home-kit. Therefore, the purpose of this study was to verify the safety, feasibility, and efficacy of a 6-month home-based resistance training program with an innovative technological solution, in healthy older adults.

METHODS: 73 subjects (36 females) were randomly allocated to either a control (C, n: 27, age 66.6 ± 6.2 years; body mass 72.1 ± 13.8 kg; height 1.67 ± 0.10 m) or an intervention (I, n: 46, age 67.1 ± 5.8 years; body mass 74.2 ± 15.5 kg; height 1.68 ± 0.09 m) group. I group underwent a 6-month home-based resistance training program utilizing an innovative technological solution, which included a wearable inertial sensor and a dedicated tablet (Kari® system, Euleria, Trento). The safety and feasibility of the Kari® system were assessed by recording training-related adverse events and training adherence. Body composition, standing static balance, 10-meter walking, and loaded 5 sit-to-stand tests were performed at the beginning (T0), midpoint (T3), and conclusion of the experimental protocol (T6).

RESULTS: No adverse events were recorded. Adherence to the training program was relatively high (61% of participants performed the target 3 sessions) in the first trimester, while it significantly dropped (-19%) during the second one. The intervention positively affected walking parameters (T0-T6: speed +10.4%, cadence +4.8%, step length +5.1%, and double support -4.7%; p< 0.05) and maximal force (T0-T6: +9.4%, p= 0.009) while marginal or no effect was recorded on body composition, balance, and muscle power.

CONCLUSION: The Kari® system was a safe and feasible solution that provided short-terms high adherence and seems to positively affect walking parameters and lower limbs maximal force. This approach should be incentivized when barriers to participation in traditional resistance exercise programs are present.

1. Chaabene H, Prieske O, Herz M, Moran J, Höhne J, Kliegl R, et al. Home-based exercise programmes improve physical fitness of healthy older adults: A PRISMA-compliant systematic review and meta-analysis with relevance for COVID-19. Ageing Res Rev. 2021;67(January).

THE EFFECTS OF SHORT-TERM TRAINING MIDDLE-OLDER AGED ADULTS AS EXERCISE INSTRUCTORS GUIDING FRAIL OLDER INDIVIDUALS AT HOME ON ENHANCING DISABILITY PREVENTION

CHEN, T.I.1, HUANG, S.F.1, HUANG, K.C.2

1. CENTER FOR PHYSICAL EDUCATION, TZU CHI UNIVERSITY, HUALIEN 970, TAIWAN. 2. CENTER OF HOLISTIC EDUCATION, MACKAY MEDICAL COLLEGE, NEW TAIPEI, TAIWAN

INTRODUCTION: Physical activity is pivotal in slowing ageing and averting physiological disabilities. The burgeoning elderly population necessitates cultivating numerous professional exercise instructors to guide the older individuals who stay home for increasing physical activity. This study aims to train certified middle-aged and elderly exercise instructors to discern early signs of declining life function in elderly individuals and to formulate targeted preventive exercise prescriptions to mitigate the onset of disabilities proactively.

METHODS: The study engaged individuals aged 55 and above in a comprehensive 48-hour exercise instructor training program. Following certification, instructors applied their skills in their respective work areas, employing Life Function assessments to pinpoint potential frailty in older individuals. They categorized the subjects into two distinct groups: normal and frail. A strategic screening process featuring the Otassha 21-item questionnaire identified high-risk groups: physical weakness (PW), urinary incontinence (UI), falls and broken bones (FB), poor nutrition (PN), and dementia (DM). Subsequently, considering participant preferences, the PW, UI, FB, PN, and DM groups underwent further segmentation into four subgroups: normal control, normal training, frail control, and frail training, respectively. Each group received customized

exercise guidance for 8 to 20 weeks (5 to 7 days/week, 30-40 minutes/day) respectively. The instructors then conducted sessions in the homes of older individuals once a week.

RESULTS: This study trained 320 qualified instructors (65.45±5.91 years old) across Taiwan. In the initial phase, 97 participants (13 males, 84 females, 77.57±7.31 years old) were enrolled. Encompassing Otassha 21-item questionnaire screening, 29 individuals were categorized as high-risk for UI, and another 29 were flagged for an elevated risk of FB. In the UI subjects, the frail elderly individuals who underwent 8 weeks of home-based exercise training exhibited notable improvements, including increased grip strength, arm curl and chair stand test ($p < 0.05$). In the FB subjects, after 20 weeks of in-home guiding exercise, the frail training group demonstrated significant improvements across various physical parameters, including grip strength, arm curl, chair stand, step-in-place, 8-foot up and go, chair sit and reach, and one-legged standing with eyes open test ($p < 0.05$).

CONCLUSION: This study suggests that, in the coming aged and super-aged society, it might be an effective strategy to recruit middle-older aged adults and train them as instructors. Using the questionnaires, they can effectively identify the early frailty of older people. The specific home-based exercise prescriptions and in-home guidance enhance physical activity capabilities in frail individuals. It can resolve the concerns about a shortage of instructors and potentially prevent disability in elderly individuals.

THE IMPACT OF ACUTE LOW-INTENSITY RESISTANCE TRAINING IN GLOBAL AND LOCAL HYPOXIA ON ADRENALINE LEVEL AND LOWER-LIMB FORCE OUTPUT

HELBIN, J., LATOCHA, A., KASZUBA, M.

ACADEMY OF PHYSICAL EDUCATION IN KATOWICE

INTRODUCTION: Hypoxia is a state in which oxygen is not available in sufficient amounts to tissues. Hypoxia can be divided into global (low oxygen environment) and local (methods of limiting blood flow in the limb). Blood flow restriction (BFR) is a training method used to induce local hypoxia by applying inflatable cuffs to the proximal part of a limb, temporarily restricting blood flow. In practice, the BFR method appears to be more accessible than global hypoxia. It has been demonstrated that a single bout of resistance exercises increases adrenaline levels and might temporarily impair performance; however, it is unclear how hypoxic conditions and their types moderate such responses. The aim of this study was to compare the effects of low-intensity resistance training in normoxia, global hypoxia, and local hypoxia conditions on lower-limb force output and adrenaline levels, and to determine whether the type of hypoxia moderates such responses.

METHODS: Twenty-one healthy and physically active participants (age: 22 ± 2 years, body mass: 77.3 ± 12.6 kg, body height: 178 ± 8 cm) were randomly assigned to one of the following conditions: i) low intensity under normoxia [N] (n=7); ii) low intensity with BFR [BFR] (n=7); iii) low intensity under normobaric hypoxia [H] (simulated altitude of 3500 m; n=7). The experimental session consisted of 4 sets of 30/15/15/15 repetitions on a leg press machine with a load of previously determined as 30% of one repetition maximum. Before and immediately after finishing the experimental session, a venous blood sample was taken to assess the level of adrenaline. To assess lower-limb force output, participants performed maximal isometric half-squat on a force platform before and approximately 5 minutes after training session.

RESULTS: Two-way ANOVA did not show any statistically significant interaction ($p=0.688$), nor main effects of condition ($p=0.605$) and time ($p=0.407$) on force output during the maximal isometric half-squat. Friedman's test showed significant differences in adrenaline levels ($p<0.001$; test=13.762). Post-hoc comparisons showed a significant increase in adrenaline levels after training compared to baseline values (mean difference=11.76±19.27 pg/ml; $p=0.001$), with no differences observed between groups.

CONCLUSION: Several studies have shown that adrenaline plays a crucial role in cardiovascular and respiratory adjustments, as well as in substrate mobilization and utilization, potentially leading to positive adaptations to exercise. Previous research has found that acute bouts of heavy resistance exercise increase adrenaline levels. Our results indicated a marked increase in the concentration of this catecholamine after low-intensity resistance training across all studied conditions. Additionally, the absence of significant differences in force output between conditions suggests that neither H nor BFR induced greater muscle fatigue compared to low-intensity resistance training in normoxia.

EXTRA-HOSPITAL RESISTANCE EXERCISE INTERVENTION AFTER ACUTE CARE IMPROVES HEALTH OF PATIENTS WITH ANOREXIA NERVOSA

DEL VALLE PAGADOR, A., PAGADOR, A.1,2, MORÁN, E.3, OLMEDILLAS, H.1, COBO, A.3, MENENDEZ, A.A.4, SUAREZ, L.3, ARIAS, L.5, FAEDO, C.3, SÁNCHEZ, M.A.5, VALLADARES, P.3, SALCEDO, S.5, DÍAZ, C.6, TERRADOS, N.4, IGLESIAS, E.1,2, FERNANDEZ-DEL-VALLE, M.1,2

1 DEPARTMENT OF FUNCTIONAL BIOLOGY, UNIVERSITY OF OVIEDO, OVIEDO, SPAIN, 2 HEALTH RESEARCH INSTITUTE OF THE PRINCIPALITY OF ASTURIAS , OVIEDO, SPAIN

INTRODUCTION: Anorexia nervosa (AN) is a mental disorder characterized by an intense fear of weight gain and a disturbed body image [1]. With low recovery rates (50%), shows the second highest mortality rate (5-7%) among all mental disorders. Coinciding with the period of highest risk of relapse (after hospitalization), AN patients show an altered body composition and poor muscular health. Resistance training (RE) has been associated with benefits in factors that "are specific or diagnostic for AN" [2], however, prescription and implementation still under debate. Given the importance of returning to a healthy physical fitness - in addition to improved mental health [3], it is key to assist professionals in exercise

prescription management. Therefore, the aim of the study was to examine the effects of an evidence-based extra-hospital RE intervention on physical and mental health of AN patients after hospitalization.

METHODS: A total of 21 patients (age 22.38±8.9 years; body mass index 17.6±2.2 kg/m2) were randomly assigned to either exercise (ANE = 11) or control groups (ANC = 10). Physical fitness assessments included anthropometry, body impedance analysis [e.g. skeletal muscle mass (SMM), percent body fat], cardiorespiratory fitness test, half-squat (HS) test [e.g. HS maximal strength (HSFmax)], and grip strength. Mental health was evaluated through the Eating Disorder Examination questionnaire and Short Form Health Survey (SF-36). Intervention consisted of a 10-week evidence-based progressive RE program [4] of moderate-high intensity, 3 days/week, and including big muscle group exercises. After checking for normality, non-parametric U Mann-Whitney or parametric Student t test were performed.

RESULTS: ANE patients improved significantly muscular fitness [SMM - t(12)=2.24, p=0.045; HSFmax - Z = - 2.36, p = 0.018], symptomatology [Weight Concern – Z = - 2.98 , p = 0.003; Shape Concern – Z = - 2.65 , p = 0.009; Global Score – Z = - 2.15 , p = 0.032] and SF-36 perceived health [Body Pain – t(19)=2.35, p=0.030] to a greater extent compared to ANC. Additionally, a trend was found on the SF-36 Mental Component Scale – t(19)=2.07, p=0.052].

CONCLUSION: This is the first study to report significant improvements in AN symptomatology linked to the participation on a moderate-to-high intensity RE program. These results show that individualized and supervised extra-hospital RE in AN is safe and allows physical and psychological improvements which are key for a positive progress.

1 Zipfel et al. Lancet Psychiatry.

2 Hausenblas et al. Exercise and Sport Sciences Reviews.

3 Alberti et al. J Sports Med Phys Fitness.

4 Fernández del Valle et al. The International journey of eating disorders.

Conventional Print Poster Presentations

CP-MH08 Health and Fitness/Mobility issues

USEFULNESS OF 30S CHAIR STAND TEST AS A SURROGATE OF GAIT SPEED IN DIAGNOSING SARCOPENIA AND FRAILTY

SAWADA, S., LIU, Z., DENG, P., YOSHIHARA, T., NAITO, H., MACHIDA, S.

JUNTENDO UNIVERSITY

INTRODUCTION: Gait speed is considered as a representative indicator for evaluating physical function in the diagnosis of sarcopenia and frailty [1-3]. Since gait speed measurements require a certain amount of space, a previous study examined the usefulness of five-times sit-to-stand test as a surrogate of gait speed [4]. On the other hand, we reported that 30s chair stand test (CS-30) could be a useful tool for screening sarcopenia in older Japanese people [5]. The aim of this study is to examine the usefulness of CS-30 as a surrogate of gait speed, and to determine the cut-off point as a surrogate for the recommended gait speed cut-off of 1.0m/s for sarcopenia and frailty [2,3].

METHODS: A total of 1416 Japanese participants aged 65 years and over volunteered to participate in this study (478 men and 938 women, aged 77.2±7.8 years). For gait speed, participants were instructed to walk a 4-10 m course at their usual pace. For CS-30, participants were instructed to complete sit-to-stand trials using a 40-cm high seat without using their arms as many times as possible in 30 s [6]. Correlation analysis, simple regression analysis and ROC analysis were used to determine the usefulness and cut-off point.

RESULTS: Correlation analysis showed a significant relationship between gait speed and CS-30 ($r = 0.62$, $p < 0.001$), and the estimated formula was derived as follows: CS-30 scores = 14.744 × gait speed - 1.0976 (R2=0.38). From this formula, the CS-30 cut-off point for gait speed cut-off of 1.0m/s was estimated to be 14 times. On the other hand, ROC analysis showed that the AUC of the CS-30 for gait speed cut-off of 1.0 m/s definition was 0.88 ($p < 0.001$), and the optimal CS-30 score was 14 times (sensitivity, 83.8%; specificity, 80.7%).

CONCLUSION: The results from both simple regression analysis and ROC analysis indicated significant associations and confirmed that the optimal CS-30 cutoff score for definition the gait speed cut-off of 1.0m/s were consistent in 14 times. CS-30 can be a useful surrogate of gait speed for screening of sarcopenia and frailty.

References:

1. Cruz-Jentoft AJ, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing, 2019. 48(1): p.16-31.

2. Chen LK, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. J Am Med Dir Assoc, 2020. 21(3): p.300-307.

3. Satake S and Arai H. The revised Japanese version of the Cardiovascular Health Study criteria (revised J-CHS criteria). Geriatr Gerontol Int. 2020. 20(10): p.992-993.

4. Nishimura T, et al. Usefulness of chair stand time as a surrogate of gait speed in diagnosing sarcopenia. Geriatr Gerontol Int, 2017. 17(4): p.659-661.

5. Sawada S, et al. The 30-s chair stand test can be a useful tool for screening sarcopenia in elderly Japanese participants. BMC Musculoskelet Disord, 2021. 22(1): 639.

6. Jones CJ, et al. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport, 1999. 70(2): p.113-119.

THE INFLUENCE OF WORK PACE ON ENERGY EXPENDITURE AND LOAD IN INDUSTRIAL WORKERS: A RANDOMIZED CROSSOVER TRIAL

JAVANMARDI, S., RAPPELT, L., HEINKE, L., FREIWALD, J., NIEDERER, D., BAUMGART, C.

UNIVERSITY OF WUPPERTAL

INTRODUCTION: A higher pace of work on repetitive tasks may affect physical strain and work-related outcomes like error rate in industrial workers. However, the effects of different work paces on cardiovascular variables have not yet been investigated. This study elucidated the impact of work pace on cardiorespiratory factors and assessed workers' comfort, effort, and load. By understanding the needs of industrial workers, we can develop tailored health interventions.

METHODS: Twelve industrial workers (age: 44 ± 9 years; BMI: 27.7 ± 4.5 kg/m2) with at least one year of experience at a repetitive workstation and no acute injuries or physical limitations were tested on three different production environments (comparable repetitive tasks and equal amount of product handled). Work paces at 100%, 115%, and 130% of the internal target yield were randomly assessed. At each pace, a 5-minute familiarization was followed by a 5-minute data collection. Every minute, participants received feedback to adjust their pace. The total ventilation (VE), oxygen uptake (VO2), carbon dioxide release (VCO2), respiratory exchange ratio (RER; Metamax 3 B, Cortex, Leipzig), and heart rate (HR; Polar H10 chest band) were measured. Thereon, energy expenditure (EE) was calculated. In addition, the carried load (CL) was recorded in kg. Moreover, for each pace, all participants provided feedback on their comfort level using the visual analogue scale (VAS; 0-100) and their perceived effort (RPE; 0-10). One-way ANOVA was performed using R version 4.2.2.

RESULTS: No significant between-pace difference was found for RER, HR, RPE, or comfort ($p \leq .993$; $\eta p^2 \geq .001$). However, significant between-pace differences were found for VE, VO2, VCO2, EE, and CL ($p \leq .042$; $\eta p^2 \geq .25$). Post hoc comparisons revealed significant differences with small effect sizes between 100% and 130% in VE (15.9±2.8 vs. 17.1±3.3 l/min, p=.041, SMD=.38), VO2 (.48±.09 vs. .52±.12 l/min, p=.006, SMD=.35), VCO2 (.43±.09 vs. .46±.11l/min, p=.023, SMD=.34), and EE (165.9±33.4 vs. 178.8±40.1 kcal/h, p=.008; SMD=.35). Significant large pace effects were found for CL between 100% and 130% (14.6±1.4 vs. 18.4±1.8kg, p<.001, SMD=2.38), and between 115% and 130% (16.2±1.7 vs. 18.4±1.8kg, p=.007, SMD=1.25).

CONCLUSION: A work pace of 130% increases the physiological demand of industrial workers. However, whether the amount of changes and a load variation of only 4 kg/5 min influence health-related factors is questionable. Nevertheless, this study sheds light on the physiological profile of industrial workers, offering insights that may be valuable for informing preventive health-promotion strategies. Specifically, interventions in physical activity, job rotation or nutrition should be tailored to address the specific demands identified in this study.

EFFECTS OF A 12-WEEK UNIMODAL VERSUS MULTIMODAL EXERCISE INTERVENTION ON SINGLE- AND DUAL-TASK GAIT PERFORMANCE IN PATIENTS WITH OPEN ANGLE GLAUCOMA

FREITAG, C., BEHRENS, M., BIELITZKI, R., BEHRENDT, T., AL-NOSAIRY, K., STOLLE, F., PRABHAKARAN, G., BEYER, R., THIEME, H., HOFFMANN, M., SCHEGA, L.

OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

INTRODUCTION: In the early stages of open angle glaucoma (OAG), the symptoms are almost unnoticeable. However, OAG-induced visual field defects are associated with impaired gait performance during single- (STW) and dual-task walking (DTW), which increases the risk of falling. Resistance and motor-cognitive exercises/training have been shown to improve postural control and to reduce the fear of falling. Thus, a combination of both training modalities might be more effective in improving spatio-temporal gait parameters during STW and DTW. Therefore, the present study aimed to investigate the effect of 12 weeks of resistance training (unimodal, UM) versus resistance combined with motor-cognitive training (multimodal, MM) on STW and DTW gait performance in OAG.

METHODS: Nineteen OAG patients were included in a 12-week intervention containing either UM (N=10) or MM training (N=9). Before and after the intervention period, participants performed STW and DTW. During DTW, patients walked at comfortable velocity and had to perform different concurrent cognitive tasks in a random order: (i) Verbal Fluency Task, (ii) N-Back Task, and (iii) Reaction Time Task, with two difficulty levels, respectively. To calculate dual task costs (DTC), each cognitive task was also performed while sitting. During STW and DTW, spatio-temporal gait parameters were assessed using inertial measurement units (sampling frequency 100Hz). DTC in gait performance were assessed by the differences between STW and DTW. For statistical analysis, three-way (time × condition × group) repeated measures analyses of covariance were conducted. The practical relevance of the results was judged on the basis of the effect size, with a medium effect (η_p^2≥0.06) being considered meaningful.

RESULTS: Due to drop out/processing issues, only 12 participants (6 UM, 70.5±2.3years), 6 MM (69.2±6.5years) were included in the final analysis. For the MM group, changes in minimal toe clearance (MTC), stride length, and the coefficient of variation (CoV) of the respective parameters were indicated by time × group interactions for MTC (p=.151,η_p^2=0.22) and stride length (p=.444,η_p^2=0.07) and for CoV of stride length (p=.309,η_p^2=0.12) and of gait velocity (GV) (p=.301, η_p^2=0.12). Furthermore for DTC, time × group interactions were found in the UM group for cognitive performance

(p=.450,η_p^2=0.07), MTC (p=.016,η_p^2=0.54), MTC CoV (p=.005,η_p^2=0.65), stride length (p=.046,η_p^2=.411), GV (p=.525,η_p^2=0.06) and GV CoV (p=.364,η_p^2=0.10) revealing a reduction in these DTC in the UM group.

CONCLUSION: The UM and MM intervention affected gait performance differently. While the MM intervention improved several parameters of gait performance, the UM intervention reduced cognitive and gait performance DTC. Consequently, both the UM and MM intervention may be beneficial to counteract the deterioration of gait performance during STW and DTW walking in OAG patients, even though with different effects on gait parameters.

PHYSICAL EXERCISE IN PATIENTS WITH AXIAL SPONDYLOARTHRITIS: A SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

DREILICH, J., TREBING, S., KUPJETZ, M., KILTZ, U., BARALIAKOS, X., ZIMMER, P., SCHÜTZ, C., JOISTEN, N.
TECHNICAL UNIVERSITY DORTMUND

INTRODUCTION: Physical exercise is recommended to relieve symptoms of pain, stiffness, and limitations in physical function in patients with axial spondyloarthritis. This systematic review summarizes the evidence on efficacy and safety of physical exercise on disease-related outcomes ranging from objective clinical measures to patient-reported outcomes.

METHODS: This systematic review (inception to November 28th, 2023) was designed according to the PRISMA 2020 guidelines and prospectively registered at PROSPERO (CRD42023395570). The TESTEX tool was used to assess risk of bias.

RCTs investigating physical exercise in axSpA patients were searched in PubMed, Scopus, and Web of Science. Studies conducting aerobic, resistance or multimodal training interventions were considered eligible for inclusion. The comparator was declared as passive, standard care, or limited active control. Publication date and outcome measures were not restricted.

RESULTS: Fourteen included RCTs with 560 patients comprised eight studies on multimodal, five on endurance and one on resistance exercise. Outcomes included disease activity, physical function, mobility, blood-based markers, as well as patient-reported outcomes and safety. Disease activity, physical function including cardiorespiratory fitness revealed to be most responsive to exercise. A median TESTEX score of twelve indicated overall high study quality and detailed reporting.

CONCLUSION: For disease activity and physical function, physical exercise shows high potential to safely improve various symptoms in patients. However, exercise prescriptions, assessments and outcome measures revealed a large heterogeneity. In conclusion, this systematic review provides level I evidence for physical exercise-mediated symptom alleviation in patients as a solid basis for future multi-centre randomized controlled trials.

PSYCHOMETRIC PROPERTIES OF PERFORMANCE BASED TESTS IN PATIENTS WITH FIBROMYALGIA SYNDROME: A SYSTEMATIC REVIEW

SOCORRO, J.L., CHALER, J., LAUNOIS, P., ALMIRALL, M., BLANCH, J., ROMAN, B.
UNIVERSITAT RAMON LLULL - FUNDACIÓ BLANQUERNA

INTRODUCTION: Fibromyalgia syndrome (FMS) significantly impacts function, affecting health status and quality of life. Its high functional impact can severely affect body function or activities and participation. Reliable and valid measures of such categories or constructs are essential to reach and accurate diagnosis and treatment. This study aimed to assess the reliability and validity of performance based-tests (PBT) in FMS patients.

METHODS: A systematic review was conducted following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) checklist, and four databases (PubMed, EMBASE, Cochrane Library and Web of Science) were searched. Eligible studies contained information on population (fibromyalgia), intervention (assessment), and outcomes (PBT and their psychometric properties). The International Classification of Functioning, Disability and Health (ICF) was used to organize the PBT into categories (body function or activities and participation). The risk of bias and the methodological quality of the studies was assessed according to the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN)

RESULTS: Twenty-two studies were included and seventeen PBT were evaluated. The psychometric properties assessed were reliability, construct validity and responsiveness. The 6 min walking test (6MWT) was the most often assessed performance-based test followed by the 30s chair stand test. Generally, for all PBT, methodological quality for reliability was rated as doubtful with very low to moderate evidence, and very good quality with low to high evidence was found for construct validity.

CONCLUSION: No studies investigated criterion validity, and construct validity and responsiveness were seldom determined, highlighting the need for further research in this area.

POSTURAL BALANCE, PHYSICAL FITNESS AND FIBROMYALGIA EFFECTS OF RESISTANCE TRAINING AND DETRAINING: A PILOT STUDY

ALBUQUERQUE, M.L., ALVAREZ, M.1, MONTEIRO, D.2,3, ANDRADE, A.4, MARINHO, D.1,2, NEIVA, H.1,2
1UNIVERSITY OF BEIRA INTERIOR, PORTUGAL; 2RESEARCH CENTER IN SPORTS SCIENCES,HEALTH SCIENCES AND HUMAN DEVELOPMENT; 3POLYTECHNIQUE INSTITUTE OF LEIRIA; 4SANTA CATARINA STATE UNIVERSITY, BRAZIL

INTRODUCTION: Fibromyalgia is characterized by widespread pain, but it also affects muscular performance and postural control [1]. This pilot study aimed to analyze the effects of 8 weeks of online resistance training and 4 weeks of detraining, on physical fitness, postural balance, and fibromyalgia impact.

METHODS: Seven bodyweight resistance exercises were performed 2x/week for 8 weeks with sessions lasting 50 to 75 minutes (1 to 8: 3 sets of 8 repetitions and 9 to 16: 5 sets of 6 repetitions). A maximal intended velocity was prioritized for intensity and the Borg scale was used to monitor perceived effort during practice [2]. Four volunteers (50.5±6.4 years old) completed the training program with three assessments: at baseline (week 0), after the training program (week 8), and after four weeks of detraining (week 12). Physical fitness was assessed by countermovement jump (CMJ), countermovement jumps with free arms (CMJFA) using a force plate (PS-2142) (PASCO® Scientific, Roseville, CA) and the 2kg medicine ball throwing test (MBT). The disease's severity was assessed by Fibromyalgia Impact Questionnaire (FIQ). The force plate was also used to record postural balance in two different conditions (eyes open and eyes closed). Centre of Pressure (COP) mean velocity and COP displacement were used as postural balance variables.

RESULTS: All volunteers improved their CMJ (between 11% and 63%) after 8 weeks of resistance training. Three participants improved CMJFA (between 6 % and 33%), the distance at the MBT (between 2% and 42%) and reduced the FIQ (between 4% and 44%). Two out of four participants showed better balance control in COP velocity eyes open (7% and 10%) and COP displacement eyes open (6% and 9%). At week 12, all participants showed a loss of previously acquired benefits in the variables FIQ (between 7% and 32%), COP velocity (between 13% and 32%), and COP displacement (between 13% and 34%). Two of four participants showed a reduction in CMJ (between 6% and 15%), and two showed a reduction of up to 8% in the CMJFA. In MBT, one participant had a reduction of 4%.

CONCLUSION: This pilot study showed promising results regarding implementing online resistance training in fibromyalgia participants, suggesting the benefits of balance with eyes open, physical fitness, and a reduction of fibromyalgia impact. Nevertheless, the training cessation caused the loss of previous gains and highlighted the importance of regular exercise in these populations.

References

1. Jones, K.D., Horak, F.B., Winters-Stone, K., Irvine, J.M., and Bennett, R.M., Fibromyalgia is associated with impaired balance and falls. J Clin Rheumatol, 2009. 15(1): pp. 16-21.

2. Albuquerque, M.L.L., Monteiro, D., Alvarez, M.C., Vilarino, G.T., Andrade, A., and Neiva, H.P., Effects of strength training in fibromyalgia on balance, neuromuscular performance, and symptomatic analysis: a 12-week study protocol. Frontiers in Neurology, 2023. 14: p. 1.

THE EFFECT OF DIFFERENT RESISTANCE TRAINING MODALITIES ON MUSCLE STRENGTH IN COMMUNITY-DWELLING OLDER ADULTS: A NETWORK META-ANALYSIS

SUHRKAMP, J., WIEDENMANN, T., RAPPELT, L., MORAT, T., HELD, S., ISENMANN, E., DONATH, L.
EXERCISE TRAINING AND SPORT INFORMATICS

INTRODUCTION: Resistance training is widely recognized as a valuable method to enhance physical function, reduce the risk of falls and improve overall health, independence and well-being in older adults [1,2]. The training can be performed through various modalities of which the comparative effects have not yet been thoroughly elucidated. This network meta-analysis (NMA) therefore aims at comparing and ranking different resistance training modalities regarding their effects on strength outcomes in older adults.

METHODS: The NMA was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for NMAs (PRISMA-NMA) [3]. The studies included in this NMA were identified through a comprehensive search across three health-related, biomedical databases (PubMed, Web of Science and SPORTDiscus). Relevant search terms were combined with Boolean operators (OR/AND) and applied on three search levels, including the targeted training modalities, strength outcomes and population. We included (randomized) controlled trials that assessed the effect of resistance training modes (including: free weight training, machine-based training, body weight training, elastic band training and mixed training) in comparison to each other or to a control condition, focusing on traditional maximal strength outcomes in older individuals.

RESULTS: This NMA includes 29 trials involving 1347 community-dwelling seniors with a mean age of 72 ± 6 years (range 66 to 87 years of age). The average study quality was rated as high, indicated by a mean PEDro score of 6 ± 1.2. and the funnel plot evaluation revealed no considerable risk of bias. All of the included resistance training modalities yield moderate to large positive effects on strength when compared to a "no intervention" control condition. Machine based training (SMD = 1.08 [95%-CI: 0.64; 1.52]) elicits the largest effect, followed by free weight (SMD = 0.96 [95%-CI: -0.05; 1.98]), mixed (SMD = 0.96 [95%-CI: 0.46; 1.45]), elastic band (SMD = 0.89 [95%-CI: 0.33; 1.46]) and bodyweight training (SMD = 0.49 [95%-CI: -0.32; 1.29]).

CONCLUSION: Machine-based training elicits the largest effect with the smallest variance and is therefore most likely to be effective. However, our findings demonstrate that various different resistance training modalities can have large positive effects on the strength development in older adults. We suggest that, with adequately chosen load criteria such as training intensity, volume and duration of the training period, the selection of the appropriate resistance training type might depend on individual preference, enjoyability and practicability.

1. Hunter GR, McCarthy JP, Bamman MM. 2004;34:329–48.

2. Fragala MS, Cadore EL, Dorgo S, Izquierdo M, Kraemer WJ, Peterson MD, et al. Journal of Strength and Conditioning Research. 2019;33:2019–52.

3. Hutton B, Salanti G, Caldwell DM, Chaimani A, Schmid CH, Cameron C, et al. Ann Intern Med. 2015;162:777–84.

DIFFERENCES IN PHYSICAL FUNCTION AND RADIOLOGY FINDINGS BETWEEN SARCOPENIC ELDERLY GENERAL POPULATION AND PERSONS WITH HIV.

MARMONDI, F., INZAGHI, C., GALLI, L., CERIZZA, C., CASTAGNA, A., SCIORATI, C., ZAGATO, L., MESSINA, C., SCONFIENZA, L.M., BANFI, G., CINQUE, P., BONATO, M.

IRCCS SAN RAFFAELE SCIENTIFIC INSTITUTE

INTRODUCTION: Sarcopenia is an aging disease caused by loss of muscle mass, strength and function, leading to an increased risk of fall and fractures. Because accelerated aging is described in persons with HIV (PWH), we compared sarcopenia-associated measures between elderly general population (GP) and PWH.

METHODS: Study participants belong to the Grow Your Muscle (GYM) study, a 48-week, parallel-group, randomized-controlled trial enrolling sarcopenic GP >60 years and PWH >50 years, which aims to assess of a home-based, app-monitored body-weight resistance training program on sarcopenia measures. At the baseline visit before exercise prescription, participants were tested for muscle strength [handgrip (HG), chair-stand-test (CST), thigh extensors]; physical function [Mini-BESTest and 6-min walking test (6MWT)]; body composition [fat mass (FM), fat free mass (FFM) at arms, limbs and total body, and appendicular skeletal muscle mass index (ASMMI)] by dual-energy X-ray absorptiometry; thigh muscle cross-sectional area (CSA) and intramuscular adipose tissue (IMAT) by magnetic resonance. Differences between groups were assessed by Mann-Whitney test.

RESULTS: We assessed 37 GP [20 males, median age 73 (IQR 69-76) years], and 71 PWH [50 males, age: 61 (57-65) years]. In the GP group, participants >70 years (n=26) were compared to those <70 (n=11): the former showed lower performance at CST (p=0.021) and 6MWT (p=0.0003), lower legs (p=0.011) and total (p=0.045) FFM and ASMMI (p=0.031), and lower CSA (p=0.031). In PWH, participants >60 years (n=39) were compared to those <60 (n=32), with no measures differences between the two groups. However, when we compared only GP and PWH men of similar age, 6MWT performance was significantly higher (p=0.018) in GP <70 years [n=9, age 67 (66-68)] than in PWH >60 years [n=31, age 64 (63-69)].

CONCLUSION: A reduction of muscle function, body and muscle composition was observed in the GP after 70 years of age, but not in PWH older than 60. Only 6MWT performance was better in the GP than in PWH of similar age, but this suggests that performance might decay earlier in PWH.

RELIABILITY OF CLINICAL TEST TO ASSESS INSTITUTIONALIZED OLDER ADULTS IN LONG-STAY RESIDENCES WITH AND WITHOUT HISTORY OF FALLS

QUINTEROS BRICEÑO, F.J.1, CANO CAPPELLACCI, M.A.1, TORTELLA GONZALEZ, J.A.2

1. PHYSICAL ACTIVITY SCIENCES LAB, UNIVERSIDAD DE CHILE. 2. FACULTY OF HEALTH SCIENCES, PHYSICAL THERAPY SCHOOL, UNIVERSIDAD AUTÓNOMA DE CHILE.

INTRODUCTION: In Chile, elderly people (EP) represent 12% of the countrys population and they will reach 19% in 2035, making it relevant to focus efforts that develop strategies to face the challenges of population aging and its consequences for health status. In Chile, the EP population is heterogeneous with representation in all social stratifications of the country, such as educational, economic, and functional levels. The objective of this research is to observe the behavior and reliability of clinical tests for the evaluation of physical condition and risk of falls in institutionalized older adults.

METHODS: 58 female volunteers (87±7,87 years old) met the eligibility criteria, stayed at the institution at least for one year and without a cognitive impairment assessed by the abbreviated mini-metal screening test (MMSE). The sample was divided according to the history of falls in without falls (WF) and with history of falls (F). Test used in this study include cognitive test MMSE; functional test Barthel Scale (BS); physical function tests: Time up and go (TUG), Single stage test (SST), hand grip test (HGT), arm curl test (ACT), four square test (FST) and sit to stand test in 30 seconds (30SSTS) and anthropometric measures corporal mass index (CMI). The data was processed with JAMOVI software.

RESULTS: The F group was 30 persons (87.5±7.9 yo) and WF 28 (87.0±8.0 yo). The BS functionality tests and MMSE cognitive performance for WF (82.5±21.9 and 15.0±2.3 points) and for F (85.0±20.4 and 16±2.2 points), respectively. Physical function tests: TUG, we observed for the group WF (12.9±11.0 seg) and for the F group (13.7±6.7seg). Right TSS, we observed for WF (1.69±4.86 seg) and for F (1.67±2.49 seg). Left TSS, observed for WF (1.43±5.59 seg) and for F (1.71±2.17 seg). HG, observed for WF (15.0±5.12 kg) and for F (16.0±5.11 kg). ACT, observed in WF (10.5±5.10 reps) and in F (12.5±6.12 reps). FST, we observed in WF (16.8±19.5 seg) and in F (19.7±14.6 seg). 30SSTS, we observed for WF (10.0±4.3 reps) and F (10.0±4.86 reps). The results showed no statistical differences between groups with and without falls history.

CONCLUSION: The behavior obtained in the Barthel test is striking: in the group without a history of falls, their performance is inverse; the higher the score, the better the performance in the TUG test, an event that was not observed in the group with a history of falls. EP with higher Barthel test scores take longer to perform the TUG test, which implies a loss of predictive power for adverse health events and falls in this population. Physical fitness and falls risk tests in the institutionalized population do not perform as well as in community-based EPs, and further efforts are needed to identify which tests could be useful for this population.

Conventional Print Poster Presentations

CP-PN08 Physiology (mixed)

THE EFFECTS OF ENDURANCE TRAINING AND CAST IMMOBILIZATION ON MUSCLE SATELLITE CELL NUMBER AND PROLIFERATION IN VITRO IN OLD FEMALE RATS

HUNG, Y.L., MACHIDA, S.

JUNTENDO UNIVERSITY

INTRODUCTION: Skeletal muscles undergoe rapid and profound atrophy in response to inactivity such as limb immobilization and bed rest. In mature or old rats, muscle atrophy also occurs mainly through loss of the existing mass, including a reduction in the loss of myonuclei. It is likely that muscle satellite cells play an essential role in preventing age-related or inactive muscle atrophy, because skeletal muscle fibers are terminally differentiated (postmitotic) and require the proliferation of muscle satellite cells to provide new myonuclei for maintaining skeletal muscle. Endurance training increases the muscle satellite cell pool of skeletal muscles (1), but the effect of endurance training on muscle satellite cell proliferation is unclear. There is no information on how the proliferative function of muscle satellite cells is affected by endurance training and inactivity. This study aimed to examine the effects of endurance training and cast immobilization on the proliferative function of muscle satellite cells in vitro.

METHODS: Female F344 rats (20 months old) were divided into three experimental groups: control (CON), endurance training (T), and immobilization (IM) groups. Rats in the T group were trained 5 days per week on a treadmill for 10 weeks, and rats in the IM group were subjected to cast immobilization of both lower extremities using casting tape for 10 days. After exercise training or cast immobilization, primary satellite cells were isolated from the quadriceps and gastrocnemius muscles of the rats. The effects of exercise training or cast immobilization on isolated satellite cell proliferation were examined by BrdU immunostaining.

RESULTS: The number of isolated satellite cells was significantly higher in the T group than that in the CON group. On the other hand, the satellite cell number was reduced in the IM group compared to that in the CON group. The BrdU-positive cell ratio was significantly lower in the IM group than in the CON and T groups, but was not significantly different between the CON and T groups.

CONCLUSION: These results suggest that inactivity in old female rats may reduce the proliferative function of muscle satellite cells and that exercise training increases the number of muscle satellite cells.

(1) M Kurosaka 1, H Naito, Y Ogura, S Machida, S Katamoto. Acta Physiol (Oxf). (2012); 205(1):159-66.

MUSCLE DISUSE LEADS TO NEUROMUSCULAR TRANSMISSION IMPAIRMENT AND ATROPHY OF FAST-TWITCH MYOFIBERS VIA NEUROMUSCULAR JUNCTION DEGENERATION IN MICE

YAMAGUCHI, T., SASAKI, K., NAKAZATO, K.

THE UNIVERSITY OF TOKYO

INTRODUCTION: Physical inactivity leads to a more pronounced decline in muscle strength than in muscle mass. Several studies suggest that the structural degeneration of neuromuscular junction (NMJ) due to muscle disuse is one of the contributing factors to this phenomenon, but direct evidence has yet to be established. We aimed to elucidate the influence of disuse-induced NMJ degeneration on neuromuscular function by using two disuse models in mice with different levels of neuromuscular activity.

METHODS: Male C57BL/6J mice (12-13 weeks old) were divided into control (CON), immobilization (IM), and immobilization with suspension (IMS) groups. IM mice were subjected to cast immobilization of lower hindlimbs but were allowed free movement. IMS mice were subjected to the same hindlimb immobilization as IM mice, and were then suspended to severely restrict their neuromuscular activity. After 20 days of intervention, plantar flexion torque and compound muscle action potential (CMAP) evoked by repetitive sciatic nerve stimulation were measured. The ratio of 10th to 1st CMAP amplitude was used as an index of neuromuscular transmission. Subsequently, mice were dissected and the wet weights of the gastrocnemius, plantaris, and soleus muscles were determined. The myofiber cross-sectional area (CSA) and NMJ morphology for each fiber type were evaluated by immunohistochemistry.

RESULTS: The wet weight of the gastrocnemius muscle was the highest in CON and the lowest in IMS. The wet weight of the plantaris and soleus muscles was the highest in CON, but was not significantly different between IM and IMS. The tetanic plantar flexion torque evoked by 100- and 200-Hz stimulation was significantly lower in IMS than in CON and IM, even when normalized by the muscle wet weight. CMAP amplitude was significantly smaller in IMS than in CON and IM.

The amplitude ratio of 10th to 1st CMAP was significantly lower in IMS than in CON but not significantly different between CON and IM. In both IM and IMS mice, myofiber CSA expressed as a percentage of the mean CSA in CON was significantly lower in type 2b fibers than in type 2a and 2x fibers in the plantaris but was not significantly different between fiber types in the soleus. The proportion of denervated myofibers in the plantaris and soleus muscles was significantly higher in IMS than in CON. The size of presynaptic nerve terminals but not acetylcholine receptors was significantly smaller in IMS than in CON. These differences were more pronounced in fast-twitch fibers than in slow-twitch fibers in the soleus.

CONCLUSION: Our results suggest that muscle disuse impairs neuromuscular transmission via degeneration of presynaptic nerve terminals of NMJ. NMJ structure is more severely deteriorated in fast-twitch myofibers, resulting in the preferential atrophy of the fibers. Both impaired neuromuscular transmission and atrophy of fast-twitch fibers lead to a more pronounced decline in muscle strength than in muscle mass during muscle disuse.

THE EFFECTS OF BONE MECHANICAL STRESS PRODUCED BY ELECTRICAL-STIMULATION–INDUCED MUSCLE CONTRACTION FORCE ON OSTEOCALCIN SECRETION OVER TIME

CHEN, Y.C., OGA, R., NAKAGAWA, K., TAMAKI, H.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: It is well known that exercise brings multiple benefits, and osteocalcin (Ocn), a bone-derived hormone, is considered one of the beneficial factors involved in the process. It has been shown to help improve insulin sensitivity, glucose and fat metabolism, and cognitive development. However, for those who are unable to do voluntary exercise, passive exercise triggered by external electrical stimulation (ES) may be a solution. Nevertheless, whether even a relatively small bone strain from ES-induced muscle contraction force can stimulate osteocytes to promote Ocn secretion, and how long any such increase in Ocn secretion lasts, remains unclear. In this study, therefore, we aimed to investigate the effects of ES-induced muscle contraction on Ocn secretion and changes in this relationship over time.

METHODS: Sixteen male ten-week-old Fischer 344 rats were randomly assigned to two groups: (1) low-frequency ES at 10 Hz (LF, n = 8); (2) high-frequency ES at 100 Hz (HF, n = 8). An acute 30 min ES intervention was applied specifically to the left tibialis anterior (TA) muscle under isoflurane inhalational anesthesia. We recorded in vivo tibia bone strain caused by ES-induced muscle contraction force at both ES frequencies using a strain gauge. Blood samples were collected from the caudal vein just before, 0, 0.25, 0.5, 1, 3, 5, 7, and 14 days after the ES intervention, and fasting blood glucose (FBG) was measured at the same time. Serum was extracted to analyze the concentration of Ocn at each timepoint using enzyme-linked immunosorbent assay (ELISA). The changes in Ocn and FBG concentration over time and the correlation between them were analyzed.

RESULTS: The in vivo tibia bone strain during ES was 35 με at 10 Hz and 264 με at 100 Hz. However, there was no significant difference between the groups in Ocn and FBG concentrations at any timepoint. The Ocn concentration in the LF group increased significantly at 0.25, 0.5, 1, 5, and 14 days after the ES intervention. In the HF group, the concentration decreased immediately after the intervention and then increased significantly at 0.25, 0.5, 1, 3, and 14 days after the ES intervention. There were significant decreases in FBG at all timepoints following the ES intervention in both groups. Further, significant negative correlations were observed between Ocn and FBG concentrations, as well as between the changes in Ocn and the changes in FBG.

CONCLUSION: Electrical-stimulation–induced muscle contraction force can promote an increase in Ocn secretion for up to five days, as well as a sustained reduction in FBG for two weeks. The elevation in Ocn secretion correlates with lower FBG levels.

A NEW ANIMAL EXPERIMENTAL MODEL TO INCREASE PHYSICAL ACTIVITY, NOT EXERCISE

YANAGITA, S., NATSUKO, K.

TOKYO UNIVERSITY OF SCIENCE

INTRODUCTION: In recent years, the importance of health promotion through increased physical activity, which includes not only exercise but also other lifestyle activities, has become prevalent. Animal experiments are required to analyze the mechanisms of the effects of exercise on physical and mental functions, and studies have been conducted using treadmills and running wheels. On the other hand, there are only a few animal models to examine the increase in physical activity during daily living activities.

Numerous studies have shown that enriched environments (EE) could be effective for experimental rodents to improve some brain functions related to stress response and anxiolytic effect, and speculating that increasing levels of physical activity and/or playing factor could have beneficial effects. We aimed to brush up the EE and further develop an environment specialized for increasing physical activity.

METHODS: We made a multistory enriched environment (Multi-EE) that can increase physical activity in rats. In this study, we examined whether the amount of daily physical activity increases when the enriched environment is multileveled. We also aimed to examine whether the biological effects of this increase in physical activity were different from wheel running. We originally made Multi-EE, which are consisted of three stories. The male Wistar rats housed the Multi-EE or normal- EE for 4weeks in group housing conditions (2 rats per cage). The rats housed in Multi-EE allow access to the three stories freely by ladders. Daily physical activity was recorded using a mobile accelerometer and compared Multi-EE and Normal-EE. Following 4weeks, brain monoamine levels, which are involved with increasing physical activity-induced-psychological effects, were measured by High-Performance Liquid Chromatography (HPLC) in several brain regions. Mus-

cle and fat volume were also measured. In this study, we have been successful to analyze voluntary physical activity in both normal-EE and Multi-EE.

RESULTS: The results showed that Multi-EE showed a different transition in physical activity than normal-EE, and an increase in vertical living space did not contribute to an increase in physical activity. On the other hand, the voluntary physical activity in Multi-EE significantly increased the volume of soleus muscle compared to normal-EE, indicating that Multi-EE might be effective to increase the physical load. However, the Multi-EE housing was not able to change the brain monoamine levels, which are known to be increased by running wheel. The changing levels of these monoamines are known to have some beneficial effects on brain health.

CONCLUSION: Therefore, the results of the present study suggest that increasing levels of physical activity by Multi-EE have a different physiological effect compared to running wheel. Investigating the relationship between increased physical activity and horizontal space expansion may lead to the development of new animal experimental models.

REPEATED EXHAUSTED TREADMILL RUNNING INDUCED NEUROPLASTIC EFFECTS IN RAT PRIMARY MOTOR CORTEX AND DORSOLATERAL STRIATUM

CUI, S., QIAO, D.

BEIJING RESEARCH INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The motor circuit composed of primary motor cortex and dorsal medial striatum which play an important role in the exercise induced fatigue. Whether exercise induced fatigue can induce the plastic changes in the glutamatergic system and synaptic proteins in motor cortex and dorsolateral striatum. Whether the exercise induced fatigue can altered plasticity-related protein NMDAR2B, CaMKII, pCaMKII, ERK expression in the motor cortex and dorsolateral.

METHODS: Young adult male Wistar rats were divided into 3 groups: control group（CG）、single exhaustive exercise group (EG) and repeated exhaustive exercise group (REG). Incremental treadmill exercise was employed, The REG groups rats conducted 7 consecutive days of incremental load treadmill training. The initial treadmill speed was 8.2m/min, after 15min the speed increased to 15m/min, 15min later the speed improved upto 20m/min until fatigue. On testing day, rats performed either a single exhaustive (EG) or after 7 days exhaustive exercise (REG) or rested (CG) were then sacrificed and primary motor cortex and dorsolateral striatum dissected. Plasticity related proteins(NMDAR2B、CaMKII、pCaMKII and ERK)were detected by Western blotting analysis.

RESULTS: The protein expression of NMDAR2B compared with group CG increased significantly of group EG and REG, There was no significant difference in the expression of CaMKII among the groups ($P > 0.05$).The pCaMKII expression of group REG significantly decreased compared with CG group($P<0.05$). the ERK expression in the M1 area in RE group significantly decreased compared with CG group ($P<0.01$).The expression of NR2B in DLS area in REG group was significantly higher than the CG group($P<0.05$),the EG group also higher than CG group, but had no significance($P>0.05$); The expression of CaMKII had no significant difference between all the groups; The expression of pCaMKII in DLS was higher in EG group and REG group than that in CG group. But there was no significant difference ($P > 0.05$);The expression of ERK in DLS region of group EG and REG were increased compared with the group CG , REG group increased more obvious and it had significant difference compared with the group CG. ($P < 0.05$).

CONCLUSION: As the increased of exercise induced fatigue, ERK expression in the primary motor cortex decreased, which may influence intrinsic excitability of motor cortex. It suggested integration ability in the primary motor cortex decreased. In contrast, ERK expression in the dorsolateral striatum increased which suggest the excitability in the dorsolateral striatum increased. CaMKII-ERK signaling in the motor cortex and dorsolateral striatum is a critical substrate for exercise induced fatigue. CONCLUSION:Single session exercise induced-fatigue does not altered plasticity-related protein expression in the M1, chronic exercise induced fatigue altered plasticity-related protein expression in M1 and DLS.

PHYSICAL ACTIVITY REDUCES CORTICOSTERONE LEVEL AND ANXIETY-LIKE BEHAVIORS IN ENVIRONMENTAL ENRICHMENT

SUDO, M., ANDO, S.

PHYSICAL FITNESS RESEARCH

INTRODUCTION: It has been suggested that aerobic exercise is beneficial to brain function. Similarly, environmental enrichment (EE) has a variety of positive effects on brain function by facilitating neuroprotection and enhancing neuroplasticity (Ramirez-Rodriguez et al, 2022). However, the relationship between physical activity and improvements in brain function in an EE environment remains unclear. We hypothesized that physical activity, including wheel running/standing movements, under long-term EE exposure plays a key role in corticosterone level reduction and better emotion. PURPOSE: The purpose of this study was to determine the effects of physical activity on corticosterone level and emotion in the EE.

METHODS: Wistar rats were housed in four different groups; EE (running wheel and objects: slope, tunnel, and hut), running wheel only (EE-R), objects only (EE-O), and standard environment (SE) (N=6/group), for a period of four weeks. Physical activity (PA) level of each rat was continuously recorded using an embedded three-axis accelerometer. Number of rearing and duration of wheel running were measured during the 12-hour dark period in the last week. After four weeks of exposure to each condition, anxiolytic-like behavior was assessed from the elevated plus maze (EPM) test. Serum corticosterone levels were analyzed using an enzyme-linked immunoassay kit.

RESULTS: The PA level of the EE, and EE-R groups were higher than the SE group in the dark period ($P < 0.0001$). Duration of wheel running was higher in the EE (56.3 ± 14.7 min) than EE-R (37.2 ± 9.4 min, $P = 0.03$) in the dark period. Number of

rearing was not different among all groups. The serum corticosterone concentration was lower in the all EE groups than that in the SE group (Ps < 0.01.) In the EPM test, ratio of open and close arms spent time (O/C ratio) was greater in the EE (163.5 ± 63.5) and EE-R (173.1 ± 130.5) groups than the SE group (11.4 ± 7.6, Ps < 0.01). Furthermore, we observed a negative correlation between total PA level and corticosterone level (r2=0.17, P = 0.04). We also observed a positive correlation between total PA level and the O/C ratio (r2=0.37, P = 0.001). In contrast, no correlations were found between duration of wheel running time and the O/C ratio. These results suggest that higher PA level is associated with lower corticosterone levels and better anxiolytic-like behavior in EE.

CONCLUSION: This study revealed that an enrichment environment reduces corticosterone level and anxiety-like behaviors. Furthermore, reduction of anxiety-like behavior was related to the amount of physical activity, but not to wheel running duration. These results suggest that spontaneous intermittent physical activity may contribute to reductions in corticosterone level and anxiety-like behavior.

Reference: Gerardo Bernab´e Ramírez-Rodríguez et al., Physiology & Behavior (2022)

EXPLORING THE IMPACT OF HIGH-INTENSITY INTERVAL EXERCISE ON EXECUTIVE FUNCTION, PREFRONTAL CORTEX ACTIVATION AND PERIPHERAL NEUROPROTECTIVE PROTEIN CONCENTRATION AMONG THE ELDERLY: A PILOT STUDY

SKUREWICZ, M., WINOWIECKA, N., SAWICKA, A., JOST, Z., CHROBOCZEK, M., LASKOWSKI, R., OLEK, R.A., KUJACH, S.
ACADEMY OF PHYSICAL EDUCATION AND SPORT

INTRODUCTION: The aging process naturally involves not only a decline in physical fitness, but also in cognitive functions. Both factors present considerable challenges to the independence and quality of life of the elderly. Interestingly, a growing body of evidence suggests that engaging in physical exercise holds considerable promise in enhancing cognition, which seems to be particularly important since populations are aging societies. Our previous research has shown that high-intensity interval exercise (HIIE) can improve the physical fitness and cognitive function of young people, but the results of studies among seniors are still ambiguous. Multiple animal and human studies have revealed that exercise enhances human cognition via exercise-enhanced neurotrophins and catecholamine synthesis, which is known to mediate neural plasticity and energy metabolism in the brain. However, the neural mechanisms responsible for the post-exercise improvement of cognitive functions in elderly are still being sought. The purpose of the present study was to assess the acute effect of HIIE on executive function focusing on underlying neural and neurobiological factors in older adults.

METHODS: The study involved twenty (n=20) elderlies. The counterbalanced, crossover, randomized trial consisted of two sessions: control (CTL) and high-intensity interval exercise (HIIE). The HIIE protocol comprised eight 60s cycling bouts at ~90% HRmax intensity separated by 60s passive rest. The participants performed the Stroop test and Trial Making Test (TMT-A and TMT-B) before and after exercise or control condition. Cortical activation has been measured by applying functional Near-Infrared Spectroscopy (fNIRS). Moreover, before and after the HIIE to assess the concentration of brain-derived neurotrophic factor (BDNF), Klotho, Cathepsin B, and Irisin, venous blood samples were collected and the ELISA method was applied.

RESULTS: HIIE contributed to a significantly shorter execution time in the TMT-B test. Moreover, an increased prefrontal activation (dorsolateral prefrontal cortex-DLPFC and middle frontal gyrus-MFG) has been observed following an acute bout of HIIE. Additionally, we found a significant increase in peripheral Klotho and Cathepsin B concentration. Despite the lack of significance, BDNF and Irisin concentrations showed a trend towards increased value.

CONCLUSION: The results suggest that the proposed HIIE protocol can effectively improve executive function in the elderly, which can be attributed to increased activation in cortical areas relevant to cognitive functioning as well as synthesis or release of neuro-supportive protein.

This work was supported by the Polish National Science Center under Grant No: 2019/33/B/NZ7/01980

HUMAN SERUM-DERIVED EXOSOMES LEAD TO SIMILAR DEVELOPMENT OF LIGAMENT ORGANOIDS AS FETAL BOVINE SERUM

PAULUSSEN, K., GRIFFIN, T., BAAR, K.
UNIVERSITY OF CALIFORNIA, DAVIS

INTRODUCTION: Exercise induces systemic changes that impact tissue repair and adaptation. One potential mechanism is through the production and release of exosomes (EXO). This study aimed to develop an in vitro screen for testing human serum-derived exosomes on human engineered ligaments (EHL).

METHODS: EHLs were cultured in vitro, with constructs receiving media containing either complete FBS (CON, n=8) or exosomes isolated from FBS (fbEXO) for the first two experiments to establish an isolation and feeding protocol. EHLs were engineered from human ACL cells and treated with normal growth media until day 8, after which fbEXO were added to reflect 10, 20, or 40% (0.2, 0.4, or 0.8 ml FBS/ml media). Once the optimal percent EXO was established, EHLs were treated with fbEXO for 1, 2, or 3 feeds. All constructs were collected and subjected to tensile testing on day 14. A hydroxyproline assay was run to determine collagen content. Once an optimized protocol was determined for fbEXO, the process was repeated with humEXO. Differences were analyzed using a 1-way ANOVA or student's unpaired t-test. Significance was set at P<0.05 and all data are presented as mean±SD.

RESULTS: Increasing the amount of fbEXO within the media resulted in a dose-dependent increase in EHL mechanics (10%: 0.280±0.178 N, 20%: 0.328±198 N, 40%: 0.483±0.365 N; r2=0.858, P=0.077) and collagen content (10%: 100.3±58.17 µg,

20%: 147.9±50.79 µg, 40%: 160.7±32.58 µg; r2:0.211). Incubating EHLs with fbEXO decreased mechanics (1 feed: 0.714±285 N, 2 feeds: 0.809±0.224 N, 3 feeds: 0.318±0.180 N) and collagen (1 feed: 394.30±26.38 µg, 2 feeds: 301.00±69.14 µg, 3 feeds: 150.50±28.25 µg) in a time dependent manner, but at 4 days (2 feeds) there was not a statistical difference between serum and fbEXO (P=0.450). Treating EHLs with 40% humEXO for 4 days (2 feeds) did not significantly decrease maximum tensile load (0.683±0.284 vs. 0.785±0.314 N, P=0.523), failure stress (1.366±0.433 vs. 1.658±0.431 MPa, P=0.214), Young's Modulus (16.460±3.687 vs. 20.340±4.098 MPa, P=0.077), CSA (0.4914±0.073 vs. 0.466±0.111 mm2, P=0.617) or collagen content (568.7±56.5 vs. 628.8±195.8 µg, P=0.450) compared with CON fed EHLs.

CONCLUSION: Human serum-derived exosomes support EHL development to the same extent as FBS. These data indicate that serum-derived exosomes modulate tissue development independent of other serum factors. The model also opens new avenues for determining the role of exosomes in muscle-tendon crosstalk in long-term health and training adaptations.

DIFFERENT FIBER-SPECIFIC EXPRESSION OF PROTEIN SYNTHESIS AND OXIDATIVE METABOLISM IN SKELETAL MUSCLE OF COPD AND HEALTHY AGED INDIVIDUALS

PEÑAILILLO, L., GUTIÉRREZ, S., FLORES-OPAZO, M., VALLADARES-IDE, D., JANNAS-VELA, S., CABELLO-VERRUGIO, C., PARADA, P., CAMPOS, C.

UNIVERSIDAD ANDRES BELLO

INTRODUCTION: Patients with chronic obstructive pulmonary disease (COPD) present muscle dysfunction (1). The mechanisms for muscle dysfunction include a decrease in muscle oxidative capacity, a shift toward a fast-glycolytic (type II) muscle fiber type and reduced cross-sectional area (CSA) of all muscle fiber types. Skeletal muscle adaptations have shown to be fiber type-specific (i.e., type I or slow-twitch and IIa or fast-twitch) (2). Thus, adaptations of molecular pathways related to oxidative metabolism, protein synthesis and degradation may be in a fiber-specific manner in COPD. Aim: To compare the protein content of the protein synthesis and oxidative metabolism protein pathways in type I and IIa skeletal muscle fibers from COPD and healthy aged individuals.

METHODS: Ten COPD (age=67.6±5.1 y) and eight healthy (age= 64.2±7,7 y) individuals underwent a muscle biopsy from the vastus lateralis. Muscle specimens were lyophilized, after which muscle fibers were identified and isolated manually. Dot-blot technique was used to identify type I and IIa MHC isoforms, after which the same fiber-type fibers were pooled. Total ubiquitination, Akt-1, p70s6K, S6 ribosomal protein, OXPHOS, COX-IV, MCU, Mitofusin2, DRP1, and AMPK total proteins from whole muscle and fiber-type pooled samples were quantified by Western blot. Indirect immunofluorescence and hematoxylin/eosin staining were used in serial cryosection to evaluate muscle fiber morphology. Two-way ANOVA and independent t-test were used to compare conditions and fiber types, and whole muscle samples, respectively.

RESULTS: Total levels of Akt-1, S6RP, AMPK, and MCU protein were similar between muscle fiber types and between whole muscle homogenates from both COPD and healthy individuals. COPD patients showed greater levels of p70S6k in whole muscle homogenates and IIa muscle fiber. Both groups showed greater levels of MCU protein in type I muscle fibers. COPD patients showed lesser levels of COX IV and subunits I to IV of OXPHOS compared to healthy individuals. Total protein ubiquitination was greater in COPD than in healthy, which was greater in type IIa fibers, opposite to healthy individuals, which showed greater levels of ubiquitination of type I fibers. Mitofusin2 and DRP1 proteins were greater in COPD patients compared to healthy individuals.

CONCLUSION: These results suggest that COPD patients have compensatory machinery for protein synthesis in response to greater ubiquitination through a p70s6K-dependent pathway, particularly in type IIa muscle fibers. Greater oxidative metabolism in healthy individuals was expected. However, greater mitofusin1 and DRP1 expression may also reveal a compensatory mechanism for increased mitophagy in COPD.

REPRODUCIBILITY OF HEART RATE VARIABILITY AND BLOOD PRESSURE BEFORE AND AFTER AEROBIC EXERCISES

VALTONEN, R., YLINEN, V., HUIKURI, H., TULPPO, M.

UNIVERSITY OF OULU

INTRODUCTION: Measurement of cardiac autonomic function, using heart rate variability (HRV) techniques, has become popular among users of wearable devices such as heart rate monitors, smart rings, and smartwatches. One application is to identify recovery status of cardiac autonomic regulation after exercise using vagally mediated short-term HRV measurements. However, the reproducibility of HRV after exercise is not well known. The aim of this study was to identify the reproducibility of heart rate, HRV and blood pressure (BP) before and after aerobic exercises and control measurement.

METHODS: Eighteen participants (age 27±6, V02max 45±7 ml/kg/min, female n=8) performed an incremental maximal exercise test by bicycle ergometer until exhaustion. Thereafter, participants performed two aerobic sessions (60% of the maximal watts), 30 min each, and one 30 min control session without exercise in randomized order. Heart rate and vagally mediated high frequency power of RR intervals (HF; 0.15-0.4 Hz) were analyzed over 5 min at rest and 30 min after interventions. BP was measured 3 times in 2 min intervals and mean values were used at rest and during recovery. The reproducibility was assessed by the 95% confident interval (CI) of intraclass correlation coefficient at baseline and in recovery phase.

RESULTS: Heart rate at rest and after interventions was 68±11 vs. 60±9 bpm, 68±11 vs. 72±10 bpm, and 66±11 vs. 70±10 bpm for control, exercise I and exercise II, respectively (time x group interaction p<0.001). Corresponding HF power at rest and after interventions was 6.51±1.68 vs. 6.71±1.36 ms2, 6.41±1.44 vs. 6.21±1.02 ms2, and 6.62±1.42 vs. 6.62±1.15 ms2

(time x group interaction p=ns), and systolic BP at rest and after interventions was 122±9 vs. 118±12 mmHg, 124±15 vs. 113±13 mmHg, and 123±12 vs. 113±12 mmHg (time x group interaction p<0.05). Reproducibility at rest was satisfactory for heart rate (95% CI 0.561-0.937), good for HF power (95% CI 0.643-0.949), and excellent for systolic BP (95% CI 0.810-0.975. Reproducibility after exercise was good for heart rate (95% CI 0.638-0.948), poor for HF power (95% CI 0.002-0.848), and excellent for systolic BP (95% CI 0.812-0.974).

CONCLUSION: Heart rate was still elevated 30 min after exercise compared to control condition and reproducibility was satisfactory at rest and good after exercise. Despite elevated heart rate, mean HF power values recovered to the baseline level 30 min after exercise and reproducibility of HF power was good at rest but poor after exercise. Finally, reduced systolic BP was obvious after exercise and reproducibility of systolic BP was excellent at rest and after aerobic exercise.

Conventional Print Poster Presentations

CP-MH11 Female related health and fitness

EFFECTS OF DIFFERENT HIGH-INTENSITY INTERVAL TRAINING PROTOCOLS ON EXECUTIVE FUNCTION OF SEDENTARY YOUNG FEMALES: A RANDOMIZED CONTROLLED TRIAL

ZHANG, B., SUN, F.

THE EDUCATION UNIVERSITY OF HONG KONG

INTRODUCTION: Recent evidence suggests that engaging more physical activity could benefit executive function (EF). Additionally, high-intensity interval training (HIIT) has gained attention as a time-efficient training protocol with positive impacts on various health outcomes including EF. However, the effects of different HIIT protocols remain unknown. Therefore, the current study aimed to compare the effects of two different HIIT protocols, i.e., high-intensity circuit training (HICT) and traditional cycling-based HIIT (TC-HIIT), on EF of sedentary young females. The potential neurophysiological mechanisms were also explored.

METHODS: Forty-five sedentary young females (age = 22.3 ± 2.2 years, BMI = 20.6 ± 2.0) were recruited and randomly assigned into three different groups: HICT group, TC-HIIT group and Control group. Prior to and following an eight-week intervention period, the participants EF was assessed by a battery of computer tests, including Stroop test, N-back test and Task switching test. Additionally, blood samples were collected to measure several neurophysiological biomarkers associated with EF, namely Brain-derived neurotrophic factor (BDNF), Insulin-like growth factor 1 (IGF-1), and Cathepsin B (CTSB).

RESULTS: In Stroop test, both HICT and TC-HIIT group significantly improved the accuracy and reaction time ($p < 0.05$), whereas during the post-test, the HICT group exhibited significantly lower reaction times compared to the TC-HIIT group ($p < 0.05$). In N-back test, both intervention groups displayed a significant reduction in reaction time ($p < 0.05$). However, an improvement in accuracy was only observed in the TC-HIIT group ($p < 0.05$). In Task-switching test, significant improvements were only found in TC-HIIT group in both accuracy and reaction time ($p < 0.05$). No significant change was found in the Control group in any tests. Regarding the blood analysis, no significant changes were detected either within or between the groups in BDNF, IGF-1 and CTSB.

CONCLUSION: The results of the current study provide evidence that HIIT can be an effective strategy for enhancing EF, regardless of the HIIT modalities. However, it seemed that the observed positive effects on EF were not directly associated with the neurophysiological biomarkers examined in the present study. Thus, future research should explore potential mechanisms underlying these effects, such as investigating brain hemodynamic responses and exploring alternative biomarkers.

FEASIBILITY AND ACUTE PHYSIOLOGICAL EFFECTS OF CONTROLLED SUPRAMAXIMAL HIGH-INTENSITY INTERVAL TRAINING IN PEOPLE WITH AND WITHOUT CHRONIC OBSTRUCTIVE PULMONARY DISEASE: A RANDOMIZED CROSS-OVER TRIAL

JAKOBSSON, J., DE BRANDT, J., HEDLUND, M., RULLANDER, A.C., SANDSTRÖM, T., NYBERG, A.

UMEA UNIVERSITY

INTRODUCTION: High-intensity exercise is essential for optimal development of cardiorespiratory fitness and health. Yet, it is challenging to perform for individuals with chronic obstructive pulmonary disease (COPD) due to ventilatory limitations, resulting in lower exercise intensities with suboptimal stress on the cardiovascular and muscular system. We aimed to compare the feasibility and acute effects of a novel concept of controlled short-duration supramaximal high-intensity interval training (HIIT) to moderate-intensity continuous training (MICT) in people with COPD and matched healthy controls (HC).

METHODS: Sixteen people with mild to severe COPD (8 males; 75±6 yr; 119±37W max aerobic power [MAP]; 21.8±5.2 ml/kg/min VO2peak; 73±13 FEV1%pred) and 16 HC (8 males; 74±5 yr; 164±38W MAP; 25.4±3.8 ml/kg/min VO2peak; 106±14 FEV1%pred) performed HIIT and MICT on a cycle ergometer in a randomized order. Supramaximal HIIT consisted of 10x6s sprints interspersed with 1-min recovery. Participants performed supramaximal HIIT at two intensities: 60% and 80% of maximal mean power output for 6-sec (HIIT60% and HIIT80%) estimated using the Borg cycle strength test. The MICT session consisted of 20 min at 60% of MAP. Breath-by-breath indirect calorimetry, ratings of perceived exertion, symptoms and exercise modality preference were obtained. Clinical trial registration: NCT05874999.

RESULTS: The mean exercise intensity was 3.5-fold higher in supramaximal HIIT (HIIT80%) compared to MICT (245±87W vs. 71±22W for COPD, 358±76W vs. 98±23W for HC, p<0.001 for all). In general, the cardiorespiratory demand was similar between the modalities. At the end of exercise, the VO2 demand was not different between modalities for those with COPD (HIIT60%: 16.3±2.9, HIIT80%: 17.6±3.7 , MICT: 18.8±4.0 ml/kg/min, p=0.09). For HC, MICT required a slightly higher VO2 demand (HIIT60: 19.1±2.1, HIIT80: 20.6±3.5, MICT: 2.2±3.1 ml/kg/min, p=0.02). For those with COPD, supramaximal HIIT during HIIT60% but not at HIIT80% resulted in significant and clinically relevant reductions in dyspnea (5.1±2.3 vs 7.1±1.9, p=0.02) and Borg RPE (14.8±2.4 vs. 17.0±2.1, p=0.03) when compared to MICT. All supramaximal HIIT sessions were completed without premature interruption, while 5 out of 16 people with COPD did not complete the MICT due to exhaustion. A general preference for the supramaximal HIIT modality was seen, with 13 out of 16 participants with COPD and 14 out of 16 HC favouring supramaximal HIIT over MICT.

CONCLUSION: Controlled short-duration supramaximal HIIT appears to be feasible in people with COPD and HC. Compared to MICT, it enabled a 3.5-fold increase in exercise intensity. Despite the higher exercise intensities, the cardiorespiratory demand during HIIT was similar to MICT, and clinically relevant reductions in dyspnea were seen in favor of HIIT in people with COPD. Notably, most participants preferred HIIT over MICT. The long-term feasibility and adaptations to supramaximal HIIT is yet to be investigated in COPD.

PHYSICAL ACTIVITY AND FEMALE STUDENTS PERCEPTION OF MENSTRUAL SYMPTOMS: IMPACT OF HORMONAL CONTRACEPTION

COLLOMP, K., SCHIANO-LOMORIELLO, S., CASTANIER, C., BUISSON, C., ERICSSON, M., TEULIER, C., BOUGAULT, V.
PÔLE STAPS, UFR ST, UNIVERSITÉ ORLÉANS

INTRODUCTION: The normal menstrual cycle (NMC) and/or hormonal contraception may significantly affect females' health, daily activities, quality of life and performance notably through perception of menstrual symptoms. The use of non-drug therapies, including regular physical activity, is reported to limit these symptoms during both the premenstrual and menstrual phases, in combination with hormonal contraception and not. However, there is currently insufficient information to propose a consensus regarding the best physical activity type, frequency, intensity or program to reduce the frequency and severity of symptoms. The aim of this study was thus to examine the association between physical activity (PA) and combined hormonal contraceptive (CHC) on female students self perception of their menstrual cycle symptoms.

METHODS: This research was approved by the Paris-Saclay Ethics of Research Committee (CER-Paris-Saclay-2021-098). Participants were recruited through student services of the Universities of Orleans and Paris-Saclay via mailing lists and on social media. The inclusion criteria were as follows: 1) female student between 18 and 28 years of age; 2) healthy with no chronic therapeutic treatment except for menstrual symptoms. From December 2021 to March 2022, female students (n = 834) completed an online questionnaire to assess their PA level (Group 1: non-active; Group 2: moderate physical activity; Group 3: high physical activity; Group 4: very high physical activity), menstrual status or contraception use, self-reported diet and medication, impact on engagement in some social activities, and self-assessment of perceived mental and physical symptoms during the week prior to menses (PM) for students with a normal menstrual cycle (NMC), and the week of menses (ME) for normal menstrual cycle students and those using combined hormonal contraception.

RESULTS: Whatever the conditions (PM and ME, NMC and CHC), fewer self-perceived symptoms and self-reported alteration in fat intake were reported by the students in Group 4, and more analgesic and anti-inflammatory medication use was reported by Group 1. Fewer self-perceived symptoms were also found in CHC vs NMC female students for all physical activity levels, but in a more marked way when associated with very high physical activity. In addition, less university and sports practice absenteeism was observed with high and very high physical activity.

CONCLUSION: In conclusion, the perception of menstrual cycle symptoms was lower with very high physical activity, as with combined hormonal contraception. Moreover, female students training more than 5 h/week also reported less university absenteeism and impairment in physical activities. Further studies are necessary to establish the causal link of physical activity and combined hormonal contraception on menstrual symptoms.

SELF-REFLECTION FOR PERFORMANCE READINESS DURING THE MENSTRUAL CYCLE

DOYLE-BAKER, P., SOUSTER, M.
UNIVERSITY OF CALGARY

INTRODUCTION: Few studies focus on collegiate athletes self-awareness and self-regulation of the menstrual cycle, despite this being an opportune time as they transition to high performance in their athletic career (Tremback-Ball et al. 2021). Online post-event reflection tool (PERT) is known to systematically help athletes process their performance during training and competition (Chow et al. 2019). Previous research has observed that performance is most often affected during early follicular and late luteal phases compared to the rest of the menstrual cycle (Armour et al. 2020). Therefore, the study purpose was to evaluate athletes' acknowledgement of their performance readiness by engaging in the PERT during their menstrual cycle.

METHODS: Seventeen self-identified female athletes (16-23 yrs.) were recruited from university social media sites across seven teams from a variety of sports. Eight athletes acknowledged the use of hormonal contraceptives (IUD, intravaginal ring, oral). The survey included the PERT (Chow et al., 2019) and five additional questions on MC symptoms and management. The repetitive nature of the PERT was meant to simulate a journal type intervention to prompt continual engagement from the athletes. The questionnaire was administered on the Qualtrics platform (https://www.qualtrics.com/) and in-

volved two weekly reflections on their performances (practice and competition) over 8-10 weeks. Thematic analysis was performed using NVivo 14 to find and recognize core themes through open coding.

RESULTS: Four broad themes were identified: (1) impact of menstrual symptoms, (2) personalized coping strategies, (3) readiness changes during performances, and (4) a wavering mindset. Not all athletes reflected twice a week but the majority did. Athletes predominantly identified symptoms during menses (bleeding) only rather than during other phases of the menstrual cycle.

CONCLUSION: Many athletes shared personal insights on the impact the menstrual cycle had on training. The PERT also increased athletes' self-awareness in recognizing cycle trends and assited with mindfulness in identifying strategies for future performance. Some athletes felt they paid too much attention to symptoms and therefore their self-talk resulted in distracting them from their performance. Like others have found, this study observed that the online PERT can promote self-awareness and reflection (Brunner et al., 2023) in a wide range of sports with female athletes. Future research, however, should ensure the athletes' menstrual cycle knowledge is at a level that they can reflect on where in the phases of the cycle their performance readiness is impacted the most.

EFFECT OF MENSTRUAL CYCLE ON FITNESS TEST PERFORMANCE OF UNIVERSITY STUDENTS

MORIYAMA, S.I., MARINHO, D., NEIVA, H., FERRAZ, R., ALVES, A., MATSUO, K.

TOKYO GAKUGEI UNIVERSITY

INTRODUCTION: Studying the influence of menstrual cycle on exercise performance reveals findings pertaining to various performance aspects. However, an association between female exercise performance and menstrual cycle phase remains unestablished [1]. However, mental and physical symptoms occurring during menstruation (premenstrual syndrome [PMS]) are observed in athletes and nonathletes and affect their performance. Herein, we examined the menstrual cycle and how PMS affects fitness test results.

METHODS: Study comprised 31 female university students with normal menstrual cycles (25–38 days): 18 were track and field athletes (active group [AG]) and 13 had no exercise habits (nonathlete group [NAG]). Analysis was performed on all participants who completed all tests; with eight participants in each group. Participants' basal body temperature was classified into hot and cold phases, and tests were conducted during menstrual, follicular, and luteal phases. Participants answered a questionnaire regarding physical and mental symptoms associated with menstruation and undertook a MEXT created physical fitness test. The mental symptoms were assessed on a scale of 0 (none) to 3 (severe); Friedman test was used for within-group analysis. A physical fitness test comprising handgrip strength, sit-ups, sit-and-reach, side-step, 1000-m endurance run, 50-m sprint, standing long jump, and handball throw was conducted. Two-way ANOVA analyzed the results for the group and phase of the menstrual cycle.

RESULTS: Significantly different scores for physical symptoms were recorded during menstrual phase than in other phases: 4 out of 18 scores were higher in AG, and 2 out of 18 items were different in NAG. No significant differences for mental symptoms were found in AG for any items measured, but significant differences were confirmed in NAG for 3 of the 12 items. No significant interactions between groups were observed in any physical fitness tests. In all tests except handgrip strength, significantly higher performance was observed in the AG group compared with NAG group, with no significant differences based on menstrual cycle observed between the two groups.

CONCLUSION: Large interindividual differences in the effects of PMS are reported and concerns have been raised regarding the impact of PMS on QOL and exercise performance [2]. Highest median PMS score confirmed was 1.00, representing "some symptoms but no effect on daily life," indicating that both groups experienced mild mental symptoms. Based on the aforementioned, we concluded that physical fitness test performance does not change in athletes and nonathletes with small or negligible effect of PMS associated with the menstrual cycle.

REFERENCES:

1. McNulty KL, et al. The effects of menstrual cycle phase on exercise performance in eumenorrheic women: A systematic review and meta-analysis. 2020. Sports Med. 50(10):1813-1827.

2. Yesildere SH, et al. Effect of exercise on premenstrual symptoms: A systematic review. Complement Ther Med. 2020. 48:102272

EXERCISE TRAINING DURING THE SECOND AND THIRD TRIMESTER OF PREGNANCY: A CASE STUDY

TROTONDA, F., CABEDO, J., GUERRA, M.

UNIVERSITAT RAMON LLULL, BARCELONA

INTRODUCTION: Currently, the guidelines regarding the intensity and frequency of exercise in pregnant women are contradictory, and some studies about its effects on the mother and fetus are controversial (1,2). The aim of this study was to follow-up a pregnant woman during the 2nd and 3rd trimester applying an adapted training program.

METHODS: A pregnant woman (39 y, 60.5 kg, 162cm) participated during the 2nd and 3rd trimester in a training program which consisted of at least 3 sessions per week, 60 min per session, during a 6-month period. It included strength, aerobic capacity, mobility, breathing and pelvic floor exercises. Assessments of the following variables were obtained at pre-intervention, after the second trimester and after birth: weight, height, belly diameter, hip diameter, waist diameter, aerobic endurance, lower trunk strength, balance, back flexibility, hamstring flexibility, thoracic amplitude when inhaling and exhaling, abdominal diastasis, low back pain (LBP) and mood applying the POMS questionnaire.

RESULTS: As expected, weight increased during pregnancy and decreased after giving birth (60.5/65/57kg), the same as belly (87/90/82cm), waist (85/85/74cm), and hip perimeter (94/94/91cm). Balance improved after the intervention, including post-partum (Flamingo test: 1.28"R/27"L; 1.30"R/1.30"L;1.30"R/1.30"L). The 6MWT showed contradictory HRpeak response pre intervention, 2nd , and 3rd trimester (100/106/133bpm), distance first increased (270/360/290m), and after giving birth decreased. Fatigue increased during pregnancy, and decreased a lot post-partum (Borg Scale: 4/8/3RPE). Thoracic amplitude remained stable. Abdominal distance appeared after birth (1.5 cm), although not considered as diastasis. There was no low back pain. Strength improved significantly after post-partum (30"sit to stand, number of squats: 20/20/25).

CONCLUSION: The adapted training program for pregnant women was positive and did not affect the fetus. The main improvement was seen in strength, balance, and low back pain. More research is needed applying the intervention program in a larger sample.

SCREENING FOR CLINICAL INDICATORS OF RELATIVE ENERGY DEFICIENCY IN SPORT USING THE GERMAN VERSION OF THE LOW ENERGY AVAILABILITY IN FEMALES QUESTIONNAIRE

WASSERFURTH, P., HALIOUA, R., LAUTZ, Z., TOEPFFER, D., ENGEL, H., CLAUSSEN, M., KOEHLER, K.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Secondary prevention of Relative Energy Deficiency in Sport (REDs) requires the (successful) identification of athletes with problematic low energy availability (LEA). The newly established International Olympic Committee REDs Clinical Assessment Tool-Version 2 (IOC REDs CAT2) enables stratification of athletes into severity/risk categories based on clinical markers associated with LEA. The Low Energy Availability in Females Questionnaire (LEAF-Q) is a commonly used screening tool for LEA in female endurance athletes, but the agreement between the LEAF-Q and the IOC REDs CAT2 is currently unknown. Therefore, we aimed to evaluate whether female endurance athletes who score positive in the LEAF-Q also show clinical indicators of REDs.

METHODS: In this cross-sectional study, 50 female endurance athletes (28±5 years, BMI: 21.2±1.9 kg/m2, 21.5±5.1% body fat) who trained ≥ 4x/week completed the LEAF-Q and were assessed for the presence of primary, secondary and potential REDs indicators. As a part of this, participants completed a clinical interview to evaluate disordered eating (DE) and eating disorders (ED). Athletes who met at least two of the following criteria were categorized as REDs case: amenorrhea or oligomenorrhea, presence of DE or ED, low free triiodothyronine (fT3). Athletes with none or only one indicator served as controls. Diagnostic properties of the LEAF-Q were assessed using receiver operating characteristics calculations.

RESULTS: In total, 14 athletes (28%) were classified as REDs cases. REDs cases showed a higher prevalence of amenorrhea (64.3% vs. 5.6%, p<0.001), DE/EDs (78.6% vs. 27.7%, p=0.002) and low fT3 (50.0% vs. 2.8%, p<0.001). To detect "mild" or more severe REDs risk, the LEAF-Q had a sensitivity of 78.6% and specificity was 50.0%, with a positive predictive value (PPV) of 37.9% and negative predictive value (NPV) of 85.7%. With the exception of DE, which was significantly more common in athletes who scored positive in the LEAF-Q (55.2% vs. 23.8%, p=0.042), there were no differences in primary, secondary or potential indicators between athletes scoring above or below the LEAF-Q cut-off (total score ≥8).

CONCLUSION: Among German female endurance athletes the LEAF-Q is a good screening tool to successfully identify athletes who meet criteria of "mild" or more severe REDs risk, as classified according to the IOC REDs CAT2. However, the low PPV highlights the need to perform individual-specific assessment of REDs severity/risk for athletes who score positive in the LEAF-Q.

EFFECT OF 10-WEEK AEROBIC EXERCISE ON SKIN ADVANCED GLYCATION END PRODUCT LEVELS IN YOUNG WOMEN

NAKAJIMA, S., YAMADA, N.

KYORITSU WOMENS JUNIOR COLLEGE

INTRODUCTION: Advanced glycation end-products (AGEs) are harmful compounds formed through an excess of protein and sugar in the human body. Excessive accumulation of AGEs has been reported to accelerate the aging process and contribute to diseases such as arteriosclerosis and diabetes. According to an age-specific survey of Japanese men and women, aging, unhealthy eating, and lifestyle habits can increase the accumulation of advanced glycation end products (AGEs) in the skin. However, most of these results were reported in middle and older age groups. Thus, the present study aimed to determine whether exercising reduces skin AGE levels in young women who do not exercise previously.

METHODS: We measured skin AGE values on the forearm of the dominant arm using AGE Scanner Mini (Diagnoptics). In addition, participants' blood sugar and HbA1c levels and body composition (body fat percentage) were measured. Simultaneously, we conducted a survey on dietary intake. For exercise activity, we set the exercise intensity based on the maximum oxygen uptake and used the heart rate as a guide. Participants were asked to cycle for 60 min using an ergometer once a week for 10 weeks. Thereafter, measurements were conducted at week 0, 5, and 10 after completion of the exercise.

RESULTS: The characteristics of the participants were as follows: age 20.3 ± 2.6 years, height 160.3 ± 3.4 cm, weight 50.6 ± 7.5 kg, and body fat percentage 25.3 ± 6.4%. The mean estimated maximum oxygen uptake was 39.5 ± 5.2 mL/min/kg. The fasting blood glucose levels were 101.8 ± 9.8, 89.9 ± 9.3, and 87.5 ± 8.3 mg/dL at week 0, 5, and 10, respectively. The fasting blood glucose levels were significantly lower at week 5 and 10 than those at week 0. Meanwhile, the HbA1c values were 47.9 ± 3.7, 30.4 ± 8.1, and 27.1 ± 1.8 nmol/mol at week 0, 5, and 10, respectively. No significant difference was observed in HbA1c at week 5 compared with that at week 0, and the value was significantly lower at week

10. However, the mean skin AGE values were 169.1 ± 25.2, 171.8 ± 25.51, and 171.5 ± 23.2 IU at week 0, 5, and 10, respectively. No significant difference was observed among the three measurements.

CONCLUSION: HbA1c reflects blood sugar status over the past 1–2 months and takes about 3 months before it is reflected in skin AGE levels. Thus, it needs to be continuously monitored and observed in the long term.

HEALTH-RELATED PHYSICAL FITNESS COMPONENTS AMONG SAUDI FEMALE UNIVERSITY STUDENTS STUDYING SPORT SCIENCE AND PHYSICAL ACTIVITY AT TAIBAH UNIVERSITY

ALJUHANI, L., ALAHMADI, M.A.

TAIBAH UNIVERSITY

INTRODUCTION: In 2018, Saudi Arabia introduced physical education for females in public schools along with launching a new Sport Science and Physical Activity (SSPA) major for Saudi females at several Saudi Universities, including Taibah University in Madinah city, western Saudi Arabia. Therefore, the aim of this study was to measure the main health-related physical fitness components among Saudi female SSPA students at Taibah University.

METHODS: 75 female university students (mean ± SD, age, 18.52 ± 0.83 years; body mass, 52.72 ± 10.22 kg; height, 158.76 ± 5.38 cm) took part in this study. Cardiorespiratory fitness was determined using the Queen's College Step Test to estimate maximal oxygen consumption (VO2max), hand grip strength was evaluated using a dynamometer, muscle endurance was estimated by the push-up test, and flexibility was evaluated with the sit and reach test. Descriptive statistics were reported as mean values and standard deviation.

RESULTS: The mean (± SD) VO2max was 35.05 ± 3.65 (ml.kg.min). The mean (± SD) hand grip strength on the right was 17.54 ± 4.32 (kg), and on the left was 17.60 ± 4.97 (kg). Finally, the mean (± SD) muscle endurance was 16 ± 9 (repetitions), and flexibility was 28.80 ± 9.86 (cm).

CONCLUSION: The study concluded that hand grip strength and muscle endurance were lower while cardiorespiratory fitness and flexibility were within the normal range among Saudi female SSPA students compared to their international counterparts, as reported in the literature. Resistance training aimed at enhancing muscular strength and endurance should be the main component of fitness programs.

13:00 - 14:15

Invited Symposium

IS-AP05 Performance Analysis in International Sport: From Practice to Application

PROFESSIONAL PRACTICE OF APPLIED PERFORMANCE ANALYSIS

MARTIN, D.

INSTITUTE OF TECHNOLOGY, BLANCHARDSTOWN

Applied performance analysts (PAs) are a well-established applied sports science practitioner group, embedded under various titles in the majority of the world's elite sports performance ecosystems. However, there has been little investigation of the nature of their professional practice within applied environments, or if performance analysis does indeed constitute a profession. This presentation will consider the evolution of applied practice within performance analysis as it has evolved to keep pace with technological developments and the emergence of big data. The presentation will focus on three key strands; 1) Harnessing data to co-create insights and ultimately value within performance ecosystems; 2) The current status of applied performance analysts as professionals; 3) Performance Analysis 3.0: future directions for the profession. Given the huge investment by sports performance organisations in the technology and human resources to generate performance data it is pertinent to pause and consider the value these data create, how value is created and for whom. Recent studies suggest that value is co-created between analysts and coaches; the analyst team generate, curate and translate insights based on the direction and guidance of the coaching or executive staff. It is becoming clear that while analysts need domain and technical knowledge, they also need particular personal attributes and professional behaviours to allow them develop the contextual intelligence required to deliver a valued service. Investigations which have captured the lived experiences of applied PAs reveal a group of dedicated and passionate practitioners who face several challenges including general role ambiguity, ad-hoc recruitment and job insecurity, poor working conditions, widespread use of unpaid internships and poor salaries, continually having to 'prove their worth' in an often volatile micro-political climate, and a general uncertainty about what skill set is required as the profession and technology rapidly evolve. There is an opportunity to re-imagine and rebrand to 'Performance Analysis 3.0' with a clear role definition, professional regulation, and a development pathway for applied professional practitioners. This presentation will be of interest to attendees engaged in the application of performance data in applied environments; analysts, coaches, and sports scientists. It will also appeal to delegates involved in professional development, reflective practice and accreditation.

ENGAGING PERFORMANCE ANALYSIS TO SUCCEED IN ELITE SPORT: AN EXAMPLE OF BADMINTON FROM THEORY TO PRACTICE

GÓMEZ RUANO, M.
UNIVERSIDAD POLITÉCNICA DE MADRID

Sports performance has evolved since the origin of sports where performance metrics were used to control, model, and prescribe the players behaviours from different approaches (e.g. technical, tactical, positional, physical, psychological). In particular, there is a need to bridge the gap that exists between sports science and the field/court. The coaches need to feel and see sports performance analysts as a relevant and contributing role within their staff where scientific knowledge is offered to improve practice and management of competition (i.e. from theory to practice). The research approach should consider the scope and relevance of coaches' research questions, instead of scientists research questions alone, which may be useful from a coaching point of view. Racket sports involve a wide range of data and key performance indicators that can be used to support decision-making with elite players including predicting, classifying, or establishing rule-based decisions that allow improvement in the quality of coaching decisions. The use of scientific methods and machine learning models may help to support this process and (sometimes) lead to success in international sports, such as badminton. This presentation will provide cooperative examples between a performance analyst and a successful badminton coach who engages with performance available information, to improve the quality of training sessions and player's performance. Thus, a holistic method will be provided to clarify how sports scientists and coaches can work together to support and assist athletes in their careers.

HARNESSING PERFORMANCE ANALYSIS TO OPTIMISE BASKETBALL SUCCESS

LEICHT, A.
JAMES COOK UNIVERSITY

Basketball is an international game that continues to increase its popularity worldwide. Many studies have examined the physical demands of this game however, there is a growing interest in metrics and performance analysis to assist basketball athletes and coaches to win at all competition levels. Examination of data from regional, national and international tournaments has highlighted potential key metrics for match success. Although, the success of these metrics across competitions, countries, and sexes to enhance winning remains unclear, possibly due to methodological issues and changing trends in athlete ability and competition strategies. This invited session will review the current application of performance analysis in basketball with a focus on those metrics most applicable to winning across wide domains. Further, it will examine the historical relevance of these metrics and analyses to modern day competition. This session will engage analysts, sport scientists, players and coaches with discussion of the crucial metrics and analytical methods for success in international basketball while proposing the future of performance analysis in this global sport.

Oral Presentations

OP-PN26 Physiology/Strength and BFR

COMPARISON OF BLOOD FLOW RESTRICTION PROTOCOLS ON HIGH-INTENSITY INTERVAL EXERCISE

CHUA, M.T., SIM, A., BURNS, S.
NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY

INTRODUCTION: Blood flow restriction (BFR) during high-intensity interval exercise (HIIE) may induce high physiological stress, but this could occur at the cost of training intensity. This study compared the acute physiological and perceptual responses to three BFR methods applied during HIIE.

METHODS: Twenty-four healthy males (age 25 ± 3.5 years, maximal aerobic power (MAP) 264 ± 61 W) completed four experimental trials in a randomised order. All HIIE consisted of 3 sets of 5 × 30-s on, 30-s off cycling intervals interspersed with 3-min of passive rest. The exercise intensities and BFR applied were: (i) control (CON) – 100% MAP, no BFR; (ii) rest occlusion (RO) – 100% MAP, 80% limb occlusion pressure (LOP) for 2-min during passive rest between sets; (iii) exercise low occlusion (ELO) – 70% MAP, 50% LOP during exercise; and (iv) exercise high occlusion (EHO) – 70% MAP, 80% LOP during exercise. Heart rate (HR), blood lactate (bLa), rating of perceived pain and discomfort (RPD) and rating of perceived exertion (RPE) were measured after warm-up and each exercise set. Surface electromyography was measured on the vastus lateralis (VL) and biceps femoris (BF) on the 1st and 5th repetition of each exercise set, followed by root mean square (RMS) analysis. Repeated measures ANOVA compared measures across conditions and time points, followed by post-hoc t-tests with Bonferroni adjustments where appropriate. Significance was set at $p < 0.05$.

RESULTS: Two participants withdrew from EHO due to intolerable pain. The RPE and RPD during exercise were: (mean ± SD) CON = 11.9 ± 2.8 and 1.1 ± 1.4; RO = 12.1 ± 2.8 and 1.7 + 1.7; ELO = 11.7 ± 2.4 and 1.9 ± 1.7; EHO = 13.0 ± 3.1 and 3.4 ± 2.6). Main effects of condition, time and condition × time interactions were observed for RPE and RPD (all $p < 0.05$) with post-hoc t-tests showing a greater increase in both RPE and RPD across sets in EHO than the other conditions. Similarly, main effects of condition, time and condition × time interactions were observed for both HR and bLa (all $p < 0.05$) which were significantly lower in ELO than all other conditions (mean HR (bpm) and bLa (mmol·l-1): CON = 137 ± 27 and 6.8 ± 3.0;

RO = 141 ± 26 and 7.1 ± 3.1; ELO = 133 ± 26 and 5.3 ± 1.9; EHO = 139 ± 28 and 6.8 ± 3.0, all $p < 0.05$). HR was significantly higher in RO vs CON from exercise set 2 onwards (all $p < 0.05$) whereas bLa was greater in RO than CON 5-min post-exercise. Main effects of condition and time (all $p < 0.05$) were observed for RMS-VL and RMS-BF, with post-hoc tests indicating significantly higher RMS on CON and RO than ELO and EHO. For RMS-VL, there was a condition × time interaction, with significantly higher RMS observed during the last repetition in RO than CON (142 ± 18.0 vs 132 ± 14.9 mV, $p < 0.05$).

CONCLUSION: Applying BFR during rest between HIIE sets (RO) elicits high physiological stresses – perceived pain, heart rate and blood lactate – without compromising muscle activation or exercise intensity.

NEUROMUSCULAR ADAPTATIONS FOLLOWING A 4-WEEK ISOKINETIC STRENGTH TRAINING PROGRAM WITH BLOOD FLOW RESTRICTED RECOVERY IN A PHYSICALLY ACTIVE POPULATION

GORDON, D., DUNN, A., PEARSON, J.1, WOJCIECHOWSKI, G.1, FRENCH, C.1, DESANLIS, J.2, GERNIGON, M.2

1ANGLIA RUSKIN UNIVERSITY, 2CIAMS, UNIVERSITÉ PARIS-SACLAY, ORSAY CEDEX, FRANCE

INTRODUCTION: Blood flow restriction (BFR) training can increase rates of muscular adaptations at equal, and lower training intensities than traditional strength training. BFR induces hypoxia in the working muscle inducing greater fatigue, promoting angiogenesis as well morphological responses. There is currently limited knowledge as to the effects of blood flow restricted recovery on morphological and neuromuscular adaptations. Therefore, the aim of this study was to investigate whether blood flow restricted recovery can elicit strength and neuromuscular adaptations over a 4-week isokinetic strength training program.

METHODS: Following local institutional ethical approval 20 physically active participants (n = 12 male, n = 8 female) volunteered to participate (mean ± SD: age = 21.0 ± 2.3 years, height = 174.5 ± 9.2 cm, mass = 75.2 ± 14.0 kg. A single-blinded repeated measures matched pairs design was implemented with 3 training conditions: 20 mmHg [SHAM], 40% limb occlusion pressure (40-LOP), and 80% LOP (80-LOP). Participants completed baseline and post testing ankle-brachial index (ABI), 60 cm Drop Jumps, 6 s and isokinetic concentric knee flexion-extension at 60 and 180 °.s-1. During dynamometer testing electromyography (100 Hz) and Near Infrared Spectroscopy (10Hz) were recorded at the mid-point of rectus femoris. Isokinetic training consisted of 12 sessions, 3 times per week for 4 weeks at 60 °.s-1 with blood flow restricted recovery. For sessions 1-6 participants completed 3 sets of 5 repetitions per leg with 120 s recovery between sets; sessions 7-9: 3 sets of 5 repetitions per leg with 90 s recovery between sets; and sessions 10-12: 2 of 5 repetitions with 120 s recovery, and 2 sets with 180 s unrestricted recovery.

RESULTS: A significant pre to post increase ($P = 0.004$) in peak torque (60°.s-1) was observed in LOP-40 (Pre: 147 ± 51 Nm, Post: 208 ± 79 Nm) ES= 0.97 ±95% CI -33.1 – 31.2. There was a significant increase in peak torque for LOP-80 (60°.s-1) from 178 ± 36 to 216 ± 33 Nm ($P= 0.02$), ES= 1.17 ±95% CI -17.0 – 14.7. Significant decreases in tissue oxygenation mean response time (MRT) were observed for LOP-40 ($P= 0.01$) from 31.2 ± 3.9 s to 23.8 ± 5.7 s, ES= 1.63 ±95% CI -0.7 – 4.0 and LOP-80 ($P= 0.01$) 38.4 ± 8.6 s to 25.6 ± 8.9 s ES= 1.56 ±95% CI -2.44 – 5.57. Average iEMG increased at 60 °.s-1 from 2892.3 ± 692.6 mV to 3472.6 ± 852.2 mV ($P= 0.01$) ES=0.80 ±95% CI -377.5 – 375.8. Non-significant changes observed for peak torque, iEMG or MRT at 180 °.s-1. Additionally there was no change across any group for drop jump performance ($P> 0.05$).

CONCLUSION: Blood flow restricted recovery promoted significant gains in both peak torque and MRT. Suggesting, that it proffers a modality that allows for maximal force generation during the exercise whilst enhancing the adaptive process by facilitating a hypoxic environment during recovery. Attention now needs be given to establishing optimal LOP and the mechanisms of these adaptations.

ACUTE EFFECTS OF PLYOMETRIC EXERCISES WITH BLOOD FLOW RESTRICTION ON MUSCLE THICKNESS AND ANABOLIC HORMONES IN FEMALE PLAYERS

CHEN, C.F., HSIN, F.Y., CHEN, Y.J., CHEN, H.H., FANG, C.C., CHAN, K.H.

NATIONAL TAIWAN SPORT UNIV

INTRODUCTION: Plyometric exercises (PLY) have been used as conditioning activity to enhance subsequent performance by eliciting postactivation potentiation (PAP). Studies indicated that exercises combined with blood flow restriction (BFR) may strengthen the PAP response. Besides, exercises combined with BFR could also increase muscle thickness and blood levels of anabolic hormones, which may contribute to enhance performance. Therefore, the aim of this study was to examine the acute effects of PLY with BFR on muscle thickness of rectus femoris (RF) and vastus lateralis (VL) as well as changes in blood levels of total testosterone (total-T), free testosterone (free-T) and sex hormone-binding globulin (SHBG). We hypothesized that PLY with BFR would increase muscle thickness or blood anabolic hormones levels of female players.

METHODS: Eleven female basketball and volleyball players (19.45 ± 0.93 yrs, 168.77 ± 5.98 cm, and 62.91 ± 9.57 kg) were recruited into the study. A crossover and counterbalanced manner was used to investigate the muscle thickness and blood levels of anabolic hormones after single bouts of PLY and PLY with BFR (PLY-BFR). Subjects conducted the 2 trials in same menstrual cycle phase. PLY consisted of 40 drops of ankle hops, hurdle hops and drop jumps. In PLY-BFR, subjects conducted PLY, and cuff pressure of 80% arterial occlusion pressure was applied to subjects' quadriceps of dominant leg. The venous blood samples were drawn before and 15 min after warm-up exercises to analysis the blood levels of total-T, free-T and SHBG. Muscle thickness of RF and VL were measured before, immediately and 15 min after exercises. A two-

way ANOVA with repeated measures was used to compare differences within trials and time points. Statistical significance was set at $\alpha = .05$. All data are expressed as mean ± SD.

RESULTS: No significant differences were found in muscle thickness of RF (PLY: 2.22 ± 0.37 and 2.16 ± 0.34 vs. 2.14 ± 0.27 cm, $p > .05$; PLY-BFR: 2.22 ± 0.35 and 2.21± 0.38 vs. 2.14 ± 0.37 cm, $p > .05$) or VL (PLY: 2.22 ± 0.37 and 2.16 ± 0.34 vs. 2.14 ± 0.27 cm, $p > .05$; PLY-BFR: 2.22 ± 0.35 and 2.21± 0.38 vs. 2.14 ± 0.37 cm, $p > .05$) within time points or trials. Furthermore, there were no significant changes in blood levels of total-T (PLY: 0.57 ± 0.20 vs. 0.58 ± 0.19 ng/mL, $p > .05$; PLY-BFR: 0.58 ± 0.19 vs. 0.56 ± 0.19 ng/mL, $p > .05$) , free-T (PLY: 8.24 ± 5.40 vs. 6.46 ± 2.75 pg/mL, $p > .05$; PLY-BFR: 6.37 ± 2.21 vs. 6.55 ± 2.27 pg/mL, $p > .05$), or SHBG (PLY: 70.85 ± 25.47 vs. 68.82 ± 22.48 nmol/L, $p > .05$; PLY-BFR: 68.84 ± 18.14 vs. 64.63 ± 14.18 nmol/L, $p > .05$) after 15 min of exercises within trials.

CONCLUSION: The results of present study indicate that a single bout of plyometric exercises with blood flow restriction could not increase either muscle thickness or blood levels of anabolic hormones of female players. More studies are needed to investigate whether it is a practical warm-up strategy to improve performance of players.

SEX DIFFERENCES IN BASELINE DIFFERENCES AND RESISTANCE EXERCISE TRAINING INDUCED HYPERTROPHY, POWER, AND STRENGTH: A SYSTEMATIC REVIEW & MULTI-LEVEL META-ANALYSIS

NOLAN, D., DARRAGH, I., GERMAINE, M., LYNCH, A., MANNINEN, M., EGAN, B.

DUBLIN CITY UNIVERSITY

INTRODUCTION: Resistance exercise training is commonly used by athletic populations as part of a comprehensive athletic development training program, eliciting morphological and neurological adaptations which contribute to changes in muscle hypertrophy, power and strength. Between-sex differences are evident in many systems of the human body. These between-sex differences are particularly evident in the musculoskeletal system, specifically regarding body composition, muscle structure, and absolute muscular strength.

METHODS: This systematic review with meta-analysis aimed to; i) quantify the mean absolute and standardised between-group differences in untrained males and females at baseline for fat-free mass, upper body strength, lower body strength, and lower body power; and ii) examine between-group differences comparing males and females regarding hypertrophy, upper body strength, lower body strength, and lower body power in adaptations to resistance exercise training. A systematic review with meta-analysis was conducted on experimental studies conducted before December 2023. The search using the online databases PUBMED, SPORTDiscus, Web of Science, Embase, and other supplementary search strategies yielded 4,468 articles, with 29 articles meeting the inclusion criteria. The articles were analysed using a meta-analytic multilevel maximum likelihood estimator model.

RESULTS: The results indicate there are significant differences at baseline between untrained males and females for absolute fat-free mass (RMD = 19.35, CI 95% [17.41, 21.29], $z = 19.53$, $p = <0.001$), upper body strength (SMD = 2.88, CI 95% [2.67, 3.10], $z = 23.47$, $p < 0.001$) and lower body strength (SMD = 2.14, CI 95% [1.84, 2.44], $z = 16.21$, $p < 0.001$). In response to resistance exercise training, no significant differences were found for either hypertrophy ($g = 0.26$, CI 95% [-1.00, 1.51], $z = 0.40$, $p = 0.68$), or lower body strength ($g = 0.10$, CI 95% [-0.06, 0.25], $t = 1.38$, $p = 0.19$). A significant effect in favour of females was observed for upper body strength outcomes ($g = -0.39$, CI 95% [-0.53, -0.26], $t = -6.35$, $p = <0.001$).

CONCLUSION: These analyses would suggest that there are significant differences in anthropometric and physical performance characteristics between untrained males and females; however, males and females respond in a similar manner to resistance exercise training for hypertrophy and lower body strength, with females displaying an advantage for relative upper body strength.

REPETITIVE HIGH VOLUME AND HIGH INTENSITY RESISTANCE EXERCISE BLUNTS ANABOLIC AND MECHANOPROTECTIVE RESPONSES IN HUMAN SKELETAL MUSCLE FIBERS

BERSINER, K., JACKO, D., SCHAAF, K., BLOCH, W., GEHLERT, S.

UNIVERSITY OF HILDESHEIM

INTRODUCTION: Phosphorylation of the ribosomal protein S6 (rpS6) is indicative for muscle anabolism and is acutely regulated by resistance exercise (RE), while phosphorylation of HSPB5 is indicative for mechanical stress in myofibers. Furthermore, HSPB5 Ser59 and rpS6 Ser235/236 phosphorylation is fiber type-specific in dependency of volume and intensity. Whether different volumes of high intensity RE over an extended period of time will reduce and re-increase prpS6 Ser235/236 and pHSPB5 Ser59 has not yet been investigated, especially when a reduction of RE in terms of detraining is applied. It is also unknown whether HSPB5 and rpS6 will display a corresponding phosphorylation pattern in single muscle fibers. We analyzed prpS6 Ser235/236 and pHSPB5 Ser59 in Western Blot and fiber type-specifically by means of immunohistochemistry in two groups with different training volumes.

METHODS: Participants (14 male, 4 female; 24 ± 3.4 yrs.; 179 ± 10 cm; 75,9 ± 12,3 kg) were assigned to two groups, differing in training volume (1 set=VOLx1; n=8, or 2 sets=VOLx2; n=10) for 14 RE sessions within 6 weeks, followed by 3 weeks without RE and one final (15th) training session. Training consisted of one or two sets at the respective 4, 8 & 16 RM on the leg extension machine as well as at the 4 and 8 RM on the leg press. Vastus lateralis biopsies were taken before and 1h after the first (R1, S1), 14th (R14, S14) and final (R15, S15) training session. Training before biopsies was carried out with equal volume in both groups (2 sets). prpS6 Ser235/236 and pHSPB5 Ser59 were analyzed in Western Blot and immunohistochemically. Two-way repeated measures ANOVA were performed to detect differences between groups and time points, and linear regression for fiber type-specific differences at S1. A statistical level of $p<0.05$ was accepted.

RESULTS: prpS6 Ser235/236 was increased after the first training session and after the detraining phase in both groups, but only in VOLx1 after the 14th session. Values at S14 differed significantly between groups ($p<0.05$). A similar regulation was observed in pHSPB5 Ser59, where S14 was significantly lower than S1 and S15 only in VOLx2 ($p<0.05$). Co-staining of pHSPB5 Ser59 and prpS6 Ser235/236 at timepoint S1 revealed a significant negative correlation in type 1, but none in type 2 fibers.

CONCLUSION: In dependency of the volume, repeated high intensity muscle contractions exceed a yet undefined adaptive threshold which reduces the acute anabolic and proteostasis-related signaling within skeletal muscle fibers, indicating sarcomeric desensitization to mechanical stimulation. Although temporarily activated, acute RE-induced chaperone activation does not correspond with the magnitude of single muscle fiber anabolism, indicating a vastly independent regulation of damage and anabolism in skeletal muscle.

Invited Symposium

IS-MH11 How sauna learnt a lesson from the gym – the shared health benefits of passive heat exposure and exercise

NO PAIN, GAIN? EXPLORING STRATEGIES TO ENHANCE THE TOLERABILITY OF PASSIVE HEATING

LEICHT, C.

LOUGHBOROUGH UNIVERSITY

While the prospect of sitting in a hot bath to increase body temperature is appealing to many, the perceptual responses to whole-body passive heating suggest that this activity can be accompanied by substantial thermal discomfort. Particularly the more dated studies investigating the acute physiological response and chronic adaptations to passive heating often employed protocols using temperatures and/or exposure durations that could be described as gruelling. Such intense protocols often resulted in the desired impact on health-related physiological outcomes, including an acute increase in inflammatory markers, decrease in blood pressure, or chronic reductions in resting blood pressure. However, more recent studies that also assessed qualitative participant feedback report statements such as 'it was intensely hot', or an outright 'it was too uncomfortable'. This is problematic. Exercise studies outline the importance of the subjective experience for long-term adherence, an essential aspect to long-term health benefits. In this talk, I will focus on approaches to optimise the subjective experience to heat interventions. I will present studies that have explored the balance between tolerability and acute physiological responses to passive heating, with a focus on inflammatory markers, blood pressure regulation, and vascular control. Reducing skin temperature, either over large body segments or those areas particularly sensitive to heat, such as the face, is a promising approach. I will discuss the application of local cooling via conduction (e.g., ice pack application) and convection (e.g., fan exposure), and unpick thermophysiological differences between heating media (e.g., hot water immersion vs sauna). Particularly the cooling of small, sensitive areas appears promising, as the overall body temperature is, if at all, only minimally affected. This results in similar beneficial changes to health-related markers, whilst improving the subjective perceptive response. Cooling larger body areas, on the other hand, may come at the expense of health benefits by reducing overall heat gain. The importance of skin temperature is also evident when comparing modalities. For the same increase in core temperature, the subjective response to hot water immersion appears to be more positive compared with hot air exposure, which results in higher skin temperatures. In summary, whilst a sufficient heat stimulus is needed to induce beneficial adaptations, protocol adjustments by limiting the increase in skin temperature may increase comfort and therefore help long-term adherence.

MOVING PASSIVE HEAT THERAPY TO THE CLINIC – EVIDENCE FOR ITS FEASIBILITY AND EFFICACY

HARWOOD, A.

UNIVERSITY OF TEXAS HEALTH SAN ANTONIO

Studies in able-bodied individuals indicate improvements in glucose tolerance, vascular function and the inflammatory profile following repeated passive heat exposure. These findings have encouraged translation to clinical populations. Indeed, disability- and chronic disease-specific alterations in physiological responses to thermal stress should be considered when investigating and aiming to implement passive heat therapy in such individuals. For example, the impaired thermoregulatory capacity in persons with spinal cord injury may limit the dose of exogeneous heat that can be prescribed. Nonetheless, preliminary studies show that passive heat therapy is feasible and tolerable in people from a range of clinical populations. Patients with peripheral arterial disease completed 99% of the prescribed lower-limb passive heating sessions during a 6-week trial. Those with coronary artery disease completed all prescribed whole-body heating sessions during a 2-week intervention and there was no difference in compliance between the passive heat therapy and exercise arms in persons with osteoarthritis. In our ongoing 8-week trial in persons with spinal cord injury, 6 out of 7 participants completed all prescribed passive heating sessions using heating blankets. However, reviewing the efficacy of chronic passive heat therapy to improve vascular, glycaemic and inflammatory outcomes paints a mixed picture. Flow mediated dilation was improved following daily sauna in persons with coronary artery disease. In contrast, reactive hyperaemia and arterial stiffness were not improved following sauna or lower-limb heating in those with peripheral artery disease. Nonetheless, a reduction in blood pressure appears a consistent finding across interventions and populations.

Fasting measures of glucose tolerance are improved in females with polycystic ovary syndrome but not in persons with osteoarthritis following repeated hot water immersion. Assessing postprandial glucose tolerance through an oral glucose tolerance test, we found no improvement in glucose tolerance in individuals with spinal cord injury following repeated whole-body heating. The same held true for basal circulating inflammatory markers (interleukin (IL)-6, tumour necrosis factors-α, C-reactive protein). While the small-scale preliminary studies discussed here may have suffered from insufficient statistical power, the mixed results regarding the efficacy of heat therapy to improve glucose tolerance and chronic low-grade inflammation in clinical populations may also be related to the comparatively small doses of exogenous heat often employed. In summary, passive heat therapy is an attractive intervention for persons with a reduced physical capacity. While early studies support its feasibility, larger scale randomised controlled trials, possibly using more demanding heating protocols than employed thus far, are required to confirm its potential to improve metabolic health in clinical populations.

POST-EXERCISE HEAT EXPOSURE TO MAXIMIZE HEALTH AND PERFORMANCE BENEFITS OF EXERCISE

BRETT, E.

PROVIDENCE COLLEGE

This talk will discuss data from studies in athletes and clinical populations examining the acute impact of post-exercise heat exposure on cardiovascular and autonomic variables, including heart rate variability, nocturnal blood pressure, and blood flow. Examination of the shared and unique mechanisms and benefits of exercise and heat therapy allow for exploration of passive heat, exercise, and combined therapies to provide protocols targeted for individual performance goals or health conditions. In athletic populations, post-exercise passive heat exposure is used to enhance cardiorespiratory fitness and prepare for hot-weather competition. However, there are concerns that the added stress of acute heat exposure may delay recovery or impair short-term performance. Examining the autonomic recovery from interval exercise with or without post-exercise hot water immersion allows to assess whether a passive heat protocol can be implemented with minimal training interruptions. Our results indicate that there is no impact of post-exercise heat exposure on next-morning heart rate variability compared to exercise alone in trained individuals. In clinical populations, including those with an impaired ability to participate in vigorous exercise and individuals with elevated cardiovascular risk, heat therapy can improve autonomic function and blood pressure control. The combination of moderate exercise with post-exercise leg heating may be a practical solution to enhance the autonomic benefits of exercise. In a series of studies in individuals with hypertension and individuals with mobility limitations, we examined acute changes in blood flow, overnight blood pressure, and nocturnal heart rate variability in response to leg heating alone, exercise combined with leg heating, or exercise with thermoneutral leg immersion. The combination of exercise and leg heating resulted in the greatest increases in leg blood flow and the most substantial improvement in overnight blood pressure compared to either standalone treatment. In summary, post-exercise hot water immersion is well-tolerated in athletic and clinical populations and can enhance the acute cardiovascular benefits of exercise. Our data suggest that the individual health benefits for exercise and passive heating combine to maximize overall benefits across the health continuum.

Oral Presentations

OP-AP33 Training and Testing/Cycling

SPRINT PERFORMANCE AND THE INFLUENCE OF BODY COMPOSITION ON POWER AND LACTATE IN A VLAMAX-TEST IN AMATEUR CYCLISTS

MEIXNER, B., KOEHLER, K., NUSSER, V., SPERLICH, B.

FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG

INTRODUCTION: vLamax-testing has recently become a much-utilized testing procedure. Mader's model of energy metabolism is the basis for the testing procedure and explains the implications of the so-called maximal glycolytic rate for short and long duration efforts [1, 2] . The testing procedure is mainly used by endurance athletes such as cyclists and triathletes. The vLamax test procedure traditionally consists of a 15-s all-out cycling test and lactate measurements before the sprint and until the ninth minute after the sprint has ended to determine maximal lactate accumulation. The calculation of vLamax is based on the equation of Heck & Schulz [3]. The aim of this study was to determine the relation between power output during and capillary blood lactate accumulation after the sprint cycling test.

METHODS: 30 male and 20 female amateur cyclists completed three trials of 15-s all-out cycle sprint tests: one familiarization trial and two trials used for this analysis. Body composition was determined during the first visit via bioelectrical impedance analysis (inbody 720, Biospace). After a 10 min warm-up at 1.5 W/kg, participants then rested for 3 min before completing an isokinetic all-out sprint at 130 RPM on a Cyclus2-ergometer (RBM elektronik-automation), which had the participants own bike installed. Capillary blood lactate was measured at the earlobe before and for 9 min after the test using BioSen C-Line (EKF Diagnostics).

RESULTS: Mean power output during the 15-s all-out sprint can be predicted by simple linear regression by fat-free mass (R2= 0.79) and by calculated total lactate production (ΔLa * 0.7*fat-free mass)(R2=0.78). A multiple linear regression model combining both predictors improves the model (R2=0.92) for each of the two trials.

CONCLUSION: Lactate production in a 15-s all-out sprint is intricately linked to body composition and power output. It remains uncertain if maximal glycolytic rate limits power production during the 15-s all-out sprint test. However, lactate production is clearly linked to mean power output. It is possible to provide calculated lactate values or vLamax if body composition and power outputs in a 15-s all-out sprint is known.

References:

1. Mader, A. and H. Heck, A Theory of the Metabolic Origin of "Anaerobic Threshold". Int. J. Sports Med., 1986.

2. Mader, A., Glycolysis and oxidative phosphorylation as a function of cytosolic phosphorylation state and power output of the muscle cell. Eur J Appl Physiol, 2003.

3. Heck, H. and H. Schulz, Methoden der anaeroben Leistungsdiagnostik. Deutsche Zeitschrift Für Sportmedizin, 2002.

CHANGES IN PHYSIOLOGICAL PARAMETERS FOLLOWING EXERCISE TRAINING PRESCRIBED RELATIVE TO CRITICAL POWER AND TO MAXIMUM OXYGEN UPTAKE

MEYLER, S., MUNIZ-PUMARES, D., BOTTOMS, L., WELLSTED, D.

UNIVERSITY OF HERTFORDSHIRE

INTRODUCTION: Prescribing exercise intensity relative to maximum oxygen uptake (VO2max) is consistently shown to poorly control and normalise exercise intensity among individuals [1]. Alternatively, prescribing exercise intensity relative to critical power (CP) is shown to reduce the variability in exercise tolerance and acute physiological responses among individuals [2]. This might have important implications on the manifestation of subsequent adaptations to training such as changes in cardiorespiratory fitness [3]. The aim of this study was to compare the magnitude and variability in changes in cardiorespiratory fitness following exercise training prescribed relative to VO2max and to CP.

METHODS: Twenty-seven healthy individuals volunteered to take part in the study. All individuals completed a maximal ramp exercise test (GXT) and three constant work rate trials (CWR) on a cycle ergometer for the determination of VO2max and CP, respectively. Exercise tests were repeated midway and at the end of the intervention. Individuals were then randomised into a threshold-group (THR; n=10), where six weeks of exercise training was completed at an intensity prescribed relative to CP; a traditional group (TRAD; n=10), where the exercise training was prescribed relative to VO2max; or a non-exercising control group (CON; n=7). Exercise training consisted of two interval training sessions and one continuous exercise session per week.

RESULTS: From pre- to post-intervention, VO2max increased by 13% (4.3 ± 3.1 mL·kg-1·min-1 [95% CI: 1.4 to 7.1]; P=0.005) in THR, 9% (2.9 ± 2.0 mL·kg-1·min-1 [95% CI: 1.1 to 4.8]; P=0.004) in TRAD, and was unchanged in CON (2.0 ± 2.2 mL·kg-1·min-1 [95% CI: -0.9 to 4.8]). Five (50%), three (30%), and two (29%) individuals experienced a meaningful increase in VO2max of ≥3.5 mL·kg-1·min-1 in THR, TRAD, and CON, respectively. No difference was observed in the variability of VO2max changes between groups (P>0.05). No significant relationships were observed between the relative change in VO2max and individual or training characteristics in either exercise group (P>0.05).

CONCLUSION: Following six weeks of exercise training, superior increases in VO2max appeared to be elicited following THR compared to TRAD. Additionally, a greater proportion of individuals experienced a meaningful increase in VO2max following THR compared to TRAD. Future primary research with adequate power is warranted to investigate whether this observation holds true in a larger sample. If consistent, these data support the use of critical power, over VO2max, when prescribing exercise intensity.

PHYSIOLOGICAL AND ANTHROPOMETRIC PROFILES OF SAUDI FEMALE CYCLIST ATHLETES

ALJUBAIRI, M., ALGHANNAM, A.F., ALOBAID, D.S., ALDARWISH, S.F., ALDAKKAN, A., ALOTHMAN, S.A.

PRINCESS NOURAH BINT ABDULRAHMAN UNIVERSITY

INTRODUCTION: The growing enthusiasm for competitive cycling, especially among Saudi women, aligns with the expansion of Saudi Arabias sports industry as part of the nations 2030 vision. Yet, there is a paucity of research focusing on the anthropometric and physiological characteristics of Saudi female cyclists, critical for optimizing performance and talent identification. This study aimed to explore anthropometric and physiological profiles of Saudi female cyclists, assisting in the design of individualized fitness evaluations and performance enhancement plans, and performance optimization strategies in line with the growing inclusivity in sports

METHODS: A cross-sectional analysis was dedicated to examining registered female cyclists through a comprehensive suite of tests. These tests aimed to map out their physical and physiological attributes, covering areas such as body measurements, body composition, hemoglobin counts, neuromuscular feedback, flexibility, bone density, muscular power, cardiorespiratory fitness, and anaerobic capabilities.

RESULTS: Seven Saudi female cyclist athletes, comprising a considerable subset of the 47 registered nationally, presented mean values across various metrics: an age of 31 years (SD ± 4.35) and a BMI of 23.30 kg/m^2 (SD ± 2.42). On average, they engaged in 4.7 (SD ± 1.97) weekly cycling sessions, spanning a distance of 192.28 km (SD ± 80.57). Muscle strength assessments yielded a mean extension MVC of 207.14 NM (SD ± 35.39) and flexion MVC of 94.42 NM (SD ± 21.72). The mean peak anaerobic power reached 575.74 watts (SD ± 92.80), while flexibility and reaction times averaged 43.21 cm (SD ± 6.25) and 0.52 seconds (SD ± 0.13), respectively. Cardiorespiratory evaluations showed a mean VO2 peak of 47.42 ml.kg-1.min-1, reaching up to 61.7 ml.kg-1.min-1, and an average maximum heart rate of 177.83 bpm (SD ± 6.09). The

mean maximal lactate concentration was 16.46 mmol/l (SD ± 3.28). Sleep analysis showed a division between participants who received less than 7 hours of sleep and those who obtained 7 or more hours

CONCLUSION: Compared to elite teenage cyclists from the U.S. and top junior cyclists from Italy, our Saudi female cyclists demonstrated notable levels of aerobic capacity and muscle strength. The study also highlights the practicality of conducting in-depth physiological and anthropometric assessments of female cyclists in Saudi Arabia, providing valuable information on their unique fitness and performance enhancement requirements

Oral Presentations

OP-BM13 Neuromuscular Physiology/Fatigue

CHANGES IN MOTOR UNIT BEHAVIOUR CONTRIBUTE TO THE REPEATED BOUT PHENOMENON

HAYMAN, O., ANSDELL, P., ANGIUS, L., THOMAS, K., ŠKARABOT, J., GRAY, S., HOWATSON, G., KIDGELL, D., GOODALL, S.
NORTHUMBRIA UNIVERSITY

INTRODUCTION: Unaccustomed eccentric exercise (EE) causes symptoms of exercise-induced muscle damage (EIMD) that are accompanied by changes in contractile properties and nervous system function, which persist for several days post-exercise [1]. Following a repeated bout of EE, the damage response is attenuated (repeated bout phenomenon [2]), but limited understanding exists [3] of how changes in motor unit (MU) behaviour are involved in this response . Accordingly, this study utilised high-density electromyography decomposition to examine single MU properties during the recovery from an initial and repeated bout of EE.

METHODS: Twenty participants performed 2 bouts of maximal lengthening dorsiflexion contractions (10 × 10) three weeks apart. Maximal isometric voluntary toque (MVT), soreness (DOMS), and pain pressure thresholds (PPT) were measured pre- 24, 48, and 72 h post EE. Single MU properties were recorded pre-EE, 24, 48, and 72 h post-EE during trapezoidal contractions at 40% MVT. Mean MU discharge rate during the plateau of the trapezoidal contractions (DRAP), along with discharge rate at recruitment, derecruitment, and co-efficient of variation of inter-spike interval (CoVISI) were computed. Changes in outcomes variables within and between bouts were assessed with a linear effects model.

RESULTS: Work done was similar between bouts (1289 ± 507 vs. 1320 ± 523 J; P=0.721). However, a faster recovery in muscle function and soreness was observed after the repeated bout (MVF & DOMS differed at 24 & 48 h, PPT differed at 24 – 72 h; all P<0.05), confirming the repeated bout effect. A similar population of MUs were identified between bouts (738 ± 26 vs. 698 ± 9; P=0.54). Mean discharge rate at recruitment increased following bout 1 at 24 and 48 h post-EE (P<0.001) with increases evident only at 24 h post-EE after bout 2 (P<0.001). Mean DRAP increased from baseline at 24 and 48 h post-EE during bout 1 (P<0.001), with the relative increase attenuated in bout 2 compared to bout 1, evident only at 24 h (18 [16.7-19.4] vs. 17.4 pps [16.0-18.7]; P<0.001). Discharge rate at derecruitment increased at 24 h post-EE in bout 1 (7.82 pps [7.21-8.42]; P=0.03) with no changes following bout 2. The CoVISI increased after bout 1 at 24 h post-EE (17.5 [16.3-18.8] vs. 19.2% [17.9-20.5]; P<0.001), but no changes were evident following bout 2, with lower respective values at the same timepoint (17.1% [15.9-18.4]; P<0.001).

CONCLUSION: A quicker recovery in muscle function and soreness was evident following the repeated bout of EE and this was accompanied by specific alterations in motor unit behaviour. Specifically, increases in DRAP and CoVISI following the first bout were attenuated. Such an adaptive response provides preliminary evidence demonstrating that the repeated bout phenomenon is partly explained by changes in MU behavior.

FATIGUE DEVELOPMENT DURING MAXIMAL CONCENTRIC AND ECCENTRIC CONTRACTIONS IN MEN AND PREPUBERTAL BOYS

CHANEL, B., BABAULT, N., COMETTI, C.
SPORT SCIENCE FACULTY, UNIVERSITY OF BOURGOGNE-FRANCHE-COMTÉ

INTRODUCTION: The current literature has shown a lower fatigue following muscular-type exercises for prepubertal boys in comparison with adults. While, isometric contractions are frequently explored, less is known in dynamic conditions. Given that fatigue is contraction mode dependent in adults, one can expect similar findings in prepubertal children. Thus, the aim of this study was to compare the fatigue development between prepubertal boys and men, during maximal concentric and eccentric knee extensors contractions.

METHODS: This cross-over, randomized study consisted in three visits at the laboratory (one familiarization session and two experimental sessions). Twelve boys (9-11 years old) and 12 men (20-25 years old) were included. Tests and exercises were conducted on the right knee extensor muscles using an isokinetic ergometer. The fatiguing protocol was composed of three sets of 30 concentric (CONC) or eccentric (ECC) knee extensor maximal contractions realized at 60°/s, separated with 30 seconds rest between each set. Maximal voluntary isometric contractions (MVIC) were conducted before the fatiguing exercise (PRE) and were repeated immediately after each sets (POST S1, POST S2, POST S3), five minutes (POST R5), and one hour (POST R60) after the end of the exercise. Torque (MVIT) and electromyographic activity (EMG) of vastus lateralis (VL), vastus medialis (VM), rectus femoris (RF) were recorded during MVIC. MVIT and EMG values were analyzed with a three-way (age x contraction mode x time) analysis of variances (ANOVA). Age corresponded to boys vs. men. Contrac-

tion Mode corresponded to the fatiguing exercise (CONC vs. ECC). Time corresponded to differences between all time points.

RESULTS: A significant Time x Age interaction was found for MVIT, revealing a decrease after both fatiguing protocols. Post-hoc revealed a signitificant difference with PRE from POST S1 to POST R60 for men ($P < 0.05$). For boys no difference with PRE values was observed with the post-hoc. When considering relative torque values, a significant Time x Age interaction was also observed. Post-hoc test revealed a significant group effect at POST S2 and POST S3 indicating a significant lower torque decrease ($P < 0.05$) for boys than for men.

A significant Contraction Mode x Age interaction was found for RF EMG. Post-hoc tests revealed a significant higher EMG decrease during MVIC for boys than for men in CONC conditions ($P < 0.05$). No difference was obtained between boys and men in ECC.

CONCLUSION: This study shown a lower MVIT decrease for boys than for adults. During concentric exercise, the EMG revealed a higher decrease for boys, like already shown with isometric fatiguing protocol. However, no difference was observed during the eccentric exercise, suggesting a similar central fatigue development during this exercise modality between prepubertal boys and adults. These observations confirmed that fatigue development between men and prepubertal boys was contraction mode dependent.

A DIRECT MOTOR UNIT RECRUITMENT LEADS TO GREATER MUSCLE FATIGUE DURING ELECTRICAL STIMULATION

VITRY, F., MARTIN, A., ENJALBERT, G., SORDET, J., PAPAIORDANIDOU, M.

INSERM UMR 1093-CAPS, UNIVERSITÉ BOURGOGNE

INTRODUCTION: Electrical stimulation can be delivered over a nerve trunk or muscle belly, and can generate contractions by activating motor (direct recruitment) and sensory (indirect recruitment) axons. The aim of the present study was to investigate the impact of the stimulation mode (nerve trunk vs muscle belly) on the extent and origin of neuromuscular fatigue of the triceps surae.

METHODS: Fifteen participants visited the laboratory for two experimental sessions. Each session consisted of delivering 25 stimulation trains (100 Hz, 20s ON – 20s OFF) at an intensity evoking 10% of maximal voluntary contraction (MVC), either applied over the triceps surae muscles or over the posterior tibial nerve. Before (PRE) and after (POST) the 25 stimulation trains, MVC, muscle contractile properties, as assessed by the twitch torque (Pt) and neural changes, as assessed by the voluntary activation level (VAL), were evaluated. For each stimulation train, the torque-time integral (TTI) was determined. Moreover, three twitches at the intensity of each stimulation train (PtIstim) were delivered before each 25-train session to identify the initial motor unit (MU) recruitment (direct vs indirect, [1]). Finally, the sum of the TTI of the 25 stimulation trains was calculated to determine the total TTI developed by each subject during each of the two sessions ($\sum$TTI).

RESULTS: Results showed that MVC, VAL and Pt were significantly decreased ($P < 0.05$) after the 25 stimulation trains for both muscle and nerve stimulation (-9.5 and -7.6% for muscle and nerve stimulation, respectively). The $\sum$TTI was not different between the two modalities of stimulation ($P = 0.72$). When the EMG associated to the PtIstim was considered to discriminate the trials according to the initial MU recruitment, independently of the stimulation modalities, 17 trials out of the 30 were considered as inducing a direct MU recruitment and the rest 13 trials were considered as inducing an indirect MU recruitment. Statistical analysis revealed a significant decrease of MVC after the 25-stimulation trains only after the trials inducing a direct MU recruitment ($P < 0.001$). Finally, $\sum$TTI developed was not significantly different between trials inducing direct and indirect MU recruitment ($P = 0.21$), although mean TTI was higher in trials inducing indirect (6270 ± 4282 Nm) comparatively to those inducing direct MU recruitment (4539 ± 3124 Nm).

CONCLUSION: These results indicate that muscle and nerve stimulation induce the same amount of neuromuscular fatigue that can be attributed both to neural and muscle alterations. It appears that the site of stimulation is not a discriminating factor for fatigue development. On the other hand, the loss of MVC reported only for the direct MU recruitment suggests that when an indirect MU recruitment is induced, fatigue development is less pronounced. It appears thus that the level of induced fatigue seems more linked to the initial type of MU recruitment than the site of stimulation.

1 - Vitry et al, 2019

ACUTE NEUROMUSCULAR CHANGES TO A STRENGTH TRAINING SESSION PERFORMED WITH HIGH AND MODERATE MECHANICAL LOADING

GAMERO DEL CASTILLO, D., PONTES, M., BAUDRY, S.

UNIVERSITÉ LIBRE DE BRUXELLES, BRUSSELS, BELGIUM AND LUNEX INTERNATIONAL UNIVERSITY

INTRODUCTION: David Gamero-delCastillo1, Matheus Pontes2 and Stephane Baudry1

1Laboratory of Applied Biology and Research Unit in Applied Neurophysiology (LABNeuro), Université Libre de Bruxelles, Brussels, Belgium

2Department of Physiotherapy, LUNEX International University of Health, Exercise and Sports, Differdange, Luxembourg

Resistance exercise differs significantly in nature and manipulating training variables [including intensity expressed as % of the one repetition maximal (1RM)] allows for specific adaptive changes which may include gains in muscle mass and maximal strength. Two types of loading in strength training protocols are mainly used, hypertrophic and maximal loading, which can induce different acute responses (1). This study aimed to measure acute neuromuscular changes induced by two mechanical loading patterns commonly used in field settings.

METHODS: Sixteen men strength training practitioners, [mean(SD); age 26(2) yr., body mass 79(8) kg, height 181(5) cm] performed two sessions in random order on a leg press machine. One session consisted of 4 sets of 4 repetitions at 85% 1RM (150s rest between sets) while the other consisted of 4 sets of 10 repetitions at 70% 1RM, (90s rest between sets). Measurement techniques, used immediately before and after the session, included proximal femoral nerve tetanic stimulations (50 pulses, 50Hz), maximal voluntary isometric contraction (MVIC), electromyography (EMG) of vastus lateralis (VL) and rectus femoris (RF), and tissue oxygenation index (TOI). In addition, transcranial magnetic stimulation (TMS) of the motor cortex was used to elicit motor-evoked potential (MEP) in VL during repetitions performed during the training sessions.

RESULTS: Following both protocols MVIC force decreased by -31(31)% and -8(7)%, as tetanic torque ($p<0.001$) by -30(20)% and -13(20)%, after 4x10 and 4x4 respectively. VL EMG activity decreased ($p<0.05$) by -24(31)% and -19(25)% after both 4x10 and 4x4 but decreased only after 4x10; (-22(17)%) for RF. For VL TOI, was reduced ($p<0.05$) for both schemes, particularly during the 4x10, (-26(4)%; 4x4, -16(2)%.

During the sessions, MEP amplitude increased ($p<0.05$), by +65(25)%; and +40(20)% during 4x4 and 4x10, respectively. Results suggest a greater metabolic stress especially after 4x10, as assessed by TOI. Metabolic stress may impact force production (2) as observed by decreased MVIC, tetanic torque, and EMG activity. Changes in MEP may indicate a potential modulation in neuromuscular excitability (3,4).

CONCLUSION: Voluntary and tetanic force decreased in the same proportions within protocols, suggesting that the changes are mainly localized at the peripheral level. In addition, the more marked reduction in strength for the 4x10 is probably associated with metabolic changes as suggested by TOI. These findings highlight the specific neuromuscular responses through two mechanical loading patterns, used in field settings.

CUMULATIVE FATIGUE EFFECT ON MUSCLE EXCITATION AND OXYGEN SATURATION DURING ISOMETRIC KNEE EXTENSION

PARK, J.1, SONG, J.1, CHOI, Y.1, TANABE, H.2

1. SEOUL NATIONAL UNIVERSITY 2. HOKKAIDO UNIVERSITY

INTRODUCTION: Muscle fatigue, which is recognized by a reduction in the ability to perform physical actions, is influenced by several physiological factors. These physiological processes begin to manifest themselves before any noticeable loss of strength occurs during submaximal effort. Thus, muscle fatigue can be viewed as a cumulative effect that occurs after the onset of sustained physical activity, rather than as a point of task failure when muscles become exhausted. This study specifically focused on the cumulative effect of muscle fatigue by examining changes in muscle excitation and oxygen saturation through the integration of surface electromyogram (sEMG) and near-infrared spectroscopy (NIRS) measurements,

METHODS: Nine male volunteers performed repetitive, sustained isometric knee extension tasks at 50% of their maximal voluntary contraction to induce muscle fatigue. The tasks were performed sequentially until the participants could no longer produce the target torque. Knee extension torque, sEMG, and vastus lateralis NIRS data were collected simultaneously. Data from trials in which a consistent target torque was maintained were used for analysis, excluding data from the last trial in which a reduction in torque occurred due to fatigue. Coefficient of variation (CV) of torque, integrated EMG (iEMG), and median frequency (MDF) of the sEMG signal were calculated. A number of NIRS-derived tissue oxygen saturation index (TSI) parameters were analyzed, including the magnitude of oxygen desaturation (ΔTSIMIN) and recovery (ΔTSIRECOV), and the rate of desaturation in the initial contraction period (TSISLOPE).

RESULTS: An increase in iEMG and a decrease in MDF were observed across trials, followed by an increase in torque variability (CV of torque), although the average magnitude of knee extension torque remained constant. The NIRS measurements showed changes in TSI parameters, reflecting increased metabolic demand and decreased oxygen delivery in the fatigued muscle. In addition, sEMG variables began to change early in response to fatigue accumulation, whereas TSI parameters showed significant changes closer to the task failure phase. Significant relationships were also found between changes in torque, sEMG, and NIRS variables due to the development of muscle fatigue.

CONCLUSION: Our findings provide a comprehensive understanding of the development of muscle fatigue and highlight the interplay between mechanical, electrical, and metabolic responses during submaximal exercise. The reduction in force generation capacity due to muscle fatigue is reflected in the sEMG signal and manifests as an increase in motor variability. NIRS parameters representing the magnitude of oxygen desaturation and recovery could serve as reliable indicators of fatigue progression, including prediction of potential muscle exhaustion, which is critical for injury prevention.

Oral Presentations

OP-AP40 Interval Sprint Training

DOSE-RESPONSE RELATIONSHIP BETWEEN THE NUMBER OF SPRINT REPETITIONS AND PHYSIOLOGICAL AND PERFORMANCE ADAPTATIONS IN TEAM-SPORT ATHLETES

YAMAGISHI, T., HAGIWARA, M., ANDO, R., SHIRAKI, S., HENDERSON, F., YAMASHITA, D.
JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Repeated sprint training (RST) consisting of short (≤ 10 s) sprints interspersed with brief (≤ 60 s) rest periods is known to bring about various training benefits including explosive, intermittent and endurance performances (1). Since RST imposes physical and physiological demands similar to those in intermittent sports (e.g., team, racket, and combat sports), this training modality is popular among various athletes. However, the number of sprint repetitions to optimise training adaptations remains unknown. Considering that athletes often face congested schedules (e.g., sport training, competitions, work/school), establishing cost-effective ways to bring about training benefits is highly desirable. Thus, this study sought to determine the dose-response relationship between the number of sprint repetitions and physiological and performance adaptations in team-sport athletes.

METHODS: Nineteen male university basketball players (20 ± 1 yrs, 176 ± 7 cm, 73 ± 9 kg, maximal oxygen uptake [VO2max]: 56.0 ± 4.6 ml/kg/min) were allocated to one of three training groups (matched for baseline physiological and performance values); high-volume group (HG, n = 7), medium-volume group (MG, n = 7) and low-volume group (LG, n = 5). All groups performed 6 sessions of RST consisting of 6-s cycle sprints interspersed with 30-s recovery over 2 to 4 weeks. In each session, HG, MG and LG completed 15-24 sprints (112 in total), 10-18 sprints (80 in total) and 5-12 sprints (48 in total), respectively. Before and after the intervention, 6-s cycle test-derived peak (PP) and average (AP) power, and maximal incremental power (MIP) and VO2max achieved in an incremental cycle test were determined.

RESULTS: A one-way analysis of variance with Gabriel post hoc test revealed a main effect of group ($p < .05$) in % change of PP (HG: 6.8 ± 6.5%; MG: 14.7 ± 8.9%; LG: 3.5 ± 2.9%) and MG showed significantly greater improvements than LG ($p < .05$). A similar result was observed in % change of AP where a main effect nearly reached significance (HG: 10.3 ± 7.0%; MG: 15.9 ± 7.6%; LG: 5.8 ± 3.6%, $p = .05$), and MG tended to show greater improvements than LG ($p = .05$). There were no group differences in % changes of MIP (HG: 4.4 ± 3.3%; MG: 2.4 ± 3.6%; LG: 3.9 ± 3.8%) and VO2max (HG: 4.2 ± 4.4%; MG: 2.0 ± 4.8%; LG: 2.7 ± 8.8%).

CONCLUSION: Our findings suggest that medium training volume is most effective in improving short-term power (PP and AP), whereas endurance adaptations (MIP and VO2max) are not dependent on training volume which is partially in line with previous findings in non-athletes (2).

References

1. Buchheit M, Laursen PB. Sports Med. 2013;43:313-38.

2. Vollaard NBJ, Metcalfe RS, Williams S. Med Sci Sports Exerc. 2017;49:1147-56.

ACUTE RESPONSES TO A SHORT-FORMAT HIGH-INTENSITY INTERVAL SESSION: ASSOCIATIONS WITH THE ANAEROBIC SPEED RESERVE IN RUNNERS

THRON, M., RUF, L., BUCHHEIT, M., HÄRTEL, S., WOLL, A., ALTMANN, S.
KARLSRUHE INSTITUTE OF TECHNOLOGY

INTRODUCTION: The proficiency to cope with high-intensity interval training (HIIT) is essential for many running-oriented disciplines like sprinting or middle-distance running [1]. Individualization of HIIT according to individual profiles, e.g., based on the anaerobic speed reserve (ASR), could improve training outcomes by implementing a level of external workload adjusted to the athlete's profile [2]. A prerequisite for ASR based training prescription is the knowledge about acute reactions to high-intensity exercise. However, only few studies have addressed acute reactions to HIIT related to individual profiles and ambiguous findings in the literature exist [3, 4]. Therefore, this study aimed to compare acute responses to a short-format HIIT session between adolescent runners with higher and lower ASR.

METHODS: Eighteen highly trained runners (15.83±0.86 years) underwent maximal sprinting speed (MSS) and maximal aerobic speed (MAS) assessments to determine ASR (= MSS minus MAS) and a standardized HIIT protocol (2x (20x 15s/15s @110% MAS)) was administered. Pre/post-HIIT assessments included creatine kinase (CK), neuromuscular responses (countermovement jump; CMJ; reactive strength index, RSI), heart rate recovery (HRR), and subjective measures (e.g., single item for fatigue). Pearson' r was calculated to assess relationships between pre/post differences and ASR, MSS, and MAS.

RESULTS: Athletes with a lower ASR exhibited a greater increase in CK ($r=-0.75$; $p<0.01$), and decline in CMJ height and RSI ($0.69 \leq r \leq 0.79$; $p<0.01$) compared to athletes with a higher ASR. However, ASR and the HRR did not correlate ($r \leq 0.37$; $p \geq 0.15$). MAS correlated with the pre/post difference of RSI ($r=-0.54$, $p=0.02$), and MSS with the pre/post difference of CK ($r=-0.50$; $p=0.03$) and of CMJ height ($r=0.76$; $p<0.01$). Subjectively, low ASR athletes showed significant increases in fatigue and decreases in recovery variables ($r \geq 0.57$; $p \leq 0.01$). While MAS did not correlate with any of the subjective variables, MSS showed a positive relationship with the pre/post difference of the single item for fatigue ($r=0.49$; $p=0.04$).

CONCLUSION: In summary, our findings highlight the significance of taking an athletes locomotor profile into account to understand individual tolerances to HIIT. Athletes with a higher ASR, categorized as speed types, experienced less increase in CK, less decrease in CMJ height and RSI, and less increases in subjective fatigue and recovery variables than athletes with a lower ASR, classified as endurance type. Speed types athletes might benefit from using lower proportions of their ASR during high-intensity exercise or from an advantageous muscle fiber typology to handle higher intensities with a reduced internal load [3]. These findings can help tailoring training programs to individual needs and avoid possible overload.

1. Cipryan et al. (2007), JSSM. 2. Dai & Xie (2023), JSSM. 3. Buchheit et al. (2012), Frontiers in Physiology. 4. Del Rosso et al. (2017), JSS.

INDIVIDUALISED TRAINING ENHANCES INITIAL ACCELERATION PERFORMANCE IN ELITE SPRINTERS: A NOVEL FRAMEWORK TO SUPPORT EXERCISE SELECTION

KLEIN, J., OEPPERT, T.J., BRAUNSTEIN, B., SCHAPSCHRÖER, M.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: The 100 m sprint is broadly distinguished into the initial and pick-up acceleration, maximum speed and negative acceleration phases [3] with athlete's performance resulting from the interaction of the subsequent sections. The acceleration phase is considered to be a key component of the race [2]. It is well established that acceleration performance is primarily determined by the athlete`s ability to generate a high ratio of forces (RF), which is highly dependent on technical components [4]. Although these characteristics seem well understood, there are currently no procedures that allow practitioners to tailor individual exercise selection to precisely target and optimize the underlying kinematic parameters.

METHODS: Spatiotemporal variables and shin-roll kinematic behaviour [1] were obtained from 15 male (100 m-PR: 10.11–11.36 s) and 13 femlae (100 m-PR: 11.19–12.49 s) national to elite level sprinters. As a measure of initial acceleration performance V/T ratio (instantaneous velocity at 10 m divided by 10 m time) was calculated. In addition, biomotor capacity was assessed using countermovement and drop jumps. These metrics have been merged into individual profiles to provide insight into athlete`s strengths and weaknesses. Based on this, each athlete was assigned six profile-specific drills to refine sprint mechanics and assist in feeling acceleration-specific muscle activation. The individualised interventions were allocated to fifteen athletes (INT) and incorporated into the warm-up routine over a 4-week period (2x/w). The remainder of the participants (n=13) were included as a control group (CON) and maintained their group-based training regimen. Statistical inference for intervention response was conducted using stratified 2000 bootstrap resamples (and 95% bias-corrected and accelerated confidence intervals). The effect of group (INT vs CON) on V/T ratio was estimated using a linear regression model.

RESULTS: Initial acceleration performance of participants who received a technical intervention improved significantly from pre- to post-intervention (mean change=.081, 95% CI [.031, .139], p=.003) and differed significantly from the observed change of CON group (mean change = -.093, 95% CI [-.173, -.03], p=.012). Increases in performance of the INT group were accompanied by changes in whole-body kinematic strategies, that were significantly greater than those of the CON group (p<.001), whereas no change in biomotor capacity was observed for both groups.

CONCLUSION: Individualized, technique-based exercises significantly improved initial acceleration performance, in contrast to the lack of meaningful change in controls who underwent a group-based sprint training protocol. This study provides an evidence-based approach for practitioners to holistically assess how aspects of technique relate to acceleration performance and support exercise selection.

REFERENCES:

[1] Alt et al., 2022

[2] Jones et al., 2009

[3] Mero et al., 1992

[4] Morin et al., 2011

THE EFFECT OF SPRINT INTERVAL TRAINING VERSUS SHORT INTERVALS ON PHYSICAL PERFORMANCE IN FEMALE FIELD BASED INVASION TEAM SPORT PLAYERS

GRASSICK, S., Ó CATHÁIN, C., KELLY, D., NÍ CHÉILLEACHAIR, N.

TECHNOLOGICAL UNIVERSITY OF THE SHANNON: MIDLANDS MIDWEST, ATHLONE CAMPUS

INTRODUCTION: Field-based invasion team sports (FITS), including camogie, require a combination of endurance, speed, and power to complement technical and tactical performance (Connors et al., 2022). High-intensity interval training (HIIT), characterized by alternating bouts of near maximal/maximal exercise with recovery, is a popular conditioning method within FITS (Laursen and Buchheit, 2019). However, limited research has compared the effects of different types of HIIT on the physical performance of FITS players. Therefore this study aimed to compare the effects of sprint interval training (SIT) versus short intervals (SIs) on female FITS players.

METHODS: Eighteen inter-county camogie players were randomly assigned to a SIT (n = 10) or SI's (n = 8) group for 6 weeks. The SIT group performed 6-8 120m all-out sprints with 3 minutes recovery twice per week. The SI's group completed 4-5 sets of 6x15s runs at 120% maximal aerobic speed (MAS) with 15s rest between reps and 2 minutes recovery be-

tween sets twice per week. Pre and post-test measures included the YoYo-intermittent recovery test level 1 (YYIR1), repeated sprint ability (RSA), MAS, speed and jump performance. Physical outputs including total distance, high speed running (HSR), accelerations, decelerations and number of sprints were also assessed for each group using individual Global Positioning System devices during each training session.

RESULTS: A significant group x time interaction for YYIR1 was observed ($p < .032$). Specifically, SIT ($p < .001$) led to a significantly greater improvement compared to SIs ($p = 0.006$). No interaction effects were observed for any other measure. A significant main effect for time was observed for MAS ($p < .001$), RSA percentage decrement ($p < .001$) and RSA mean time ($p = .005$). However, no significant changes were found in RSA best, RSA overall time, sprint performance, or jump performance. Significant differences were observed among the physical outputs between the training groups, with the SI's group covering significantly more total distance ($p = .014$) and engaging in significantly more HSR ($p <.001$). However, the SIT group completed significantly more accelerations ($p < .001$) and decelerations ($p < .001$) compared to SI's.

CONCLUSION: The results of this study highlight the effectiveness of both SIT and SI's in improving key components of fitness associated with FITS performance. However, the findings indicate that SIT is a significantly more effective approach in enhancing the aerobic capacity of FITS players. Notably, given the significant differences in the physical outputs between the two groups, coaches must carefully evaluate the players training load and the stage of the season when determining the most appropriate training method. Therefore, both SIT and SIs serve as valuable tools for FITS coaches as they target multiple fitness components, optimizing training efficiency.

Oral Presentations

OP-PN12 Nutrition/Ergogenic Aids and other supplements III

EFFECT OF ACUTE CANNABIDIOL INTAKE ON AEROBIC PERFORMANCE: A RANDOMISED, DOUBLE-BLIND, PLACEBO-CONTROLLED, CROSSOVER STUDY

FERREIRA-DA-CUNHA, M., PEDEN, D., YAXLEY, J., TAMAK, J., FISHER, D., NORRIS, K., CABLE, T., BAILEY, S., HEANEY, L., JAMES, L.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Cannabidiol (CBD) is a non-psychoactive cannabinoid derived from the Cannabis Sativa plant. There are several proposed benefits of CBD, such as reduced pain, inflammation and anxiety, as well as improved sleep. These benefits may be important to athletes, and research is required to examine if CBD supplementation can influence exercise performance. We therefore aimed to examine whether a single 600 mg CBD dose affects endurance exercise performance.

METHODS: Twelve healthy active adults (2 female, 10 male, age 25 ± 2 y, height 1.76 ± 0.1 m, mass 75.1 ± 12.2 kg, VO2peak 43 ± 7 mL/kg/min) visited the laboratory on four occasions, completing a VO2peak test/workload challenge (WC) familiarisation, a full familiarisation, and two experimental trials in a double-blind, randomised order, with exercise on an electronically braked cycle ergometer. Participants consumed gelatine capsules containing 600 mg (CBD) or 0 mg (PLA) of CBD in 6 mL hemp oil, 30 min after a standardised high calorie breakfast. After another 150 min rest, participants cycled at 60% peak aerobic power for 8 min (SS), followed by 5 min rest and then the WC. In the WC, participants completed as much work as possible in 15 min, during which they could adjust work rate, but were blinded to all data except time. Expired gas was collected in the final minute of SS, with rating of perceived exertion (RPE) measured post-SS and post-TT. Capillary blood was collected at 0 h, 3 h, post-SS and post-WC and analysed for concentrations of electrolytes, lactate, glucose, and haemoglobin. Subjective scales measuring gastrointestinal comfort, thirst, nausea, and headache were completed at 0 and 3 h.

RESULTS: There were no significant interaction effects for blood electrolyte ($P \geq 0.270$), glucose ($P = 0.972$) or haemoglobin ($P = 0.091$) concentrations, but blood lactate concentration post-WC was higher in CBD (CBD 12.64 ± 2.8 mmol/L; PLA 11.35 ± 3.0 mmol/L; $P = 0.021$) and RPE post-SS was lower in CBD (CBD 11 ± 1; PLA 12 ± 1; $P = 0.025$). In the WC, total work (CBD 164.8 ± 44.2 kJ; PLA 162.4 ± 42.9 kJ; $P = 0.434$), mean heart rate (CBD 173 ± 17 beat/min; PLA 172 ± 18 beat/min; $P = 0.572$) and post-WC RPE (CBD 20 ± 1; PLA 19 ± 1; $P = 0.166$) were not different between trials. Additionally, subjective measures of gastrointestinal comfort, thirst, nausea and headache were not different between trials ($P \geq 0.339$).

CONCLUSION: These data suggest that CBD, even at doses of 600 mg is unlikely to acutely influence high-intensity endurance performance, although CBD may influence substrate use at high intensities and perceived exertion at moderate intensities. Future studies should seek to explore metabolic responses to endurance exercise in more detail to understand these effects.

THE EFFECT OF CANNABIDIOL ON SUBJECTIVE RESPONSES TO AEROBIC EXERCISE: A RANDOMISED CONTROLLED TRIAL

MCCARTNEY, D., IRWIN, C., BAWA, Z., PALMER, B., SAHINOVIC, A., DELANG, N., COX, G.R., DESBROW, B., LAU, N.S., MCGREGOR, I.M.
UNIVERSITY OF SYDNEY

INTRODUCTION: Exercise is known to improve health. However, it can be unpleasant, often inducing negative feelings, or 'affect'. Cannabidiol (CBD), a non-intoxicating constituent of the cannabis plant, has been reported to enhance the subjective experience of exercise; specifically, in trained individuals performing fixed-intensity aerobic activity (1, 2). Here, we investigated the effects of CBD on subjective responses to exercise in recreationally active individuals performing self-paced aerobic activity.

METHODS: A randomised, double-blind, placebo-controlled, crossover trial was conducted at Griffith University (GU) between July 17 and August 28, 2023. GU students studying sports nutrition were invited to participate. Fifty-five signed informed consent and 54, all ≥18 years of age and able to perform aerobic exercise, were eligible to take part. Participants ingested placebo or 150 mg CBD in two soft-gel capsules 90 minutes before completing a self-paced 25-lap (10 km) run around a standard outdoor athletics track (400 m, synthetic). The primary outcomes were affective valence during exercise, assessed on completion of laps 6, 12, 18 and 24 using the 'Feelings Scale', and positive and negative affect, assessed at baseline, pre-run and post-run using the 'Positive and Negative Affect Schedule'. Exercise enjoyment, motivation and self-efficacy, the core features of the 'runner's high' (i.e., euphoria, pain, anxiety, sedation), run time, and perceived exertion were also assessed. All values are median [interquartile range] on placebo vs CBD.

RESULTS: Fifty-two participants were randomised and 51 were included in the final sample (n=22 female; age: 21.9 [21.0–25.3] years). CBD did not alter affective valence (Lap 6: 2.0 [0.0–2.0] vs 1.0 [0.0–2.0]; Lap 12: 0.0 [-1.0–1.0] vs 0.0 [-2.0–2.0]; Lap 18: -1.0 [-2.0–1.0] vs -1.0 [-2.0–1.0]; Lap 24: -1.0 [-3.0–1.0] vs -1.0 [-2.8–1.0]), positive affect (Baseline: 23.5 [20.0–29.3] vs 25.5 [20.0–32.8]; Pre-Run: 24.0 [19.8–30.0] vs 23.0 [17.0–30.0]; Post-Run: 26.0 [21.0–29.0] vs 27.0 [22.0–30.0]) or negative affect (Baseline: 12.0 [10.0–14.3] vs 12.0 [11.0–13.0]; Pre-Run: 11.5 [10.0–13.0] vs 11.0 [10.0–13.0]; Post-Run: 10.0 [10.0–11.0] vs 10.0 [10.0–11.8]) (p's>0.10). The secondary outcomes were likewise unchanged (p's>0.10). Of note, despite inducing negative affect and pain, exercise, once completed, increased positive affect, and decreased negative affect and anxiety (p's<0.05).

CONCLUSION: CBD (150 mg) does not appear to enhance the subjective experience of self-paced aerobic exercise in recreationally active individuals. Nor, however, does it appear to compromise it (or exercise performance). These findings suggest that CBD use is unlikely to impede physical activity participation. Our study also reaffirms the powerful mood-enhancing effects of exercise. Trial Registration: ACTRN12623000593639

REFERENCES:

1) Sahinovic et al. (2022) Sports Med Open. doi: 10.1186/s40798-022-00417-y

2) Gibson et al. (In Press) Sports Med. doi: 10.1007/s40279-023-01980-4

CANNABIDIOL (CBD) BLUNTS MARKERS OF EXERCISE-INDUCED MUSCLE DAMAGE FOLLOWING DOWNHILL RUNNING IN A DOUBLE-BLIND RANDOMISED CROSSOVER TRIAL.

GAFFNEY, C., WRENCH, E., WOODWARD, T., BRADSHAW, H., WRIGHT, K.
LANCASTER UNIVERSITY

INTRODUCTION: Cannabidiol (CBD) has demonstrated anti-inflammatory, analgesic, anxiolytic and neuroprotective effects, which have attracted the attention of athletes. CBD is available commercially in the UK with a daily limit of 70mg advised by the Food Standards Agency at the time of the study design. This study investigated the effects of CBD following muscle-damaging exercise.

METHODS: Twenty healthy volunteers (mean ± SD) age 22 ± 3 years (10 males and 10 females), VO2max: 46.5 ± 6.7 mL.min-1.kg-1, participated in this randomised, double-blind, crossover trial. Participants completed two experimental sessions, separated by a ≥7-day washout. During experimental sessions, participants were administered a single oral dose of CBD (70 mg in medium-chain triglyceride (MCT) oil) or placebo (MCT oil) (randomised), co-administered with consumption of a standardized snack bar (257 kcal, 41g CHO, 8g fat, 3g protein), 1 hour before undertaking a submaximal -10% downhill run for 30 minutes at 70% VO2max. Pain tolerance was measured using muscle algometry and venous blood was drawn pre- and post-run, then at 24- and 48-hours post-run. Data were analysed using mixed-model ANOVA with a Šidák post-hoc test. Significance was defined as $p<0.05$.

RESULTS: Downhill running caused a significant decrease in pain tolerance that was blunted in the CBD treatment (post-run: -19.6 ± 15.6% in placebo, -2.4 ± 17.3% in CBD, $p<0.01$). This was associated with an increase in plasma creatine kinase activity 24h after running in the placebo treatment that was similarly blunted by CBD (24h: +25.3 ± 23.4% in placebo, +3.1 ± 14.2% in CBD, $p<0.01$). Downhill running increased plasma TNF-α ($p<0.05$) across the 48h following downhill running, but there was no effect of CBD ($p>0.05$). There was no difference in plasma IL-10 or IL-1b across the 48h ($p>0.05$). Lipidomics of plasma samples pre- and post- downhill running revealed an increase in N-acylethanolamines anandamide ($p<0.001$), oleoylethanolamine ($p<0.001$), palmitoylethanolamine ($p<0.001$), stearoylethanolamine SEA ($p<0.001$), and linoleoyl ethanolamine LEA ($p<0.001$) but there was no effect of CBD ($p>0.05$).

CONCLUSION: A single ingested dose of 70mg CBD blunts markers of exercise-induced muscle damage within the 48h following exercise. The mechanism of this benefit is not reflected in plasma-derived inflammatory cytokines nor changes in fatty acid amide metabolites.

DOES BOVINE COLOSTRUM SUPPLEMENTATION AFFECT INFLAMMATORY AND IMMUNOLOGICAL OUTCOMES IN ENDURANCE ATHLETES?

DURKALEC-MICHALSKI, K., GLÓWKA, N., PODGÓRSKI, T., WOZNIEWICZ, M., MALIK, J., WOCHNA, K., NOWACZYK, P.M.
POZNAN UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Bovine colostrum (BOV-COL) contains about 100-fold higher concentration of immunoglobulins (Ig) and is more plentiful in lactoferrin than mature milk. It is assumed to be one of the strongest natural immune stimulants. Regular ingestion of BOV-COL may contribute to a decreased risk of upper respiratory tract infections and eventually result in improved physical performance in athletes, especially those exposed to exercise-induced immune disturbances.

METHODS: Twenty trained endurance male athletes, aged 27.6±8.3 years (body mass 82.9±10.1 kg; height 184±6 cm), completed this double-blind placebo(PLA)-controlled crossover study aimed at investigating the effect of BOV-COL supplementation on resting and exercise-induced changes in selected inflammatory and immunological outcomes in blood (interferon gamma, [IFN-γ], tumor necrosis factor alfa [TNF-α], interleukin[IL]-6, IL-10, IgA, IgD, IgE, IgG, IgM) and saliva (secretory IgA [SIgA]). Study participants were supplemented with 25 g·day-1 of BOV-COL powder and PLA (high-quality milk protein powder) in randomly assigned crossover manner for 12 weeks with 4 weeks of wash-out period. The protocol assumed 4 study visits – before/after supplementation with BOV-COL (BOV-COLPRE and BOV-COLPOST) and PLA (PLAPRE and PLAPOST). At each visit the following evaluations were performed: body mass and composition; resting (REST), post-exercise (POST-EX; 3 min after exercise) and post-short-term-recovery (REC; 1 h after exercise) blood and saliva indices; the incremental test on the rowing ergometer; and the specific performance test (eight 100-meter-long sections to swim through, of which the sections I–III were performed at level of 75% maximal effort [ME], IV–V at 85% ME, VI at 90% ME, VII at 95% ME and VIII at 100% ME). Data were analyzed via RM ANOVA or Friedman ANOVA.

RESULTS: Significant differences between study visits were found for IL-6 and IgG at POST-EX, and TNF-α at REC. At POST-EX the concentrations of a) IL-6 was lower at PLAPOST compared to PLAPRE ($p=0.046$; no differences between other visits), and b) IgG lower at BOV-COLPOST compared to BOV-COLPRE ($p=0.028$; no differences between other visits). At REC, the concentration of TNF-α was lower at PLAPOST compared to PLAPRE ($p=0.003$; no differences between other visits). However, no significant differences in the analyzed indices were noted between BOV-COL and PLA after supplementation.

CONCLUSION: Bovine colostrum ingestion had no more beneficial effect than high-quality milk protein (PLA) on the inflammatory and immunological outcomes in trained endurance athletes. The legitimacy of implementing BOV-COL supplementation in athletes require further analyzes and searching for optimal supplementation strategies, including the form of supplement, dosages and duration of supplementation.

THE EFFECTS OF A 6-WEEK PREBIOTIC INTERVENTION ON MARKERS OF GASTROINTESTINAL DAMAGE, IMMUNITY AND ILLNESS FOLLOWING A SIMULATED FOOTBALL PROTOCOL IN THE HEAT

PARKER, C., JOHNSON, M., HUNTER, K., SHARPE, G., ABBOTT, S., WILLIAMS, N.
NOTTINGHAM TRENT UNIVERSITY

INTRODUCTION: It is becomingly increasingly common for team-based athletes to perform in hot climates which may increase the likelihood of gastrointestinal and respiratory illness. Gut microbes have a substantial influence on systemic immune function and gastrointestinal health. Dietary prebiotic galactooligosaccharides are effective at altering the gut microbiome and have been shown to alleviate upper respiratory symptoms (URS) and gastrointestinal symptoms (GIS) in elite rugby union players during a competitive season (Parker et al., 2023). Therefore, the aim of this study was to investigate whether a 6-week prebiotic intervention can protect gastrointestinal integrity, immunity, and reduce URS following football specific exercise in the heat.

METHODS: Twenty-four male team sport athletes were randomised to receive 2.9 g/d of either Bimuno-galactooligosaccharide (B-GOS; n=12) or a maltodextrin placebo (PLA; n=12) for 6 weeks in a double-blind design. Pre- and post-intervention, each participant completed an experimental trial where they completed a simulated football match on a treadmill in 33oC. During each experimental trial, plasma intestinal fatty acid binding protein (I-FABP) was measured at baseline (B), half-time (HT), full-time (FT) and 60-min post full time (FT60). Salivary immunoglobulin A (sIgA) secretion rate was measured at B and FT, and GIS for each half were measured at HT and FT. Throughout the 6-week intervention, daily URS and weekly GIS were self-reported using questionnaires.

RESULTS: The Δ I-FABP following exercise from V1 and V2 was lower in B-GOS than PLA (B-GOS: -358 ± 259 pg/mL; PLA: 218 ± 322 pg/mL; $P < 0.001$). A similar finding occurred for sIgA secretion rate (B-GOS: 30.11 ± 85.83 µg/min; PLA: -42.09 ± 64.25 µg/min; $P = 0.040$). During exercise, there was a greater V1-V2 reduction in the total GIS score in B-GOS than PLA (B-GOS: -16.7 ± 96.3 %; PLA: 13.3 ± 66.9 %; $P = 0.021$). There was no between-group difference in URS incidence, but the mean duration of episodes was shorter (B-GOS: 3.4 ± 5.1 days; PLA: 9.0 ± 5.9 days; $P = 0.025$) and the severity (B-GOS: 12 ± 16.5; PLA: 34.5 ± 22.5; $P = 0.029$) was lower in B-GOS than PLA.

CONCLUSION: Six weeks of a prebiotic B-GOS intervention improved gut barrier resistance, GIS and maintained sIgA secretion rate in response to football specific activity in the heat. There was also a reduction in the duration and severity of

URS. These findings suggest that B-GOS has the potential to protect gut barrier function and modulate immune function, which may reduce the burden of illness and improve an athlete's availability to train and compete.

References

Parker, C., Hunter, K. A., Johnson, M. A., Sharpe, G. R., Gibson, G. R., Walton, G. E., & Williams, N. C. (2023). Effects of 24-week prebiotic intervention on self-reported upper respiratory symptoms, gastrointestinal symptoms, and markers of immunity in elite rugby union players. European Journal of Sport Science, 1-8.

Oral Presentations

OP-BM17 Running II

EFFECT OF LOAD TRANSPORT OVER DIFFERENT VELOCITIES ON STRIDE SYMMETRY IN ADVENTURE RUNNERS

DE OLIVEIRA FAGUNDES, A., CARRERA, R.A.S., DA ROSA, R.G., MACHADO, H.E.S., PEYRÉ-TARTARUGA, L.A., PASSOS-MONTEIRO, E.

FEDERAL UNIVERSITY OF RIO GRANDE DO SUL - UFRGS

INTRODUCTION: Adventure running requires carrying additional loads during competition. This load transportation impacts biomechanical parameters like spatio-temporal and coordination variables. In this study we proposed to evaluate the effect of loads of 7% and 15% of body mass and different velocities (9, 12 and 15 km/h) on stride time (ST) and frequency (SF), contact time (CT), stride length (SL), flight time (FT), duty factor (DF), bilateral coordination consistency (BCC), bilateral coordination accuracy (BCA) and phase coordination index (PCI).

METHODS: Twelve male athletes at the national level participated in three tests with random loads on different days. Kinematic data were collected by a video camera (CASIO - EXFH25) recording at 100hz perpendicularly placed 2m from the treadmill. The spatiotemporal data analyses were realized using the software Kinovea® (v. 0.8.27) and plotted into a spreadsheet. A Generalized Linear Model (SPSS v. 20.0) was used to evaluate kinematic parameters between load and velocity conditions with a p-value of < 0.05.

RESULTS: Extra load conditions of 7% and 15% did not significantly change the running kinematics ($p>0.05$), and there were no interactions between loads and velocities ($p>0.05$). Regarding coordination variables, %BCC ($p=0.06$), % of BCA ($p=0.24$), and % of PCI ($p=0.06$), the additional load did not affect the coordination and symmetry of the athletes, except for velocities parameters ($p < 0.05$), which is expected according to literature.

CONCLUSION: The novel finding of the present research states that running with 7 or 15% body mass as additional load does not seem to influence kinematic variables in adventure runners besides those for velocity parameters, which is expected according to the literature. Although there is a relative increase in processes that regulate attentional mechanisms during slow walking (1), these mechanisms do not seem to impair the lower limb's kinematics investigated during fast walking or running (1, 2), revealing that these aspects may behave similarly with additional loads. Also, compensatory cortical function and supraspinal input effect with extra load may help athletes keep stable running. Some limitations may be considered in the study: i) there is an invariant gait pattern in a treadmill compared to overground conditions (3) and ii) the time used to analyze the kinematic parameters.

1 - Plotnik, M., et al. (2013). Effects of walking speed on asymmetry and bilateral coordination of gait. Gait & posture, 38(4), 864-869.

2 - Hafer, J. F., et al. (2016). Changes in coordination and its variability with an increase in running cadence. Journal of sports sciences, 34(15), 1388-1395.

3 - Hollman, J. H., et al. (2016). A comparison of variability in spatiotemporal gait parameters between treadmill and overground walking conditions. Gait & posture, 43, 204-209.

A METHOD TO COMPUTE THE FORCE-VELOCITY-ENDURANCE PROFILE OF TRAIL RUNNER FROM IN-SITU GNSS DATA

DELHAYE, C., MILLET, G., SABATOR-PASTOR, F., BOWEN, M., PONARD, F., SAMOZINO, P., MOREL, B.

UNIVERSITÉ DE SAVOIE

INTRODUCTION: A mathematical model describing the force-velocity-endurance (FoVE) relationship has recently been proposed. This model provides a framework to understand the force production capacity of an athlete during locomotion as a function of movement velocity and effort duration [1]. It has recently been evidenced that FoVE profile during endurance event can be determined from training and race data recorded by cycling power meters [2]. It might be possible to use a similar approach in trail running. Using GNSS data, the runners velocity can be assessed. In addition, the force needed to raise the runners center of mass is proportional to the sinus of the angle of inclination (alpha), the body mass (m), and the gravitational constant ($g = 9.81\ m.s^{-2}$), according to the equation $F = m.g.\sin(alpha)$. This study aims to investigate the goodness of fit and validity of in situ FoVE profiles determined for trail runners from GNSS data.

METHODS: FoVE profiles of 18 well trained trail runners (16 M, 2 F; age :35.8) were computed based on GNSS data preceding from 3 month a world-class ultra-trail (166km 10000m D+). The maximum mean velocity (V) was calculated for every 2% gradient between -20 to 20 % for 3 to 20 min duration (1 min increment). Gradient was then expressed in force nor-

malized to body mass: F = m.g.sin(alpha). The record velocity for each gradient and duration conditions was used to fit the 4 parameters (D', F0c, V0c and C) of the FoVE model: F(V,t) = D'/t + (F0c × (V0c − V))/(V0c + V×C). An incremental test with VO2 measure was performed with a 12% gradient on treadmill which allow to determine the velocity at anaerobic threshold (AeT). This velocity was then compared to the critical velocity at a force corresponding to at 12% gradient calculated from the FoVE profile with a correlation approach.

RESULTS: FoVE profile was computed based on 103 (± 45) training sessions. The goodness of fit of the FoVE model fitting presented a median r^2 = 0.93 (all > 0.82). AeT velocity in 12% gradient was 2.54 ± 0.34 m.s-1. Critical velocity at a force corresponding to a 12% gradient was 2.49 ± 0.34 m.s-1. Correlation between AeT and 12%-critical velocity from the FoVE model was significant (r^2=0.74; RMSE = 0.18 m.s-1 or 7%; p<0.001) and ICC was 0.86.

CONCLUSION: These findings suggest that in situ FoVE profile can be determined from GNSS data in trail running. The observed correlations with physiological measures confirm a practical validity of this approach. In addition, the FoVE profiling makes it possible to model the entire critical force-velocity relationship of a runner. In other words, it is possible to know his critical speed for any slope condition. This has the potential to become a valuable tool for trail runners and coaches to modify training session or proposed pacing strategies.

[1] B. Morel et al, ECSS Congress (2024)

[2] Y. Bertron, M. Bowen, P. Leo, P. Samozino, F. Hintzy, B. Morel, SportRxiv (2022) 1–10.

INFLUENCE OF COMPRESSION GARMENTS ON MUSCLE ACTIVATION AND SOFT-TISSUE VIBRATIONS DURING EXHAUSTING DOWNHILL RUN

GASSIER, R., ESPEIT, L.1, RAVEL, A.2, BEAUDOU, P.2, TRAMA, R.3, EDOUARD, P.2, ROSSI, J.2, HAUTIER, C.1

1:UNIVERSITÉ CLAUDE BERNARD LYON 1 ; 2:UNIVERSITÉ JEAN MONNET SAINT ETIENNE ; 3:UNIVERSITY OF CALGARY

INTRODUCTION: Downhill running (DR) causes important mechanical stress like increased electromyographic signal (EMG) of knee extensors, high ground reaction forces and muscle soft-tissue vibrations (STV) (1). STV are known to accelerate fatigue onset and generate muscle damage (2). Compression garments (CG) seem to be effective in reducing acute and delayed neuromuscular alterations, when used as a preventive strategy during running (3). It has been hypothesized that the protective effects of CG were likely due to a significant modification of muscle activation, and to a reduction in STV (4). This study aimed to evaluate the influence of CGs on the evolution of heel impacts, STV and muscle activation during exhausting DR.

METHODS: Twenty healthy active men running at least once a week performed a DR bout to exhaustion, at 55% V02max on a -15% slope, wearing CG on one randomly selected leg and standardized sport shoes. Participants were fitted with EMG sensors on compressed (COMP) and control (CONT) Vastii Laterali (VL), tri-axial accelerometers on the heel cup of the shoes and the VL. All signals were recorded during 30-sec every 3-min until exhaustion. The second recording was considered to be the subjects state of "freshness" (FRESH), while the last one represented the state of "fatigue"(FAT). Continuous wavelet transform was used to enable the assessment of magnitude and frequency of the acceleration and EMG signal. Statistical non-Parametric Mapping (SnPM) and 2-factor ANOVA with repeated measures were performed to compare continuous and discrete means of COMP and CONT during the DR bout.

RESULTS: No difference was observed for the heel impacts between COMP and CONT but total magnitude of STV of VL (TMV) was significantly reduced in COMP (406,3±35 UA) compared to CONT (535±62 UA, p=0,016) just as the median frequency (MF) (CONT : 45,2±7,6 Hz, COMP : 38±5,8 Hz; p=0,012). SnPM analysis showed a significant reduction in STV above 150Hz for COMP. The evolution from FRESH to FAT showed a significant increase of TMV of VL (432±180 UA vs 510±210; p=0,004) and MF (41,1±6,7 HZ to 42,2±6,8 Hz; p=0,034). SnPM showed a significant increase of heel impacts and STV of VL with fatigue above 150Hz (also between 70-110Hz for VL). No interaction compression/fatigue was detected. No significant differences were found for the evolution of surface EMG signals.

CONCLUSION: Analysis of the evolution of shocks and STV parameters during DR indicates that fatigue leads to a significant increase in TMV in particular at high frequencies, while wearing CGs leads to a significant reduction of the same parameters during the run. The use of CG during downhill running might contribute to the "mechanical protection" of the muscle and reduce neuromuscular alterations without modifying muscle activation.

REFERENCES

1) Vernillo & al., 2017

2) Ritteweger & al., 2000

3) Play & al., 2022

4) Ehrström & al., 2018

THE ROLE OF LOWER-LIMB KINEMATICS AND SPATIOTEMPORAL GAIT CHARACTERISTICS IN RUNNING ECONOMY

CHEN, S., ZHANG, Q., LI, F.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Running economy (RE) is a key physiological indicator for evaluating aerobic endurance, and there are large individual differences in RE between runners of comparable levels. Therefore, it is crucial to investigate the factors influencing RE to promote endurance sports performance enhancement. Currently, the relationship between RE and kin-

ematic and spatiotemporal gait characteristics is unclear, and most studies have focused on high-level runners. Therefore, this study aimed to explore the relationship between RE, lower-limb sagittal plane kinematics, and spatiotemporal gait characteristics in recreational runners.

METHODS: Thirty male recreational runners were recruited and underwent two separate tests. In the first session, the portable metabolic analyser was used to test RE at 10 and 12 km/h. In the second session, a three-dimensional motion capture system and three-dimensional force plate were applied to collect hip, knee, and ankle sagittal plane joint angles, contact time, swing time, duty factor, stride frequency, and stride length. Pearson's bivariate correlation was used to identify the correlation between the above indicators and RE.

RESULTS: Pearson's correlation coefficients analysis found that RE at 12 km/h was moderately correlated with ankle dorsiflexion at foot strike, hip and knee flexion at toe-off, peak hip flexion during the stance phase, and peak hip, knee, and ankle flexion/dorsiflexion during the swing phase ($r=0.367\sim0.423$, $P<0.05$). The peak ankle dorsiflexion during the stance phase ($r=0.397$, $p=0.030$; $r=0.383$, $P=0.037$) was moderately correlated with RE at 10 and 12 km/h. The peak knee flexion, knee extension range of motion, contact time, swing time, and duty factor ($r=-0.451\sim0.457$, $P<0.05$) were moderately correlated with RE at 10 km/h.

CONCLUSION: Smaller ankle dorsiflexion at foot strike, smaller hip, and knee flexion at toe-off, lower peak hip and ankle flexion (dorsiflexion) during the stance phase, reduced peak hip, knee, and ankle flexion (dorsiflexion) during the swing phase and smaller knee extension range of motion during the swing phase are beneficial to improving RE in recreational runners. Furthermore, longer contact times at low speeds and increasing the duty factor are probably effective strategies for recreational runners to improve RE.

Oral Presentations

OP-AP41 Training and Testing/Team Sports

EFFECTIVENESS OF SPECIFIC PROFESSIONAL TRAINING IN MALE ELITE ADOLESCENT TEAM HANDBALL PLAYERS

WAGNER, H., HINZ, M., RADIC, V.
UNIVERSITY OF SALZBURG

INTRODUCTION: In male team handball, the professional training of adolescent players in elite team handball academies is a crucial element for becoming a top-elite player. Professional training at this age often consists of 7-8 sessions per week, which include both physical and team handball-specific training, as well as 1-2 national or international top-level matches. Despite the frequency and intensity of this training, its effectiveness is often assessed through coach observations during training and matches, as well as general physical performance tests. However, the direct influence of this professional training on specific physical performance in team handball is unknown, despite its importance as a criterion for effective training in adolescent elite team handball. Consequently, the aims of the study were (1) to provide professional training to elite adolescent team handball players, and (2) to measure their performance improvement utilizing a team handball specific performance test.

METHODS: Thirty adolescent elite male team handball players, including six goalkeepers and 24 field players, participated in an eleven-week training program. This program included the pre-season preparation phase (eight weeks) and the initial three games of the highest German Team Handball Leagues official season (three weeks). The training program included 2-3 physical sessions, 4-5 specific team handball sessions, totaling 7-8 training sessions per week, and 1-2 matches weekly. Inclusion criteria for field players encompassed completing at least 80% of all training sessions. Consequently, the study comprised nine under-19 players (age: 17.2 ± 1.3 years, body weight: 77.8 ± 6.0 kg, body height: 1.82 ± 0.04m) and nine under-17 players (age: 15.6 ± 0.9 years, body weight: 71.5 ± 14.5 kg, body height: 1.82 ± 0.06m). All participants performed the team handball game-based performance test twice (pre- and post-testing). A paired sample t-test was used to compare the difference in performance between the pre- and post-tests of both under-19 and under-17 players.

RESULTS: Significant differences ($P < 0.05$) were observed in the defense and offense time in the game-based performance test and body weight for both under-19 and under-17 players. Furthermore, among the under-17 players, additional significant differences were noted in peak oxygen uptake, fast break time, as well as ball velocity and jump height in the jump shot.

CONCLUSION: As expected, team handball specific agility in defense and offense improved for both under-19 (+3%) and under-17 (+6%) players, which was one of the training programs main aims. However, for the under-17 players the massive increase in peak oxygen uptake (+16%) as well as ball velocity (+7%) and jump height (+20%) in the jump shot was unexpected. We suggest that professional and targeted specific training in this age has a significant impact on the long-term development of adolescent team handball players and is the basis for a professional handball career.

THE TEST-RETEST RELIABILITY OF MAXIMAL STRENGTH, EXPLOSIVE POWER, AGILITY, AND SPRINT PERFORMANCE OF FEMALE HANDBALL PLAYERS.

OSBORNE, J., PEDERSEN, S., PETTERSEN, S.A., WELDE, B., ANDERSSON, E.P.
UIT - THE ARCTIC UNIVERSITY OF NORWAY

INTRODUCTION: Handball is popular team-sport, defined by rapid changes-of-direction, high-intensity sprints, acceleration, and shooting.1 Coaches and sports scientists often assess the athletic performance of handball players via testing various physiological components, such as neuromuscular power, strength, agility, and speed. However, there is limited data available to support the consistency and reproducibility (i.e., test-retest reliability) of these tests in female handball players, as the majority of previous research has instead focused on males. Due to the anthropometric and physical differences between the sexes, as well as the potential confounding influence of the menstrual cycle, it is important to establish specific normative reliability data for female handball players. Therefore, the present study aimed assess the test-retest reliability of various athletic tests in a cohort of female handball players, with a further sub analysis conducted for non-hormonal contraceptive using players (PlayersNC).

METHODS: Eighteen female Norwegian handball players (PlayersNC: n = 8) undertook an athletic test battery on three separate occasions across a single menstrual cycle (PlayersNC) or approximately one month (all other players). The test battery included: 1-repetition back squat, maximal handgrip strength, counter-movement jumps (CMJ), squat jumps, modified agility T-test, and 15 m sprint. Statistical analysis for test reliability included: intraclass correlations (ICC), minimum difference, standard error of measurement (SEM), and coefficient of variation.

RESULTS: The test data demonstrated good-to-excellent test-retest reliability for all measured variables (ICC2,1 = .82 to .94), although maximal squat jumps were found to be somewhat lower reliability (ICC2,1 = .75). The subgroup analysis for NM players also indicated a consistently high reliability for all performance tests (ICC2,1 = .83 to .74).

CONCLUSION: In conclusion, these reliability data support the periodic use of the aforementioned performance tests in routine handball player assessments, in order to identify changes in athletic performance and to monitor player progress. As test reliability was also not notably influenced by the menstrual cycle phase, coaches and sports scientists can schedule testing sessions for all athletes, without concern of a considerable confounding effect from the menstrual cycle.

1. Michalsik, L. B., and P. Aagaard. 'Physical Demands in Elite Team Handball: Comparisons between Male and Female Players'. The Journal of Sports Medicine and Physical Fitness 55, no. 9 (September 2015): 878–91.

OPTIMIZING IN-SEASON STRENGTH AND POWER DEVELOPMENT IN HIGH-LEVEL HANDBALL PLAYERS: COMPARING HEAVY STRENGTH TRAINING VERSUS COMBINED STRENGTH- AND POWER TRAINING

VÅRVIK, F.T., RAASTAD, T.1,2, TORSTVEIT, M.K.1, RUIVEN, M.V.1, GUDDAL, M.1, KRISTIANSEN, S.1, AARRESTAD, S.1, LUND, A.B.1, BJØRNSEN, T.1
1 UNIVERSITY OF AGDER, 2 NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Handball players often combine strength and power training for additive performance benefits. However, in-season handball-specific training and matches include high-intensity actions questioning the benefit of adding power training in this period. Hence, the aim of this study was to compare the effect of high-load versus combined high-load and power training on strength and power capacities during the competitive season in handball players.

METHODS: Twenty-nine (11 males) high-level handball players were randomized into high-load strength training (HL; n=15, 20±3 years) and combined high-load and power training (COM; n=14, 22±3 years). Training sessions were conducted twice weekly for 15 weeks, with weekly supervision. Per week, the HL group completed 5-9 sets per muscle group (80-85% one-rep max [RM]), and the COM completed 2-4 high-load sets, 56-66 bodyweight jumps, and 4-7 sets of power exercises (≤50% 1RM). Outcomes pre- and post-intervention included 1RM squat and bench press, maximal isometric strength (MVC) and rate of force development (RFD; 0-30, -50, -100, and -250ms time intervals), pneumatic resistance leg press maximal power (Pmax), countermovement jump (CMJ) height and power; 10- and 30m linear sprint and change of direction (CoD) times (4x180 turns). Subjective readiness was rated using a 5-point Likert scale before all matches. The data were analyzed with t-tests and are reported as mean change with 95% confidence intervals or standard deviations.

RESULTS: Over 15 weeks, players engaged in ~one match and four handball training sessions per week. Training attendance was 87±11% in the HL group and 84±13% in the COM group. MVC and CMJ power increased 6.6% (1.2, 12.1, p<0.02) and 5.7% (0.9, 10.6 p<0.03) more in HL versus COM, but the change in jump height did not differ between groups (HL: 0.8±4.9%, COM: -1.4±7.9%, p=0.13). No other between-group differences were observed (p=0.14-0.9). Squat 1RM increased in both groups (HL: 6.7±2.9%, COM: 5.6±3.5%, p<0.01); 1RM bench press improved in HL (5.3±7.3%, p<0.02) but not in COM (0.9±5.8%). Leg press Pmax increased only in HL (3.9±5.1%, p<0.02, COM: 2.4±4.1%, p=0.07). RFD time points from 0-100 to -250ms improved by 15-18% in HL (p<0.02), while COM improved 0-30 and -50ms by 20-33% and -100ms by 12% (p<0.03). CoD time improved in COM (-1.5±1.9%, p<0.04) but not in HL (-1.3±2.8%, p=0.12). Match readiness was rated high with no group differences (HL: 3.9±0.5, COM: 3.8±0.5).

CONCLUSION: In general, more favorable adaptations were observed with the HL training regime compared to COM training. Nevertheless, only the COM group improved RFD in the early phase (0-30 and -50ms), suggesting certain velocity-specific adaptations, but these improvements did not transfer to other power metrics or performance improvements. Importantly, the HL group did not impair match readiness. Consequently, high-load strength training should likely be emphasized for in-season maximal strength and power enhancement in high-level handball players.

EXPLORING THE RELATIONSHIP BETWEEN HEART RATE TRAINING IMPULSE AND SESSION RATING OF PERCEIVED EXERTION IN FEMALE RUGBY VARSITY PLAYERS: ASSESSING THE INFLUENCE OF LOW ENERGY AVAILABILITY SCORES

FERNANDES DA SILVA, D., OZECHOWSKI, B., WILD, J., THAANE, T., HAJJ-BOUTROS, G., GIMUNOVÁ, M., PALUDO, A.C.
BISHOPS UNIVERSITY

INTRODUCTION: Rugby players strive for peak performance through demanding training regimes, marked by heightened training loads. Key methods for gauging these loads include the Heart Rate Training Impulse (HR TRIMP) technique, developed by Edwards [1], and the Session Rating of Perceived Exertion (sRPE) method by Foster [2]. Despite their distinct approaches—HR TRIMP focusing on physiological measurements and sRPE on perceptual markers—studies in various sports have shown significant correlations between them. Yet, research gaps still exist, particularly regarding their applicability in contact sports such as rugby, female athlete-focused analysis, and the impact of low energy availability risk on the HR TRIMP-sRPE relationship. Thus, our study aims to explore the link between HR TRIMP and sRPE among female rugby varsity players across a season.

METHODS: Six female rugby varsity players (age: 22 ± 3 years; Weight: 69.8 ± 8.3 kg; Rugby experience: 1.6 ± 1.3) completed 2-3 monitored training sessions per week, employing both HR TRIMP and sRPE methods to quantify training loads for a total of 7 weeks. Polar H10 heart rate monitors were used during sessions, with data processed using the Polar Beat application to track time spent in specific heart rate zones. Time in each zone was multiplied by corresponding zone factors (1-5) and summed to calculate training loads in Arbitrary Units (AU) [1]. Additionally, participants provided 0-10 Ratings of Perceived Exertion (RPE), multiplied by session duration to determine sRPE in AU [2]. Prior to the season, participants completed the Lower Energy Availability for Females Questionnaire (LEAF-Q) [3] to assess the risk of low energy availability. To mitigate within-participant effects, residuals from a linear regression between participant as a random factor and the two training load markers were calculated. Spearman's correlation was then applied to analyze the relationship between HR TRIMP and sRPE residuals, with separate analyses conducted for participants with LEAF-Q scores ≥8 and <8. Statistical significance was set at $p < 0.05$.

RESULTS: A total of 39 collected data points revealed a large and positive correlation between HR TRIMP (203 ± 80 AU) and sRPE (362 ± 160 AU), with an observed correlation coefficient of $r = 0.61$. Among the six participants, four (66.7%) exhibited a risk of low energy availability. Subsequent sub-analysis focused on participants with a risk of low energy availability and those without. For those with a risk of low energy availability, a correlation coefficient of $r = 0.69$ was noted ($n = 27$ points), compared to $r = 0.63$ ($n = 12$ points) for the groups without risk.

CONCLUSION: The physiological (HR TRIMP) and perceptual (sRPE) methods for quantifying training loads demonstrated a significant association, irrespective of the presence of low energy availability risk, among female rugby varsity players.

Oral Presentations

OP-AP42 Tennis

ACCURACY OF AN ULTRA-WIDEBAND BASED TRACKING SYSTEM FOR TIME-MOTION ANALYSIS IN TENNIS

CUI, Y., YANG, W., WANG, J.
BEIJING SPORT UNIVERSITY

INTRODUCTION: The application of player tracking systems automatically provide time-motion and tactical information for athletic performance analysis purposes. Compared to the GNSS based system with lower accuracy and optical tracking system with higher cost, the local positioning system seems to be feasible for racquet sports of smaller court area. The aim of this study was to comprehensively verify the accuracy of a ultra-wideband (UWB) player tracking system for monitoring tennis-specific movements.

METHODS: Ten amateur tennis players (International Tennis Number: 2 to 5) were recruited in the study and wore the UWB device (GenGee Insait KS) on their left upper arm during the whole experiment. An infrared camera-based motion capture system with 16 cameras (VICON, Oxford, UK) was employed as the reference to determine criterion position. Five adhesive retro-reflective markers with a diameter of 10mm were fixed to each participant's skin to determine the center of mass. All participants performed the following 4 exercises without racquets and 3 with racquets: warm-up (walk, jog, acceleration, side-shuffle), agility ladder, spider run, T-run, hit-and-turn, fixed tactics, free rallying. Each drill was repeated at least twice expect for the last one, with adequate rest time allocated for participants. The raw derived data from two systems were processed to calculate the distance traversed. The linear mixed model, intra-class correlation coefficient (ICC) and root mean square error (RMSE) were used to estimate the accuracy of the UWB-based system.

RESULTS: The smallest differences of RMSE in raw x and y coordinate accuracy were shown for agility ladder (0.31m) and walk (0.40m), while largest RMSE in x and y were shown for spider run (0.90m) and T-test (1.07m). The ICC statistic of 0.913 was showed for the distance covered during the while experiment measured by UWB system with that by the reference system, indicating almost perfect agreement. However, noticeable exercise-dependent variation in measurement accuracy were exhibited, particularly in agility ladder, T-run and fixed tactics (ICC: -0.28—0.14), which were also confirmed by the significant difference from the linear mixed model ($p<0.05$).

CONCLUSION: The UWB-based device presented acceptable accuracy in recording tennis-specific movement, but noticeable difference from the criterion was shown exercises with high intensity acceleration, deceleration and change of direction, suggesting large error margin of measurement. Apart from the inherent error, the arm-fixed location of UWB device might also led to the discrepancy in measuring actual distance in these drills, as arm swing and early hip rotation are inevitable. The application of the system should be done with caution given its potential overestimation of external load, and practitioners are advised not to directly compare the data with other tracking system during training and competition scenarios.

QUANTIFYING THE TECHNICAL DIVERSITY OF ELITE TENNIS PLAYERS DURING MATCH PLAY

ZHAO, Z., CUI, Y., QI, B.
UNIVERSITY

INTRODUCTION: Winning elite tennis match necessitates the considerable repertoire of technical skills to attune relevant tactics. Previous studies evaluated the impact of specific technical indicators on match outcome such as serve efficiency, ace%, but little research comprehensively assess the level of technical variety players may demonstrate during competitive scenarios. Therefore, the study aimed to model the diversity in technical performance among elite tennis players during matches in relation to gender and match outcome.

METHODS: Match performance data of 236 singles matches (136 for male and 130 for female) from the 2023 Australian Open and US open were retrieved from a publicly-accessed match statistics website. In total, 50 male (Ranking of Association of Tennis Professionals: 1 to 82) and 50 female professional players (WTA ranking from 1 to 78) with 532 observations were included. Standard entropies of the following 7 technical performance categories were derived to reflect player's technical diversity: first/second serve, serve landing area in deuce/advantage courts, forehand\backhand shot direction (down the line, crosscourt, down the middle, inside-out, inside-in) and shot type (flat/topspin, slice, volley, smash, lob, drop shot). The mixed linear model was utilized to analyze the effects of gender and match outcome on each technical diversity.

RESULTS: The results indicate that match outcome and gender had no statistically significant interaction effect on all 7 technical performances ($p>0.05$). But match outcome and gender have showed significant main effects on shot type, forehand/backhand baseline shot direction, first serve area ($p<0.05$, r-squared conditional=0.17-0.70). Losing players showed higher level of diversity of shot type (ES=0.33, small) than for winning players. Male players generally had higher degrees of diversity in shot type, forehand baseline shot direction (ES=0.63-0.97, moderate) than female players, while lower in backhand baseline shot direction, first serve area (ES=0.62-0.70, moderate).

CONCLUSION: The higher diversity of shot types in winning players compared to losing players may be attributed to the necessity of having a reliable scoring technique to secure victory. Accordingly, it is advisable to emphasize on the training of stable scoring techniques.The higher diversity of shot types and forehand baseline shot direction in male compared to female may be attributed to the fact that male generally exhibit more tactical variations in matches by launching forehand attacks more frequently than female. Therefore, elite female players are recommended to incorporate additional tactical training focused on forehand combinations while developing their footwork.The lower diversity of first serve area in male compared to female suggests that males first serves tend to be directed more towards the outer or inner corners. This indicates a high demand for serving precision in elite males matches, emphasizing the need to enhance serving skills in training.

COMPARATIVE ASSESSMENT OF MARKERLESS AND MARKER-BASED MOTION CAPTURE FOR TENNIS SERVE BIOMECHANICAL ANALYSIS

OZAN, S., FOUREL, L., TOUZARD, P., DEGHAIES, K., MARTIN, C., KULPA, R.
UNIVERSITY OF RENNES2, INRIA

INTRODUCTION: To perform an effective tennis serve, it is essential to hit the ball from a high point. This provides a margin above the net and makes it easier to reach wide angles [1]. To achieve this, the centre of mass (CoM) must be elevated by maximising the angular velocities of the lower limb joints (knee and ankle) during the leg drive [2]. State of the art experiments usually assess these parameters using a 3D motion capture (MoCap) system based on markers placed on players skin. This tool is considered as the most accurate but is not suitable for in-situ assessment. Markerless MoCap, a new MoCap system based on videos and artificial intelligence, offers the possibility of analysing motion in ecological situations [3]. The aim of this study is to compare those kinematic variables using both MoCap methods.

METHODS: Eight tennis players equipped with 49 markers placed on anatomical landmarks, performed 42 serves (336 serves in total). Markers positions were recorded at 300 Hz using an infrared MoCap system and processed to compute joint centre positions, segmental orientations, and CoM position using a musculoskeletal software (CusToM) [4]. Markerless MoCap was simultaneously recorded using 10 synchronized video cameras at 300Hz and the same parameters was computed from a commercial software (Theia3d) [3]. Ankle and knee angles between ball toss and impact, CoM height at impact, and peak angular velocities of the rear ankle and knee during the leg drive were computed from both systems. Validity of markerless MoCap for joint angles was assessed with respect to marker-based MoCap using Pearson's correlation coefficient (CC) and root-mean-square difference (RMSD), while differences in peak velocities and CoM height at impact were assessed using CC and Bland-Altman bias and limit of agreement (LoA) [5].

RESULTS: RMSD of ankle and knee angles are 5.1° and 8.8° with CCs of 0.99 ($p<0.05$) and 0.99 ($p<0.05$) respectively. In markerless MoCap, CoM height at impact is lower by 22.2mm on average with LoA values of [-32.9, -11.4]. In addition, ankle plantar flexion velocity peak is lower by 19.7°/s on average and knee extension velocity peak is greater by 14.8°/s on average with LoA values of [-175.6, 136.3] and [-104.9, 134.5], respectively. CC means of ankle plantar flexion and knee extension velocities are 0.93 ($p<0.05$) and 0.97 ($p<0.05$), respectively.

CONCLUSION: This study highlights the potential of markerless MoCap as a valid alternative to marker-based systems for assessing lower limbs key variables in tennis serve performance. Some discrepancies remain, particularly in joint angle velocity peaks. Further investigations are still required to validate the markerless method on the upper limbs joints kinematics.

References:

[1] Elliott et al., 2009.

[2] Reid et al., 2008.

[3] Kanko et al., 2021.

[4] Muller et al., 2019.

[5] Bland & Altman 1986.

THE METHODS OF PROFESSIONAL TENNIS RETURNS WITH IMPLICATIONS FOR SUCCESSFUL RETURNS, RETURN ACES AND RECEIVERS WINNING

TASHIRO, S., NAKAMURA, K.1, MURAKAMI, S.2, TAKAHASHI, H.2

1 GRADUATE SCHOOL, NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA; 2 NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: A previous study found that the percentage of break points won was the most determining factor for winning the match in tennis [1]. Furthermore, another study indicates that return points won were among the variables that set high-level players apart from low-level players [2]. Now, the question is: what are the key factors for winning points when returning a serve? This study aims to identify crucial variables that contribute to the receiver's winning points, as well as successful returns and return aces.

METHODS: This study examined 5249 points in 18 right-handed professional mens tennis matches at the US Open between 2019-2021. The direction of the split-step hop, the types of spins and ground strokes used, the landing location of returns, the direction of returns, and the time duration of serves and returns were collected from video recordings. Dilated quantification type 2 was used to identify important variables that could contribute to successful returns, return aces, and receiver's winning points in four conditions (1st serve-returns in the deuce and ad court, and 2nd serve-returns in the deuce and ad court).

RESULTS: The types of spins ($p<0.01$) and the direction of returns ($p<0.01$) significantly influenced the success rate of returns for each condition. The findings show that returns toward the center of the court led to successful returns, while off-center returns resulted in more return errors. The landing location of returns ($p<0.01$) significantly contributed to the occurrence of return aces for each condition, and returns that landed on the server's forehand side increased the likelihood of achieving more return aces. The time duration of returns ($p<0.05$) significantly affected the receiver's winning points for the three conditions (1st serve-returns in the deuce and 2nd serve-returns in the deuce and ad court),and a shorter time duration of returns increases receiver's chance of winning a point.

CONCLUSION: The results of the present study suggest that players should target the center of the court and adopt techniques such as a compact swing to avoid off-center impact in return shots. Returns directed to the forehand side increase the chances of winning return aces. A faster speed of return shots or getting inside the court is a good strategy for a shorter time duration of returns that leads to more opportunities to win points for the receiver.

1. Fernández-García, Á, et al., (2019). Differences in competition statistics between winners and losers in male and female tennis players in Olympic Games. German Journal of Exercise and Sport Reseach, 49 : 313-318

2. Cui, Y, et al., (2017). Effects of experience and relative quality in tennis match performance during four Grand Slams. International Journal of Performance Analysis in Sport, 17(5) : 783-801.

APPLICATION OF AN INERTIAL SYSTEM TO IMPACT DISTANCE DETECTION IN THE TENNIS FOREHAND.

CAPRIOLI, L., BONAIUTO, V., CAMPOLI, F., EDRISS, S., ROMAGNOLI, C., SALVI, V., PADUA, E., ANNINO, G.

TOR VERGATA UNIVERSITY OF ROME

INTRODUCTION: Assessing the distance to the ball in the tennis forehand is critical. Proper distance maximizes ball contact in the ideal area of the racquet, known as the "sweet spot" allowing more control over the direction and power of the shot. In fact, if the impact occurs too close to the body the extension of the arm is limited, and as well as in the case of excessive distance reduced power and accuracy of the shot. Keeping the right distance from the ball also can help reduce the risk of injury, as it allows you to execute the shot with proper technique and without excessive stress on joints, muscles, and ligaments. The help a non-invasive assessment system can provide a technician is even more apparent in amateur tennis, where players still unaware of the act need continuous feedback.

METHODS: The analysis was conducted on 3 amateur tennis players (32.7 ± 6.8 years, 175.3 ± 8.2 cm) with an average of 4 years of playing experience. The subjects wore a sensorized chest strap with an inertial unit Movella DOT acquired at 120Hz. A Tennis Tutor Plus ball-launching machine, positioned on the opposite baseline at 1.60m from the mid-point, was set to two settings for two practice sets. For the first set, subjects received 10 balls each, at speed 4 with no effect, and easy to handle. In the second instead, 10 balls at speed 6 with top-spin. Two action cameras 240 Hz captured 20 forehands of each player from side and rear perspectives both aligned about 6m from the point of impact and placed on a stand at 1.10m above the ground. Video analysis was conducted using the BIOMOVIE ERGO software to identify the anteroposterior and lateral distance of the ball at the point of impact from the longitudinal axis coincident with the first toe of the nondominant foot. Jasp 0.18.1 was used for data analysis. Pearsons correlation between ball distance and trunk inclination during the impact phase (coinciding with the point of maximum angular velocity of trunk rotation) was investigated for each player and the group.

RESULTS: A highly significant strong Pearsons correlation was found in all the subjects. In player 1 the correlation between Euler Y angle, (i.e., flexion-extension angle) and lateral distance of the ball was 0.7 $p<0.001$, in player 2 of 0.8 $p<0.001$, and in player 3 of 0.7 $p<0.001$. A more moderate partial correlation of 0.4 $p<0.001$ was found in the analysis of the 60 forehand shots of the whole group, due to the variability of distance to the ball in players with different body stature and joint levers.

CONCLUSION: This preliminary study found a strong correlation between the torso tilt detected by the IMU system and the lateral distance to the ball at the impact point. This bodes well for how a sensorized chest strap can aid the technician in assessing the individual optimal distance to the ball in the forehand of amateur tennis players. Subsequent studies are needed to develop the full potential of the system, broaden the sampling of the investigation, and examine all game fundamentals.

Oral Presentations

OP-AP43 Fitness Science

DETERMINING MAXIMUM OXYGEN UPTAKE IN ENDURANCE AND CROSSFIT® ATHLETES: COMPARISON OF A RAMP TEST, TIME TRIAL AND ALL-OUT TEST

BRUGGISSER, F., KNAIER, R., SCHOCH, R., INFANGER, D., NIEMEYER, M., SCHMIDT-TRUCKSÄSS, A., WAGNER, J.
UNIVERSITY BASEL

INTRODUCTION: The aim of this study was to investigate whether a 4-minute time trial (4TT) or a 3-minute all-out test (3MT) might be an alternative to a ramp cycling test for the determination of maximum oxygen uptake (VO2max) in endurance and CrossFit® athletes.

METHODS: Data from two cross-sectional studies were analysed. In study 1, 18 male and 13 female endurance athletes completed two ramp tests and two 4TT on different days. In study 2, 23 male and 17 female CrossFit® athletes completed one ramp test followed by a 3MT with an intervening 20-minute recovery phase. Tolerance limits for ΔVO2max between the two exercise tests were set a priori to ± 0.13 L/min.

RESULTS: In study 1 and 2, the mean (standard deviation) VO2max attained during the ramp test was 3.93 (0.73) L/min and 4.01 (0.74) L/min, respectively. In study 1, mean differences between the first ramp test and the first 4TT and between the second ramp test and the second 4TT were 0.02 L/min ($p=0.930$) and 0.03 L/min ($p=0.873$), respectively. However, the tolerance limits were -0.35 to 0.31 L/min and -0.36 to 0.42 L/min, respectively. In study 2, mean difference and tolerance limits were 0.08 L/min ($p=0.637$) and -0.42 to 0.58 L/min, respectively.

CONCLUSION: Due to the limited agreement between either the 4TT or 3MT and the ramp test to determine VO2max in endurance and CrossFit® athletes, neither test is interchangeable. However, the lack of systematic differences in measured VO2max and the investigation of other performance-related outcomes suggest that the use of time trials and/or all-out tests remains a worthwhile option.

12-WEEK STRUCTURED PHYSICAL TRAINING IMPROVES OCCUPATIONAL ROLE-RELATED FITNESS AND PHYSICAL FUNCTION IN UK SPECIALIST POLICE OFFICERS

BRADLEY, E., COULSON, M.
UNIVERSITY OF SUNDERLAND

INTRODUCTION: UK police firearms officers require a range of physical attributes to perform demanding tasks [1] and are required to wear protective equipment and carry weapons and shields which can negatively affect occupational performance [2]. Given this, it is important that officers carry out regular exercise to maintain a range of components of fitness so that they can perform their duties safely and effectively. However, they are expected to carry out their own training whilst off-duty despite lack of time being cited as a typical barrier to adopting exercise programs [3]. To date there have been no long-term exercise intervention studies on changes in fitness and wellbeing for serving UK firearms officers. The aim of the study were to evaluate the effect of a 12-week structured training program across a range of fitness and wellbeing measures.

METHODS: 23 officers completed initial physical assessments. Measures were wellbeing and injury reports, mass, height, blood pressure, heart rate, hand-grip strength, reaction, balance, FMS, push-up, sit-up, and squat reps in 1-min, 30-15 intermittent fitness test. Officers were provided with a 12-week unsupervised structured training program followed by reassessment of physical attributes. The intervention included exercises that targeted aerobic and anaerobic capacity, muscular strength and endurance, and flexibility with the advice that the principle of overload should be adopted and to complete 3 d.wk-1 10 minutes per session. Changes in physical performance and wellbeing were calculated using paired samples t-tests with significance set at $p \leq 0.05$. Effect sizes were calculated to indicate the meaningfulness of any differences and presented as Cohen's d.

RESULTS: The intervention produced moderate significant increases in VO2max of 1.7 ml·kg-1·min-1 (d=1.12; p<0.001), grip strength of 8 kg (d=0.89; p=0.002) and reaction of 3 strikes (d=0.73; p=0.007), while there was a small non-significant improvement in balance of 1.3 secs (d=0.25; p=0.174). The participants had a good level of muscular endurance which stayed relatively stable post intervention (Push Ups 42; Sit Ups 50; Squats 52). FMS was high for individual and total score pre and post intervention with a significant moderate increase in leg raise (d=0.58; p=0.02), asymmetry (d=0.54; p=0.028), and total (d=0.54; p=0.027). Positive scores of wellbeing were reported pre and post intervention along with a reduction in injury incidence of 0.39 per officer.

CONCLUSION: To our knowledge, this is the first study in serving UK officers and a 12-week structured training program is effective at improving physical and fitness measures. Physical performance is crucial to enable officers to complete occupation-related tasks. The outcomes support the inclusion of a qualified strength and conditioning professional to administer progressive training programs along with a flexible approach to allow on-duty time for training purposes.

1. Dawes et al. (2017) 2. Dempsey et al. (2013) 3. Boyce et al. (2008)

EXAMINING THE RELIABILITY OF NEUROMUSCULAR, MORPHOLOGICAL, AND FUNCTIONAL TESTS ACROSS DIFFERENT SUBSETS OF AGING ADULTS

SCHAUN, G., RAIDL, P., ANDRADE, L., DAVID, G., KRÜGER, V., MARINS, E., NUNES, G., HÄFELE, M., MENDES, G., PINTO, S., ALBERTON, C., CSAPO, R.

UNIVERSITY OF VIENNA

INTRODUCTION: Evaluating the effectiveness of training interventions to prevent or mitigate age-associated neuromuscular impairments typically involves diverse neuromuscular, morphological, and functional tests. Although these generally demonstrate established test-retest reliability, their reproducibility could vary depending on the age and functional status of the subjects examined. Therefore, the goal of the present investigation was to determine the test-retest reliability of some of the most frequently applied tests in middle-aged and older adults of differing functional conditions.

METHODS: Middle-aged (n = 17, 48.7 ± 4.6 years) and older adults with (n = 18, 68.0 ± 6.2 years) and without (n = 8, 77.3 ± 7.6 years) mobility limitations were included in this study. Participants were familiarized with the study procedures and then attended two testing sessions separated by four weeks. Measures included ultrasound-derived muscle thickness (MT) and muscle quality (EI), lower limb maximal isometric (MVIC) and dynamic strength (1-RM), peak power, and a battery of seven functional tests (Short Physical Performance Battery, 30 s Sit-to-Stand, habitual and maximal gait speed, Timed Up-and-Go, Stair Climb, and 6-min Walk Test). The intraclass correlation coefficients (ICC2,1), standard error of measurement (SEM), coefficient of variation (CV%), and minimal detectable change (MDC) were determined.

RESULTS: In the entire sample, both dynamic and isometric strength measures displayed excellent reliability (ICCs = 0.96-0.99; CV% = 6-12%), whereas ultrasound MT and EI results ranged from good to excellent (ICCs = 0.90-0.98; CV% = 5-12%). Peak power results displayed good to excellent relative reliability (ICCs = 0.76-0.98), whereas absolute reliability values varied for loads between 30-90% 1-RM (CV% = 12-39%). Finally, functional performance measures showed good to excellent reliability (ICCs = 0.78-0.92; CV% = 3.5-6.8%). When groups were analyzed separately, dynamic and isometric strength, as well as MT and EI measures showed mostly similar results between the groups (all ICC > 0.9 and CV% ≤ 13%), whereas peak power and functional tests results differed slightly on a per-load and per-test basis, respectively.

CONCLUSION: Overall, our results suggest that the investigated tests are reliable in both middle-aged and older adults of different functional statuses. Notably, the reliability of some of these tests remained relatively consistent across distinct subsets of participants, suggesting their suitability for studies involving comparisons among these populations.

NEUROMUSCULAR ADAPTATION OF THE FINGER FLEXOR MUSCLES CONTRIBUTES TO THE GREATER ENDURANCE CAPACITY IN EXPERIENCED CLIMBERS DURING SUSPENSION TASKS

VIEIRA, T., BRUNO, M., CERONE, G., BACHERO-MENA, B.

POLITECNICO DI TORINO

INTRODUCTION: Climbing is a physically demanding discipline, placing significant loads on the finger flexors. Notwithstanding the documented greater endurance capacity of experienced climbers, the mechanisms explaining these training-induced adaptations remain unknown. We therefore investigate whether two non-competing strategies—muscle adaptation and alternate muscle recruitment—may explain the disparity in endurance capacity in participants with different climbing experience.

METHODS: A total of 38 climbers volunteered to participate in this study, after providing written informed consent. Participants were split into two groups, Advanced (n=21) and Intermediate (n=17), according to their score in the French system for grading sport climbing routes: at least 7a and from 6a to 6c+, respectively. We analyzed 64 (8×8, 1cm inter-electrode

distance) high-density surface electromyograms (EMGs) during suspension exercises using a half-crimp grip with different depths (15mm, 20mm, 30mm). From the spatial distribution of changes in MeDian Frequency (MDF) and Root Mean Square (RMS) values until failure, we assessed how much and how diffusely the myoelectric manifestations of fatigue took place. To account for anatomical, inter-individual differences, intergroup comparisons were conducted after normalizing data based on forearm size.

RESULTS: Advanced climbers exhibited greater endurance, as evidenced by significantly longer failure time for the three grip depths. With respect to the myoelectric fatigue, MDF values decreased while RMS values increased significantly until the failure time, for both groups and for the three edge depths. These changes in RMS and MDF values were confined to a small skin region (nearly 25% of the grid size) and centered at variable locations across participants, for the three edge depths. In Intermediate climbers, however, MDF decreased significantly more steeply when compared with Advanced climbers, whereas RMS changes did not differ between groups. Correlation analysis indicated the greater time to failure was associated with lower changes in MDF, for the three depths considered. Conversely, RMS slopes were far more variable across groups and edge depths and were not correlated with failure time.

CONCLUSION: Collectively, our results convey the following practical implications:

• The topography of muscle excitation, as assessed from high-density surface EMGs, revealed relevant differences between Intermediate and Advanced climbers.

• Advanced climbers endured suspension tests for longer durations, regardless of whether holding on 15 mm, 20 mm, or 30 mm thick edges.

• The liability to muscle fatigue was greater in Intermediate than Advanced climbers. The muscle region where fatigue buildup was most evident varied dramatically across subjects and groups, justifying the importance of assessing muscle excitation from multiple skin locations.

Oral Presentations

OP-PN27 Respiration/Pulmonary

BIOLOGICAL SEX DIFFERENCES IN THE PERCEPTION OF AIR HUNGER DURING A CARBON DIOXIDE REBREATHING TASK

HALL, L., SHARPE, G., WILLIAMS, N., JOHNSON, M.

NOTTINGHAM TRENT UNIVERSITY

INTRODUCTION: Biological sex has been shown to influence perceptions of 'dyspnoea' in individuals with asthma and COPD, and in healthy individuals performing submaximal exercise [1]. However, whether biological sex affects air hunger (AH), which is the most aversive form of dyspnoea, remains unknown and was therefore the focus of this study.

METHODS: 40 healthy, non-smoking adults (20 female) aged 18-45 years visited the laboratory on two occasions separated by ≥24h. Visit 1 comprised baseline measures. Visit 2 comprised a CO2 rebreathing task to induce AH, which included: (1) a 6-min room air breathing phase, and (2) a CO2 rebreathing phase, whereby a hypercapnic-hyperoxic gas mixture (5% CO2, 95% O2) was breathed from two 6 L anaesthesia bags. Participants wore a nose clip and breathed through a flanged mouthpiece and provided subjective ratings of AH intensity (AH-I) and unpleasantness (AH-U) every 30-s using a modified Borg Scale [0 ('none') to 10 ('maximal')]. The task was concluded if participants stopped of their own volition, rated maximum perception (i.e., 10), and/or reached an end-tidal carbon dioxide partial pressure (PETCO2) of 70 mmHg. Subsequently, the Multidimensional Dyspnoea Profile (MDP) was administered with a focus on the 'final moments of the task'.

RESULTS: Area under the curve (determined using the trapezoid rule) for AH intensity (AUC-I) and unpleasantness (AUC-U) were higher in females than males (AUC-I: 1422 ± 752 vs 1006 ± 349 AU P = 0.017; AUC-U: 1310 ± 714 vs 836 ± 374 AU, P = 0.007). On the MDP females felt more anxious (5 ± 3 vs 3 ± 3, P = 0.049) and afraid (4 ± 3 vs 2 ± 3, P = 0.043) than males. Furthermore, females perceived a higher magnitude of 'tight/constricted lungs' (6 ± 3 vs 2 ± 2, P < 0.001) and 'mental effort/concentration' (7 ± 3 vs 4 ± 3, P < 0.001) than males. PETCO2 slope was higher in males than females (4.75 ± 0.75 vs 3.88 ± 0.65 mmHg/min, P < 0.001). Baseline values for PETCO2, minute ventilation (VE) and tidal volume (VT) were higher in males compared to females (PETCO2: 38.9 ± 2.4 vs 37.1 ± 2.0 mmHg, P = 0.006; VE: 16 ± 2 vs 14 ± 3 L/min, P = 0.021; VT: 1215 ± 306 vs 906 ± 138 mL, P < 0.001). End-task values for PETCO2, VE and VT were higher in males compared to females (PETCO2: 68.3 ± 2.7 vs 61.8 ± 5.0 mmHg, P < 0.001; VE: 79 ± 22 vs 58 ± 23 L/min, P = 0.002; VT: 2442 ± 624 vs 1801 ± 545 mL, P < 0.001).

CONCLUSION: Compared to males, females report greater subjective perceptions of AH-I and AH-U during a CO2 rebreathing task, along with a greater negative emotional response. These findings therefore suggest that sex differences in the perceptions of dyspnoea extend beyond conditions of exercise (exertional) and respiratory disease.

References

1. Archiza, B., Leahy, M. G., Kipp, S., & Sheel, A. W. An integrative approach to the pulmonary physiology of exercise: when does biological sex matter? European Journal of Applied Physiology, 2021. 121(9): p.2377-2391.

PERIPHERAL FATIGUE OF THE QUADRICEPS MUSCLES INCREASES PERCEPTIONS OF RESPIRATORY EFFORT AND AIR HUNGER INDEPENDENT OF CENTRAL FATIGUE

BROWN, J., HALL, L., BOAT, R., WILLIAMS, N., JOHNSON, M., SHARPE, G.
NOTTINGHAM TRENT UNIVERSITY

INTRODUCTION: Exercise-induced leg muscle fatigue increases dyspnoea (specifically the sensation of Respiratory Effort) in a subsequent respiratory challenge (1). This effect could be attributed to either central or peripheral fatigue (or both). This study aimed to isolate the impact of peripheral fatigue on dyspnoea by inducing leg muscle fatigue via electrical stimulation. As dyspnoea is a multidimensional sensation, and air hunger (AH), is commonly experienced during physical activity (PA) by those with pulmonary conditions (2), the present study investigated whether leg muscle peripheral (and not central) fatigue affects Respiratory Effort and AH.

METHODS: Fifteen participants completed four separate experimental sessions. Each session comprised one of two breathing challenges (Respiratory Effort or AH), with (QFATIGUE) or without (CON) quadriceps fatigue (30 mins of neuromuscular electrical stimulation (NMES). The Respiratory Effort challenge involved progressive inspiratory flow resistive loading (two minutes each of 20, 35, 50, 65% of maximum inspiratory mouth pressure (MIP)). The AH challenge was carbon dioxide (CO_2) rebreathing to the limit of tolerance. Respiratory Effort and AH intensity were rated using a modified Borg Scale (0-10). The multidimensional dyspnoea profile (MDP) was administered post challenge. Cardiorespiratory data was measured continuously. Quadriceps fatigue was evaluated by changes in potentiated twitch force ($\Delta Qtw,pot$; peripheral fatigue), and voluntary muscle activation (ΔVA; central fatigue).

RESULTS: NMES successfully caused peripheral fatigue ($\Delta Qtw,pot$;- 24 + 8%), without reducing VA (0.5 ± 3.3%). During resistive loading of 65% MIP, Respiratory Effort was 12.3% higher in QFATIGUE (7.3 ± 1.9) than CON (6.5 ± 1.5) ($P < 0.05$). The immediate perception MDP scores were 12.4% higher in QFATIGUE (24.4 ± 9) than CON (21.7 ± 8.2, $P < 0.05$). During CO_2 rebreathing AH was 44.4% higher in QFATIGUE than CON at 50% (QFATIGUE: 2.6 ± 1.2; CON: 1.8 ± 0.9, $P < 0.01$) and 21.7% higher at 75% (QFATIGUE: 5.6 ± 1.8; CON: 4.6 ± 1.7, $P < 0.05$) of the challenge duration despite no differences in $PETCO_2$. CO_2 rebreathing duration was not different between conditions ($P > 0.05$).

CONCLUSION: Peripheral limb muscle fatigue increases perceptions of Respiratory Effort and AH independent of central fatigue. An increase in type III/IV afferent feedback may elevate these perceptions during PA through an increase in corollary discharge from both cortical (Respiratory Effort) and medullary (AH) motor activity. Pulmonary disease often reduces PA which subsequently increases skeletal muscle fatiguability (3). Our data suggest that peripheral muscle fatigue may further exacerbate exertional dyspnoea which may in turn cause a downward spiral in PA (4).

References:

1. Grippo et al. (2003) 2. Banzett et al. (2021) 3. Mador et al. (2009) 4. Brunton et al. (2021)

THE DIFFERENCE IN BREATHING FREQUENCY AND VOLUME IN RECREATIONAL CYCLISTS AND RUNNERS AS A FRACTION OF MAXIMUM OXYGEN UPTAKE

GUDMUNDSSON, J.O., EINARSSON, I.
REYKJAVIK UNIVERSITY

INTRODUCTION: The accessibility of variables describing physiological responses in recreational activities has increased with the use of smart technology. The objective of this study was to investigate the correlation between variables obtained by TymeWear Smart T-shirt with direct measurements of breathing frequency and volume in recreational cyclists and runners.

METHODS: Graded exercise tests (GXT) to time of exhaustion were taken on 35 recreational runners (age 25 – 65) and 31 recreational cyclists (age 25 – 65). During this exercise, participants wore a TymeWear Smart T-Shirt measuring breathing frequency, breathing volume, and heart rate. Participants were also connected to a Cosmed K5 gas analyzing device for breath by breath measurements. Runners completed a GXT test on a treadmill starting at 5km/hr and increasing by 1km/hr every 3 minutes, and at a constant incline of 1%. Cyclists also completed a GXT test on an indoor bike with controlled resistance, starting at 75W and an increase of 25W every 3 minutes. Blood lactate was measured at the last 15 seconds at every intensity stage.

RESULTS: A significant positive correlation was found with breathing frequency measurements ($r=0.879$) on a bicycle and ($r=0.808$) on a treadmill and a significant positive correlation with breathing volume on the bike ($r=0.928$) and treadmill ($r=0.913$) between the TymeWear technology and direct air exchange measurement. The breathing rate as a fraction of VO_2max increased at a lower rate for cyclists than runners, even though breathing volume had no significant difference.

CONCLUSION: Even though a significant positive correlation was found, both with breathing frequency and breathing volume for both runners and cyclists further research is needed to understand and develop LT1/VT1 establishment using calculations with indirect measurements. The results provided a positive outcome helping recreational runners and cyclists to establish their training thresholds without doing expensive and complicated measurements.

COGNITIVE AND PULMONARY FUNCTION CORRELATION IN OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT: EXPLORING THE LINKAGES

PONLASEN, S., TONGTAKO, W., TARUMI, T.
CHULALONGKORN UNIVERSITY

INTRODUCTION: Mild cognitive impairment (MCI) is an intermediate stage between the cognitive changes of normal aging and early dementia [1]. MCI is rapidly becoming one of the most common clinical manifestations affecting the elderly [2]. Some studies showed that various pulmonary measures are associated with cognitive function. However, there has been limited investigation into this matter regarding cognitive impairment among community-dwelling individuals, particularly in relation to considering pulmonary function. Therefore, the aim of this investigation was to determine the association between pulmonary function and cognitive function in older adults with mild cognitive impairment.

METHODS: This study included 21 individuals diagnosed with MCI, aged between 64 and 77 years, with cognitive scores ranging from 17 to 24 on the Montreal Cognitive Assessment (MoCA). Executive function was assessed using the Trail Making Test Part B (TMT-B). Pulmonary function, specifically Force Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1) and Maximum Voluntary Ventilation (MVV) were evaluated using a computerized spirometer (SpirobankG). The cognitive function and pulmonary function variables were analyzed using Person's correlations.

RESULTS: The correlation analysis revealed a moderate positive correlation between MoCA scores and FVC ($r = 0.470$, $p < 0.032$) and MoCA scores and FEV1 ($r = 0.476$, $p < 0.029$). Additionally, a moderate negative correlation was observed between TMT-B and FVC ($r = -0.618$, $p < 0.003$). Nevertheless, No significant changes in MoCA scores and MVV ($r = 0.315$, $p < 0.165$).

CONCLUSION: Based on the present findings, there appears to be an association between higher pulmonary function and a reduced incidence of cognitive impairment. This positive relationship between pulmonary function and cognitive performance was particularly pronounced among older adults with MCI.

References:

1. Vega JN, Newhouse PA. Mild cognitive impairment: diagnosis, longitudinal course, and emerging treatments. Curr Psychiatry Rep, 2014, 16:490.

2. Mufson EJ, Binder L, Counts SE, DeKosky ST, de Toledo-Morrell L, Ginsberg SD, Ikonomovic MD, Perez SE, Scheff SW. Mild cognitive impairment: pathology and mechanisms. Acta Neuropathol, 2012, 123(1) p.13-30.

ARTERIO-VENOUS SHUNTING, CARDIOPULMONARY HEMODYNAMICS, AND EXERCISE PERFORMANCE IN TIBETANS AND HAN CHINESE

MÖLLER, F., FAN, J.L., FUTRAL, E., HODGMAN, C.F., KAYSER, B., LOVERING, A.T.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

INTRODUCTION: Differences in cardiopulmonary hemodynamics of high-altitude and acclimatized sea-level natives might augment exercise performance at altitude and decrease pulmonary artery systolic pressure (PASP) by increased blood flow through intrapulmonary arteriovenous anastomoses (Q̇IPAVA) (1). Although one study reported lower PASP in Tibetans in hypoxia at rest and during exercise (2), most studies have found no differences between populations at rest (3,4), and limited data exist during exercise. We hypothesized that Tibetans would have better exercise capacity at sea level (SL) and 5000 m altitude (ALT) and more favorable cardiopulmonary physiology, such as normal right and left heart function, lower PASP at rest, and greater Q̇IPAVA during exercise.

METHODS: 10 Tibetans and 10 Han Chinese without intracardiac shunts (PFO-negative) cycled stationary from 70 W with stepwise increases of 30 W every 3 min to exhaustion (Wpeak), in a hypo/hyperbaric chamber at SL and ALT. At the end of each step, respiratory variables were averaged over 30 s, and stroke volume (SV) and PASP were determined by ultrasound. Transthoracic saline contrast echocardiography (TTSCE) was used to determine Q̇IPAVA using a bubble scoring system (5). Cardiac output (Q̇T) was calculated as HR x SV and total pulmonary resistance (TPR) as TPR = PASP/Q̇T. Unpaired t-tests compared cardiorespiratory measures at peak workload. Mann-Whitney test compared bubble scores. Significance was set to $p < 0.05$ a priori, and effect sizes are presented as r2, with $r2 > 0.1$ indicating small, > 0.25 medium, and > 0.37 large effects.

RESULTS: Resting cardiac structure and function was not different between groups. Tibetans achieved a higher WPEAK at SL ($p = 0.026$, $r2 = 0.243$) and at ALT ($p = 0.024$, $r2 = 0.280$), and higher V̇O2PEAK at ALT ($p = 0.042$, $r2 = 0.2340$), but not at SL ($p = 0.207$, $r2 = 0.087$). No differences were observed in HR, SV, or Q̇T. Q̇IPAVA was only lower in Tibetans during 100 W exercise at ALT ($p = 0.039$), while the increases in PASP and TPR at ALT were similar between the groups.

CONCLUSION: Lower Q̇IPAVA in Tibetans during exercise at ALT might support higher WPEAK and V̇O2PEAK. However, no differences were observed in PASP and TPR. Our data suggest that the Tibetans superior aerobic exercise capacity over Han Chinese may be independent of cardiopulmonary features and possibly linked to differences in local muscular oxygen extraction, as previously hypothesized in Sherpas (7).

1 Stickland et al. (2004). DOI: 10.1113/jphysiol.2004.069302

2 Groves et al. (1993). DOI: 10.1152/jappl.1993.74.1.312

3 Foster et al. (2014). DOI: 10.1113/jphysiol.2013.266593

4 Faoro et al. (2014). DOI: 10.1152/japplphysiol.00236.2013

5 Elliot et al. (2011). DOI: 10.1152/japplphysiol.00145.2010

6 Kayser et al. (1991). DOI: 10.1152/jappl.1991.70.5.1938

TESTING THE EFFECT OF TWO TYPES OF OPEN-SKILLS TRAINING ON COGNITIVE FUNCTIONS: THE CASE OF PARKOUR

GROSPRETRE, S., RUFFINO, C.

C3S - EA4660

INTRODUCTION: Over the recent decades evidence of the positive impact of physical activity on cognitive functions have been found (1). However, the type of improvement could be highly dependent on the type of exercise. For instance, single endurance-like activities may appear less efficient to probe cognitive enhancement, as compared to open-skilled activities. While closed-skill sports rely on optimizing one single movement within a standardized situation, open-skill activities are characterized by a variety of unpredicted situations that lead the practitioner to manage high adaptation skills. Team sports are usually considered as open-skill sports by excellence. However, according to the infinite variety of environment in which it is practiced, parkour can also be classified among open-skilled activities (Grosprêtre & Gabriel, 2020). The aim of the present study was two compare the effect on cognitive functions of two opposite form of open sport practices: either practicing various activities in the same environment (indoor collective sports) or practicing same activity but in various environments (parkour).

METHODS: Forty healthy young participants (Age: 21.5 ± 3 years old) were split in two groups: control group (CT, n=19) and parkour group (PK, n=21). Both groups trained 4 weeks with 2 sessions of 2h per week, being composed of various activities including indoor collective ball games (e.g. volleyball, football) for CT and only parkour for PK. This latter involved practicing parkour focused on a wide variety of environments. Before and after each training period, all participants underwent the same testing procedure, involving a battery of cognitive tests: the trail making test (TMT), letter cancellation test (LCT), change blindness test (CB), visual memory test, instant and delayed recall of a list of 15 words for short- and long-term memory, respectively.

RESULTS: The PK group significantly increased their score in both TMT and CB ($P < 0.001$), while the CT group did not ($P > 0.05$). Regarding the LCT and the working memory test (Instant recall of words), both groups increased similarly their performance ($P<0.001$). However, regarding long term memory, PK group remembered more words that CT group ($P<0.001$).

CONCLUSION: Both training led to enhancement of working memory and selective attention (LCT). However, the variety of environments and the explorative approach of parkour to overcome a wide range of obstacles with various skills lead to a specific enhancement of observation capacity (CB test), long-term memory and visuo-spatial attention (TMT). Varying the configuration of environments seems to have a better effect on specific cognitive abilities, such as visual capacities, than practicing open-skill team sports.

REFERENCES:

1. Chang et al. (2017), J Sport Health Sci, 6(1):89-95.

2. Grosprêtre and Gabriel (2020), Percept Mot Skills, 128(1):96-114.

Oral Presentations

OP-MH41 Exercise interventions in breast cancer

EFFECTS OF HIGH AND LOW-TO-MODERATE INTENSITY EXERCISE DURING (NEO-)ADJUVANT CHEMOTHERAPY ON MUSCLE STRENGTH, BODY COMPOSITION, MUSCLE FIBER SIZE, MYONUCLEAR CONTENT AND SATELLITE CELL NUMBER.

VIKMOEN, O., WIESTAD, T.H.2,3, THORMODSEN, I.2, NORDIN, K.4, BERNTSEN, S.4,5, DEMMELMAIER, I.4,5, STRANDBERG, E.4, RAASTAD, T.1,5

1NORWEGIAN SCHOOL OF SPORT SCIENCE, 2HAUKLELAND UNIVERSITY HOSPITAL, 3UNIVERSITY OF BERGEN, 4UPPSALA UNIVERSITY, 5UNIVERSITY OF AGDER

INTRODUCTION: (Neo-)adjuvant chemotherapy for breast cancer has deleterious effects on muscle mass, muscle cells, and muscle function (1,2). Exercise during treatment may counteract these negative effects, but the optimal exercise intensity is unknown. The aim of this study was to compare the effectiveness of high (HIT) and low-to-moderate intensity (MIT) exercise in counteracting treatment effects on muscle strength, body composition, muscle fiber size, myonuclear content and satellite cell number in women diagnosed with breast cancer.

METHODS: Women diagnosed with stage I-III breast cancer were randomized to either HIT (n= 30, n=10 for biopsi analyses) or MIT (n=37, n= 13 for biopsy analyses) during chemotherapy treatment. Patients receiving usual care recruited from another pool of patients with the same inclusion criteria acted as a comparison group. MIT and HIT engaged in home-based endurance training and supervised strength training twice a week. The HIT group trained at an intensity of 80-90% of heart rate reserve (HRR) and 1 repetition maximum (RM) and the MIT group at 40-50% of HRR and 1RM. The aerobic exercise for the HIT group consisted of 5x2 minutes intervals, while the MIT group performed continuous work in bouts of at least 10 minutes with the aim of reaching 150 minutes per week. Testing of muscle strength, body composition and collection of muscle biopsies from m. vastus lateralis was performed before chemotherapy (T0), after 3 months of chemotherapy (T1) and after 6 months of chemotherapy (T2, not biopsies).

RESULTS: HIT improved strength in leg press (T1: 12±17%, p=0.002, T2: 9±13%, p=0.01) and chest press (T1: 9±14%, p=0.01, T2: 12±16%, p=0.01) with no changes in MIT. Compared to MIT, the strength improvements in HIT were significantly larger in leg press (T1: p=0.02, T2: p=0.03) and tended to be larger in chest press at T2 (p=0.05). In the usual care group, no change in leg press and a decrease in chest press strength (-3 ± 5% p = 0.023) were observed.

At T1, neither group had changed lean body mass, but at T2 both HIT and MIT experienced increases in lean body mass (3.3 ± 3.7%, p=0.002 and 3.0 ± 4.2%, p= 0.009 respectively), without any significant differences between them. The usual care group reduced lean body mass (-5.2 ± 4.9%, p < 0.01) and increased fat mass (16 ± 20%, p = 0.02).

Neither group had a significant change in muscle fiber size or myonuclear content neither in fiber type. Preliminary data indicate an increased SC count in type 2 fibers in HIT (n=4) with no changes in MIT (n=6).

CONCLUSION: Our data suggest that HIT is superior compared to MIT in improving strength both in the lower and upper body in women undergoing chemotherapy treatment for breast cancer. Nevertheless, both methods were successful in increasing lean body mass and preventing the decrease observed during usual care.

References

1. Mijwel et al., FASEB J, 2018, 32(10):5495-5505.

2. Klassen et al., J Cachexia Sarcopenia Muscle, 2017, 8(2):305-316.

EFFECTS OF HIGH VS. MODERATE INTENSITY EXERCISE DURING (NEO-)ADJUVANT CHEMOTHERAPY ON CARDIORESPIRATORY FITNESS, MITOCHONDRIAL ENZYMES AND CAPILLARIES IN WOMEN WITH BREAST CANCER

HELGE WIESTAD, T., VIKMOEN, O., RANES, M., THORMODSEN, I., FLUGE, Ø., MELLA, O., BERNTSEN, S., NORDIN, K., RAASTAD, T.

HAUKELAND UNIVERSITY HOSPITAL

INTRODUCTION: (Neo-)adjuvant chemotherapy for breast cancer has deleterious effects on maximal oxygen uptake (VO2max), mitochondrial function and capillary content in muscles (1,2). Physical exercise during treatment may counteract some of these negative effects but the optimal exercise intensity is unknown. The aim of the current study was to investigate if high (HIT) or low-to-moderate intensity (MIT) exercise can counteract deleterious effects of chemotherapy treatment on VO2max, lactate threshold and muscle content of mitochondrial enzymes and capillaries in women diagnosed with breast cancer.

METHODS: Women diagnosed with stage I-III breast cancer were randomized to either HIT (n=27) or MIT (n=35) and compared to a usual care (UC) (n=15) group. Both training groups performed combined strength and endurance training over the course of chemotherapy (approximately 12-24 weeks) at an intensity of 80-90% of heart rate reserve (HRR) and 1RM (HIT) or 40-50% of HRR and 1RM (MIT). The UC group was encouraged to continue with their usual activities. Measures of VO2max (UC T0-T1 only), lactate threshold (not UC) and collection of muscle biopsies from m. vastus lateralis was performed before (T0), between (T1) and after chemotherapy (T2). Biopsies were analyzed for mitochondrial enzymes (Citrate Synthase [CS], COX4 and HADH) in western blots and capillaries per fiber (CAF) by immunohistochemistry (not UC).

RESULTS: VO2max decreased in all groups from T0 to T1 by 8% in HIT, 10% in MIT and by 13% in UC (p<0.01) with no differences between the groups (p=0.45). At T2 VO2max was further reduced by 23% (p<0.01) in HIT and by 19% (p<0.01) in MIT with no differences between groups (p=0.27).

Lactate threshold, measured as % of VO2max, decreased by 6% (p<0.01) in the HIT and MIT group from T0 to T1. From T0 to T2 lactate threshold decreased by 14% (p<0.01) in the HIT group and 16% (p<0.01) in the MIT group with no differences between groups (T1: p=0.14, T2: p=0.51).

CS levels were reduced from T0 to T1 in the HIT group (-19%, p=0.02), MIT group (-11%, p=0.03) and UC group (-18%, p=0.01) and from T0 to T2 in the HIT group (-34%, p=0.01) and UC group (-14%, p=0.03). HADH levels were reduced from T0 to T1 in the UC group (-10%, p=0.03) and from T1 to T2 in the HIT group (-23%, p=0.02). COX4 levels were reduced from T0 to T1 in the UC group (-20%, p=0.05).

CAF was reduced in the HIT group from T0 to T1 with 16% (p=0.03) in the type 2 fibers and from T1 to T2 in the type 1 fibers (-18%, p=0.02) and type 2 fibers (-22%, p=0.04). There were no changes in the MIT group.

CONCLUSION: Neither HIT nor MIT counteracted the decline in VO2max, lactate threshold or muscle mitochondrial enzymes in breast cancer patients during the chemotherapy treatment. However, MIT prevented the decline in capillaries which was observed in the HIT group.

References

1. Peel et al., J AM Heart Assoc; 2014; 3(1): p. e000432 PMID:24419734

2. Mijwel et al., FASEB J; 2018; 32(10): p. 5495-5505 PMID:29750574

A LIFESTYLE INTERVENTION PROGRAM (AEROBIC EXERCISE AND MEDITERRANEAN DIET) IN BREAST CANCER (BC) SURVIVORS IMPROVES THE HEALTH-RELATED QUALITY OF LIFE AND REDUCES THE TUMORIGENIC POTENTIAL OF BC CELLS

BARBIERI, E., BALDELLI, G.1, NATALUCCI, V.2, FERRI MARINI, C.1, SISTI, D.1, ANNIBALINI, G.1, IMPERIO, M.1, LUCERTINI, F.1, SALTARELLI, R.1, VALLORANI, L.1, BOCCONCELLI, M.1, GENTILINI, V.1, EMILI, R.3, CATALANO, V.3, BAROCCI, S.3, ROCCHI, M.B.L.1, BENELLI, P.1, VAGNINI, D.4, SAITA, E.4, BRANDI, G.1, DE SANTI, M.1

1DEPARTMENT OF BIOMOLECULAR SCIENCES, UNIVERSITY OF URBINO CARLO BO, 61029, URBINO, ITALY 2DEPARTMENT OF PATHOPHYSIOLOGY AND TRANSPLANTATION, UNIVERSITY OF MILAN, MILAN, ITALY 3URBINO HOSPITAL, AST PU, URBINO, ITALY 4DEPARTMENT OF PSYCHOLOGY, UNIVERSITÂ CATTOLICA DEL SACRO CUORE, MILAN, ITALY

INTRODUCTION: The role of muscle as an endocrine organ, expressing and releasing circulating myokines that have potentially health-promoting effects and oncoprotective options, has recently gained attention. Indeed, the beneficial effect of exercise through the induction of exercise-induced systemic biochemical-metabolic changes can improve components of health-related quality of life (HRQoL) and reduce/control cancer cell proliferation. This emerging translation research is becoming useful for evaluating physical activity habits and lifestyle modifications based on nutrition and exercise.

METHODS: A 12-week lifestyle intervention (LI) focused on the Mediterranean Diet and incremental aerobic exercise was conducted on 30 female BC survivors (stages 0-II; non-metastatic; aged 53.6 ± 7.6 years; non-physically active) with a risk factor related to metabolic diseases.

Anthropometric measurements (e.g., body mass index [BMI], waist circumference), cardiorespiratory fitness (VO2max), physical activity level (PAL), adherence to the Mediterranean diet (MeDiet questionnaire), and metabolic markers (e.g., glycemia, insulin, insulin resistance [HOMA-IR index], IGF-1, triglycerides, high-density [HD] and low-density [LD] lipoprotein) were assessed before and at 3, 6, 12, and 24 months after the LI. Participants were asked to complete questionnaires for quality of life indicators (EORTC-QLQ-C30). In this study, we also evaluated the effects of serum samples obtained before and after a LI in terms of modulation of the tumorigenic potential of BC cells. Triple-negative BC cell line MDA-MB-231 was cultured in a semi-solid medium for spheroid formation in 3D culture with sera collected before (PRE) and after (POST) the LI program.

RESULTS: Beneficial effects of the LI were observed on most of the HRQoL variables (i.e., anthropometric data, MeDiet, PAL, VO2max, glycemia, insulin, HOMA-IR index, IGF-1, LDL, total cholesterol, triglycerides, testosterone) after 12-week. The significant effect on Mediterranean diet adherence and V ̇O2max persisted until the 24-month follow-up (1). The improved quality of life indicators of the participants was also confirmed in long-term measurements (2). Moreover, a significant reduction of spheroid formation induced by serum collected POST compared to those obtained PRE LI was found. HRQoL parameters associated with 3D cell proliferation revealed the proliferative inducer IGF-1 as the only predictor of cell tumorigenic potential (3).

CONCLUSION: This study provides evidence of the positive association between LI and HRQoL in BC survivors. In the context of tertiary prevention, our findings emphasize the significance of LI for controlling cancer progression. Translational research could offer a useful tool to identify metabolic and physiological changes induced by exercise and nutritional behaviors associated with cancer progression and recurrence risk.

Natalucci V, et al. Heliyon (2023)

Vagnini D, et al. PLoS One (2024)

Baldelli G, et al. Sci Rep (2024)

THE EFFECT OF EXERCISE AND DISEASE STATUS ON MOBILIZATION OF ANTI-TUMORIGENIC AND PRO-TUMORIGENIC IMMUNE CELLS IN WOMEN WITH BREAST CANCER

KOIVULA, T., LEMPIÄINEN, S., NEUVONEN, J., NORHA, J., HOLLMÉN, M., SUNDBERG, C.J., RUNDQVIST, H., MINN, H., RINNE, P., HEINONEN, I.

UNIVERSITY OF TURKU

INTRODUCTION: Acute exercise has been shown to mobilize immune cells in healthy individuals, but the phenomenon is less investigated in cancer patients. Mobilization of certain immune cells may improve the ability of the immune system to combat against tumor cells. Therefore, we examined how acute exercise influences circulating leukocytes in breast cancer patients.

METHODS: Nineteen newly diagnosed breast cancer patients aged 36-68 performed 30 minutes of moderate-intensity exercise with a cycle ergometer. Blood samples were collected at various time points: at rest, at 15 minutes (E15) and 30 minutes (E30) after onset of the exercise, and at 30 minutes and 60 minutes post-exercise. Several immune cell subsets were analysed using flow cytometry.

RESULTS: Acute exercise increased the number of total leukocytes, neutrophils, lymphocytes, monocytes, basophils, total T cells, CD4+ T cells, T helper (Th)1 cells, Th 2 cells, Th 17 cells, CD8+ T cells, CD4-CD8- T cells, CD56+ natural killer (NK) cells, and CD14-CD16+ monocytes ($p<0.05$ in all). Many of the changes were transient and even biphasic. Proportions of NK cells and CD8+ T cells increased, while the proportion of myeloid derived suppressor cells (MDSCs) reduced, and proportion of regulatory T cells remained unchanged by exercise. Several associations were detected between cell mobilizations and disease state. For instance, cancer grade correlated positively with basophil mobilization at E15. Tumor size correlated negatively with NK cell mobilization at E15, and progesterone receptor positivity correlated negatively with CD8+ T cell mobilization at E15 and E30.

CONCLUSION: The findings show that the blood profile of immune cells change towards more cytotoxic/anti-tumorigenic in breast cancer patients with 30-minute exercise. The mobilization of some immune cells also appears to be related to the disease state.

Oral Presentations

OP-SH23 Mental Health

A NEW TEMPORAL FRAMEWORK FOR THE PASSIONATE JOURNEY OF ULTRA-ENDURANCE ATHLETES

BILL, T., ANTONINI PHILIPPE, R.
UNIVERSITÉ DE LAUSANNE

Background:

Ultra-endurance (UE) sports have emerged as a domain of considerable interest within the realm of sport psychology, with numerous studies probing the psychological endurance and sociocultural dynamics of participants. Despite this attention, there remains a gap in the temporal examination of the development of engagement and passion within UE sports and its psychological underpinnings—especially its influence on the athletes self-concept and identity over time. This study endeavored to illuminate the longitudinal development of passion in UE athletes and its integration into their self-identity and lifestyle.

Methodology:

Grounded in the Self-Determination Theory and the Dualistic Model of Passion, this research utilized semi-structured interviews to explore the experiences of 16 non-professional UE athletes. Interpretative phenomenological analysis facilitated the extraction of five dominant themes and numerous sub-themes that chronicle the UE engagement and passion trajectory, yielding a textured narrative of the participants psychological experiences.

RESULTS: The developmental journey of UE athletes emerged as a multi-faceted, often lifelong pursuit characterized by peak experiences, emotional vicissitudes, narratives of resilience, and spiritual growth. The identified themes were instrumental in constructing a "Temporal Framework for Progressive UE Engagement and Passion Development," elucidating the psychological maturation of the UE athlete, the construction of social identity within the athlete community, the nature and impact of peak experiences, the adoption of UE activities as central to lifestyle, and the evolution of passion and its psychological outcomes.

CONCLUSION: This study contributes a novel temporal and psychological framework to the existing literature, providing an integrative model that aligns empirical findings with advanced conceptualizations in UE athlete psychology. It invites scholarly discourse on the psychological complexity of the UE athletes journey and encourages sport psychologists to adopt an integrative and identity-centric approach to athlete support. The serious leisure perspective encapsulated within UE sports is posited as a vehicle for athletes to navigate self-concept in a post-modernist context, striving for self-coherence, actualization, and fulfillment of psychological needs. The proposed framework and its implications for sport psychology practice and research are detailed further in the links provided for the academic communitys perusal.

Full article:

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0293864

Temporal Framework of Ultra-Endurance Journey:

https://journals.plos.org/plosone/article/figure?id=10.1371/journal.pone.0293864.g002

A SYSTEMATIC REVIEW OF BENEFITS AND MECHANISMS OF FAMILY-BASED MIND-BODY THERAPY PROGRAMS TARGETING FAMILIES OF CHILDREN AND ADOLESCENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

SUN, F., FANG, Y.
THE EDUCATION UNIVERSITY OF HONG KONG

Introduction

The growing evidence has shown that family-based mind-body therapy (FMBT) programs act as an important alternative for attention deficit hyperactivity disorder (ADHD) treatment in youth with minimum side-effect; more importantly, FMBT contributed to improve family functioning of those affected by ADHD.

Methods

To summarize and analyze the benefits and mechanisms, a systematic literature search in the databases of EBSCOhost, PubMed, Web of Science, and Scopus was conducted to identify eligible studies. Finally, 15 studies published during 2010-2023 were reviewed.

Results

The included FMBTs were implemented in 850 children/adolescents and 996 parents, among which 201 parent couples attended the programs together with their child. All included FMBTs adopted mindfulness/meditation as the core practice to enhance participants' mental focus and attention. All programs were in long-term practice, of which six included par-

ent-child joint session(s). The positive changes were found in both children/adolescents (ADHD symptoms, behavioral problems, executive function, and school performance) and their parents (ADHD traits/symptoms, mental health, and parenting behaviors). Moreover, ways of FMBTs to improve the family functioning were identified, including delivering mindful strategies to family, restoring psychological capacity and interpersonal skills in family members, and improving parent-child relationship. Moreover, reviewed FMBTs showed a high level of feasibility and satisfaction in participants.

Discussion

Factors and issues potentially influencing the effectiveness and feasibility of FMBTs were discussed. For children/adolescents, the intervention effect of FMBT is regardless of age, sex and medication status according to the included studies. For parents, falling back to old habits (i.e., making no effort for a change), the busy pace of life, and self-trait/experience in ADHD were perceived by parents as barriers to practice MBT. In addition, ethnicity, medium socioeconomic status, city of living, and adherence to MBT were positively related to higher self-control and family empowerment in participants. However, the reviewed FMBTs showed a significant benefit for children to help them manage ADHD symptoms with a reduced level of medication. Thus, a low risk of side effect, non-pharmaceutical FMBT intervention potentially act as an alternative for the home-setting ADHD treatment. Nevertheless, there are still issues challenging the implementation of FMBTs, which include logistic barriers, lack of persistence, jealousy raised in siblings, and lack of confidence in treatment effect. Therefore, future efforts may be put into optimizing the design of FMBTs to meet the needs of families with different circumstances.

This study was substantially supported by a donation from Lam Kin Chung Morning Sun Charity Fund and a matching grant from the Research Grants Council of the Hong Kong SAR, China (Project No. CB339).

EXAMINING THE INDEPENDENCE OF MENTAL HEALTH AND MENTAL ILLNESS IN STUDENT-ATHLETES.

SULLIVAN, P., CELEBRE, J.

BROCK UNIVERSITY

The Dual Continua Model views mental health and mental illness are two separate but related constructs (Keyes, 2002). This model has been applied to athletes, including collegiate student-athletes, who may be at elevated risk for mental health concerns (Foster et al., 2019; Van Slingerland et al., 2018). Within the dual continua, distinct groups are formed based on various levels of mental health and mental illness. If these two continua are separate, as the model proposes, these groups should show different relationships to various outcomes. In other words, if groups with the same level of mental illness but different levels of health have different relationships to a given outcome, it provides evidence for the independence of these two continua. The current study analyzed the 2022 Canadian cohort of the National Collegiate Health Association's American College Health Assessment. A sample of 349 university student-athletes (65% female, 46.4% underclass, 53.1% living off campus) completed the Mental Health Continuum-Short Form (MHC-SF; Keyes, 2008), the Kessler K6 (Kessler, 2002), the Connor Davidson Resiliency Scale (Connor & Davidson, 2003), and the UCLA Loneliness Scale (Russell, 1996), as well as a measure of help seeking created for the NCHA. Of the six groups of mental health proposed within the Dual Continua Model, moderate mental health with a mental illness (n = 74), flourishing with a mental illness (n = 67), and flourishing (n = 68) showed relatively large and equal cell sizes. Student-athletes who were flourishing (with and without mental illness) were significantly less lonely than those who had moderate mental health with a mental illness. Those who were flourishing were significantly more resilient than flourishing with a mental illness, who were significantly more resilient than moderate mental health with a mental illness. There were no differences among these groups on help seeking. These results support that mental illness and mental health may be separate but related constructs in this population. Furthermore, they suggest that campaigns aimed at promoting mental health, in addition to those reducing mental illness, could be a legitimate objective for student-athletes (Uphill et al., 2016).

OLYMPIC COMBAT SPORTS AND MENTAL HEALTH IN CHILDREN AND ADOLESCENTS WITH DISABILITY – PRELIMINARY RESULTS OF A SYSTEMATIC REVIEW

CIACCIONI, S., LEE, Y., HAUCK, J., CAPRANICA, L., GUIDOTTI, F., BENZING, V., PESCE, C.

UNIVERSITY OF ROME "FORO ITALICO"

Introduction: Among sports widely recognized as beneficial for mental health, Olympic combat sports as multicomponent and holistic exercises might uniquely impact children and adolescents with disabilities [1,2]. Given their heightened susceptibility to mental health challenges, exploring how these sports could potentially mitigate such risks while improving their well-being is crucial [3].

Methods: A systematic online search was conducted using Cochrane Library, ERIC, PsycINFO, PubMed, Scopus, SPORTDiscus, and Web of Science databases (PROSPERO: CRD42023452489). Inclusion criteria were randomized controlled trials (RCTs), controlled trials (CTs), and observational studies with control groups published from inception to December 2023 that considered mental health outcomes in school-aged children and adolescents (5-18 years). Screening and data extraction were conducted in duplicate. Data were analysed and systematically graded for their methodological quality (RoB 2.0 and ROBINS-I).

Results: Published in Asia (n=6), Europe (n=4) and America (n=2) between 1975 and 2022, 12 studies (six RCTs and CTs, respectively) were included, which involved karate (n=5), judo (n=3), karate and judo (n=2), boxing (n=1) and taekwondo (n=1) mostly novice practitioners. Within educational or training settings, 436 predominantly male young individuals (age: 11.4±2.8 years) were divided either in exercise or control groups. All included disabilities were mental, behavioural or

neurodevelopmental disorders (ICD-11, code: 06) with autism spectrum and developmental disorders as the most represented conditions. Positive effects ($p<0.05$) emerged in stereotypy, communication, socio-emotional and executive functioning, personality, and sensory organization. Mental health-related outcomes were also considered, including physical functioning as well as oxytocin and cortisol levels. Risks emerged for selection and confounding biases.

Conclusions: Within a growing and promising research area, studies on Olympic combat sports and mental health suggest positive results although causal mechanisms and confounders need to be investigated [1]. Suitable for professionals, coaches and scientists, findings may be also used to inform future research and policy designed to increase levels of mental health in young people with disabilities [3]. Future research should prioritize high-quality interventions to solidify these findings and expand the evidence base, particularly focusing on inclusivity and methodological rigor [2].

References:

1. Ciaccioni et al. (2023). Martial arts, combat sports, and mental health in adults: A systematic review. PSE, 70(2024), 102556.

2. Biddle et al. (2019). Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. PSE, 42, 146-155.

3. International Classification of Diseases, Eleventh Revision (ICD-11), WHO 2019/2021.

Oral Presentations

OP-SH15 Sociology II

IS IT POSSIBLE TO DE-POLITICIZE AND DE-NATIONALIZE IN THE OLYMPICS WITH A MECHANISM TO TRANSFORM THE SPORTS PLAYER TO UPGRADE THEMSELVES

CHEN, Z.

BEIJING SPORTS UNIVERSITY

The original part "Fundamental Principles" of the Olympic Charter states that the aim of the Olympic Movement is to contribute to the building of a peaceful and better world by educating young people through sporting activities without discrimination of any kind and with the Olympic spirit - mutual understanding in the spirit of friendship, solidarity and fair play. It can be highly summarized as "peace, friendship and progress". In each Olympic Games, athletes from different countries represent their countries in the competition, and some athletes become naturalized athletes, that is, athletes recruited by other countries, which has become a common phenomenon in sports such as football, basketball, baseball and table tennis. Many have questioned this: By admitting these athletes to the games, doesnt the IOC recognize the legitimacy of their status? The nationality of athletes is objective and historical, which is the basic content of their national identity. By allowing naturalized athletes to participate in the competition, isnt that the realization of their identity migration? Wouldnt their identity problems lead to new ones? From the perspective of athletes identity migration, will it cause the Olympic movement to lose the spirit of fairness? This paper analyzes the naturalization of international Olympic athletes by using the method of literature, case analysis and inductive deduction, and puts forward: We need to face up to the controversies caused by the value identification and identity transfer caused by the naturalization of athletes in the post-Olympic cycle, because the cross-cultural differences and even contradictions provide infinite possibilities and common meanings for the future exchanges between civilizations, inter-organizational exchanges and interpersonal communication that is, the discussion space of identity. In the International Olympic Committee, it is necessary to establish a new working mechanism to promote the coordination of athletes nationality migration and their national identity, so as to ensure the fairness of athletes participation, respect their self-identity and cultural identity, get rid of the political bondage of national identity, and empower athletes to confirm their identity through self-identification in international cooperation and competition.

RESIDENTS' PERCEPTION OF TECHNOLOGICAL INNOVATIONS AT EURO 2012 STADIUMS IN POLAND

ZAWADZKI, K.

GDANSK UNIVERSITY OF TECHNOLOGY

Introduction

While there has been a rise in studies recently that discuss innovation research in the sports industry (Ratten 2019; Corthouts et al. 2020), there are still few studies on technological advancements in relation to sports facilities (Skinner, Smith, and Swanson 2018). Thus, the primary goal of the study that is being presented is to give a social valuation of the technological innovations used at four Polish stadiums hosting Euro 2012.

Methods

Using the contingent valuation method (CVM), the study was carried out in Gdansk, Poznan, Warsaw, and Wroclaw, four Polish cities that hosted sports venues for the 2012 European Championship. 1,200 people in total took part in the survey. Regression analysis was used to determine whether the study can be regarded as reliable in this regard and whether the

residents willingness-to-pay (WTP) level depends on the adopted variables related to the access to fast wireless internet, the installation of solar panels and the utilization of drones among other technological improvements.

Results

Nearly PLN (polish zloty) 70 million is the estimated value of the technological advancements for all four sporting venues. The total value indicating support for the Warsaw stadiums adoption of technological innovations is more than 40% greater than the PLN 30 million annual stadium maintenance costs. Surprisingly, this amount demonstrates how much local communities value having sports facilities in their cities and how eager they are for assisting in the process of modernizing these facilities technologically. In the other three cities, the aggregate valuation of social benefits is significantly lower and fluctuates around PLN 9 million. But in light of the yearly maintenance costs, the obtained amounts should still be regarded as high. When taken into account in the financial statement, all of the Polish stadiums participating in Euro 2012 turn a profit because the aggregate valuation in each case surpasses 40% of the stadiums annual maintenance costs.

Discussion

Studies conducted in Polands stadiums during Euro 2012 have demonstrated the significance of technological advancements. It has been established, therefore, that the local communitys opinion of technological advancements may be taken into consideration when evaluating whether or not to use public funds to finance large sports facilities.

References

Corthouts, J., E. Thibaut, C. Breuer, S. Feiler, M. James, R. Llopis-Goig, S. Perényi, and J. Scheerder. 2020. "Social Inclusion in Sports Clubs Across Europe: Determinants of Social Innovation." Innovation: The European Journal of Social Science Research 33 (1): 21–51.

Ratten, V. 2019. Sports Technology and Innovation. Assessing Cultural and Social Factors. Palgrave Macmillan.

Skinner, J., A. C. T. Smith, and S. Swanson. 2018. Fostering Innovative Cultures in Sport. Leadership, Innovation and Change. Palgrave Macmillan.

A KEYWORD ANALYSIS OF THE LEISURE SCIENCE JOURNAL: 1977-2024

ELÇI, G., KURAL, S., KESKIN, Y.
FACULTY OF SPORT SCIENCES

Introduction

This study aims to conduct a historical content analysis of keywords in articles published in The Journal of Leisure Science from 1977 to the present. With keyword network analysis and concept modeling, changes at the central level can be noticed.

Methods

In field-specific research, how the main topics and keywords in this field change can be analyzed to raise awareness about the main topics and keywords. Various themes were explored, including identifying research trends in studies by focusing on analyzing and modeling concepts with keyword networks.

Results

It is seen that the basic themes reflected in the titles and keywords of the research emphasize the conditions of leisure, followed by articles focusing on the meaning of leisure, culture/diversity, leisure management, and the protection and development of health published. When the network analysis of keywords is examined, it is seen that leisure studies, which is an interdisciplinary research field, are temporally linked to various subjects and constantly expand its research.

Conclusion

Analysis can also facilitate discussion about theme connections through knowledge mapping. In addition, the research may enable the formation of inferences, limitations and thoughts regarding future research aimed at developing literature knowledge.

16:15 - 17:30

Plenary Session

PS-PL03 Exercise is (not just) medicine: getting more people more active for health and development

EXERCISE AS MEDICINE IN A TRANSLATIONAL PERSPECTIVE: THE ROLE OF MYOKINES

PEDERSEN, B.
RIGSHOSPITALET

During the past couple of decades, it has been apparent that skeletal muscle works as an endocrine organ, which can produce and secrete hundreds of myokines that exert their effects in either autocrine, paracrine, or endocrine manners.

During exercise, myokines allow for crosstalk between the muscle and other organs, including brain, adipose tissue, bone, liver, gut, pancreas, vascular bed, and skin, as well as communication within the muscle itself. Myokines mediate effects on cognition, lipid, and glucose metabolism, browning of white fat, bone formation, endothelial cell function and tumor growth. Importantly, an anti-inflammatory environment is mediated with each bout of exercise, and long-term anti-inflammatory effects are mediated via an effect on abdominal adiposity. These effects are at least partly mediated by the myokine IL-6. The physiology and molecular biology of exercise suggests that exercise activates multiple signaling pathways of major health importance. There is, however, a need to close the gap between knowledge and practice and assure that basic research is translated, implemented, and anchored in society, leading to change of praxis. In order to make more people move, we need a true translational perspective on exercise as medicine, from molecular and physiological events to infrastructure and architecture, with direct implications for clinical practice and public health.

ATTACKING THE PANDEMIC OF PHYSICAL INACTIVITY: IT IS NOT AN INSOLUBLE PROBLEM

FOWLES, J.

ACADIA UNIVERSITY, SCHOOL OF KINESIOLOGY

Physical activity has been identified as a best buy in health for many years. No pill and few other behaviors provide such an array of disease prevention and health and quality of life enhancing benefits. Thus, it is not a surprise that we expect physicians and other health professionals to advise their patients to become more active. And over the last three decades evidence has mounted indicating that brief counseling from a physician coupled with referral to other health professionals with more knowledge about exercise and physical activity and more time to dispense this information leads to increased participation in physical activity among those counseled. This is especially so if the referrals extend to community sites and programs where sport, recreation, and physical activity actually occur. From the Green Prescription in New Zealand to national practice guidelines in the UK (NICE) and the US (Guide to Clinical Preventive Services) to progressive private health care systems (Kaiser Permanente in the US) and even to national programs such as in Slovenia there are many excellent examples of effective incorporation of sport, exercise, and physical activity into health care. But these examples are far from the norm. In this talk we will examine why it has been so challenging to get physicians and health care systems to truly integrate physical activity promotion into standard practice. We will also try to place physical activity counseling and referral into context as part of an overall strategy to increase population levels of physical activity. How much should we expect of physicians and health care systems? Are they an essential component of national physical activity promotion, necessary but not sufficient, or merely a distraction? Exercise is medicine, but only if taken as prescribed!

Dr. Fowles will be highlighting the learnings from Exercise is Medicine Canada over the last decade and describe a provincial approach to integrate EIM into health care systems and communities, outlining the key recommendations being implemented to improve population physical activity and exercise participation.

PP-UD01

E-poster

Biomechanics

TRAINING IMPROVEMENT FOR PERSONS WITH DIFFERENT NOSOLOGY OF MUSCULOSKELETAL SYSTEM INJURIES IN BILLIARDS

MYTKO, A., NAGORNA, V., LORENZETTI, S.
DEPARTMENT OF ELITE SPORTS

INTRODUCTION: The use of adaptive sports for persons with a spinal cord injury, particularly those who use wheelchairs, plays a crucial role in enhancing their physical fitness, mental well-being, and overall quality of life. In this context, billiards offer a pathway to rehabilitation, empowerment, and social inclusion for people with these types of injuries. Billiards provide a crucial outlet for adaptive sports, allowing individuals with musculoskeletal injuries worldwide to engage in competitive activities. However, training billiards athletes with spinal cord injuries presents challenges in executing shots. Our research aims to increase the integration of persons with musculoskeletal disorders into sports activity in billiards by implementing innovative technologies and developments in the training process.

METHODS: The research employed a multifaceted methodology, encompassing the analysis and synthesis of scientific and methodological literature, sociological research methods (utilizing questionnaires from coaches and officials of countries participating in the European Pool Championship spanning 2017 to 2023), expert assessments (involving 23 professional pool players participating in the European Pool Championship, wheelchairs division during the same period), pedagogical research methods (including observation and testing of special technical and tactical billiard exercises involving 16 pool players with spinal cord injuries from Ukraine), biomechanical analysis (utilizing OpenCaps web application for estimating movement dynamics from videos, involving calibration of cameras, video collection and processing, estimation of marker positions, kinematics assessment, and physics-based dynamic simulations of movements), and mathematical-statistical methods.

RESULTS: To comprehensively assess the stroke technique of billiard players in wheelchairs, we conducted organoleptic measurements using the innovative "OpenCap" web software for evaluating 3D kinematics. Kinematic parameters were registered during the execution of a standardized billiard shot using two different techniques. A significant correlation was identified between the indicators of cue motion for players using two techniques: with the forearm in the vertical plane and with the forearm in the horizontal plane. The latter proved more suitable for players with spinal cord injuries in the C5-C6 vertebrae.

The implementation of innovative developments, including special straps for cue fixation, a modified "bridge," and specialized training programs, resulted in noteworthy improvements: technical preparedness increased by 25% (basic shots by 26% and complex shots by 24%), technical-tactical preparedness improved by 30%, specialized physical preparedness enhanced by 44%, and competition results showed a remarkable improvement of 40%.

CONCLUSION: Over the research period of employing individual programs and implementing innovative techniques, the performance of athletes with disabilities increased by an average of 15%. The scientific and applied relevance of these innovations for enhancing the effectiveness of training and competitive activities in adaptive billiards has been demonstrated. These developments hold potential applicability to various forms of adaptive sports in Ukraine, Switzerland, and worldwide.

IMPACT OF CAUSE- OR EFFECT-BASED TEACHING ON PERFORMANCE LEVEL: A MOTOR LEARNING APPROACH IN ADOLESCENTS

FOGLIATA, A., DELVECCHIO, A., AMBRETTI, A.
UNIVERSITÀ VANVITELLI & UNIVERSITÀ TELEMATICA PEGASO

INTRODUCTION: This study delves into the intricacies of evolutionary motor teaching, based on the Sincrony methodology, and explores how different instructional approaches focused on the causes or effects of movement can influence athletic jumping performances in adolescents. The objective was to assess whether specific linguistic instructions, selected based on the biomechanical study of the gesture, could optimise athletic execution during crucial phases of growth and learning

METHODS: We employed an experimental setting, using ChronoJump Boscosystem and dual experimenters to measure jumping performances in 49 female adolescents aged between 13 and 14 years. Athletes were selected based on BMI (average=14-16), heart rate per minute (average=70-80), and respiratory rate per minute (average=25-30) to reduce sample variability. All athletes performed the same number of training hours weekly and had been practising jumping sports for an equal number of years. They were all tested on three different types of jumps: Squat Jump (SJ); Abalakov or counter-

movement jump with free arms (ABK) and Drop Jump (DJ). Each type of jump consisted of 9 attempts per session, based on three different experimental instructions, 3 jumps per type in the same session. A familiarisation session was conducted before the experimental trial to acclimatise to the tests, setting, and instructional methods requested by the experimenters. The session instructions for each jump were: cause-based instruction ("push down"); effect-based instruction ("jump high"); and generic descriptions of the Tests execution modality. Performance results were calculated based on the average height of the jumps (h), the power exerted by the lower limbs, the acceleration at the start, and strength.

The jumping sessions and their instructions were randomised among the subjects. All subjects completed all three sessions in the same day, allowing only the necessary time for muscular recovery between them.

RESULTS: ANOVA analyses conducted over the years have revealed statistically significant differences in various jumping performance variables. For jump height (h), the results with a p-value <0.00001 indicate significant differences between types of jumps. Similarly, power showed an F-value of 9.085399 and a p-value less than 0.00001, indicating improvements for jumps performed on cause command. In contrast, strength (F-value of 0.84973, p = 0.467604) and speed (F-value of 0.849091, p = 0.467944) did not show significant differences. The results of the Tukey HSD post-hoc test further outlined these differences, finding substantial improvements in power and height compared to the other two typologies

CONCLUSION: These findings suggest that while strength and speed do not show significant variations among different types of jumps, jump height and power are strongly influenced by the type of command requested. Commands focusing on the mechanical cause of the action have proven more effective than others. The study thus highlights the importance of teaching strategies, suggesting that teaching based on the causes of movement is likely more effective in optimizing jumping performances compared to teaching based on effects, given equal technique. Further research is underway to explore how cause-based training affects long-term motor learning.

COMPARISON OF RESULTS OF SCALING ANALYSIS OF HAND GRIP FORCE, QUADRICEPS FORCE AND EMG RECORDS OF A PERSON WITH KNEE INJURY

RADIC, I., BLESIC, S.1, MILOVANOVIC, S.1, STEFANOVIC, Z.2, MIRKOV, D.2, KNEŽEVIC, O.2

UNIVERSITY OF BELGRADE, INSTITUTE FOR MEDICAL RESEARCH; UNIVERSITY OF BELGRADE, FACULTY OF SPORT AND PHYSICAL EDUCATION

INTRODUCTION: The maximum voluntary contraction of the forearm muscles and the muscles of quadriceps was tested, as well as endurance in strength at F50% of the maximum intensity of both (injured and non-injured) leg, before anterior cruciate ligament (ACL) surgery, after the surgery, and in the periods after one month, three and six months upon the surgery. We compared recorded signals of force and EMG for all the parameters and both limbs, and compared them with the average values of non-injured subjects. EMG signals along with the hand grip strength test were applied to three forearm muscles: Flexor Carpi Radialis (FCR), Flexor Digitorum Superficialis (FDS) and Extensor Digitorum Communis (EDC) and three muscles of quadriceps: Vastus Lateralis (VL), Vastus Medialis (VM) i Rectus Femoris (RF).

METHODS: We used wavelet transform spectral analysis (WTS) to quantify force of hand grip and quadriceps muscles and EMG data from same muscles, to characterize force and EMG with WTS peaks as relevant parameters, and to show how those parameters change with knee injury to one leg. WTS is a method comparable to Fourier spectrum analysis (PwS) that has better signal localization in both time and scale (frequency). It is a two-dimensional time series decomposition in both time and frequency, with functions constructed by expanding by time scale and translating along real time of a specifically chosen original wavelet function.

RESULTS: Differences in force when comparing injured and average values of non-injured participants were not found by using WTS analysis (HG, MVC, 50% from MVC), even if WTS gave us good discrimination in force in quite standing. EMG was the method that gave us more information about muscle activity. It clearly showed which muscle is actived and in what percentage, as well as that the activity of the injured leg is the highest before the operation, while the activity decreases afterwards. The activity is stronger in the right arm and leg (non-injured side and limb) as well as in the average values of non-injured group.

CONCLUSION: Our results showed that, in addition to being able to see where the injury is by way of use of WTS, it is potentially possible to determine which type of muscle is more or less involved in relation to the part of the body that is injured. In that regard, further researches on this topic can be focused on the use of WTS as as simpler and less invasive methods to detect or understand injury, and its combination with EMG as a more conventional analysis method.

INTERDEPENDENCE OF HIP, LUMBAR SPINE AND THORACIC SPINE IN BASEBALL PLAYERS WITH A HISTORY OF LOW BACK PAIN

KUO, Y.L., CHENG, H.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Athletes with a chief complaint of low back pain (LBP) are frequently observed with mobility restrictions in the thoracic spine and hip joint. These restrictions may contribute to compensatory hypermobility in the lumbar spine and subsequently leads to recurrent LBP. The objectives of this study were to: (1) investigate if there is a significant mobility difference in the thoracic spine and hip joint between baseball players with and without a history of LBP; (2) identify thoracic spine and hip mobility related predictors for batting velocity in baseball players.

METHODS: Ten male adult baseball fielders with a history of LBP (age: 20.3±2.2 years; weight: 76.9±12.4 kg; height: 175.4±7.6 cm; baseball experience: 9.6±4.1 years) and 10-aged matched controls (age: 19.5±1.6 years; weight: 75.9±12.0 kg; height: 177.0±4.4 cm; baseball experience: 7.1±2.6 years) participated in this study. Joint mobility and muscle stiffness for the thoracic spine and hip joints were measured using a hand-held inclinometer and a MyotonPRO device, respectively. Batting velocity was measured using a 13-camera Vicon motion analysis system. Independent t-tests and multiple linear regressions were used to analyze the data between the LBP and control groups.

RESULTS: The LBP group had a statistically significantly smaller internal rotation range in the lead hip (31.70±5.17 vs. 37.45±5.42, t = -2.427, p = 0.026) and significantly decreased iliotibial band flexibility in the pivot hip (7.80±3.57 vs. 12.80±3.21, t = -3.295, p = 0.004) compared to the control group. No significant between-group differences were found in thoracic spine mobility and muscle stiffness measurements ($p > 0.05$). Hip joint mobility statistically significantly predicted the linear batting velocity ($F(12, 7) = 4.335$, $p = 0.030$, $R^2 = 0.881$). Among all measurements for hip joint mobility, the internal rotation range (ß= -1.303, p = 0.034) and measurement of the FABER test (ß= -1.235, p = 0.023) in the pivot hip added statistically significantly to the prediction. Thoracic mobility, on the other hand, did not predict the linear batting velocity ($F(6, 13) = 1.638$, $p = 0.214$, $R^2 = 0.431$).

CONCLUSION: Baseball players with a history of LBP showed mobility restriction in the hip joint but not in the thoracic spine compared to healthy controls. More emphasis should be placed on hip internal rotation mobility when treating or training baseball players to enhance batting performance.

RELATIONSHIP BETWEEN STROKE PARAMETERS DURING THE CURVE PHASE AND PERFORMANCE IN 500-M SPEED SKATING RACE OF ELEMENTARY SCHOOL CHILDREN

YUDA, J., YOKOZAWA, T.2, KIMURA, Y.2, KUMAGAWA, D.3

JAPAN WOMENS COLLEGE OF PHYSICAL EDUCATION; 2 JAPAN INSTITUTE OF SPORT SCIENCES; 3 KOKUSHIKAN UNIVERSITY

INTRODUCTION: The skater must exert push-off power to the right direction with tilting to the inside of the ice rink to counteract the centrifugal force during the curve phase. Therefore, obtaining a high skating velocity during this phase poses a significant challenge for novice speed skaters during their developmental period. This study identified the characteristics of stroke parameters that influence performance during the curve phase in a 500-m speed skating race among elementary school children.

METHODS: A total of 93 elementary school children (56 boys and 37 girls) participated in a 500-m speed skating time trial using a single track (inner lane). They were recorded using three synchronized high-speed video cameras (300 fps) positioned at the middle of the second curve (~350 m from the start line). The recorded images were analyzed using a panning direct linear transformation technique. The three-dimensional coordinates of the segment endpoints and blades were determined to calculate the stroke parameters during the skating cycle. One skating cycle was subdivided into right and left strokes based on the instant when the blade left the ice. The average horizontal velocity of the skater's center of mass during one cycle (CM velocity) was obtained by differentiating the displacement. The cycle and, left and right stroke frequencies were calculated as the reciprocal of the time for one cycle and each stroke, respectively.

RESULTS: The height, weight, age, and 500-m race time for boys (mean ± SD) were 1.44 ± 0.10 m, 39.2 ± 9.0 kg, 10.8 ± 1.0 y, and 52.10 ± 4.21 s, respectively. Girls had corresponding values of 1.44 ± 0.09 m, 39.9 ± 9.2 kg, 10.7 ± 1.0 y, and 53.29 ± 5.19 s. Significant negative relationships were found between 500-m race time and anthropometric parameters (height and weight) for boys ($r = -0.696$ and $r = -0.503$, $p<0.001$, respectively). In contrast, no significant relationship as well as boys observed in girls. Regarding performance during the curve phase, the importance of higher skating velocity during this phase was highlighted by strong significant negative relationships between 500-m race time and CM velocity for boys and girls ($r = -0.985$, $r = -0.986$, $p<0.001$, respectively). In boys, concerning the relationship between CM velocity (10.40 ± 0.95 m/s) and temporal parameters (cycle frequency: 1.05 ± 0.08 cycle/s, left stroke frequency: 2.36 ± 0.21 stroke/s, right stroke frequency: 1.92 ± 0.17 stroke/s), a positive relationship was observed only with the right stroke frequency ($r = 0.375$, $p<0.01$).

CONCLUSION: These results indicate that the performance of boys in the 500-m race improved with growth. In boys, achieving higher velocity in skating requires skaters to enhance their external power output, defined as the product of work per stroke and stroke frequency. The performance development in boys was primarily attributed to an increase in work per stroke during the left stroke with growth.

EFFECTS OF RUNNING SHOE WITH DIFFERENT CARBON-FIBER PLATE DESIGNS ON INTERNAL FOOT MECHANICS DURING FOREFOOT IMPACT: A PILOT COMPUTATIONAL ANALYSIS

SONG, Y., WANG, M., CEN, X., SUN, D., BÁLINT, K., GU, Y., ZHANG, M., WANG, Y.

THE HONG KONG POLYTECHNIC UNIVERSITY; NINGBO UNIVERSITY

INTRODUCTION: Long-distance running is known to cause foot pain and injuries due to repetitive loading. One potential solution to reduce foot injury risk is using carbon-fiber plates (CFP) in footwear, which may alleviate forefoot pain by offloading this area [1]. However, the effectiveness of CFP footwear may vary depending on its design features [2, 3]. Thus, the aims of this study were to 1) develop a 3D foot-shoe coupled FE model that can be used to reveal the internal foot mechanics; 2) compare the load changes on plantar tissue and metatarsal bones under different CFP modifications at the impact peak during forefoot running.

METHODS: A male recreational runner (age: 27 years, height: 175cm, mass: 70kg) was involved. Using his medical CT images, all major foot and shoe structures were reconstructed. The foot model included 20 bones, 5 plantar fasciae, 66 ligaments, and an encapsulated soft tissue. Cartilage function was resembled by a frictionless contact algorithm without reconstructing its geometry. A custom running shoe was reconstructed to represent the control condition, with various CFP configurations (three stiffness levels: stiff, stiffer, stiffest; two shapes: flat plate (FCFP) and curved plate (CCFP)) integrated into the shoe sole. Running biomechanics in sagittal plane, including foot-ground angle, MTP joint contact force, Achilles tendon force as well as vertical ground reaction force, were calculated for finite element analyses. A quasi-static contact approach was utilized to simulate the impact peak instant during forefoot running.

RESULTS: Comparing the shoes with no CFP (NCFP) to those with CFP, we consistently observed a reduction in peak forefoot plantar pressure with increasing CFP stiffness. This decrease in pressure was even more notable in a CCFP demonstrating a further reduction in peak pressure ranging from 5.51% to 12.62%, compared to FCFP models. Both FCFP and CCFP designs had a negligible impact on reducing the maximum stress experienced by the 2nd and 3rd metatarsals (less than 3%). However, they greatly influenced the stress distribution in other metatarsal bones. These CFP designs seem to optimize the load transfer pathway, enabling a more uniform force transmission by mainly reducing contact force on the medial columns (the first three rays, measuring 0.333 times body weight for FCFP and 0.335 for CCFP in stiffest condition, compared to 0.373 in NCFP).

CONCLUSION: It is concluded that a running shoe equipped with a CCFP may offer greater potential for overuse injury prevention. Such a design leads to reduced peak pressure under the forefoot without notably impacting the stress state of the metatarsal bones, as compared to the NCFP and FCFP conditions. Employing a CFP with appropriate stiffness, in general, appears to redirect the load transfer pathway toward a more evenly distributed force transmission, potentially mitigating the risk of overuse injuries during long-distance running.

1. Stefanyshyn et al. (2016) 2. Flores et al. (2019) 3. Song et al. (2023)

THE KINEMATIC CHARACTERISTICS OF BATTING MOTION TO THE DIFFERENT BALL VELOCITIES IN SOFTBALL PLAYERS

TANABE, G., HATASHIMA, K., AKIBA, S., TANAKA, S.
KOKUSHIKAN UNIVERSITY

INTRODUCTION: Baseball and softball hitters must respond to a various pitches and velocities thrown by the pitcher. It has been there are several reports to examine the focus on timing of the baseball batting motion (1, 2, 3). In softball, the distance from the pitchers plate to home base is 14.02 m, and the hitter must respond to the ball in a short time. To clarify the characteristics of batting motions with shorter time will be useful for coaching and skill training. The purpose of this study was to examine that the kinematic characteristics of batting motion with the different ball velocity in softball players.

METHODS: The subjects were nine male university softball players (age: 20.3±1.2yrs, height: 172.2±6.5cm, weight:68.8±9.2kg). Batters hit fastballs (FB) and slowballs (SB) thrown randomly by the pitcher. Bat swing speed was measured with a swing speed measurement system (BLAST Mizuno). Batting motions were captured using 3D motion capture system (Xsens MVN, Movella co.) and two high-speed cameras (Degimo co.). The analysis phase was from the batters takeback (TBM) to impact (IMP), and the release (RLC), toe ground contact (TOP), and heel contact (HC) times were extracted. The analysis trials were hits in the center direction both FB and SB. The analysis parameters were rotation angle of upper torso, twist range of upper and lower torso, displacement on center of gravity and velocity on the center of gravity.

RESULTS: The pitched ball velocity by the pitchers were 26.8±2.8m/sec in FB and 19.9±0.6m/sec in SB. There was a significant difference of motion time during HC and IMP. Significant differences of relative time were also found in the TOP phase. No significant difference of bat swing speed was showed both FB and SB. The rotation angle of upper torso during TBM to IMP in FB was observed significantly greater than that of SB. On the other hand, significant difference was not observed twist range of upper and lower torso. Furthermore, displacement of the center of gravity showed greater values SB than FB. The velocity of the center of gravity in SB was higher than that of FB in HC.

CONCLUSION: In this study, the characteristics of the batting motion for different pitched ball velocities were observed at HC and IMP phase, with significant differences at TOP phase for normalized time. In addition, it was found that the motion was characterized by a greater displacement of the center of gravity in SB. This trend was similar to baseball batting (2). From these results, it was suggested that the softball batting motion may be correspond to different ball velocity during TOP to HC phase, depending on the rotation of the upper torso and displacement of the center of gravity.

REFERENCES:

1) Ae, Human Movement Science, 2018

2) Katsumata, Human Movement Science, 2007

3) Nasu, NTT Technical Review, 2018

HIGH-DENSITY ELECTROMYOGRAPHY EXCITATION IN FRONT VS. BACK LAT PULL-DOWN PRIME MOVERS

PADOVAN, R., TONINELLI, N., LONGO, S., TORNATORE, G., ESPOSITO, F., CÈ, E., CORATELLA, G.
UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: The current study compared the spatial excitation of the primary muscles during lat pull down with the bar passing in front (front-LPD) or behind the neck (back-LPD) using high-density electromyography.

METHODS: Fourteen resistance trained men performed front-LPD or back-LPD with in a non-fatiguing set with 8-RM as external load. The muscle excitation centroid of latissimus dorsi, middle trapezius, pectoralis major, biceps brachii, triceps brachii and posterior deltoid were recorded during the ascending and descending phase.

RESULTS: During the descending phase, front-LPD showed superior excitation of latissimus dorsi (ES = 0.97) and pectoralis major (ES = 1.17), while in the ascending phase, back-LPD exhibited superior excitation of latissimus dorsi (ES = 0.63), and front-LPD showed superior excitation of biceps brachii (ES = 0.41) and posterior deltoid (ES = 1.77). During the descending phase, front-LPD showed a more lateral centroid of latissimus dorsi (ES = 0.60), biceps brachii (ES = 0.63) and triceps brachii (ES = 0.98), while the centroid was more medial for middle trapezius (ES = 0.58). The centroid of middle trapezius was also more medial in front-LPD during the ascending phase (ES = 0.85). The pectoralis major centroid was more cranial in front-LPD for both the descending (ES = 1.58) and the ascending phase (ES = 0.88).

CONCLUSION: Front-LPD appears to provide an overall greater amount excitation in the prime movers. However, distinct spatial excitation patterns were observed, making exercise suitable for the training routine.

ACUTE EFFECTS OF TRAINING ON AGILITY LADDERS ON KINEMATICAL CHARACTERISTICS IN YOUNG SPRINTERS

PARADISIS, G., KOUTSODONTI, M., GKIKA, N., ZACHAROGIANNIS, E.

NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Agility ladder training is widely used as both a warm-up and training tool to improve running speed and its characteristics in many sports. Exercising in agility ladders requires athletes to move their feet as quickly as possible in a precise and specified motion. Although there are some data indicating the beneficial effect of training on this specific mode (1), there are no data regarding the post activation effect (PAP) of the exercises on agility ladders in the subsequent sprinting performance. So, the aim of this study was to investigate the PAP of agility ladder exercises on the 30 m maximum speed effort.

METHODS: Eleven young sprinters (17 ± 3.50 y, 64.85 ± 8.31 kg, and 1.72 ± 0.08 m). performed an experimental and a control condition with a difference of one week. The experimental condition included three sets of four agility ladder exercises (ladder one step, ladder sidestep, side straddle hop and 2 in 2 out), while the control condition included active recovery (walking) of the same duration as the exercises in the experimental condition. Five minutes before and 5 minutes after each condition, participants performed a maximal effort sprint of 30 m. A standardized warmup routine was performed before the 30 m pre sprint. All sprinting bouts were video recorded (300 fps) and after kinematic analysis time of 30 m sprint as well as the split times (every 5 m) and average speed per 5 m were calculated for each participant. A two-way (condition x time) repeated measures ANOVA ($\alpha < 0.05$) was used to identify any potential differences.

RESULTS: The results showed that in the experimental condition there was no statistically significant difference in 30 m performance (4.58 ± 0.30 s vs 4.58 ± 0.30 s) as well as in all split times and average speeds per 5 m before and after the intervention. In contrast, in the control condition, statistically significant increases in time were observed at 20 m (3.53 ± 0.26 s vs 3.62 ± 0.29 s, Δ post-pre %: 2.3%), 25 m (4.14 ± 0.29 s vs 4.23 ± 0.32 s, Δ post-pre %: 2.1%) and 30 m (4.74 ± 0.33 s vs 4.84 ± 0.34 s, Δ post-pre%: 2.1%) and a statistically significant decrease in speed at 15-20 m, 20-25 m and 25-30 m (Δ post-pre%: -1.5%, -0.9% and -2.2% respectively).

CONCLUSION: The agility ladder intervention in the experimental condition maintained performance at the same levels between pre-post. In contrast, 30 m performance showed a statistically significant decrease between pre-post in the control condition suggesting that the intervention protocol in the experimental condition was beneficial and that the agility ladder exercises helped the participants to maintain the same performance before and after the intervention. It can be concluded that agility ladder exercises could be incorporated as a PAP exercise during the warmup when the subsequent performance included sprinting performance.

REFERENCES:

1) Pratama et al., IOSR-JSPE, 2018.

BEHAVIOR DYNAMICS OF ANTAGONISTIC MONOARTICULAR MUSCLE PAIRS IN THE LOWER LEG ARE RELATED TO GROUND REACTION FORCE DURING 50 M MAXIMAL SPRINT RUNNING IN COLLEGE SPRINTERS

YOKOTA, K., NITA, Y., OGA, R., URA, A., MIYAZAKI, T., TAMAKI, H.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: The relationship between surface electromyographic (sEMG) activity and ground reaction force (GRF) factors has been shown to have significant implications for factors such as sprint running velocity and acceleration, as indicated in a previous study1. However, that study focused mainly on hip flexor/extensor muscles, with the ankle plantar/dorsiflexion muscles largely unexplored. Additionally, according to a recent study, sprint acceleration performance is strongly correlated with mean net anteroposterior force (mAP) normalized by body mass2. We therefore investigated the relationships between sEMG activity in the ankle plantar/dorsiflexion muscles and mAP during sprint running for each step in Japanese college sprinters.

METHODS: Twelve male college track and field athletes performed maximal sprint running over 50 m. During this test, we recorded the sEMG signals from their tibialis anterior (TA) and soleus (Sol) muscles and GRF data using a 50 m force plate system (it recorded 26 steps, including the block-clearing phase as one step). The sprint-running phases were divided into three phases (stance, early swing, and late swing) based on GRF data. The sEMG signals were processed for normaliza-

tion (expressed as a percentage of the maximum voluntary contraction) and integration (using the "trapz" function in MATLAB 2023 for each phase).

RESULTS: There was a significant correlation between sEMG activity in the TA and mAP during each phase. Specifically, they were negatively correlated in the stance and early swing phases in many steps, but positively correlated in the late swing phase. However, there was little correlation between sEMG activity in the Sol and mAP during each phase of most steps.

CONCLUSION: Our data suggest that sEMG activity in the TA during the late swing phase contributes to obtaining a higher mAP in 50 m sprint running. We therefore propose that sEMG activity in the TA before ground contact may predict the sprint-running acceleration of sprinters.

REFERENCES:

1 Morin et al., (2015), Frontiers in Physiology, 6:404

2 Nagahara et al., (2018), Sports Biomechanics, 20(3), 363–369

COMPARISON OF A CHRONIC STATIC AND DYNAMIC HAMSTRING STRETCHING PROTOCOL ON RANGE OF MOTION AND RUNNING BIOMECHANICS

PAMBORIS, G.M., WILLIAMS, D.S.B., WELCH, L., POWELL, D.W.

EUROPEAN UNIVERSITY CYPRUS

INTRODUCTION: Recreational running, popular worldwide for its health benefits and accessibility, often leads to overuse injuries, affecting a significant percentage of runners annually (1). Running intensity and volume strain the musculoskeletal system, often leading to injuries (2). Hamstring flexibility is crucial in preventing injuries, yet optimal stretching techniques, such as static stretching (SS) and dynamic stretching (DS), on hamstring flexibility and lower extremity running biomechanics warrant further investigation. This study aimed to quantify the effects of SS and DS on hamstring flexibility and lower extremity running biomechanics in healthy athletes.

METHODS: Eighteen healthy recreational runners with inflexible hamstrings (popliteal angle >25° away from zero) were randomly assigned to SS, DS, or control (CON) groups. Hamstring flexibility was measured using a standard goniometer, and running biomechanics were assessed using a motion analysis system and two force platforms before and after the six-week stretching program. Two-way repeated measures ANOVA and independent samples t-tests were performed.

RESULTS: The six-week intervention significantly improved hamstring flexibility; with post-intervention assessment, the CONT had significantly greater popliteal angles than the SS (p=0.018) or DS groups (p=0.046). No differences in popliteal angles were observed between the SS and DS groups (p=0.192). While ankle and knee joint angles showed no significant changes, in the post-stretching intervention, the DS group exhibited significantly greater hip flexion at initial contact compared to CON (p=0.029), while the SS had similar hip joint angles at initial contact when compared to CON (p=0.088) and DS groups (p=0.241). No significant changes in ankle joint range of motion (RoM) during running were observed. No significant differences were found at the knee from pre- to post for all groups. However, the SS group had significantly greater RoM at the knee compared to the CON (p=0.013) and DS groups (p = 0.046). No differences in knee RoM were observed between the CON and DS groups (p=0.492). At the hip post-intervention, the CON group exhibited a significantly greater RoM than the DS group (p=0.029), while no differences in hip joint RoM were observed between the CON (p=0.118) and SS or SS and DS groups (p=0.423).

CONCLUSION: SS and DS increased static RoM and altered lower extremity positions at initial contact during the stance phase of running. However, no significant differences were observed between the two techniques. Yet, moderate effect sizes indicate DS induces more pronounced changes. These findings support that stretching interventions can alter lower extremity running biomechanics. However, it is not clear whether these changes would be considered beneficial.

REFERENCES:

1) Fredericson & Misra, Sports Medicine, 2007

2) Taunton et al., British Journal of Sports Medicine, 2003

BIOMECHANICAL RESEARCH IN FIGURE SKATING: A LITERATURE REVIEW

KOGA, A., LIU, J.

TSINGHUA UNIVERSITY

INTRODUCTION: Biomechanical analysis is one of the most used procedures for sport performance optimization, injury reduction and equipment development. Figure skating is one of the most popular sports in winter Olympic sport categories. Despite its competitiveness and high risks of injuries, to the author's knowledge, no review study of biomechanical research in figure skating has been conducted yet. Therefore, the purpose of this study is to provide an overview of existing biomechanical research in figure skating.

METHODS: Articles were searched in reliable databases such as PubMed, Web of Science (WOS) Core Collection. The search were completed in May 2023 by using year range of 2000~ 2023 and searching keywords including figure skat* and biomechanic*. Only English, full-text and original research articles were selected. Total of 13 articles out of 42 were topic related papers were included in this study. Then, two more articles were added from additional search using keywords, plantar pressure and muscular activation.

RESULTS: Result of annual trends analysis shows no rapid growing trend of publications from 2000 until 2023, however; a very visible increase in 2015 is observed. Out of 15 articles, kinematic analysis of figure skating jumps accounts for the majority of biomechanical research done by researchers. The increase in rotational velocity in air, vertical velocity at take – off, subsequent time in air, greater knee-hip angle of the supporting leg and decrease the angle of jump take-off are commonly observed in higher level jumps (1). Kinetic analysis in figure skating are mostly focused on the effect of different skating equipment including insoles, skates, blades on skater's body and performance. Only one article utilized pressure insole to examine the landing impact on lower extremity caused by jumps, which is published in 1997 (2). Moreover, in recent 20 years, only one research assessed muscular activation patterns during different jumps. Higher plantar pressures and stronger lower extremity muscle activations were observed in jumps with more rotations (3).

CONCLUSION: The findings of this study suggest that recent biomechanical research on figure skating have mostly focused on kinematic analysis of figure skating jumps, and very limited number of studies evaluate electromyography (EMG) activation pattern of muscles during jumping movements to explore the force generation and impact on the lower limbs. Also in the future, more studies on plantar pressure pattern during elements take-off and landing can potentially provide deeper understanding in both jump and spin take-off techniques include correct power execution methods, foot weight distribution for better balancing to not only optimize athletes' performances but also to reduce potential lower extremity injuries. better balance.

REFERENCES:

1) Deborah K et al., Sport Biomech, 2004

2) Lockwood K et al., Clin Biomech, 1997

3) Taylor C.L et al., JESP, 2009

RELATIONSHIP BETWEEN ISOMETRIC KNEE EXTENSION-FLEXION MUSCLE STRENGTH AND MECHANICAL ACTIVITY OF AGONIST AND ANTAGONIST MUSCLES

TANAKA, S.1, ARAI, C.1, HATASHIMA, K.1, HIRATSUKA, K.2, KUMAGAWA, D.1

1 KOKUSHIKAN UNIVERSITY, TOKYO, JAPAN; 2 HACHINOHE GAKUIN UNIVERSITY, AOMORI, JAPAN

INTRODUCTION: The Muscle Contraction Sensor (MC sensor) method has been used to evaluate the mechanical activity during muscle contraction. It has been reported that muscle tension in the biceps brachii muscle measured by the MC sensor was related to the elbow flexion muscle strength under the isometric contraction (2, 3). In addition, interaction activity of thigh extensor muscles during knee extension has also been evaluated with the MC sensor (4). However, mechanical activity of agonist and antagonist muscles during knee extension-flexion is not clear. Therefore, the purpose of this study was to investigate the relationship between isometric knee extension-flexion muscle strength and mechanical activity of agonist and antagonist muscles by MC sensor method.

METHODS: Eleven males (age: 23.8±1.7yrs, height: 174.1±5.6cm, weight: 67.5±5.9kg) without disabilities to knee joint were participated in this study. The isometric knee extension torque at knee joint angle of 90 degrees and flexion torque at knee joint angle of 30 degrees were measured using a dynamometer (Biodex co.). At the same time, the muscle tension as an index of mechanical activity at rectus femoris (RF), vastus lateralis (VL), vastus medialis oblique (VMO), and biceps femoris long head (BF) were measured by Muscle Contraction Sensor (TMG-BMC) method. These measurement parameters were calculated the relative mean value based on each 5% per maximal knee extension-flexion torque in all subjects.

RESULTS: The mechanical activity of RF, VL and VMO as the agonist muscles increased with increasing knee extensor muscle strength. Significant correlations were observed between the mechanical activity of the knee extensor muscles and extension muscle strength, respectively. In addition, a significant correlation was also observed BF for the antagonist muscle with knee extension muscle strength. Significant correlations were also obtained between mechanical activity of thigh muscles and flexion muscle strength. The correlation coefficients were 0.993 for the BF as the agonist muscle, and 0.988 for the RF, 0.994 for the VMO, and 0.965 for the VL as the antagonist muscles.

CONCLUSION: The level of muscle strength is affected by the co-activity of the agonist and antagonist muscles (1). Therefore, it is important to maintain a balance between the activity of the agonist and antagonist muscles. In this study, it was cleared that the mechanical activity measured by the MC sensor could be an indicator to estimate the level of muscle strength not only in the agonist muscles but also in the antagonist muscles. From these results it was suggested that mechanical activity using the MC sensor method is useful for estimating muscle strength and evaluate the balance between the agonist and antagonist muscles.

REFERENCES:

1) Baratta et al., A. J. Sports Med, 1988

2) Srdjan et al., Sensor, 2011

3) Srdjan et al., Sensor, 2014

4) Tanaka et al., 28th ECSS, 2023

NEUROMUSCULAR RECRUITMENT STRATEGIES OF THE LOWER LIMB AMONG YOUTH ATHLETES DIFFERENT AGE CATEGORY DURING MAXIMAL SPRINT RUNNING.

KAKEHATA, G., ÖRS, T., SAHROM, S., LIM, J., WYLDE, M., ISO, S., LOW, C.Y.
THE UNIVERSITY OF TOKYO

INTRODUCTION: The adolescent period represents are phase of development in not only structure (e.g., muscle size, body height) but also neural factors (e.g., muscle activation). It is known that during sprinting the thigh muscle plays an important role in the swing phase, rapidly moving the leg forwards and backwards. Previous research has reported that step frequency is associated with earlier timing of rectus femoris (RF) muscle activation among high-level adult sprinters. However, such neuromuscular characteristics of the lower limbs during sprinting in youth athletes is an area that has been under researched. Therefore, the purpose of this study is to investigate the difference in strategy in the neuromuscular activation patterns of the lower limb muscles among youth athletes during maximal sprinting.

METHODS: Eighteen youth male athletes were divided into two groups based on age; 17-19 years (U19: N=8) and 13-16 years (U16: N=10). Subjects ran 50 m with maximal effort. The spatiotemporal variables (e.g., running speed, step frequency, and step length) were measured over a distance from 30 m to 50 m using a high-speed camera (240 Hz) and timing gate systems. Electromyography (EMG) signals were obtained using wireless EMG sensors (2000 Hz) from ten lower limb muscles (RF, biceps femoris: BF, semitendinosus: ST, gluteus maximus: Gmax, gluteus medius: Gmed, vastus lateralis: VL, vastus medialis: VM, tibial anterior: TA, gastrocnemius: GAS, and soleus: SOL). The running cycle was divided into four phases from foot-strike and foot-off timings from both feet that consisted of contact, early-swing, mid-swing, and late-swing phases. Root mean squares (RMSs) were calculated every four phases. The RMSs were normalized maximal voluntary contraction value (% MVC)

RESULTS: The U19 group showed significantly greater spatiotemporal variables than the U16 group. Muscle activation patterns during one gait cycle were similar, but there was a significant interaction of RMS of hip flexor (RF) ($P = 0.003$, $F = 5.257$). Post-hoc tests showed that the U19 group produced greater activation of RF during early-swing phases than the U16 group ($P = 0.033$). However, RMS of other muscles was found to be similar between both groups of athletes.

CONCLUSION: The main finding in this study was that the U19 group showed greater hip flexor (RF) activation (RMS) than the U16 group. Rectus femoris muscle is a biarticular muscle and the major role of RF during sprinting is hip flexion rather than knee extension. Thus, greater performance in the U19 group may be explained by strong RF activation during the early swing phase. This recruitment of more RF would allow the youth athlete to swing the leg forward more rapidly and produce greater maximum velocity. Our results suggest that not only muscle growth, but also neuromuscular adaptations would be acquired during sprint-specific training among youth athletes and that the recruitment of RF is greater in older youth athletes.

AUTOMATIC IMAGE TRACKING AND RECOGNITION OF JUMP-LANDING MOVEMENTS: TAKING LANDING ERROR SCORING SYSTEM (LESS) AS AN EXAMPLE

HSUEH, Y.H., CHANG, H.Y., HUANG H.L., CHEN H.H., LIN, P.C.
NATIONAL YUNLIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: The Landing Error Scoring System (LESS) is a tool used in sports medicine and biomechanics to assess the quality of movement during landing tasks, particularly in activities such as jumping and cutting motions. LESS evaluates several key components of landing technique, including body position, foot placement, and joint movement, to assign a numerical score indicative of the quality of the landing. The system typically involves video recording a participant performing a series of standardized landing tasks, which are then reviewed and scored based on predefined criteria. However, this system assessed the video recording by using a manual method, instead of an automatic method. Researchers need to spend a lot of time dealing with those recorded videos to assess the jump-landing movements. The purpose of this study was to use an automatic image tracking and recognition method to assess jump-landing movement and track joint angle when participants performed Landing Error Scoring System Scoring.

METHODS: Twenty-six collegiate athletes (10 women and 16 men, age 20.4 ± 0.72 years, height 169.5 ± 7.9 cm, weight 65.4 ± 9.7 kg) performed 3 jump-landing trials that were recorded by 2 web cameras (Logitech C920 Full HD Pro webcam) in the front and lateral side of the participates. For the jump-landing assessment, participants jumped from a 30-cm-tall box to a designated area in front of the box. We instructed them to complete a maximal vertical jump immediately after landing in the designated area. The web cameras were controlled by a laptop computer with a self-written joint angle tracking software (written with Labview VISION module). The values obtained from 3 trials were averaged to obtain a participant's LESS score. After data collection, one researcher (H.Y.C.) evaluated the recorded video data and scored the LESS. The participants according to their LESS scores divided into the Good group (LESS score $\leqq 5$) and the Poor group (LESS score >5). The independent T-test was used to compare the joint angle differences in each item of the LESS assessment (17 items). Significance was set at $P < .05$.

RESULTS: The results indicated that significantly better LESS score for the Good group (3.92±0.9) than the Poor group (6.6±1.0) (p=.00); Among the joint angle, the mean hip angle in maximum knee flexion (p=.011), hip joint displacement (p=.02), mean maximum knee flexion angle (p=.025), knee joint displacement (p= .018), and the hip joint displacement greater than 45 degrees in the maximum knee flexion (p=.001) were reached a significant difference, and the rest of the items did not reach a significant difference. In total, the joint angles in the Good group were better than those of the Poor group.

CONCLUSION: The Good group had better joint angle and displacement than the Poor group. The automatic image tracking and recognition method to assess jump-landing movement and track joint angle when participants performed Landing Error Scoring System Scoring could spend less time dealing with data.

CHANGES IN THE CHARACTERISTICS OF LOWER FRONT LEG IN KICK START OF A SWIMMING RACE AT DIFFERENT BACK PLATE POSITIONINGS

UMEMOTO, M., YASUNORI, F., HIROKI, H., NATSUMI, F., TADASHI, W., KAZUO, F.

PHYSICAL EDUCATION

INTRODUCTION: Recent studies of the swimming kick start have examined the differences in backplate position and reported on the relationship between the back plate position and the horizontal velocity at the start and the subsequent transit time. However, there are no studies that have reported on the details of the movement on the platform, so there is no established index to indicate the optimal back plate position for on-site instruction. The purpose of this study was to clarify the effects in the lower front leg joint angle in different back plate positions.

METHODS: Six male swimmers who were senior swimmer (including national level swimmier) and university swimming clubs. Ten motion capture systems (PrimeX13 OptiTrack, Acuity Inc., Japan) were used to acquire kinematic data from the start signal to the entry into the water. Motion data was sampled at 180 Hz, and three-dimensional coordinate data were obtained from the subjects markers. Each swimmer participated using two back plate positions; each dive using a different back plate position and recordings of time were made from the start to 5-10m. The back plate position was varied in two levels: Front (the position closest to the tip of the starting platform) and Back (the position farthest from the tip of the starting platform).

RESULTS: Lower front leg ankle, knee and hip joint angles at the starting position (0 sec) were no different. There was no difference in maximum flexion angle at each joint angle on the platform. Regarding the beginning of extension, ankle and knee joint angles of the lower front leg were no different, and hip joint angle showed that Back had faster and significantly smaller than Front ($p<0.05$).

CONCLUSION: The results showed that the timing of extension for hip joint angle was faster and significantly smaller than Front at the Back plate position. As a result, the swimmer had enough time to raise the upper body, and the take-off angle was close to being horizontal. For further expectation, the effect in the lower rear leg joint angles and the relationship with the start performance in swimming race should be examined.

LINEAR ACCELERATION VERSUS CENTER OF PRESSURE EVALUATION OF POSTURAL STABILITY ON UNSTABLE SURFACES

ROUSANOGLOU, E., PADERI, F., EMMANOUIL, A., BOUDOLOS, K.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, GREECE

INTRODUCTION: In recent years, wearable sensors (based on miniaturized inertial measurement units) are increasingly used in postural stability studies [2], however, their application on unstable surfaces is still very limited [3].This study aimed to test the validity of postural stability estimation during single-legged standing on unstable surfaces using a with a triaxial accelerometer against the CoP path estimation.

METHODS: Twenty women (24±3.6 years of age) performed five trials of single-legged standing (40 s each) on the floor and on four unstable surfaces commonly used in postural stability training (pad, disc, air, bosu). The twofold evaluation of postural stability included the 3D recording of the linear acceleration using a triaxial accelerometer (Biopac BN-ACCL3, samling at 100Hz, placed at the side of the tibia) in synchronization with the CoP recording using a force plate (Kistler, 9286AA, sampling at 500Hz). The extracted postural stability variables (absolute values) were the JERK (m/s3, rate of acceleration change) (anteroposterior-AP, mediolateral-ML, vertical direction) as well as the CoP path (m) (AP and ML direction). The percentage difference of each unstable surface relative to the floor (100%) was also calculated (relative values). A linear curve fit analysis was applied to estimate the slope coefficient among the 5 surfaces (scaled: floor, pad, disc, air, bosu) which was used to compare the JERK and the CoP path surface scaling. Statistics included one way ANOVA (surface effect on JERK and CoP path absolute and relative values, respectively) ($p \leq 0.05$, SPSS v29.0).

RESULTS: The surface effect was significant for both the JERK and the CoP path, (AP and ML direction, $p < 0.001$) indicating an increasing scale from floor, pad, disc, air, bosu. All pairwise differences (absolute and relative values) were also significant ($p < 0.001$), except for floor versus pad and air versus bosu solely for the CoP path (AP and ML direction). The linear fit was significant for the floor, pad, disc, air and bosu scaling, with a signficant difference between the JERK and the CoP path slope (AP and ML directions, $p < 0.01$). The JERK slope in the vertical direction differed significantly with the CoP path slope in the AP direction ($p < 0.01$) but not in the ML one ($p = 0.204$).

CONCLUSION: The postural stability estimation using the JERK measure yielded from the linear acceleration obtained with a triaxial accelerometer appears to be valid against the gold standard of the CoP path estimation and yielded the same 3D scaling of the four unstable surfaces concerning the single-leg standing task. The results enhance the limited number of relevant studies [3] concerning the valid use of a portable device as the accelerometer during single-leg standing, which facilitates the in field evaluation of postural stability.

1) Lee et al., Int J Environ Res Public Health, 2020

2) Agostini et al., IEEE 23rd Int Symp Consum Tech, 2019

3) Mayer et al., Front Physiol, 2023

VALIDATION OF A MARKER-LESS CAMERA-BASED SYSTEMS AGAINST A MARKER-BASED 3D KINEMATIC SYSTEM DURING LOWER-LIMB EXERCISES

SLEVIN, M., VALENTIN, S., UGBOLUE, U., EASTON, C., WHITE, A.D., FORREST, L.J.
UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Marker-based motion capture systems are deemed the gold standard method to collect and analyse human movement within sport. With technology constantly evolving, marker-less systems are now readily available to evaluate movement out with a laboratory environment. However, the validity of these systems within the applied sporting environment requires attention. This study aimed to validate the use of Vald Performance's HumanTrak Movement Analysis System against the 'gold standard' Vicon Motion Capture System during single- and double-leg squatting exercises.

METHODS: Twenty healthy, recreationally active adults (10 males; 10 females; age, 24.05 ± 3.62 years) completed two exercises: (1) single-leg squat (SLS) and (2) overhead squat (OHS) whilst kinematic data was simultaneously obtained from the marker-less system HumanTrak Movement Analysis System, and a gold standard 3D motion analysis system (Vicon Motion Capture System). Specifically, knee flexion angles were obtained during SLS and OHS, and knee varus/valgus was obtained for SLS only. Bland-Altman plots with 95% CI were used to depict levels of agreement (LoA) for knee angles and spearman's correlation coefficients to report relationships between systems. Statistical significance was accepted at $p < 0.05$.

RESULTS: No systematic bias was reported for knee flexion during both the SLS (-2.64; LoA between -38.15 and 32.88) and OHS (-2.07; LoA between -35.98 and 31.84), however wide limits of agreement report variability between the systems. A trend was illustrated during SLS knee varus/valgus (bias = 3.14; LoA between -28 and 34.27), the two systems systematically produced different results and wide limits of agreement reported variability between the two systems. There was a significant positive correlation between HumanTrak and Vicon during knee flexion of both the SLS ($r = 0.683$, $p < 0.001$) and OHS ($r = 0.843$, $p < 0.001$) but no significant relationship between HumanTrak and Vicon were identified for knee varus/valgus during the SLS ($r = 0.104$, $p = 0.663$).

CONCLUSION: Knee flexion during both the single-leg and overhead squat exercises reported high accuracy between the two systems. Knee varus/valgus angles collected from HumanTrak were inaccurate as a result of very poor agreement when compared to Vicon during single-leg squat movements. HumanTrak Movement Analysis system is a valid marker-less system to assess knee flexion angles within an applied environment, however, should not be used to assess knee varus/valgus angles.

REACTIVE STRENGTH INDEX AND ITS RELATIONSHIP WITH STRENGTH AND POWER PERFORMANCE TESTS. CASE STUDY OF ELITE YOUTH ICELANDIC CYCLISTS.

PETROVIC, M., HAFSTEINSSON, T., GISLADOTTIR, T.
UNIVERSITY OF ICELAND

INTRODUCTION: The reactive strength index (RSI) is a ratio of input to output – the input is represented by time spent on the ground generating the force to perform a countermovement jump (CMJ), and the output is the height of the jump. The RSI holds particular relevance in cycling, serving as a crucial indicator of an athletes capacity for explosive power output during pedal strokes. There is very limited research in this area of cycling. Still, generally, it has been known that there is a significant correlation between RSI and strength performance tests, indicating that superior strength levels can enhance an athletes capacity for rapid force production during efforts. Integrating RSI assessments alongside traditional strength tests provides a comprehensive understanding of an athletes potential to excel in cycling disciplines requiring bursts of power. We hypothesised that there will be a strong association between RSI measurements and performance in cycling-specific strength tests, highlighting its importance in assessing a cyclists ability to generate rapid force during crucial moments of acceleration and climbing. This article aimed to establish the correlation between the RSI and certain metrics involving strength and power production off lower limb

METHODS: Seven male cyclists, members of the youth national team of Iceland (age: 18.9 ± 0.9 years; body weight: 77.7 ± 4.6 kg, body height: 182 ± 3.6 cm) participated in this study. The cyclists underwent a comprehensive series of biomechanical assessments encompassing various metrics: countermovement jump, drop jump (DJ), isometric mid-thigh pull (IMTP) measured on the force plates, as well as measurements of Nordic hamstring and hip abduction and adduction strength by using dynamometers. Knee extension and flexion were measured on an isokinetic dynamometer. Data were imported in Jamovi software and Pearson correlation was run to establish to relationship between the variables.

RESULTS: A significant positive correlation has been observed between the RSI and knee flexion and extension peak torque/BW at 60 degrees per second, CMJ Jump Height, CMJ Concentric Peak Force/BM, DJ Jump Height, DJ Peak Power/BM, DJ Concentric Peak Velocity, DJ RSI, IMTP Force at 200ms/BM, IMTP Peak Vertical Force/BM, Nordic hamstring Force/BW.

CONCLUSION: The significant positive correlation observed between the RSI and various measures of strength and power underscores the importance of RSI in enhancing cycling performance. These findings suggest for the first time that improving RSI may contribute to enhanced cycling-specific power production and overall athletic performance, emphasizing its relevance as a key metric for cyclists aiming to optimize their training strategies. Incorporating RSI-focused training methodologies could potentially lead to improved sprinting capabilities, climbing efficiency, and overall cycling performance.

EFFECT OF SEGMENTAL ADDITIONAL LOAD ON THE VELOCITY, STEP LENGTH, AND THIGH RELATIVE ANGLE DURING THE WALK TO RUN TRANSITION

BOUDOLOS, K., CHALKIADAKIS, E., EMMANOUIL, A., PADERI, F., ROUSANOGLOU, E.
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, GREECE.

INTRODUCTION: Gait transitions behave like bifurcations between attractors with the relative phase of the leg segments as an order parameter and step velocity and length as control parameters [1]. The vast majority of studies examine the walk-to-run (W-to-R) transition on the treadmil rather than on ground surface with few studies testing the external load attractor [2]. This study tested the load effect on the W-to-R transitional step (step0) and on the inter-thigh relative phase angle (IT-RPA) during ground surface gait.

METHODS: Twenty-three men (18-26 yrs) performed 5 W-to-R trials (preferred speed, 3.5m walking, 2.3m transition, and 4.5m running length corridor) in 3 load conditions (no load: NoL, Trunk load: TrL-vest of 5.1kg front, 5.1kg back, Extremities Load: ExtrL-2.5kg each wrist and ankle). Five inertial sensors (Xsens Master MTx, sampling at 50Hz) attached (velcro straps) at the dorsal trunk lumbar level, and at thighs and shanks (center of mass, lateral surface) were used to record the segmental angular displacement. Trials were videotaped (camera at 4.0m distance vertical to the middle of the transition length, at 0.71m height, sampling at 50Hz). The step0 velocity (m/s) and length (m), and IT-RPA (deg) of the 4 steps before (walking: Wsteps) and 3 steps after (running: Rsteps) step0 were inserted in statistics. One-way repeated measures ANOVA (pairwise comparisons) tested the load effect on step0 velocity and length, and the IT-RPA of Wsteps and Rsteps. Trend analysis was used on IT-RPA of the Wsteps and Rsteps (SPSS v28, $p \leq 0.05$).

RESULTS: In both load conditions, step0 velocity and length were decreased ($p \leq 0.05$) (velocity, NoL: 2.56±0.34 m/s, TrL: 2.46±0.36 m/s and ExtrL: 2.49±0.39 m/s, length, NoL: 1.16±0.15m, TrL: 1.10±0.16m and ExtrL: 1,13±0.14m) with no significant load effect on IT-RPA at any of the examined steps ($p > 0.05$). Across all load conditions, Wsteps yielded a 3rd order polynomial trend ($p \leq 0.05$) (descending limb, step-4: 49.0±0.5m, step-3: 46.9±1.0m, step-2: 45.8±0.9m, ascending limb step-2 to step-1: 52.5±1.2m), and Rsteps a linear decreasing trend ($p \leq 0.05$) (step+1: 42.8±0.8m, step+2: 38.9±1.4m, step+3: 31.5± 0.8m). Step0 (48.4±0.9 m) was smaller and greater, respectively, than the last Wstep and the first Rstep ($p \leq 0.05$).

CONCLUSION: The decrease of step0 velocity and length during the W-to-R transition, irrespective of the load condition, indicates their significant role as control parameters of the load attractor. The significant decrease of step0 velocity agrees with Diedrich et al. [2], however, the step0 length was not altered in their study. The increase and decrease, respectively, of IT-RPA in the NoL Wsteps and Rsteps, agrees with the dynamic theory [1] indicating the IT-RPA as potential order parameter for the overall W-to-R behavior which may be possibly modulated by the individual hip range of motion [3].

1) Diedrich & Warren, J Exp Psychol Hum Percept Perform, 1995

2) Diedrich et al., J Mot Behav, 1998

3) Wade et al., J Biomech, 2022

MUSCLE TONE, STIFFNESS, AND ELASTICITY IN ELITE FEMALE CYCLISTS AFTER CONSECUTIVE SHORT COMPETITIONS

ROTLLAN, C., CORBI, F., VISCOR, G.
UNIVERSITAT DE BARCELONA

INTRODUCTION: In professional road cyclists, most overload injuries affect the lower limbs and are mostly represented by contractures or muscle shortening, characterised by a variation of muscular tone, stiffness, and elasticity. This real-life study aimed to assess specific mechanical parameters in top-class female cyclists who participated in 3 races a week.

METHODS: Six professional cyclists were evaluated. This pilot study consisted of a controlled trial and three days of competition, with rest days between them. MyotonPRO was used to measure tone, stiffness, and elasticity in six leg muscles: vastus lateralis (VL), vastus medialis (VM), rectus femoris (RF), biceps femoris (BF), lateral gastrocnemius (LG) and medial gastrocnemius (MG). Daily basal and pre- and post-race measures were carried through to the 3 races in a week.

RESULTS: The muscular tone of VL, VM, LG, and MG and the stiffness of VL, VM, RF, BF, LG, and MG decreased after races. VL and RF were mostly affected ($p = 0.05$) and ($p = 0.009$), respectively. Basal elasticity improved over time until the last day.

CONCLUSION: Muscle tone and stiffness decreased after a very intense and exhausting cycling endurance competition. Basal elasticity improved immediately after the race and continued this trend until the end of the week. Two aspects could affect muscle properties during competition; stress factor before and during competition and post-competition neuromuscular fatigue.

EVALUATING FABRIC-BASED IMU AND BLUE TRIDENT SYSTEM AGAINST OPTICAL MOTION CAPTURE FOR LOWER BODY KINEMATICS IN BADMINTON SPECIFIC MOVEMENT

TAN, K., MCERLAIN-NAYLOR, S.A.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: In the biomechanical analysis of badminton, a sport necessitating high precision and agility (1), optical motion capture is the established standard despite its high cost and operational limitations in natural settings (2). Recent advancements in wearable technology, particularly fabric-based and Blue Trident IMU systems, have emerged as viable

alternatives, reputed for their ease of use and adaptability to various environments (3). This study critically evaluates these novel IMU technologies in comparison with traditional optical systems, focusing on their capability to accurately record lower body joint kinematics during dynamic badminton movements. The findings are intended to guide future research and enhance biomechanical applications in sports, potentially influencing training, performance analysis, and injury prevention.

METHODS: Ten university-level badminton players volunteered. Demographic and anthropometric data, including age, gender, height, weight, and limb measurements were recorded, to inform biomechanical analyses. Participants were equipped with fabric-based IMU leggings and the Blue Trident system to evaluate their efficacy in capturing lower body joints kinematics during specific badminton actions: front forehand lunges, front backhand lunges, and jumping smashes. Each action was performed in three sets of three repetitions, under shuttlecock feeds to mimic game conditions, ensuring the ecological validity of the data collected. Data were analyzed to compare the accuracy and consistency of the IMU systems against traditional motion capture benchmarks, focusing on key lower body kinematic variables. The study adheres to ethical guidelines, with procedures designed to minimize risk and ensure participant safety, concluding with a standard cooldown protocols.

RESULTS: The studys comparative analysis of the Blue Trident IMUs and fabric-based IMU against conventional optical motion capture systems demonstrated adequate concurrent validity during low-velocity badminton maneuvers. Nevertheless, the precision of IMU devices attenuated with the escalation of movement speed. Notably, during expedited lunges aimed at shuttlecock interception, both IMU modalities recorded deviations from the mocap data, indicating a potential limitation in their capacity to track rapid biomechanical events with high fidelity.

CONCLUSION: The study indicates that while IMU systems, including fabric-based and individuals IMU unit, show promise for biomechanical analysis in badminton, their accuracy diminishes with increased movement speed. This suggests potential for IMUs in practice settings but also highlights the need for enhanced sensitivity in high-velocity scenarios. Further research should focus on improving IMU precision for rapid sports movements to fully harness their practicality in real-world applications.

Ref:

1. Phomsoupha et al., Sports Medicine, 2015

2. Sers et al., Measurement, 2020

3. Lin et al., Smart Learning Environment, 2023

THE INFLUENCE OF CYCLING POSTURE AND PEDALING STRATEGY ON PEDAL, SADDLE, AND HANDLEBAR KINETICS

FUCHS, P.X., HUANG, H.C., LEE, Y.S., SHIANG, T.Y.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Cycling is widely incorporated into rehabilitation and therapy regimes due to small joint loads and force impacts. Posture and pedaling strategy (e.g., resistance, cadence) play an important role in force distribution as they affect cycling mechanics. Previous research debated about posture-dependent pressure in wrists and hips, potentially causing inflammation and muscle strains. Additionally, pedaling strategies have been linked to risks of knee injuries. Therefore, the purpose of this study was to investigate the effects of posture and pedaling strategy on kinetics at the pedals, saddle, and handlebar.

METHODS: Twenty healthy adults completed a cycling test on a training stand in three riding postures (standard, sports, comfort) and six pedaling strategies (three cadences: self-selected and self-selected±10 rotations/minute; two resistances: heavy and light) in randomized order. A corporate, strain gauge-based measurement system (50 Hz; Giant Manufacturing Co. Ltd., Taiwan) was integrated into the pedals, the saddle, and handlebar grips to collect vertical forces, force distribution among the five sensor locations, and vertical impulse during the downstroke phase. Fifteen consecutive stable pedaling cycles (i.e., cadence fluctuation<5 rotations/minute) during each condition were analyzed. Repeated measures two-way ANOVA examined differences between postures and pedaling strategies at a significance level of $p<0.05$.

RESULTS: Peak forces differed between postures at both handlebar grips [$F(2,18)=5.58–31.62$, $p<0.01$] but not at the saddle and pedals [$F(2,18)=0.29–1.86$, $p=0.19–0.66$]. No differences between postures were found in force distribution at any of the sensor locations [$F(2,18)=0.42–1.11$, $p=0.35–0.67$]. Impulse differed between postures at both handlebar grips and the left pedal [$F(2,18)=4.12–10.13$, $p<0.05$] but not at the saddle and right pedal [$F(2,18)=0.61–1.07$, $p=0.36–0.55$]. Pedaling strategy affected peak forces, impulse, and force distribution across all sensor locations and postures [$F(5,45)=2.73–399.09$, $p<0.05$], with the highest values occurring at high cadence and heavy resistance.

CONCLUSION: The observed effects of posture and pedaling strategy on kinetics should be interpreted in the context of individual needs. In a therapeutical context, patients with upper body (e.g., wrist) injuries may select the comfort posture to reduce peak forces and impulse at the handlebar, thereby avoiding overload-related risks in the upper extremities. In addition, light resistance contributed to reduced peak forces and impulse at all sensor locations, irrespective of posture. The findings can be consulted to optimize cycling protocols in various settings where peak forces, force distribution, and impulse play an important role.

Acknowledgment: This work is supported by "The Application of Cycling Science in Sports and Health" of the National Science and Technology Council in Taiwan, R.O.C. under the grant number "NSTC 112-2622-8-003-005-SP".

RELATIONSHIPS BETWEEN WHOLE-BODY KINEMATIC STRATEGIES, BIOMOTOR CAPACITIES, SHIN ROLL MECHANICS AND INITIAL ACCELERATION IN ELITE SPRINTERS

OEPPERT, T.J., KLEIN, J., BRAUNSTEIN, B., SCHAPSCHROEER, M.
GERMAN SPORTS UNIVERSITY COLOGNE

INTRODUCTION: Initial acceleration from starting blocks is considered a complex task. While ground reaction forces associated with improved acceleration performance are well established, kinematic aspects during stance and physical characteristics are less clear [1]. In addition, recent findings in rugby players suggest that different acceleration techniques result in similar sprint times [2]. Therefore, this study aimed to investigate the influence of biomotor capacities, technical abilities (particularly the shin roll [3]) and spatiotemporal parameters on initial acceleration and to investigate if different whole-body kinematics within a group of sprinters exist.

METHODS: 25 female (100 m PR: 11.99±0.37 s) and 19 male (100 m PR: 10.72±0.42 s) national to elite level sprinters performed 10 m sprints from starting blocks and completed countermovement (CMJ), triple broad (TBJ) and drop jumps (DJ). Pearsons correlation coefficients and stepwise regression determined relationships between variables and the V/T ratio (instantaneous velocity at 10 m divided by 10 m time). Participants were categorised into step length (SL) or step rate (SR) and contact time (CT) or flight time (FT) dominant based on normalised SL/SR and CT/FT ratio z-scores (resulting in four subgroups). One-way ANOVA with Tukey post-hoc test identified significant ($p < 0.05$) technical and capacity differences.

RESULTS: CMJ relative peak power (59.2±3.5 W/kg, $r = 0.85$, $p < 0.001$), TBJ distance (788±152 cm, $r = 0.76$, $p < 0.001$), and DJ RSI (2.05±0.4, $r = 0.72$, $p < 0.001$) showed very large correlations with V/T ratio. The mean sagittal plane shin angle during the heel lock' position relative to the supporting ground was negatively related to V/T ratio (56.5±3.5°, $r = -0.79$, $p < 0.001$). Forward stepwise regression analyses highlighted CMJ relative peak power, DJ RSI, and heel lock angle as predictive variables for V/T ratio (R2 adj. = 0.78). FT and SR dominant athletes showed a significantly reduced shin roll motion (change in shin angle from late flight to late stance) compared to the SL and CT ($\Delta = 6.1°$, $p = 0.03$) and SL and FT dominant athletes ($\Delta = 6°$, $p = 0.02$). However, no significant differences in V/T ratio and biomotor capacities were observed.

CONCLUSION: At a group level, mechanical power, reactive capabilities, and acute shin angles during stance are crucial for acceleration performance. However, no single optimal technique appears to exist, as evidenced by the lack of significant differences in the V/T ratio across distinct whole-body kinematics. Whilst recent research has advocated for the design of tailored training based on the identification of different kinematic strategies [4], the lack of differences in biomotor capacities between identified subgroups may suggest the need for further individualised analyses.

1) Haugen et al. (2011) J Appl Phy

2) Wild et al. (2022) J Sports Sci

3) Alt et al. (2022) J Sports Bio

4) Wild et al. (2023) J Sports Phy

BIOMECHANICAL ANALYSIS OF THE HANDSTAND: A SYSTEMATIC REVIEW

BAKER, J.S., MACDONALD, M., GU, Y., UGBOLUE, U.C.
NINGBO UNIVERSITY

INTRODUCTION: In gymnastics, the handstand is one of the most important fundamental skills. It provides a progression route for transferable skills on various apparatuses i.e. (rings, beam, uneven-bars and parallel bars) and various floor disciplines (1). The handstand can be characterized as the action of manoeuvring the body into a fixed body configuration in an inverted vertical position while balancing on the hands. However, this manoeuvre can be made extremely difficult as it involves the use of specific apparatuses, overall balance influences, and mechanical characteristics (2). Challenging conditions during the handstand become apparent when the distance between the base and the centre of gravity is increased as a result of support of extended arms which causes decreased stability (3). The aim of this systematic review was to investigate the performance of the handstand from a biomechanical perspective.

METHODS: Databases SPORTDiscus, ScienceDirect and PubMed were searched up to November 2020. The search terms used were EMG or Electromyography and Handstand AND Gymnastics, Kinetics AND Kinematics and Handstand AND Gymnastics Kinetics AND Handstand, Kinematics AND Handstand". Originally 489 publications were identified, and 19 studies were included in this systematic review.

RESULTS: From the data extracted from the articles, 31% of studies conducted an analysis of balance-control-strategies in the handstand, 57% conducted a kinetic and kinematic analysis of the handstand and 10% of publications compared muscle activity during the handstand. 42% analysed centre of pressure, 36% analysed joint angles, 21% reported on velocity related parameters, 21% reported on joint torque contributions, 15% reported on angular velocity, 10% analysed ground reaction forces (GRF), 10% reported on EMG and 5% reported on vertical ground reaction forces (vGRF).

CONCLUSION: Gymnasts employ a wrist strategy to maintain balance in handstands, resorting to a mixed control strategy involving wrists, shoulders, hips, and elbows if needed. Greater strength enhances balance control, while factors like participation level and age also impact handstand performance.

Coaching

HEART RATE ANALYSIS OF ELITE CHEERLEADERS DURING TRAINING AND SIMULATED COMPETITION

GAVANDA, S., RIDDELL, S., LUBIAK, S., TIRALLA, G., FOSTER, T., TAMULEVICIUS, N., QUITTMANN, O.J., LANGE, M., ZINNER, C.
IST UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Competitive cheerleading (cheersport) is growing in popularity every year and so is the level of performance. Although cheersport is a physically very demanding sport, there is little information about the physiological profile. Therefore, the purpose of this study was to examine heart rate (HR) throughout practice and simulated competition routines (full-outs).

METHODS: Members of the German All Girl and Coed cheerleading national team were recruited to participate in this study (males: n=6, 25.3±2.7 years of age; females: n=10, 27.1±3.7 years of age). In the first session, the YoYo intermittent recovery test level 1 was conducted to measure athletes' maximum heart rate (HRmax). In three other sessions, HR was measured throughout training including full-outs. Each of the participants HR zone was computed: Zones 1, 2, 3, 4 and 5 were set at 50-60%, 60-70%, 70-80%, 80-90%, and 90-100% of HRmax, respectively.

RESULTS: The training sessions analyzed had an average duration of 4:01 (h:mm). Most of the training time (51-68%) was spent in Zones 1 (28-32%) and 2 (23-36%), whereas less time was spent in in Zone 3 (14-19%) and Zone 4 (8-12%). Only 3 to 4% of the total training time was spent above 90 % HRmax (Zone 5). During the full-outs (2:15 min duration), the athletes spent most time in Zone 4 (41-50%) and 5 (26-30%). Only 14-20% of the full-out was spent in Zone 3. The least time was spent in zones 1 (0-1%) and 2 0-18%).

CONCLUSION: Our data shows that simulated competitions (full-outs) in Cheersport are performed at high to very high intensities. Athletes must therefore have high aerobic and anaerobic capacities in order to achieve peak performance. However, this must be verified in further studies including measurements such as blood lactate concentration, oxygen uptake, or measures of fatigue (i.e., countermovement jumps). The presented data also suggests that cheersport athletes benefit from having a good aerobic base. This can allow cheerleaders to recover rapidly between high-intensity drills and repetitions that are seen in training.

THE RELATIONSHIP BETWEEN BODY COMPOSITION AND SPRINT PERFORMANCE IN ELITE JUNIOR HANDBALL PLAYERS.

NOUTSOS, K., MELETAKOS, P.
NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: The high demands of handball mean that athletes must be in top physical condition, so body composition is a key factor in their athletic performance.

METHODS: Purpose: The purpose of the present study was to investigate the relationship between body composition and sprint performance of adolescent handball players. Methods: The sample consisted of 60 elite junior handball players all members of the Greek Junior National Teams. The measurements included body height (cm), body mass (kg), and five skin folds thicknesses (5SKFS) (mm) (biceps, triceps, subscapular, suprailiac and calf). Body mass index (Kg/m2), fat mass percentage (%), fat free mass (kg), fat mass (Kg), and sum of 5SKFS (mm) were also calculated. The precise anatomical sites of measurement by the respective somatometric instruments and the measurement procedures were all carried out according to Norton et al., 2000. Sprint time was recorded at 5, 10 and 30 m. The Pearson's correlation coefficients were calculated between all parameters. A stepwise multiple regression analysis with sprint performance as the dependent variables and body composition indices as potential predictors was carried out.

RESULTS: Results: The 5 m sprint time correlated positively with fat mass percentage (%), fat free mass (kg), fat mass (Kg), and sum of 5SKFS (mm) ($r = 0.296$, $p = 0.05$; $r = 0.275$, $p = 0.05$; $r = 0.345$, $p = 0.01$; $r = 0.325$, $p = 0.05$ respectively). The 10 m, 30 m Sprint times correlated positively with fat mass percentage (%), fat mass (Kg), and sum of 5SKFS (mm) ($r = 0.359$, $p = 0.01$; $r = 0.371$, $p = 0.01$; $r = 0.379$, $p = 0.01$ respectively), ($r = 0.374$, $p = 0.01$; $r = 0.358$, $p = 0.01$; $r = 0.390$, $p = 0.01$respectively). Prediction models for the performance of sprints performance showed that body composition could explain 10-18% of cases ($p < 0.001$).

CONCLUSION: Conclusion: The results of the study showed that the body composition of elite junior handball players may affect sprint results.

THE EFFECT OF MOUTHGUARD ON THE STABILITY OF BENCH PRESS MOVEMENTS

SUGAJIMA, Y., KANEKO, K., ISHIDA, N., OMORI, T., KATO, T., YAMAMOTO, H.
ASAHI UNIVERSITY

INTRODUCTION: Para-powerlifting, a highly competitive sport, challenges athletes to lift maximum bench press weights within strict time limits. Successful lifts demand not only strength but also precise and stable movements. Our prior study1) hinted at a potential connection between asymmetry in para-powerlifters bench press movements and variations in upper limb strength. This study aims to scrutinize whether the utilization of a mouthguard (MG) can effectively alleviate the observed left-right asymmetry in bench press movements.

METHODS: Ten male university rugby players, familiar with MG usage (height: 173.3±5.3 cm, weight: 90.1±10.9 kg, age: 21.4±0.5 years), willingly participated. Bench press repetitions at 25%, 50%, and 70% of individual one-repetition maxi-

mum (1RM) were performed, with each weight category involving five consecutive lift repetitions to assess stability. Trials were conducted under two conditions: with and without MG, using a custom-made 3 mm thick mouthguard. High-speed recordings of bench press movements (250 frames per second) were made using ten infrared cameras (Vicon). Reflective markers were strategically placed on the shafts ends, upper body locations, and both arms. Center of pressure (COP) during bench press was measured with a pressure plate (Kistler). Various measurements, including body composition, muscle thickness, shoulder and elbow joint angles, were taken and used to quantify COP displacement (COPy) at the bench press movements bottom and top positions. Repeated measures two-way ANOVA statistically evaluated the impact of MG on lift weight differences and left-right asymmetry.

RESULTS: No statistically significant differences were observed in muscle mass between dominant and non-dominant arms. Similarly, muscle thickness and joint ranges exhibited no substantial variations between sides. In bench press movements, no significant disparities were found in shaft, elbow, and shoulder heights between lift weights and MG presence or absence at both bottom and top positions. The non-dominant/dominant ratios of shaft height also demonstrated no significant variations across different lift weights and MG conditions. Elbow joint angles and COPy showed no significant differences.

CONCLUSION: This investigation found no significant left-right asymmetry in shaft height during bench press movements bottom and top positions, irrespective of lift weights and MG usage. However, noticeable differences in speed between left and right sides during continuous bench press repetitions contributed to variations in shaft height. Future research should focus on movements with substantial speed differences, exploring nuanced left-right speed or acceleration differences throughout the lifting process.

AN INVESTIGATION OF RESISTED SPRINT TRAINING PRACTICES OF COACHES AND THEIR PERCEPTION OF HOW RESISTED SPRINTING INFLUENCES KINEMATICS

OSTERWALD, K., KELLY, D., Ó CATHAIN, C.

UMIT TIROL; TECHNOLOGICAL UNIVERSITY OF THE SHANNON

INTRODUCTION: Resisted sprint training (RST) has gained popularity for enhancing sprint performance [1]. However, to our knowledge, there remains a lack of clarity on coaches' understanding and application of RST. This study aimed to explore coaches perspectives on RST, focusing on their understanding of kinematics, decision-making processes, and perceptions of this training method.

METHODS: A web-based survey was conducted with 52 coaches from various sports settings. Questions covered coaches' background information, education, their perception of how RST influences kinematics, equipment and methods used. Descriptive statistics and thematic analysis were employed for data analysis.

RESULTS: The majority (92%) of surveyed coaches expressed a belief in the efficacy of RST for enhancing sprint performance, with notable variations based on coaching qualifications. Scientific or Coaching Journals were their primary sources of information (90%), and coaches demonstrated a high confidence level in their theoretical knowledge. Notably, 73% of coaches believe RST induces acute changes in sprinting technique, leading to adjustments in training loads. Coaches expressed concerns about negative impacts on unresisted sprint performance (14.6%). Coaches prefer %BM over %Vdec for load selection. Despite this preference, practical considerations heavily influenced their choice of RST methods. Video analysis emerged as the primary tool (63%) for monitoring kinematic changes during RST.

CONCLUSION: Coaches preferences for %BM over %Vdec, driven by ease and existing literature, highlight an educational gap that needs addressing. Practical considerations strongly influence the selection of RST methods, indicating a potential misalignment between scientific principles and practical application. Coaches acute awareness of technique changes during RST, coupled with concerns about negative impacts on unresisted sprinting, underscores the need for nuanced program design and education.

This study provides valuable insights, suggesting the need for education on load selection methods, and aligning scientific principles with practical considerations. Coaches should be aware of context-specific needs, considering the specific phase of sprinting and sport objectives. Bridging the gap between theoretical knowledge and practical application is crucial for optimizing RST effectiveness. The findings emphasize the importance of tailored educational initiatives to enhance load selection strategies and promote evidence-based RST program design in coaching practice.

GAME PERFORMANCE AND GRIPPING TECHNIQUES PRECEDING SCORED THROWS OF ELITE FEMALE JUDO ATHLETES OF 52 KG CATEGORY

CHEN, H.H., TSAI, C.Y.

TAITUNG UNIVERSITY

INTRODUCTION: Effective gripping techniques play a crucial role in success of judo, serving as the foundation for initiating throws or attacks. In a very limit number of studies exploring the gripping techniques preceding scored throws.This study aimed to examine the game performance of female athletes in the category of 52kg, specifically focusing on their gripping behavior before executing throwing techniques.Additionally, a Multi-layer Perceptrons (MLP) model and a CycleGAN are constructed to distinguish between effective and ineffective gripping techniques

METHODS: Analysis was conducted on 100 videos of female athletes ranked in the top 50, taken from the world circuit tournament spanning 2019-2022. The process were notated by 5 experienced observes.

RESULTS: (1) Time analysis revealed a mean combat time of 261.5 secs (±128 secs) with an average of 9.1 (±5.2) attacks. Attack duration decreased over sections, from 18.5(±7.3secs) to 14.4 secs. The effort-pause (EP ratio) also reduced from 4 to 2.5 (2). Motions analysis demonstrated that 91% of gripping before throwing techniques did not show obvious effectiveness out of 593 attacks. The afterward throwing techniques executed almost same side as the gripping force motion particular for the foot and hip skills (97%). However, only 32.2 % of throwing techniques got the advantage consequence and over half of them without advantage (66%). Although the foot and hand claimed the majority of the percentage of skills (58% and 22%, respectively), the hip and sacrifice skills had a lager efficiency ratio (numbers of throws / number of advantage) for gaining the attack advantage (1.3 and 0.74). (3) Multi-state Markov model identified primary gripping behaviors preceding the throwing motions, such as grasping approaching sleeves or grasping the right collar then left sleeve. (4) The initially-constructed MLP gripping model achieved a mean test accuracy of 67.72±0.93 and a mean test F1-score 79.09±0.46 in discriminating the attack consequences. As we pre-train another CycleGAN model to generate adequate augmented data and use it to train the MLP along with the original data, we get an improved mean test accuracy and a mean F1-score up to 73.68±0.00 and 81.29±0.013, respectively.

CONCLUSION: (1) The decline of EP ratio suggested more time for attempting and strategic planning at the beginning of combat, leading a stable gripping behavior pattern. (2) Almost none effective gripping preceding the initiation of attacks may implicate the brinkmanship behaviors applied by the athletes in the interpersonal synergy of judo combat. (3) Limited combat data sets may affect the accuracy of the gripping model. However, the data generation mechanism could be an alternative that can produce enough and effective augmented data to facilitate the classification model training for better generalization. Therefore, the intricate combination of griping and throwing motion emerges as a critical skills for elite judo athletes. An accurate gripping model could be built.

ANALYSIS OF THE SHOT DISPLACEMENTS PERFORMED BY PROFESSIONAL TENNIS PLAYERS: A CASE STUDY

KIM, H., JUNG, K.

UNIVERSITY OF WISCONSIN LA CROSSE

INTRODUCTION: Performance analysis in tennis was conducted with the aims of tactical evaluation, movement analysis, and database development [1, 2]. Players strategically execute shots to control court space and to disrupt stable relations during a competition. Players attempt to make their opponent cover more ground forcefully [3]. This study focused on shot displacements dispersed across the court, examining whether the area of shot displacements can serve as indicators of tactics and overall performance. We hypothesized that winners occupy a great shot displacement area, reflecting superior tactical performance since highly skilled players make opponents move back and forth or left and right.

METHODS: A first-round professional tennis match from the Australian Open was selected to leverage expected level differences between seed and non-seed players. Kinovea software converted high-definition video (720p) to image sequences. Images containing ball bouncing on the court were imported to a custom-written MATLAB enabling shot displacements tracking. The entire court was divided into 16 sections and the area of shot displacements for each section was calculated using a convex hull algorithm.

RESULTS: In the first-round match, the seed player exhibited a total shot displacements area of 35.34 m2, which is greater than non-seed player's 26.87 m2. Particularly in section 1 and 2 at the intersection of endline and sideline, the seed player had 3.58 m2, whereas the non-seed player had 2.09 m2. In section 2, the seed player also showed a greater shot displacements area than non-seed player. Respectively, 3.86 m2 for seed player and 2.99 m2 for non-seed player were shown, indicating seed player made more shots to the far side corners to make opponents move forcefully.

CONCLUSION: This study underscores the significance of shot displacement analysis as a valuable indicator of tactics and performance in tennis. Tennis players these days emphasize stroke plays over serve-and-volley strategies. The seed player consistently utilized a greater shot displacements area than the non-seed player in most of sections, affirming its potential as an additional tool for performance evaluation, in conjunction with traditional notational analysis. Future studies should expand the dataset to generalize these findings across more tennis matches.

A FUNDAMENTAL STUDY ON GPS DATA IN COLLEGE FUTSAL LESSONS

FUKUSHI, N., TAMURA, T.2, HASEGAWA, D.3, SUDA, Y.1

1 KEIO UNIVERSITY, 2 KYOTO SANGYO UNIVERSITY, 3 TOYOKAWA HIGH SCHOOL

INTRODUCTION: It has been shown that liberal arts education through practical physical education contributes to the acquisition of athletic skills, maintenance of physical and mental health, and improvement of life skills and other skills. Conversely, it has been reported that many university students are unable to obtain the amount of physical activity necessary to prevent lifestyle-related diseases due to COVID-19, which has continued recently (Fukushi et al., 2021). In futsal, an indoor sport, data collection using GPS has not yet been conducted; however, classes are offered at universities using outdoor courts. This study aimed to clarify the distance traveled, speed of movement, and heart rate in a university physical education futsal class using GPS.

METHODS: The participants were 12 male students (19.3±1.1 years) enrolled in a general education futsal class at a private general university. In this study, GPS devices manufactured by KNOWS were used. The participants performed practical training while wearing a special vest and inserting the main body of the GPS device into a pocket on the back. During the futsal class, data on distance traveled, speed of movement, and heart rate were collected. Measurements were obtained 11 times out of 14 classes in the spring semester of 2023 (April to July). The items analyzed in this study were activity time,

total distance traveled, distance traveled ≥18 km/h (standard intensity [SI]), distance traveled ≥21 km/h (high intensity [HI]), number of sprints (number of times ≥24 km/h), maximum speed (instantaneous maximum speed), and average heart rate.

RESULTS: The mean and standard deviation of each analysis item were calculated from the data of the 12 participants and 11 measurements, respectively. The results showed that activity time was 73.13 ± 5.46 min, total distance traveled was 3,009.23 ± 613.96 m, SI was 19.38 ± 18.36 m, HI was 2.54 ± 7.56 m, number of sprints was 0.01 ± 0.09, maximum speed was 19.50 ± 2.03 km/h, and average heart rate was 146.72 ± 14.12 beats per min.

CONCLUSION: Ohmuro et al. (2020) reported quantifying the percentage of distance traveled and speed of movement during futsal matches between top level players (adults) and high school students (youth) in Japan. The distance traveled was 4,151 ± 942 m for adults and 4,670 ± 1,202 m for youth, and percentage of travel speeds > 18.4 km/h was approximately 10% in both categories. Although this study covered one 90-min class, which included a warm-up, basic practice, shooting practice, and game format, the total distance traveled was approximately 70% of the distance traveled in one game in a previous study. The percentage of SI was extremely low (approximately 0.6 %). Regarding the average heart rate, the exercise intensity was approximately 60–70% of the maximum heart rate for the participants' age, suggesting that the exercise standards for preventing lifestyle-related diseases set by the Ministry of Health, Labor and Welfare (2013) may be fully achieved.

ELUCIDATION OF GAME ANALYSIS PROCESS IN SOCCER

TAMURA, T., NAMIKI, N.2, FUKUSHI, N.3

KYOTO SANGYO UNIVERSITY

INTRODUCTION: Game analysis is important because it has a substantial impact on team victory. In recent years, game analyses using video images and statistics have been conducted for various ages and levels. Almost all professional soccer clubs have staff members (analysts) who specialise in game analysis. We conducted an interview survey with analysts at professional soccer clubs to elucidate the process of game analysis.

METHODS: The participants included five members of a Japanese professional soccer club (the J-League). The survey was conducted using one (interviewee) versus two (interviewers) semi-structured, in-depth, open-ended interviews. Five core questions were prepared for the interviews, such as the team's role in game analysis, among others. Thematic analysis methods were used, and finally, comparisons and integration were conducted. Meaningful responses were converted into text, and texts sharing similar meanings were grouped into subcategories. Small categories with high affinity were grouped into medium categories. Furthermore, medium categories were grouped into large categories. Finally, large or medium categories that were deemed to be related were spatially arranged.

RESULTS: Five of the participants were coaches and analysts charged with analysing opponents, developing countermeasures, and proposing strategies. Based on their "background as analysts", they played the role of analysts in the following order: "data collection", "preparation for game analysis", "game analysis", "sharing with coaches and staff", and "sharing with players. In "data collection", preparation began about 2 weeks prior to kickoff, and involved reviewing video footage of about five opponents games. Additionally, they checked interviews with the coach and social networking services, and made predictions about the players who would play in the game as part of the "preparation for game analysis. In "game analysis", they analysed the game based on their own teams game model, and checked the overall picture of the game as well as the details. Numerical data were used only to understand the overall picture, and no analyst actively utilised it. In the "sharing with the coach and staff" section, the data intended for player presentation was determined, and in the "sharing with the players" section, the data was conveyed in a manner that positively framed the players' perception and made it straightforward for them to comprehend and relate to their training.

CONCLUSION: In Japan, analysts often work concurrently with coaches and their analyses focus on game footage. Their responsibilities include match analysis; specifically requiring the capability to analyse video footage aligned with the coachs game model. Moreover, effective communication skills were essential for conveying the analysis appropriately to the coach and players. Additionally, only few clubs and staff members were employing numerical data, attributing this to a lack of knowledge on how to effectively use the generated data.

TALENT IDENTIFICATION IN SOCCER: THE INFLUENCE OF TECHNICAL, PHYSICAL AND MATURITY-RELATED CHARACTERISTICS ON A NATIONAL SELECTION PROCESS

KING, M., BROWN, M., COX, J., MCLELLAN, R., TOWLSON, C., BARRETT, S.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: The present study examines the influence of technical, physical, and relative age characteristics on players selection success within the Scottish Performance School trials.

METHODS: Ninety adolescent players (81 males, 9 females; mean ± standard deviation: age = 11.3 ± 0.4 years, height = 149.6 ± 6.9 cm, mass 38.1 ± 4.7 kg) performed a battery of physical fitness (20m Sprint, CMJ, 5-0-5 agility test), anthropometric, and 8 small-sided games (SSG; 9v9) as part of a talent identification (TID) programme. Players technical (ball touches, time on the ball, high-speed releases) and locomotor activities (high-speed running distance, sprint distance, accelerations, and decelerations) were monitored using foot-mounted inertial measurements units during SSG's. The data was analysed using independent sample T-tests. Mann-Whitney U analyses were conducted to examine the differences between groups whose data was determined as being (non)parametric, with Cohen effect sizes applied.

RESULTS: Successful players performed significantly better during physical tests (Effect size ± confidence limits: Left 5-0-5 = -0.89±0.13, Right 5-0-5 = -0.51±0.11), had significantly higher locomotor activities during SSG (high-intensity distance = 0.4±26.6, horizontal accelerations = 0.59±1.19) and significantly higher technical outputs during SSG (touches = 0.71±6.1, releases = 0.49±2.5, high-speed releases = 0.59±2.7, time on the ball = 0.52±3.4) compared to unsuccessful players.

CONCLUSION: Successful players had significantly higher locomotor activities and technical outputs during SSG than their unsuccessful counterparts. Monitoring technical and locomotor activities during SSG may compliment or replace physical testing batteries for assessing TID processes in soccer.

EFFECTS OF LONG-TERM ENDURANCE TRAINING ON POWER GENERATION CAPACITY IN LONG-DISTANCE RUNNERS

MIYAZAKI, D.1, TANAKA, S.2, KUMAGAWA, D.2, OKADA, M.

1 KOKUSHIKAN UNIVERSITY SPORT PROMOTION CENTER, TOKYO, JAPAN, 2 KOKUSHIKAN UNIVERSITY, TOKYO, JAPAN

INTRODUCTION: In previous studies, it has been reported that improving aerobic capacity is important for improving the athletic record in long distance athletes (1,2). Recently, running speed, as seen in world record breaking and last spurts in marathons, has been influencing victory and defeat. Therefore, it is considered that long-distance runners need not only aerobic capacity but also anaerobic capacity. The effects of anaerobic power and middle power on changes in athletic records at more marathon like distances due to long-term endurance training have not been examined. Therefore, the purpose of this study was to examine the effect of power capacity on the improvement of 20 km records in collegiate long-distance runners.

METHODS: Twenty-two collegiate long-distance runners (age: 19.2±0.9yrs, Height: 169.8±4.8cm, Weight: 56.4±4.9kg) participated in this study. The athletic records in 5,000m, 10,000m and 20km were researched throughout pre-season (Pre) and post-season (one year after Pre). These subjects were classified by athletic record based by 20km athletic record in S2. The records of 14 subjects (HG) were improved in S2 than that of S1, while 8 subjects (LG) remained unchanged athletic record. The maximal anaerobic power (MAP), middle power (MP) and middle power to peak power ratio (MP/PP ratio) in Pre and Post as an anaerobic power generation capacity were measured by cycling ergometer (Power max VII), respectively. The change ratio of measurement parameters was calculated in all subjects.

RESULTS: As a results, the S2 athletic record of 5000m, 10000m and 20km in all subjects were improved than that of S1 by endurance training during 1 year. There was no significant difference of MAP in AG between S1 and S2. On the other hand, BG showed a significantly lower value in S2 than that of S1. The change ratio in S2 relative to S1 of MAP in AG was 99.3 ± 5.3%, and BG was 89.4 ± 8.9%. Change ratio of MP and MP/PP showed no significant differences between the two groups. And, the change ratio of MAP was observed related to the change ratio of 20km record.

CONCLUSION: These results indicates that one year of endurance training significantly improved 5000m, 10,000m, and 20km athletic records in collegiate long-distance runners. In addition, AG who improved their 20km athletic record showed maintenance of MAP, MP, and MP/PP. However, BG who did not improve their 20km athletic record showed a significant decrease in MAP, although MP and MP/PP were maintained after one year of endurance training. From these results, it was suggested that not only the improvement of endurance power generation capacity but also training to maintain MAP is important to improve the 20km athletic record.

REFERENCES:

1. Taunton et al. (1981) 2. Dotan et al. (1983)

SELECTION ODDS IN TALENT SELECTION AMONG FEMALE HANDBALL PLAYERS BY RELATIVE AGE, BIOLOGICAL MATURITY, BODY SIZE, AND BODY COMPOSITION

TRÓZNAI, ZS., UTCZÁS, K., PÁPAI, J., PÁLINKÁS, G., SZABÓ, T., PETRIDIS, L.

HUNGARIAN UNIVERSITY OF SPORT SCIENCE

INTRODUCTION: Selecting talented players is a common practice in youth sports. However, it is widely recognised that selection may be biased by variations in relative age or maturation, which in turn may result in differences in body size and muscular development. Previous research has suggested that talent selection should include technical tasks instead of body size and physical test measurements potentially reducing in this way the impact of the relative age effects and maturation. In this study we examined a single national female adolescent handball selection process, which was based only on sport-specific technical tasks exploring the effects of relative age, biological age, body size, body composition and maturity status on the selection.

METHODS: Measurements were performed in a sample of n=530 female handball adolescent players (aged 13-14 years). Participants went through anthropometric, body composition, and bone age measurements and then performed the selection tasks. Body mass and body composition were assessed using inBody 720, biological maturity was estimated based on bone age using an ultrasound-based device. The selection program consisted of three selection stages including handball-specific skills and in-game performance as selection criteria. Binary logistic regression was used to examine the effects of body size, body composition, and biological age (predictors) on the selection (dependent variable). The odds of selection (0=not-selected, 1=selected) were examined in separate models according to body size (body height and body mass), body composition (skeletal muscle mass and percent body fat), and developmental status (maturity status and relative age).

RESULTS: At the first selection stage, the explanatory power of the regression models was significant for the developmental status (9.6%) and body composition (8.0%), but not for body size. At the regional stage, all three models were significant, however the explanatory power remained rather small (15.1%, 13.0%, and 10% respectively). At the national stage, only developmental status (15.2%) had a significant effect on the selection. At the regional stage, larger body height increased selection odds by about 12%, larger muscle mass by 25%, whereas larger percent body fat decreased selection odds by 7%. The largest odds were found for relative age with larger age increasing selection odds by 3.5-4 times, while more advanced biological maturity by 1.8 times.

CONCLUSION: Regression results suggest that the examined variables may have a significant effect on the selection, but their explanatory power is rather limited indicating that additional factors may account in the selection process. The developmental status was the strongest predictor in the selection, but it seems that the impact of relative age and maturation is not limited to body size and muscular development, but it may expand to other important aspects in handball, such as technical competence or game intelligence.

WHAT DO SCHOOL STAKEHOLDERS NEED TO LEARN ABOUT TEACHING LIFE SKILLS DEVELOPMENT AND TRANSFER?

TROTTIER, C., TOUPIN, J., SABOURIN, C., DRAPEAU, V., PÉPIN, M.A., FRENETTE, E., GOULET, C., FALCÃO, W.R., BILLAUT, F., PELET, S., TRUDEL, P., VEILLETTE, R., LAVOIE, S.

LAVAL UNIVERSITY

INTRODUCTION: In Canada, high schools are increasingly offering school sport programs, which provide ideal settings for student-athletes to develop personally, academically, and athletically. However, despite these known benefits, participating in sports does not automatically produce positive outcomes. The negative consequences include performance anxiety, injuries, and eating disorders, which may be due to busy schedules, social pressures, the sport context itself, and/or the pivotal period of adolescence. To address these issues, training programs have been developed to equip school stakeholders to teach student-athletes life skills development and transfer. Recent studies suggest that these programs can provide instruction in explicit teaching strategies and engender a philosophy of positive development. However, researchers call for future programs to be designed in consultation with key actors so as to incorporate their perspectives and account for their needs and expectations for program implementation. Accordingly, this study examines the perspectives of school stakeholders on what they need in order to foster life skills development and transfer in student-athletes in school sport programs.

METHODS: We used a qualitative descriptive study design to explore the perspectives of 77 school stakeholders at 10 French-language high school sport programs in the province of Québec, Canada. Data were obtained from 14 focus group interviews lasting 60 minutes on average. Data were analysed using thematic analysis.

RESULTS: Three main findings emerged. First, regarding program objectives, stakeholders wanted all school stakeholders to collaborate on program design and parents to be involved in student-athletes' training. Second, opinions were mixed on the optimal program format: in-person classes, online courses, or hybrid modes. Third, regarding program content, most stakeholders found it challenging to foster life skills transfer beyond sport and wanted to know more about how to promote overall development (i.e., beyond sport and academic performance).

CONCLUSION: In conclusion, future training programs should be designed with a collaborative approach and should allow for parental involvement and flexible hybrid formats. Ultimately, and in line with the mission of School Sport Canada, the programs should enable school stakeholders to effectively promote overall positive development in student-athletes through life skills development and transfer.

PHYSIOLOGICAL MARKERS OF ENDURANCE CAPACITY AND YO-YO INTERMITTENT RECOVERY TEST PERFORMANCE IN PROFESSIONAL SOCCER PLAYERS CONSIDERING THEIR PLAYING POSITION

ESTRELLA, R., FERREIRA, R., SILVINO, V., VILHENA, L., SILVA, M., SANTOS, M., VIEIRA, R., PRADO, D.

INSTITUTO JOAQUIM GRAVA

INTRODUCTION: Endurance capacity is a critical component of performance in soccer, characterized by intermittent high-intensity activities interspersed with periods of low-intensity recovery. The Yo-Yo Intermittent Recovery Test (YYIR1) has emerged as a popular and reliable tool for assessing aerobic capacity and endurance in soccer players. This study aims to verify the association between the physiological markers of endurance capacity and YYIR1 performance in professional soccer players taking into consideration the playing position.

METHODS: Twenty-six professional soccer athletes (defenders n = 10, midfielders n = 10, forwards n = 6) performed the YYIR1 and underwent a cardiopulmonary exercise test in order to assess their ventilatory thresholds (anaerobic threshold, respiratory compensation point and maximal oxygen consumption).

RESULTS: No differences were observed in the parameters at anaerobic threshold among playing positions. However, defenders reached the respiratory compensation point at a higher speed compared to midfielders (15.00 ± 1.33 vs 13.20 ± 1.48, respectively). Moreover, we found a positive correlation between VO2 max and YYIR1 total distance ($r = 0.492$; $p = 0.02$) considering all participants.

CONCLUSION: Our results highlight the interplay between maximal oxygen consumption and YYIR1 performance. We observed that VO2 max work load is the best predictor of YYIR1 performance compared to the submaximal thresholds. Additionally, defenders exhibited a higher speed at the respiratory compensation point compared to midfielders. These

findings suggest differences in cardiorespiratory adaptations associated with different playing positions in soccer, which can inform training regimens and performance optimization strategies to specific positions.

UNRAVELLING SPRINT HURDLING PERFORMANCE: THE BIOMECHANICAL TRIAD OF BLOCK START EFFICIENCY, REACTION TIME, AND TIME TO FIRST TOUCHDOWN

GISLADOTTIR, T., HAFSTEINSSON, T., PETROVIC, M.

UNIVERSITY OF ICELAND

INTRODUCTION: The interplay between block start biomechanics, reaction time, and the time to first touchdown in 60m hurdles races is integral to unravelling the dynamics of sprint hurdling performance. A proficient start from the blocks sets the tone for the entire race, with reaction time directly influencing the athletes initial acceleration. Additionally, scrutinizing the biomechanical aspects of the time to first touchdown offers valuable insights into hurdling technique and race strategy, highlighting the intricate relationship among these key factors in achieving competitive success.

METHODS: Data were obtained from the report of Nicholson et al. (2019), on 7 female and 8 male finalists of the IAAF World Championship in the 60m hurdles race held in March 2018 in Birmingham, UK. The following variables were analyzed and presented: reaction time, time to block exit, and time to first touchdown and ranking.

RESULTS: In analyzing the data, it is evident that Harrison faced challenges across multiple key metrics, ranking last in block exit time, reaction time, and time to first touchdown. Despite being ranked first overall, Manning demonstrated remarkable efficiency by securing the top spot in all three categories. Notably, Pedersen showcased consistency, ranking joint seventh in reaction time while excelling with the sixth fastest block exit time and the third fastest time to first touchdown.

In this women's race, Eaton emerges as a standout performer, securing the second spot overall while boasting impressive rankings in both reaction time and time to block exit. Meanwhile, Pozzi demonstrated consistency by clinching the top spot in block exit time and maintaining a solid performance across other metrics, earning her first place overall. Notably, Martinot-Lagarde showcased a balanced approach, ranking consistently across all categories and securing the fifth position overall.

CONCLUSION: The analysis reveals that superior sprint hurdling performance is characterized by athletes who demonstrate quick reaction times, efficient block exit transitions, and adapt handling of hurdles with minimal time to the first touchdown. Consistency across these variables underlines the importance of a well-rounded approach, with athletes like Manning and Pozzi showcasing prowess in balancing speed, technique, and strategy for optimal race execution. Overall, these findings emphasize the critical role of reaction time, block exit efficiency, and hurdling technique in determining success in sprint hurdling events. Particularly is the interesting case of Harrison, runner who had reaction time and time to block exit almost the slowest of all finalists but could manage to win the race. This example shows that there is always an exception to the rules.

COMPARING THE TECHNICAL AND INDIVIDUAL POSSESSION STATISTICS OF ACADEMY PLAYERS ACROSS DIFFERENT AGE GROUPS IN MATCH-PLAY

BARRETT, S., ESCREET, E., IGA, J., TONER, J., TOWLSON, C.

PLAYERMAKER

INTRODUCTION: Background: Youth soccer players in the UK transition into the professional game at 16 years of age. Understanding the differences between youth and professional standards can help coaches and clubs to support player development during this transition. Objectives: To (i) assess the differences in technical and possession statistics between different age groups (U16, U18, U23) and outfield positions (central defender [CD], wide defender [WD], central midfielder [CM], attacking midfielder [AM], wide midfielder [WM], striker [ST]), within an English academy soccer programme, during match-play.

METHODS: All matches were monitored using foot-mounted inertial measurements units (F-IMU; PlayermakerTM) to quantify the technical (touches and releases from the feet) and individual possession statistics (Time on the ball, Time on the ball per possession) from each match. Teams were instructed to play a 1-4-3-3 formation as part of their clubs playing philosophy, with positions defined per this formation. Data were analysed using a multi-variate ANOVA Two-tailed statistical significance was accepted as $p < 0.05$ and measures of effect size were calculated using partial eta-squared ($\eta 2$). Magnitude of the effect sizes were small (0.2 RESULTS: Trivial to small effect sizes were observed across age groups for both technical and possession-based statistics during match-play. Across all age groups and positions, CD`s had the highest number of technical actions (touches and releases), whereas ST`s & AM`s, had the highest amount of time in possession of the ball. Further, positional analysis showed ST`s and AM`s had moderate to large decreases in time on the ball per possession at the U23's age group in comparison to the U16 and U18's, with no technical differences observed within the same positional analysis.

CONCLUSION: Attacking players (AM & ST) are required to move the ball quicker as they progress from U16 to U23's within the current English football academy. Further exploration is required to assess if these changes are context specific given requirements of those age groups, which may have implications for both performance and talent identification at these age groups.

EXPLORING OFFENSIVE DYNAMICS: A COMPARATIVE STUDY OF TACTICS, EFFICIENCY, AND PACE ACROSS COMPETITIVE BASKETBALL STAGES

LAN, Y.C.1, LIU, Y.T.2

1 NATIONAL YANG-MING CHIAO-TUNG UNIVERSITY, 2 NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Possessions (POSS) are the foundational elements for scoring in basketball. Within the possessions, the dynamic interplay between the offensive and defensive maneuvers is intricately shaped by offensive tactics such as set offenses and transitions (fast break, FB), and the dynamic complexity of these tactics is further amplified across different competition stages (Selmanović et al., 2015). A POSS may entail multiple set offenses (plays), while an FB occurs exclusively upon initial ball possession by the team. Therefore, the set offense rate is the percentage of plays with set attacks, whereas the FB rate is the percentage of POSS that executes FB. This study analyzed the offensive tactics, efficiency, and pace between competitive stages to identify patterns and factors contributing to game success or failure.

METHODS: One hundred thirty-nine games (32 from the advanced stage) were analyzed from the 2022-2023 Taiwan University Basketball Association (UBA) Division 1 tournament. Two independent observers recorded data from two games not part of the study for the reliability test. Cohen's Kappa was 0.83 and 0.80 for the intra- and inter-observer reliability, respectively. Data were divided and recorded separately by the two observers. Three categories of offensive tactics were recorded: (1) set offense, an attack duration over 8 s; (2) FB, an attack executed within the first 8 s of POSS without a turnover; and (3) others. Data were analyzed using 2 (stage) by 2 (outcome) mixed design MANOVA on the set offense rate, FB rate, number of POSS, number of plays, and scoring rate, with the game outcome as the repeated factor.

RESULTS: There was no significant interaction effect between stage and outcome, Wilksλ =.971, $F(8, 266) = .969$, $p>.05$. For the stage effect, the POSS (82.97, 77) and plays (101.81, 90.81) showed a significantly higher frequency in the preliminary stage than in the advanced stage (ps<.001), and the rate of set offenses in the advanced stage (84.13%) was higher than in the preliminary stage (80.68%) ($p < .05$). For the outcomes effect, the winners (19.49%, 34.39%, 11.03%) were significantly higher for FB rates, set score rates, and FB score rates compared to the losers (16.43%, 28.30%, 8.09%) (ps <.05).

CONCLUSION: The advanced stage demonstrated a reduction in possessions and plays compared to the preliminary stage, accompanied by a reduced play/possession ratio, indicating a slower-paced game with heightened defensive intensity. The increasing set-play ratio likely reflected evenly matched teams engaging in a tactical battle between offense and defense in the advanced stage. However, regardless of the competition stage, the ability to capitalize on fast break opportunities and achieve a high score rate remained crucial for winning.

Reference

Selmanović, et al., (2015). Basic characteristics of offensive modalities in the Euroleague and the NBA. Acta Kinesiologica, 9 (2), 83-87.

Disabilities

EXPLORING DEMOGRAPHIC DYNAMICS IN WEIGHT TRAINING ENGAGEMENT AMONG ADULTS WITH DISABILITIES

LEUNG, W., HIRSCH, A., FIORE, G., FARRELL, C., MILLER, A., TAMULEVICIUS, N.

THE UNIVERSITY OF TAMPA

INTRODUCTION: Demographic factors, encompassing age, sex, ethnicity, and education levels, have been linked to weight training engagement in individuals without disabilities [1]. Notably, older adults and women have exhibited lower levels of engagement in weight training [1]. However, there exists a gap in understanding how these demographic factors influence weight training participation among people with disabilities [2]. Despite the recognized importance of fitness, research on weight training participation in the disability community remains limited. This study seeks to address this gap by crafting a comprehensive profile of adults with disabilities engaged in weight training, delving into the demographic factors that predict their participation.

METHODS: An analysis included 251,062 participants with disabilities, identified using the Washington Group on Disability Statistics Question Set from the 2015-2019 Behavioral Risk Factors Surveillance System. The study focused on weight training engagement, self-reported by participants as either engaged or not engaged. Demographic variables, including, sex, ethnicity, and education levels were examined for their association with weight training engagement. The prevalence of weight training engagement within the disability community was estimated, while logistic regressions were conducted for each demographic factor to examine its impact on weight training participation. Survey analyses were conducted, factoring in sampling weights to address the complex survey design of the dataset.

RESULTS: The findings revealed that only 30.68% (95% CI [30.29, 31.08]) of participants reported engaging in weight training. Significantly, a higher proportion of individuals aged ≥65 years, males, Caucasians, and those with a college education reported engaging in weight training ($p<.05$). Logistic regressions further illuminated the influence of demographic factors: older adults (OR=1.57, 95% CI [1.51, 1.63]), males (OR=1.35, 95% CI [1.30, 1.40]), and those with a college education (OR=1.73, 95% CI [1.67, 1.80]) were more likely to participate in weight training. Conversely, Caucasian participants were less likely to engage in weight training compared to their counterparts of color (OR=0.98, 95% CI [0.86, 0.93]).

CONCLUSION: The current study sheds light on the engagement of weight training among adults with disabilities. Overall, only a small percentage of participants reported engaged in weight training, suggesting people with disabilities might be

facing barriers and disparities regarding weight training engagement. The study also emphasized the impact of demographic factors on weight training among people with disabilities.

1. Chevan, J., Demographic determinants of participation in strength training activities among U.S. adults. JSCR, 2008. 22(2): p. 553-8.

2. Jacinto, M., et al., Prescription and effects of strength training in individuals with intellectual disability – A systematic review. Sports, 2021. 9(9): p.125.

BRAIN HEALTH AND FITNESS CLASSES IN OLDER ADULTS WITH PARKINSON'S DISEASE: INITIAL FINDINGS OF A PILOT PROJECT

BARDUTZ, H., KAHN, Z., WITTE, K., HA, H., SINGHARATH, A., SHAFIQ, M., SINGH, J.

UNIVERSITY OF REGINA

INTRODUCTION: Parkinson's Disease (PD) involves motor and non-motor conditions which affects day-to-day functioning. Literature suggests a positive influence among educational interventions involving physical activity and specific nutrients on cognitive health and quality of life for individuals with PD. The following study was conducted to evaluate the cost effectiveness and introductory findings related to cognitive health and fitness interventions on cognitive function and feelings of subjective hope.

METHODS: People with PD participated in an 8-week brain health and fitness intervention with an option to bring a support person. This class taught participants about socialization, nutrition, sleep, stress, and exercise. Each class was tailored to include relevant activities depending on the weekly topic allowing individuals to interact with other participants. People were given the option to participate in research and 3 people with PD choose to participate in the research. Prior to the classes, individuals completed the Montreal Cognitive Assessment (MOCA) and the Adult Hope Scale which they completed again following the conclusion of the 8-week class.

RESULTS: The three people successfully finished the entire 8-week course intervention and pre- and post- assessments with no complaints about the length of the course nor the requirements of the study. After the course, three participants performed either equally or better on both the Hope and Moca tests.

CONCLUSION: The Brain Health and Fitness classes can be effectively completed for research purposes in the Parkinson's population, with the methods being feasible for the participants to complete and understand. Adherence remained high, suggesting good feasibility. Future research will include larger sample sizes, including those with Parkinson's Disease and other neurological conditions and in the general population.

EXPLORING SELF-REPORTED SPORT MENTAL HEALTH ASSESSMENT TOOL-1 (SMHAT-1) SCORES ACROSS IMPAIRMENT TYPE OF TEAM USA PARALYMPIC ATHLETES

GALÁN LÓPEZ, N., ANDERSON, T.2,3, BARTLEY, J.D.2,3, DONALDSON, A.T.2,3, TAYLOR, L.1,4, ADAMS, W.1,2,3,5

1LOUGHBOROUGH UNI, 2UNITED STATES OLYMPIC & PARALYMPIC COMMITTEE, 3UNITED STATES COALITION FOR THE PREVENTION OF ILLNESS & INJURY IN SPORT, 4UNI OF TECHNOLOGY SYDNEY, 5UNI OF NORTH CAROLINE-GREENSBORO

INTRODUCTION: Paralympic athletes face additional mental health-related challenges to Olympic athletes due to social forces that differentially affect people with disabilities. Indeed, Paralympic athletes score less favourably (i.e., increased self-reporting of mental health symptoms) than their Olympic counterparts on the Sport Mental Health Assessment Tool – 1 (SMHAT-1). However, the impact of impairment type (IT) and origin of condition (OC; congenital or acquired) on mental health outcomes remains largely unexplored. Therefore, this project examines SMHAT-1 scores considering IT, OC, sex, and competing season among Paralympic athletes.

METHODS: Ninety-five Team USA Paralympic athletes competing in Tokyo and Beijing (55 male, 40 female) completed the SMHAT-1, including the components: Athlete Psychological Strain Questionnaire [APSQ], Athlete Sleep Screening Questionnaire [ASSQ; sleep], General Anxiety Disorder [GAD7; anxiety], Patient Health Questionnaire [PHQ9; depression], Alcohol Use Disorders Identification Test-Consumption [AUDIT-C; Alcohol], Cutting, Annoyance, Guilt and Eye openings [CAGE-AID; drug] and Brief Eating Disorders in Athletes [BEDA-Q; food]. Scores on the SMHAT-1 components were treated as binary (i.e., flag or no flag), and continuous variables (i.e., total scores, TS). General linear regression was used to analyse association between TS and IT, adjusting for OC and sex. Risk of flagging by OC, IT, sex, and season (winter/summer) was assessed via $\chi 2$ tests, with phi (φ).

RESULTS: For the APSQ, AUDIT-C and BEDA-Q, hypertonia, ataxia and/or athetosis (HAA) showed highest TS among IT (mean+-SE: 23+-2, 3+-1, 14+-2, respectively). Within the PHQ9, GAD7 and ASSQ, the IT short stature showed highest TS (10+-3, 12+-4, 11+-2, respectively). APSQ TS was greater in athletes with HAA (23+-2) compared to impaired muscle power (IMP; 14+-1, p=.049). PHQ9 TS was significantly greater among athletes with HAA (7+-1) compared to IMP (1+-1, p<.001), limb deficiency (2+-0.4, p=.002), and vision impairment (3+-1, p=.038). PHQ9 TS was also significantly higher in athletes with IMP (1+-1) than athletes with short stature (10+-3, p=.045). Flagging in SMHAT-1 questionnaires was not associated with OC (p range=.414 to 1) or IT (p range=.125 to .562). Females (71%) were more likely to flag on the APSQ than males (31%; $\chi 2[1, 96]=13.373$, p< .001, $\varphi=0.37$), and were more likely (20%) to flag on the GAD7 (males, 4%; p=.017, OR=0.16). Flagging on the APSQ ($\chi 2[1, 96]=45.534$, p<.001, $\varphi=0.69$) and ASSQ ($\chi 2[1, 96]=4.5817$, p=.032, $\varphi=0.22$) was associated with season, where summer athletes (21%) were more likely to flag on GAD7 compared to winter athletes (5%; p=.029, OR=0.19)

CONCLUSION: Athletes with HAA scored significantly higher on the SMHAT-1 (23+-2) and PHQ9 (7+-1) components compared to athletes with other impairment types. However, flagging on the SMHAT-1 was not associated with IT and OC. Finally, there was an increased likelihood of flagging on the SMHAT-1 among female and summer Paralympic athletes.

Health and Fitness

ESTIMATION OF PHYSICAL ACTIVITY AND SEDENTARY TIME DURING SCHOOL WEEK DAYS AMONG OMANI STUDENTS WITH RELATIONSHIP TO LEG POWER AND WALKING TEST

AL-HADABI, B.1, SASS, R.1, ELASHKAR, H.1, ALJAHANI, O.2, FAROQ, A.3, ALMAMARI, M.4

1 SULTAN QABOOS UNIVERSITY - OMAN 2 KING SAUD UNIVERSITY- KSA 3 HELWAN UNIVERSITY - EGYPT 4- MINISTRY OF EDUCATION- OMAN

INTRODUCTION: This study aimed to estimate the amount of physical activity and sedentary time during school days of the second cycle of basic education students and to determine its relationship to leg power and the 6-minute walking test.

METHODS: Eighteen first-cycle students volunteered to participate in this study (age: 11.8 ± 0.3 years, height: 148±9.0 cm, body mass: 43.4 ± 13.5 kg). ActiGraph GT3X was used to estimate the amount of physical activity, over three school days during the week (from 8:00 am to 12:00 pm, daily). All participants performed a 6-minute walk test and vertical jump tests (Countermovement jump: CMJ and free Countermovement jump: FCMJ).

RESULTS: Results showed that during the three study days, the sedentary time reached 455.9 ± 56.7 minutes, while the level of moderate and high-intensity physical activity reached 17.01 ± 67.9 minutes. Results showed also a significant negative relationship between sedentary time and 6-minute walk performance (r= -0.677, p= 0.02 (without recording any significant correlations between all levels of physical activity and vertical jump heights.

CONCLUSION: The findings of the current study indicate a significant decrease in the levels of physical activity practiced during the 3 days of the week among the second-cycle Omani students.

PREDICTORS OF LONG-TERM PHYSICAL ACTIVITY IN PATIENTS WITH CHRONIC HEART FAILURE. RESULTS OF A RANDOMIZED, TELEMONITORING-BASED INTERVENTION STUDY

HAUFE, S., LÖDDING, P., BEYER, S., PÖKEL, C., KÜCK, M., LEPS, C., RADZIWOLEK, L., KERLING, A., TEGTBUR, U., BUSSE, M.

DEPARTMENT OF REHABILITATION AND SPORTS MEDICINE

INTRODUCTION: Chronic heart failure (CHF) is one of the most common diseases in industrialized countries, disproportionately affecting the elderly. In addition to consistent drug therapy, physical activity (PA) is an integral part of current guidelines. Yet, adherence to regular PA and exercise interventions is poor and potential predictors and barriers to PA remain elusive.

METHODS: We examined the effects of a 12-month telemonitoring-based exercise intervention in 699 CHF patients in a prospective, randomized-controlled (1:1), multicenter trial. At each study centre, anthropometric parameters, physical activity recordings with questionnaires and activity trackers, and a general medical examination by a physician (including electrocardiogram, medical history, and cardiopulmonary exercise tests) were conducted.

RESULTS: For both, the exercise and control group, self-reported PA (MET*hours/week) increased and sedentary behavior declined during the 12-month intervention period. The average number of completed exercise instruction videos provided via an online application was 1.50 [1.44] videos/week at the beginning and gradually decreased to 1.00 [1.50] videos/week; $p < 0.01$. Multivariate regression models for both groups combined revealed that exercise-related PA (MET*hours/week) ($\beta = -0.620$) and exercise capacity at baseline ($\beta = 0.150$), CHF severity ($\beta = 0.145$), atrial fibrillation ($\beta = -0.145$), and age ($\beta = 0.127$) predicted changes during the 12-month intervention in self-reported exercise-related PA ($R2 = 0.396$).

CONCLUSION: Our results show the influence of certain baseline characteristics as barriers and predictors of PA adherence. Therefore, exercise programs should pay attention to patients' individual characteristics and disease-related conditions to set achievable goals, and eventually promote the adherence and sustainability of exercise-focused interventions.

HIIT FOR LOW-RISK CARDIAC PATIENTS: THE IMPACT OF A 6-WEEK INTERVENTION ON PATIENTS' CARDIOMETABOLIC HEALTH

BRAVO, J.D., FARIA, L., RAIMUNDO, A., GONÇALVES, C.

UNIVERSIDADE DE ÉVORA

INTRODUCTION: With the escalating prevalence of cardiometabolic disorders and an aging demographic, there is a critical imperative to investigate efficacious interventions, especially in the context of heightened cardiometabolic risk in cardiac patients. In this reality, high-intensity physical exercise assumes a pivotal role, standing as a promising and significant modality for addressing these health challenges [1]. This study aims to assess the effects of a 6-week high-intensity interval training (HIIT) program on cardiometabolic risk factors in low-risk cardiac patients.

METHODS: Twenty-three participants (50.1±9.2 years old) underwent an exercise-based HIIT program. Cardiometabolic risk factors included waist circumference (cm), HDL cholesterol (mg/dL), triglycerides (mg/dL), glucose (mg/dL), systolic and

diastolic blood pressure (mmHg). The Friedman test and Cohen's d were used for within-group comparisons and effect size, respectively.

RESULTS: At post-intervention, within-group improvements were found for all cardiometabolic risk factors: waist circumference (98.4±14.5 cm vs. 93.6±11.1 cm, p<0.001, d=-0.37), HDL cholesterol (42.9±6.7 mg/dL vs. 54.5±12.3 mg/dL, p<0.001, d=1.17), triglycerides (200.1±60.6 mg/dL vs. 137.3±51.2 mg/dL, p<0.001, d=-1.12), glucose (118.4±28.3 mg/dL vs. 106.5±22.5 mg/dL, p=0.002, d=-0.47), systolic (135.4±9.4 mmHg vs. 126.7±7.6 mmHg, p<0.001, d=-1.02), and diastolic blood pressure (91.3±8.4 mmHg vs. 85.4±6.8 mmHg, p<0.001, d=-0.77).

CONCLUSION: Our findings highlight the pivotal role of a 6-week HIIT program in effectively reducing cardiometabolic risk factors among low-risk cardiac patients. The significant improvements observed in waist circumference, triglycerides, glucose levels, and blood pressure, alongside a notable increase in HDL cholesterol, underscore HIITs clinical efficacy. Beyond advancing scientific understanding, these findings have profound implications for community health, presenting a tangible and effective strategy to enhance cardiovascular well-being amidst the challenges of an aging population and increasing cardiometabolic disorders.

Funding: This work is funded by national funds through the Foundation for Science and Technology, under the project UIDB/04923/2020 and UIDP/04923/2020.

1 - Hannan, A. L., Hing, W., Simas, V., Climstein, M., Coombes, J. S., Jayasinghe, R., ... & Furness, J. (2018). High-intensity interval training versus moderate-intensity continuous training within cardiac rehabilitation: a systematic review and meta-analysis. Open access journal of sports medicine, 1-17.

ANTI-OXIDATIVE SYSTEM PARAMETERS IN SHORT PERIOD OF RELATED ENERGY DEFICIENCY AND PHYSICAL LOAD.

PLAVINA, L.

NATIONAL DEFENCE ACADEMY OF LATVIA

INTRODUCTION: The physical endurance exercises are important part of process for training professional skills and improving results of performance. The high physical load with dietary limits leads to conditions when total energy expenditure higher than energy intake. Related energy deficiency has impact on physical and cognitive performance, it could lead to changes of biochemical markers of antioxidative system, oxidative stress expression. The purpose of study was characterized changes of anti-oxidative system parameters in short period of high physical load and related energy deficiency, and associated oxidative stress markers with total antioxidant capacity status and with physical preparedness

METHODS: The study group included 75 healthy persons in aged from 23 till 34 years. They participated in ten days long (total 24 hours) high intensity physical training with aerobic and strength training elements with combination to related energy deficiency. Dietary limits characterized with one meal in day, that had 700-800 kcal energy volume, no water limits. The antioxidative system activity was investigated by detection of superoxide dismutase activity (SOD), and total antioxidants capacity (TAC), glutathione system markers in plasma. Participants tested before physical training directly after ten day long physical training.

RESULTS: The results revealed lowering of enzymatic proteins SOD activity(p=0.002) that connected to specific high physical load and related energy deficiency. The parameter of the non-enzymatic proteins of the antioxidative system (TAC) did not change during the intensive training (p=1) that assess positively. The training effect in study group manifested as increasing of oxidative glutathione concentration(p<0.001) and lowering of oxidative stress index(p=0.001). We found the correlation between, oxidative stress parameters and physical fitness level by using Spearman `s correlation analysis.

CONCLUSION: Intensive physical load induced changes of parameters value for all participants. The correlation between oxidative stress parameters and physical fitness level indicated that physical fitness level optimizing the adaptation of participants to oxidative stress in specific short period of related energy deficiency and physical load, that minimized the training-related injuries and enhancing the physical performance.

EFFECTS OF CIRCUIT AEROBIC EXERCISE ON NEUTROPHIL FUNCTION IN SEDENTARY MEN

KAO, Y.L., LIM, A.Y., WANG, J.S.

CHANG GUNG UNIVERSITY

INTRODUCTION: Regular exercise ameliorates cardiorespiratory fitness and is associated with immune regulation. Circuit exercise is a relevantly new concept involving multi-station training and targeting multiple major muscle groups. Although previous studies reported benefits of improved physical fitness with lesser fatigue experienced during exercise, most of the research involved resistance exercise or functional training. How aerobic exercise in a circuit pattern affects immunity was not explored. This study aimed to investigate the effects of a 6-week circuit aerobic exercise, as compared to cycling exercise, on exercise performance and neutrophil function.

METHODS: We recruited and randomized 16 inactive young men to the circuit exercise group (CAT, n=8, cycling-rowing-elliptical training, each 10-minute bout) or cycling exercise group (CYC, n=8, cycling, 3 sets of 10-minute bout) with moderate intensity (60% of heart rate reserve), 5days/week for 6 weeks. Participants' body composition and cardiorespiratory fitness, were assessed before and after training, using cardiopulmonary exercise testing, respectively. Venous blood samples were collected for analysis of neutrophil subtypes, phagocytosis ability, respiratory burst, and apoptosis using a flow cytometer.

RESULTS: At baseline, CAT and CYC did not show significant differences in mean age, body composition, and cardiorespiratory fitness (VO2peak=30.97±2.93 and 27.86±1.11, respectively). After training, both groups showed significant improvement in VO2peak (within-group mean difference 4.23±0.8, $p<0.001$ and 7.91±0.13, $p<0.001$, for CAT and CYC, respectively). Both groups demonstrated a significant increase in the expression of adhesion molecules (CD16b, $p<0.05$ and CD88, $p<0.05$) on neutrophils. CYC, but not CAT, enhanced phagocytosis of Escherichia coli (E. coli) in neutrophils was observed in ($p<0.05$). However, both training was insufficient in facilitating respiratory burst and the subsequent apoptotic activity.

CONCLUSION: A 6-week circuit aerobic exercise improves cardiorespiratory fitness in inactive men along with improved expression of adhesion molecules and phagocytosis, but did not regulate the release of oxidant product and subsequent apoptosis of neutrophils.

EXPLORING IMPACT OF EXERCISE ON ERYTHROCYTE LIFE SPAN VIA EXHALATION TESTS

CHEN, X.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Red blood cell lifespan (RBCL) refers to the survival time of red blood cells in circulating blood after being released from bone marrow.This index varies greatly between different individuals of the same species. The normal value of human red blood cell life is 120±10 days. Red blood cell life is usually used as an important physiological indicator to reflect the survival state of red blood cells.

The successful development of exhaled breath analysis instrument can quickly and accurately measure the content of CO and CO2 in gas samples, and obtain the sample red blood cell life data after calibration and calculation.The collection of samples is also very convenient, only by simple blowing.It can achieve dynamic detection that can not be completed by marker method [1].

METHODS: By comparing the red blood cell life data of different samples, to explore the effects of different exercise intensity and duration on the human red blood cell life index, and provide scientific reference for healthy exercise. The latest version of exhaled breath analyzer was used to collect the exhaled breath sample data of each subject regularly, and the exhaled breath related components of the sample were analyzed quantitatively and accurately combined with Levitt method to calculate the red blood cell life. Using the group random sampling method, a random sampling was conducted among the undergraduates and graduates of Beijing Sport University, and 31 sample data were obtained. The daily exercise habits and long-term exercise years of the subjects were investigated, and they were divided into a sedentary group, a moderate group and a professional group. The exhaled gas content and the red blood cell life data of the samples in each group were compared and analyzed.

RESULTS: The average red blood cell life of normal humans was 120±10 days. The average red blood cell life of the long-term high-intensity exercise group was 101.3, which was lower than the normal adult red blood cell life. The average red blood cell life of the long-term sedentary group was 124.1 days, and the average red blood cell life of the continuous moderate exercise load group was 138.9 days, which were both within the normal adult red blood cell life range.

CONCLUSION: Long-term participation in high-intensity overload exercise will have a certain negative impact on the body, resulting in the shortening of the life of red blood cells. The people involved in physical training should exercise scientifically and reasonably. It also provides a scientific theoretical basis for the rational and healthy participation in exercise, the development of scientific exercise plans.

[1], Li Luxi, Deng Huimin, Ma Wen, et al. Progress in the Detection of Erythrocyte Lifespan by Exhalation Tests and its Clinical Application [J]. Medical Recapitulate, 2019, 25 (04): 706-710.

PSYCHOPHYSIOLOGICAL RESPONSES OF NOVICE ESPORTS PLAYERS AFTER SUSTAINED MOBILE GAME PLAYING

AJJIMAPORN, A., BUAPRAPAHN, P., SENWANDEE, P., SIRISOONTHORN, N., CHALERMTHAMRONG, P., MILLS, A., RAMYARANGSI, P.

MAHIDOL UNIVERSITY

INTRODUCTION: The online mobile game Realm of Valor (ROV) has gained significant global popularity due to providing competitive thrill and entertainment (1). Owing to the games heightened competitiveness and entertainment value, players often engage in prolonged gameplay sessions. However, this extended sedentary behavior could be linked to an increased risk of all-cause mortality (2). Given this context, the purpose of the present study was to examine the impact of sustained ROV gameplay on the psychophysiological responses of novice Esports players.

METHODS: A total of twenty Esports participants, whose ages ranged from 20 to 22 (with a mean age of 21+1 years), took part in the investigation. They were divided into four teams, with five players per team. Each team was randomly assigned to compete against an opposing team in a series of three ROV games (approximately 60 minutes) and seven ROV games (approximately 180 minutes). The psychophysiological variables including heart rate (HR), stress levels, cognitive functions, and visual short-term memory (VSM) were measured pre-and post-competition.

RESULTS: The findings of the study indicate a significant increase in HR following competition in both the three-game and seven-game conditions, as compared to the baseline measurements ($p<0.05$). Furthermore, stress levels were significantly higher after playing seven games compared to three games ($p<0.05$). Conversely, cognitive function was found to be

enhanced in the three-game condition compared to the seven-game condition ($p<0.05$). No significant effect was found for either group on VSM.

CONCLUSION: The present study demonstrated that prolonged periods of online ROV mobile gameplay could elevate HR and stress response in gamers, indicating that the immersive, competitive, and fast-paced nature of battle games such as ROV could trigger physiological reactions that mimic the bodys response to stress. From a practical standpoint, gamers should exercise caution and be mindful of the duration of their gameplay sessions. The promotion of responsible gaming habits and generating awareness of the potential health implications would also seem important in maintaining a balanced and healthy lifestyle for recreational Esports gamers.

References

1) How many people play Arena of Valor? -2023 statistics [Internet]. 2023 [cited 15 November 2023]. Available from: https://levvvel.com/arena-of-valor-statistics/

2) Rezende LFM, Sa TH, Mielke GI, Viscondi JYK, Rey-Lopez JP, Garcia LMT (2016). Am J Prev Med. 51(2):253-263.

PHYSICAL ACTIVITY MODERATES THE ASSOCIATION BETWEEN CHRONOTYPE AND SLEEP IN HIGHLY ACTIVE ITALIAN UNIVERSITY STUDENTS

GALASSO, L.1, CASTELLI, L.1, CIORCIARI, A.1, BORRELLI, M.1, ESPOSITO, F.1, MONTARULI, A.1, ROVEDA, E.1

1 UNIVERSITY OF MILAN

INTRODUCTION: Active university students generally report better sleep quality than their inactive mates, as well as Morning- (MT) sleep better than Evening-types (ET) [1-3]. The present study evaluates the differences in sleep quality (SQ) in highly active students and the potential moderation effect of physical activity (PA) on the relationship between SQ and chronotype.

METHODS: 433 university students at the Sports Science School (University of Milan) (males=70%; 19.7±1.6 years) filled in the Godin-Shepard Leisure-Time Physical Activity Questionnaire (GSL-TPAQ – LSI as measure unit), Pittsburgh Sleep Quality Index, and Morningness-Eveningness Questionnaire, to assess PA, SQ, and chronotype. All the participants were highly active and divided into tertiles based on GSL-TPAQ: low (LSI<53), medium (LSI>53 and<72), and high (LSI>72). A three-way ANOVA (sex, chronotype, and PA effects) and moderation analysis with PA, SQ, and chronotype as the moderator, independent and dependent factors were performed.

RESULTS: 65% of the participants were good sleepers. The chronotype*physical activity interaction was significant ($p=0.03$), with ET sleeping significantly worse than Neither-types (NT) considering either low (ET: 5.4±2.2; NT: 4.5±1.7; $p=0.04$) or medium PA tertile (ET: 5.3±2.1; NT: 4.4±1.9; $p=0.03$) and compared to MT in high PA tertile (ET: 5.7±1.8; MT: 4.4± 2; $p=0.02$). Considering the MT sample, the participants in the low PA tertile slept significantly worse than those in the high PA tertile (low: 5.6±1.8; high: 4.3±2; $p=0.05$). The moderation analysis was significant ($\beta=0.4$, $p=0.02$) at the 50th and 84th percentile ($p<0.001$, $p<0.001$, respectively), explaining that, in the medium-high PA level, only MT improved the sleep quality while increasing the PA.

CONCLUSION: University students of Sports Science showed good sleep quality. Their active nature could predispose them to sleep better. MT, rather than ET, university students are those who benefit most from PA to improve their SQ. ET students have to deal with various factors affecting their SQ, and the PA alone is insufficient to smooth out the problems causing bad SQ.

1. Litwic-Kaminska, K, Sleep quality of student athletes and non-athletes. Sleep Sci. 2020. 13(4):249–255.

2. Silva, VM, Quality of sleep and anxiety are related to circadian preference in university students. 2020. PLoS One.15(9):e0238514.

3. Wang, F, Determinants of sleep quality in college students: A literature review. Explore, 2021. 17(2):170–177.

COMPREHENSIVE ASSOCIATION BETWEEN PART-TIME JOBS AND LIFESTYLE/HEALTH AMONG JAPANESE UNIVERSITY STUDENTS

ANNOURA, T.1, AOYAGI, O.2, NAGAMINE, K.2, KOMURE, I.2, TAGATA, S.3, OHYAMA, Y.4, YAITA, A.

JAPAN UNIVERSITY OF ECONOMICS

INTRODUCTION: In Japan, most university students spend their student life working part-time. It is not unusual for some PTJs (part-time jobs) to end late at night, start early in the morning, or require irregular and long hours. As a result, students may not get enough sleep, may easily rely on eating out or fast food for meals, and may also suffer from a lack of exercise and stress stemming from interpersonal relationships. These could have a serious impact on their lifestyles/health. Therefore, this study examined the comprehensive relationship between PTJs and lifestyle/health among Japanese university students.

METHODS: The subjects were 452 university students (283 males and 169 females) from F city in Japan. The survey items included 1) The number of PTJs per week; 2) The type of PTJ; 3) Hours per day; 4) Start time; and 5) The end time of the PTJ. It also incorporated 4 items related to "Sleep," such as "Waking time" and "Sleeping time;" 5 items related to "Diet," e.g., "The number of breakfasts;" 7 items related to "Exercise," including "Membership in an athletic club" and "Time spent doing high-intensity exercise;" and 7 items, e.g., grades, smoking, drinking, use of cell phones, and housing, 23 items in total. A cross table of options combining each of the 5 items related to part-time work and each of the 23 items related to

lifestyle was created and tested for independence. The data was formed in which 1 was inserted when significantly related and 0 when not. Then, to examine the comprehensive association between the two, the Quantification Theory Type Three (QTTT) was applied to the data. A cluster analysis was performed on the configuration showing the degree of mutual association obtained, and groupings were made.

RESULTS: The scree plot of the contribution of each dimension obtained in QTTT showed an elbow between the 2nd and 3rd dimensions, and since 67.5% was explained up to the 2nd dimension, a two-dimensional solution was adopted. A cluster analysis was performed on the two-dimensional configuration obtained, and grouping resulted in five clusters with every cluster containing each item of the PTJ. The 1st cluster containing "the number of PTJs per week" included "Sleep satisfaction" and "The number of times of strong-intensity exercise;" the 2nd cluster incorporating "Type of PTJ" contained "Waking time" and "The number of cigarettes smoked;" the 3rd cluster with "Hours per day" included "Sleeping hours" and "Exercise content." the 4th cluster containing "Start time" included "The number of lunches" and "The number of evening meals"; and the 5th cluster with "The end time of PTJ" encompassed "Bedtime," "The number of breakfasts," and "The number of evening meals." From this, it can be assumed that a PTJ imposes some restrictions on a student's sleep, exercise, and diet, which in turn affects a healthy lifestyle. In other words, long hours of part-time work that extend into the late-night hours may harm a student's healthy lifestyle.

CONCLUSION: EFFECTS OF THREE HOURS UNINTERRUPTED SITTING, FOWLER'S, AND STANDING POSITIONS ON MUSCLE OXYGEN METABOLISM

ENDO, T., TANAKA, R., SUZUKI, S., KATO, Y., HAMAOKA-FUSE, S., KUROSAWA, Y., KIME, R., HAMAOKA, T.

MEIJO UNIVERSITY

INTRODUCTION: Prolonged sitting in daily life increases the risk of all-cause mortality and is associated with the morbidity of cardiovascular disease, cancer, and diabetes [1]. Although the underlying mechanisms are not fully understood, the acute impacts of prolonged sitting on human physiological parameters are a decline in lower-limb blood flow and vascular endothelial function, induced by gravity and reduced muscle activity during prolonged sitting [2]. However, it remains unknown whether reduced peripheral microcirculation in the lower limbs during prolonged sitting would change peripheral metabolic function. We therefore aimed to examine the effects of maintaining 3-h uninterrupted sitting (SiP), Fowler's (FP), and standing positions (StP) on lower-limb muscle oxygen metabolism.

METHODS: Seven healthy young participants (5 males and 2 females; age, 18.4 ± 0.7 yrs; body mass index, 18.8 ± 2.2 kg/m2) performed three posture maintenance experiments in randomized order on separate days. Each participant rested in a supine position for 30 minutes, followed by maintenance of 3-h uninterrupted SiP, FP, or StP. Muscle oxygen metabolism (resting metabolic rate, RMR) in the tibialis anterior (TA) and medial head of the gastrocnemius muscle (MG) was evaluated from the rate of decline in muscle tissue oxygen saturation (StO2) with an arterial cuff occlusion test using near-infrared spectroscopy [3]. Two-way repeated-measures ANOVA was used to compare the changes in RMR due to posture maintenance. For all statistical analyses, $P < 0.05$ was accepted as the level of significance. All data are expressed as mean ± standard deviation.

RESULTS: In TA, the relative changes in RMR before and after the maintenance of SiP, FP, and StP were a 20.9 ± 11.7% reduction, a 28.7 ± 24.2% reduction, and an 8.1 ± 17.4% reduction, respectively. In MG, the changes in SiP, FP, and StP were a 21.9 ± 20.3% reduction, a 31.7 ± 18.0% reduction, and an 11.9 ± 18.5% reduction, respectively. There were no interactions between time (baseline vs. post) and posture for RMR in TA or MG ($P = 0.11$ and $P = 0.22$, respectively), whereas significant main effects for time were found in both TA and MG ($P = 0.01$ and $P < 0.01$, respectively).

CONCLUSION: Maintaining 3-h uninterrupted SiP, FP, and StP significantly reduced lower limb muscle oxygen metabolism. In addition, the minor changes in RMR in StP, where muscle activation in TA and MG is assumed to be greater, suggest that intermittent muscle contractions during posture maintenance may prevent the decline in muscle metabolism.

REFERENCES:

1) Biswas A et al., Ann Intern Med, 2015.

2) Padilla J & Fadel PJ, Am J Physiol Heart Circ Physiol, 2017.

3) Hanna R et al., Physiol Rep, 2021.

THE IMPACT OF RACE/ETHNICITY ON MEASURES OF PHYSICAL FUNCTION: A SCOPING REVIEW

MBULI, A., GALLAGHER, I.1, DIAS-SCOON, M., RICHARDS, J., KALIARNTAS, K.1

1 EDINBURGH NAPIER UNIVERSITY; 2 UNIVERSITY OF CENTRAL LANCASHIRE

INTRODUCTION: Physical function assessments play a crucial role in clinical practice, serving as key indicators of an individuals health status. However, despite their established significance and their association with quality of life and morbidity, these assessments often lack consideration of an individuals race and ethnicity. Race is a sociocultural categorization with shared physical characteristics that influences lives, experiences, perceptions, and health. Ethnicity, on the other hand, is a classification based on familial origins and shared cultural, traditional, and familial bonds and experiences. Given the physiological variations associated with different races/ethnicities, understanding the potential impact on functional movement is essential for accurate health assessments. The aim of this scoping review was to identify and synthesise the relevant literature examining differences among ethnically and racially diverse groups in the assessment of physical function, including measures such as gait speed, Short Physical Performance Battery (SPPB), and grip strength.

METHODS: A comprehensive search strategy was applied using keywords such as: Gait, Walking, Ethnic, Race differences, Physical activity, Physical function. The search covered five databases: PubMed, Science Direct, Web of Science, Medline, and SportDiscus. Only English language publications, and all study designs were included. Independent screening by two reviewers resulted in the inclusion of thirty-five studies meeting the specified criteria.

RESULTS: Studies commonly used the terms "race" and "ethnicity" interchangeably, with only few providing a clear operational definition for each term. In 86% of those focusing on gait speed, significant differences were found between ethnically diverse groups. Black participants consistently exhibited slower walking speeds than White participants, with Whites consistently outpacing other races/ethnicities. Methodological inconsistencies were noted in assessing walking speed, with variations in reporting approaches. Studies that examined grip strength revealed significant racial disparities in performance levels, with Blacks more often in lower SPPB performance categories. Grip strength variations further highlighted racial and ethnic disparities in physical function.

CONCLUSION: This review highlights the importance of considering racial and ethnic differences in the interpretation of different physical function assessments. The multidimensional nature of racial and ethnic differences is evident. This can have significant implications for clinical practice and indicates the need for development of normative datasets for racially and ethnically diverse populations.

CAN CROSSFIT TRAINING INFLUENCE PELVIC FLOOR MUSCLES STRENGTH IN NULLIPAROUS FEMALE ATHLETES?

RODRÍGUEZ LONGOBARDO, C., PÉREZ-CALZADO, E., LÓPEZ-TORRES, O., ÁLVAREZ-SÁEZ, M.M., CANOSA-CARRO, L.
UNIVERSIDAD POLITÉCNICA DE MADRID

INTRODUCTION: CrossFit is a demanding physical conditioning regimen focused on high-intensity exercises and resistance training, that offers numerous healthy benefits. However, its impact on pelvic floor muscles remains less discernible (1). Repeated engagement in CrossFit exercises is believed to induce fatigue in pelvic floor muscles, potentially compromising their ability to contract and withstand stress, thereby increasing the risk of pelvic floor disorders such as urinary incontinence (2). Consequently, this study aims to scrutinize the immediate effects of a CrossFit workout (WOD) on pelvic floor force production among nulliparous female CrossFit athletes with no additional risk factors.

METHODS: Twenty-three female CrossFit athletes participated in this study, undertaking a 15-minute CrossFit WOD involving as many repetitions as possible (AMRAP) of 20 wall balls, 15 box jumps, and 10 burpees. These exercises were specifically chosen to fatigue pelvic floor muscles, as they may trigger urinary leakage (3). Pelvic floor strength measurements were taken before and after the WOD using the Pelvimètre Phenix by Vivaltis (4). A linear mixed model for repeated measures was employed to assess changes in maximal, medium, and minimum force production, treating the subject (ID) as a random factor and time as a fixed factor.

RESULTS: No significant differences were observed in either maximal or minimum force production before and after the WOD ($F = 0.924$, $p > 0.05$; $F = 0.025$, $p > 0.05$, respectively). However, medium force production increased post-WOD ($F = 4.354$, $p = 0.041$, $ES = 0.45$).

CONCLUSION: Participating in a CrossFit WOD does not seem to impact overall pelvic floor strength in female athletes. The observed increase in medium force production post-WOD may be attributed to improved proprioception and heightened familiarity with pelvic floor contractions, even in the face of increased general fatigue.

References:

(1) Gephart LF, Doersch KM, Reyes M, Kuehl TJ, Danford JM. Intraabdominal pressure in women during CrossFit exercises and the effect of age and parity. Baylor University Medical Center Proceedings. 2018;31(3):289-293. doi:10.1080/08998280.2018.1446888

(2) Thomaz RP, Colla C, Darski C, Paiva LL. Influence of pelvic floor muscle fatigue on stress urinary incontinence: a systematic review. Int Urogynecol J. 2018;29(2):197-204. doi:10.1007/S00192-017-3538-6

(3) Yang J, Cheng JW, Wagner H, et al. The effect of high impact CrossFit exercises on stress urinary incontinence in physically active women. Neurourol Urodyn. 2019;38(2):749-756. doi:10.1002/nau.23912

(4) Navarro Brazález B, Torres Lacomba M, de la Villa P, et al. The evaluation of pelvic floor muscle strength in women with pelvic floor dysfunction: A reliability and correlation study. Neurourol Urodyn. 2018;37(1):269-277. doi:10.1002/NAU.23287

DOSE-RESPONSE EFFECTS OF HYBRID-TYPE, MULTICOMPONENT INTERVAL TRAINING ON MENTAL HEALTH-RELATED PARAMETERS IN OVERWEIGHT AND OBESE ADULTS

BATRAKOULIS, A., MORRES, I., JAMURTAS, A., POULIOS, A., DRAGANIDIS, D., LOULES, G., PAPANIKOLAOU, K., TSIMEAS, P., ANGELOPOULOS, T., DELI, C., HATZIGEORGIADIS, A., FATOUROS, I.
UNIVERSITY OF THESSALY

INTRODUCTION: The increasing prevalence of overweight/obesity is a serious public health challenge negatively affecting more than one in two adults globally. Physical exercise is an essential component of an all-inclusive strategy for preventing, managing and treating obesity-related mental health disorders. In particular, a hybrid-type, multicomponent interval training programme (DoIT) has been reported as an effective exercise solution for lowering distress while increasing subjective vitality and exercise behavioral regulation. This study investigated the dose-response relationship between a 1-year hybrid-type, multicomponent interval training and mental health-related parameters in overweight and obese adults in the real world.

METHODS: This study was a 4-group, randomized controlled trial using a parallel-group design. Initially, 215 volunteers were interviewed, 120 met the eligibility criteria and were recruited and 97 completed the study. DoIT was a supervised, intermittent-type, multimodal exercise protocol using progressive full-body resistance training with nontraditional modalities in a circuit fashion. Following a power analysis, 97 middle-aged (44.8 ± 5.2 years) individuals (66% females) with overweight/obesity (body mass index: 31.2 ± 5.7 kg/m2) were recruited and randomly divided into four groups: i) DoIT assigned to 1 session/week (DoIT-1, n=24), ii) DoIT assigned to 2 sessions/week (DoIT-2, n=23), iii) DoIT assigned to 3 sessions/week (DoIT-3, n=21), and iv) no-exercise control group (CON, n=29).

RESULTS: No baseline differences were detected in all outcome variables. The overall dropout rate was 19%. At post-training, all DoIT groups showed more beneficial changes than CON in (i) exercise enjoyment (+26% to +37%, p<0.001); ii) affective valence (-35% to -40%, p<0.001); (iii) physical QoL (+7% to +10%, p<0.001); (iv) mental QoL (+7% to +13%, p<0.001); (v) mood (+29% to +53%, p<0.001); (vi) depression (-21% to -47%, p<0.001); (vii), and anxiety (-19% to -40%, p<0.001). DoIT-induced adaptations were somewhat volume-dependent showing a dose-response relationship between weekly exercise volume (DoIT-3 vs. DoIT-1) and the magnitude of mental health improvements. These adaptations were observed even with a limited net exercise time (DoIT-1, 14 min/wk). Correlational analyses revealed low to moderate positive relationships (r=.29–.36, p<.05) between body mass and anxiety, depression, and mood, while both physical and mental HRQoL demonstrated a low to moderate negative relationship (r=–.25 to –.37, p<.05) with body mass at post-training.

CONCLUSION: These outcomes indicate that a low-volume, multicomponent interval training approach integrating body-weight movements and functional resistance-based exercises into a real-world gym setting may improve various mental health-related markers in a dose-dependent manner (3 d/wk vs. 1 d/wk) in previously inactive, middle-aged overweight and obese individuals.

COMPARISON OF PHYSIQUE AND MOTOR SKILLS OF KOREAN AND JAPANESE INFANTS BY AGE.

KIM, M.J., KWAK, Y.S.

1. SAITAMA JUNSHIN COLLEGE, JAPAN 2. DONG EUI UNIVERSITY, KOREA

INTRODUCTION: In Korea and Japan, childrens physical strength and exercise ability tend to decline as they get older. Although many studies have been conducted on infant physique and physical strength in both countries, there seems to be a lack of mechanism research on comparing physical activity and motor skills between Korean and Japanese children. In addition, since Korean and Japanese children have age differences, the researcher needs to consider the age difference when comparing physical ability levels between Korean and Japanese children. By doing so, we can obtain more accurate and meaningful results that can inform promoting physical fitness, motor ability, and health promotion in both countries. Therefore, this study aimed to clarify the physical characteristics of infants growth and development in both countries by comparing the characteristics of physique and motor ability of infants in the two countries by age.

METHODS: In Korea and Japan, physique and motor skills were measured on 3- to 5-year-old children attending kindergarten. The subjects were 245 children in Korea (boys, 3.95 ± 0.81 years, girls, 3.93 ± 0.82 years), and 232 children in Japan (boys, 4.04 ± 0.79 years, girls, 4.20 ± 0.80 years). Age was divided into two groups: 0-5 months and 6-11 months, and each age group was classified. Since Korea and Japan have different kindergarten class systems by age, the 0-5 months group is born between July and December in Korea, and between October and March in Japan. The 6-11 months group is born between January and June in Korea and born between April and September in Japan.

Physique was measured by height and weight. Motor ability was measured using the MKS Infant Ability Test, which included 7 events: 25m run, 15m round trip running, standing long jump, tennis ball throw, repeated double-foot jump, body support endurance time, and ball catching.

RESULTS: In Korea, the average body weight for boys in the 5-year, 6-11 months group was 23.56±6.40kg, in girls, 17.96±2.52kg in the 4-year-old, 6-11 months group, and 23.15±3.81kg in the 5-year-old, 6-11 months group were lower than the average for the 0-5 months group, weight can change as children age (p<0.001). In addition, in terms of athletic ability, in the Korean group of 6 to 11 months old, 25 m running (9.77 ± 2.52 s for girls at 3 years old), 15 m round trip running (10.86 ± 1.29 s for girls at 3 years old), standing long jump (93.63 ± 15.61 cm for boys at 4 years old), Regarding the duration of support (8.34±8.99s for males aged 3 years), there was a tendency for the mean value to be slightly higher in the 0-5 months group (p<0.001). In Japan, the average values of the 0-5 months group were slightly higher in tennis ball throwing (8.13±2.51 m for 5-year-old boys) and catching (7.75±2.45 times for 5-year-old boys, 7.15±2.07 times for 5-year-old girls) (p<0.001).

CONCLUSION: Accordingly, it was revealed that Korean and Japanese infants differ in age-related changes in physique and motor ability. Further study is needed in this area.

HEART RATE VARIABILITY DYNAMICS DURING LONG-HAUL TRAVEL IN ELITE CHEERLEADERS – A PILOT STUDY

RIDDELL, S., LUBIAK, S., GAVANDA, S., LANGE, M., HOUSTON, F., TAMULEVICIUS, N.

1. UNIVERSITY OF TAMPA, 2. UNIVERSITY OF CENTRAL FLORIDA, 3. IST UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Heart rate variability (HRV) reflects neurocardiac function and is often used as a marker of fatigue (1,2). A variety of factors can influence HRV characteristics, which may be marker for readiness before athletic performance (2,3). However, there is a lack of information regarding these characteristics amongst elite cheerleaders prior to competition. The purpose of this investigation was to assess whether long haul travel influenced readiness for competition by examining HRV among elite cheerleaders traveling to the World Championships.

METHODS: Seven elite cheerleaders (M: 4; W: 3; 24±2.8 y.o; 172±15.7 cm; 75.3±15.7 kg) from the All Girl and Coed National German Cheerleading Teams (Cheersport) were monitored during their flight from Germany to the United States. Each participant wore the heart rate (HR) monitor (Acentas, Hörgertshausen, Germany) throughout the duration of their travel, including the flight, connections, and delays. HR data was collected across the total 16-hour travel duration and was based on the Kubois HRV Lite Software (4.1.0) which determined root mean square of successive differences between normal heart beats (RMSSD), RR interval (RR), heart rate (HR), parasympathetic nervous system index (PNS), and sympathetic nervous system index (SNS). To identify differences across time, data was collected at 4hr and 16hr time points. Due to the small sample size, Wilcoxon Signed Rank tests were performed to assess mean differences across time.

RESULTS: There were no significant ($p>0.05$) differences across time for all HRV characteristics. Specifically, across time, there were no significant differences for RMSSD (47.6±26.3 vs. 50.6±23.7ms ; $p=0.865$), RR (749.7±86.5 vs. 752.1±87.6ms; $p=0.297$), HR (81.1±9.1 vs. 82.6±8.2bpm; $p=0.399$) PNS (-0.6±1.2 vs. -0.5±1.1; $p=0.688$), or SNS (0.6±0.8 vs. 0.6±1; $p=0.352$).

CONCLUSION: HRV was not affected during long haul travel among elite cheerleaders. There are some considerations as to why this occurred such as age, and physical activity. Due to the Cheerleaders' advanced training background, and younger cardiac tissue, HRV maintained over the time periods. Further research is needed to examine whether variables such as sex or training background are sensitive on HRV during long haul travel.

REFERENCES:

1. Shaffer & Ginsberg. Frontier Public Health, 258(5), (2017)

2. Bestwick-Stevenson et al. International Journal of Sports Medicine, 43(14), 1151–1162 (2022)

3. Flatt & Howells D. International Journal of Sports Physiology Performance, 17(6), 951-960, (2022)

SPORTS LEVEL VS. AEROBIC ENDURANCE OF ELITE POLISH FEMALE ATHLETES IN SPORTS AEROBICS

OZIMEK, M., CIEPIELOWSKA, J., DUDEK, D.

UNIVERSITY OF PHYSICAL EDUCATION IN KRAKOW, JAGIELLONIAN UNIVERSITY IN KRAKOW

INTRODUCTION: Sports aerobics is a young discipline, gaining popularity year after year around the world and developing more and more rapidly in Poland as well [1]. Among the essential motor abilities in sports aerobics for training, learning and coaching are endurance (aerobic) abilities [2]. The main purpose of this study was to determine the variation of aerobic endurance parameters by sport level, of the best Polish female athletes in sports aerobics in relation to a control group.

METHODS: In order to achieve the objectives of the study, a group of 25 women from the best sports aerobics sections in Poland were surveyed. Among the subjects, the elite, the top 3 athletes in terms of sports performance (ranking of athletes according to the most important achievements in sports aerobics competitions) were selected. The oxygenic efficiency - BIP TEST - what 3 min. the growth of burden and the biochemical investigation (K4b2 Cosmed, BIOSEN C - line). The study was approved by the Bioethics Committee of the Regional Chamber of Physicians in Krakow No. 42/KBL/OIL/2015.

RESULTS: The results showed that the elite athletes differed from the control group in terms of indicators: Rf (b/min) - medium to high, VE (l/min) - medium, VO2max (ml/min/kg) - medium, and HR (beats/min) - medium to high. The largest values of normalized differences were noted, in terms of lactate concentration measurements, especially the maximum blood lactate concentration measured after exercise (max_LA (mmol/L). The results presented here may indicate positive adaptive changes of the cardiovascular system to the effort of elite female athletes and thus the achievement of a higher level of sports.

CONCLUSION: Similar thematic papers have also looked for correlations between aerobic endurance performance of male and female athletes in sports aerobics, indicating positive adaptive changes of the cardiovascular system to exercise in this (and similar to gymnastic aerobics) sport [3, 4, 5, 6].

References

1. Cichalewska et al. 2002, 2. Tibenská et al. 2010, 3. Regecova and Andrásyova 2002, 4. Kyselovičová and Tibenská 2007, 5. Aleksandraviciene et al. 2015, 6. Artemyeva and Khorkova 2019

THE EFFECTS OF MAT AND APPARATUS PILATES EXERCISE ON BODY COMPOSITION, BASIC PHYSICAL FITNESS, AND LUMBAR ACTIVITY IN ADULT WOMEN.

KIM, D., TAE DONG, K., DONG HUN, S., GI DUCK, P.

KYUNGPOOK NATIONAL UNIVERSITY

INTRODUCTION: The purpose of this study is to compare the effects of Mat Pilates and Apparatus Pilates on body composition, basic fitness, and lumbar muscle activation in a sample of 20 healthy adult women, with the aim of determining which exercise is more effective. Additionally, the study aims to provide foundational data for the development of Mat Pilates and Apparatus Pilates exercise programs.

METHODS: Participants in this study excluded individuals with a surgical history within the last 3 months, vascular diseases, or neurological issues. The subjects were randomly divided into two groups: 10 participants in Mat Pilates and 10 participants in Apparatus Pilates. Over the course of 8 weeks, the participants engaged in exercise sessions three times a week, with each session lasting 50 minutes, totaling 24 sessions. The outcomes are as follows.

RESULTS: Firstly, both Mat and Apparatus Pilates exercises showed significant changes in skeletal muscle mass and body fat percentage compared to baseline (p<.001). However, there was no statistically significant difference between the two groups (p>.05).

Secondly, both Mat and Apparatus Pilates exercises exhibited significant changes in muscular strength, muscular endurance, and flexibility for basic fitness compared to baseline (p<.001). Nevertheless, there was no statistically significant difference between the two groups (p>.05).

Thirdly, both Mat and Apparatus Pilates exercises demonstrated significant changes in lumbar muscle activation, including left and right rectus abdominis muscle, external oblique muscles, superior erector spinae muscle, and inferior erector spinae muscle, compared to baseline (p<.001). However, there was no statistically significant difference between the two groups (p>.05).

CONCLUSION: Through this study, it can be confirmed that an 8-week Mat and Apparatus Pilates exercise program for healthy adult women has positive effects on body composition, basic fitness, and lumbar muscle activation. Moreover, despite significant differences observed within each group from pre to post, there were no significant differences between the two groups. Therefore, it is recommended to engage in either Mat or Apparatus Pilates exercise based on individual preferences and circumstances. Considering the decreasing age range of spinal disorders among modern individuals, Pilates exercises, incorporating both Mat and Apparatus techniques, are actively encouraged for maintaining a pain-free and fulfilling life.

LIGHT AEROBIC TRAINING COMBINED WITH WHOLE BODY VIBRATION, OR A WEIGHTED VEST PROTECTS AGAINST BONE LOSS IN OSTEOPENIC OR OSTEOPOROTIC OLDER FEMALES.

MANIMMANAKORN, A., TANTANASEST, J., MANIMMANAKORN, N., HAMLIN, M.J.

KHON KAEN UNIVERSITY

INTRODUCTION: Older adults suffer from degenerative physiological changes including musculoskeletal disorders such as osteoporosis, osteopenia, and sarcopenia. Several studies have reported that a reduction of muscle strength and muscle mass lead to a high prevalence of low bone mineral density (BMD) osteopenia and osteoporosis. Resistance exercise training is recommended as an effective way to stimulate bone osteogenesis in osteoporosis patients. Other forms of exercise that stress the osteogenic pathways may also prove useful in such patients including aerobic training with whole body vibration or aerobic training with weighted vests. The aim of this study was to investigate the effect of light aerobic exercise supplemented with weighted vest or whole-body vibration on BMD and skeletal muscle mass in osteopenic or osteoporotic older females.

METHODS: This randomized controlled trial was conducted on 31 osteopenia/osteoporosis females (T-score -2.15±0.9, mean ± SD) aged 60 to 79 years. The participants were randomly assigned to one of three experimental groups. The control group (CON; n=10) received 40 minutes of light aerobic exercise3 days per week for 8 weeks, whereas the weighted vest group (WV; n=11) completed the same aerobic exercise program wearing a vest filled with sand equivalent to 5% (first 2 weeks) then 10% (last 6 weeks) of their body weights. The whole-body vibration group (WBV; n=10) completed the same aerobic exercise programme supplemented with vibration exercise (30 Hz., 1 min x 8 sets) he BMD, muscle mass and percent body fat of participants were assessed before and after the 8 weeks training.

RESULTS: We found a significant decrease in BMD over the course of the study in the CON group (pre = 956 ± 58, post = 941 ± 57 mg/cm2, p<0.05, mean ± SD) but no substantial BMD changes in WV and WBV groups. Only the WV participants showed a significant increase in leg lean mass (pre = 11.69 ± 1.59, post = 12.82 ± 2.13 kg, P< 0.05). Like the BMD changes, skeletal mass index (SMD) showed a significant reduction (pre = 6.38 ± 0.6, post=6.22 ± 0.7 kg/m2, p<0.05) only in CON participants, with unchanged SMD in the WV and WBV groups (p>0.05). Furthermore, compared to the pre-test, only participants in the WV (92.95 ± 36.80 m) and WBV (57.80 ± 41.18 m) groups substantial improved their aerobic performance in the 6-min walk test.

CONCLUSION: The addition of a weighted vest or whole-body vibration training to light aerobic exercise may protect against bone mineral loss in older female participants. This may be a practical therapeutic exercise for osteopenic or osteoporotic individuals.

EFFECTS OF HEALTH PROMOTION TO PREVENT DISEASES OF THE LOCOMOTOR SYSTEM IN COMMUNITY PHARMACIES

ONUMA, N., NAKAJIMA, R., MATSUO, E., OGAWA, T., SHINDO, D.

NIHON UNIVERSITY

INTRODUCTION: Japan is a super-aging society, and the number of older people suffering from diseases of the locomotor system, such as sarcopenia and osteoporosis, is increasing. Locomotor diseases are a challenge for health promotion as they can cause a person to become bedridden. Recent health promotions by community pharmacies have attracted attention. Although Europe and the United States have made various efforts, limited efforts have been made to prevent locomotor system diseases or verify their effectiveness in Japan. This study aimed to examine efforts to prevent musculoskeletal diseases in community pharmacies and evaluate their effectiveness.

METHODS: We conducted physical (body composition, such as weight and muscle mass, locomotive syndrome risk test and grip strength) and conscious surveys (exercise habits and health awareness) among participants recruited from local pharmacies (three stores). The same measurements and surveys were obtained again approximately three months later (second time) to examine any changes.

RESULTS: This study included 44 people (74.3±1.74 years) who participated in both the surveys. Physical examination revealed no significant differences in body composition or grip strength. The locomotive syndrome risk test consisted of a stand-up and two-step test. The percentage of people who fell under locomotive syndrome stage (LS stage) 3, those at high-risk of Locomotive Motion, was 13.6% in the first test. However, it reduced to 6.8% in the second test. The percentage of people with LS stage 2, a state that indicated progressed decline in mobility, decreased from 22.7% to 15.9%. Furthermore, those with LS stage 1, which indicated the beginning of a decline in mobility, increased from 63.6% to 77.3%. Regarding the awareness survey, 25% answered that they exercised more often and 58% reported that they became more conscious of their health after the first measurement.

CONCLUSION: Although health support was implemented at pharmacies for three months, the rates related to locomotor disorders improved.

EFFECT OF EXERCISE INTERVENTION ON TELOMERE LENGTH AND MITOCHONDRIAL DNA COPY NUMBER IN BREAST CANCER SURVIVORS: A RANDOMIZED CONTROLLED TRIAL

KONG, I.D.1, MIN, J.H.2

YONSEI UNIVERSITY WONJU COLLEGE OF MEDICINE, NATIONAL CANCER CONTROL INSTITUTE, NATIONAL CANCER CENTER

INTRODUCTION: Telomeres, repetitive nucleotide sequences situated at the terminal ends of linear chromosomes, play a pivotal role in maintaining genomic stability. Telomere length (TL) is intricately linked to biological aging, and cancer treatments are known to contribute to telomere shortening. While the benefits of exercise in breast cancer survivors (BCs) are well-established, its specific impact on TL remains an active area of investigation. This study aims to explore the factors associated with TL and evaluate the efficacy of exercise on TL in BCs.

METHODS: Fifty BCs (Stage 0-3), with a mean age of 53.9±6.5 years, were randomly assigned to either the exercise or usual care group (1:1 ratio). Participants in the exercise group engaged in a supervised aerobic and resistance exercise program three times a week via Zoom (30 minutes per session for 12 weeks) along with unsupervised home-based exercises. The control group maintained their usual daily activities. The primary outcomes measured were TL and mitochondrial DNA copy number.

RESULTS: Of the 50 participants enrolled, 46 (92%) completed the trial with high exercise compliance. Baseline measurements revealed a positive correlation between TL and mitochondrial DNA copy number ($p<0.001$) and negative correlations with WISP-1 ($p<0.01$) and WISP-2 ($p<0.05$). BCs in the exercise group demonstrated significant improvements in Telomere/Single Copy Gene (T/S) ratio (1.7±0.7 vs. 2.5±0.9; $p<0.01$) and mitochondrial DNA copy number (291.3±124.6 vs. 453.5±182.2; $p<0.001$). Conversely, the usual care group exhibited a significant decrease in T/S ratio (2.5±0.8 vs. 1.8±1.1; $p<0.05$) and mitochondrial DNA copy number (464.2±212.3 vs. 274.8±140.9; $p<0.001$) after 12 weeks compared to baseline.

CONCLUSION: The implementation of a remote exercise intervention resulted in a significant improvement in TL in breast cancer survivors. These findings highlight the potential of structured exercise programs to impact telomere dynamics in this population positively. Further research is warranted to explore the long-term implications and mechanisms underlying this observed improvement.

QUALITY ASSESSMENT TOOL FOR THE PHYSICAL ACTIVITY CAPACITY OF URBAN GREEN SPACES

WU, Y., YU, Z., HAOYUE, X., YUNJING, H.

NORTHEAST FORESTRY UNIVERSITY

INTRODUCTION: Physical activity (PA) can effectively improve the publics health, and urban green space (UGS) is an important carrier for PA, influencing the publics physical health, mental health, and social health to varying degrees. The improvement of accessibility and quality of UGS has a positive impact on PA [1], which is crucial for the publics health development. However, existing research often focuses more on the fairness of UGS, and does not pay enough attention to the diverse and multi-level PA needs of the public, making it difficult to achieve more precise allocation of public resources.

METHODS: The study primarily uses social network analysis (SNA) to construct a dual-layer network model of the physical activity capacity of UGS in Xiangfang District, based on the supply-demand relationship between UGS and PA from an accessibility perspective. The dual-layer network model is analyzed at three levels: overall, sub-area, and individual point, to explore the differences in the physical activity capacity of UGS. Additionally, after considering more influencing factors, a quality assessment system for the physical activity capacity of UGS is constructed, and linear regression analysis is used to explore how the quality of UGS physical activity capacity affects the level of physical activity demand. Finally, the quality level of UGS physical activity capacity is matched with the level of physical activity demand.

RESULTS: When only accessibility is considered, we find a significant imbalance between supply and demand for physical activity capacity in UGS across three levels. Upon integrating quality factors of physical activity capacity in UGS into consideration, we found that, in addition to accessibility factors, for larger UGS areas, the proportion of equipment sports area, the proportion of spatial sports area, and waterfront interface ratio are significantly correlated with the level of physical activity demand. For smaller UGS areas, the proportion of spatial sports area, parking occupancy ratio, and maintenance management level are significantly correlated with the level of physical activity demand.

CONCLUSION: Two major strategies are proposed to achieve more precise optimization of physical activity capacity network system: in areas with no or low physical activity capacity, it is necessary to reasonably supplement small UGS and improve the quality of surrounding UGS; in areas with physical activity capacity, it is necessary to categorically improve UGS nodes that are classified as optimized (quality level > demand level), upgraded (quality level < demand level), or matched (quality level = demand level).

References:

1. Zhang, Y., Koene, M., Reijneveld, S. A., Tuinstra, J., Broekhuis, M., van der Spek, S., & Wagenaar, C. (2022). The impact of interventions in the built environment on physical activity levels: a systematic umbrella review. International journal of behavioral nutrition and physical activity, 19(1), Article 156. https://doi.org/10.1186/s12966-022-01399-6

INVESTIGATING THE RELATIONSHIP BETWEEN GOLFING AND THE PHYSICAL, MENTAL, AND SOCIAL HEALTH AND WELLNESS OF INDIVIDUALS AGED 40-65 YEARS-OLD.

HUANG, M.Y.1,2, HUANG, J.Y.4, HO, Y.K.1, SUM, K.W.2,3

1. PHYSICAL EDUCATION UNIT, THE CHINESE UNIVERSITY OF HONG KONG 2. NEW ASIA COLLEGE, THE CHINESE UNIVERSITY OF HONG KONG 3. DEPARTMENT OF SPORTS SCIENCE AND PHYSICAL EDUCATION, THE CHINESE UNIVERSITY OF HONG KONG 4. FACULTY OF HUMANITIES AND SOCIAL SCIENCES, CITY UNIVERSITY OF MACAU

INTRODUCTION: As people age, the range of suitable, safe, fun, and health-promoting sports activities becomes limited. However, there is one sport that can be played from 3 years old to 80 years old: golf. Compared to other sports, golf offers relatively low intensity and physical aggression, making it particularly suitable for the elderly. Regularly playing golf not only improves physical fitness but also nurtures temperament through moderate-intensity exercise that can be easily pursued by individuals of any age. Golf provides both physical and psychological benefits, fostering mindfulness during play, which can reduce stress, anxiety, and improve sleep quality in older adults. Among various sports, the 4-6 miles of walking during a golf game (equivalent to over 8000 steps) already met the weekly exercise guideline outlined by the Physical Activity Guidelines of ACSM (2020). Moreover, golf movements can enhance shoulder, back, and hip mobility and stability, effectively preventing falls, the most common injury among the elderly.

METHODS: Participants who completed both pre- and post-online or offline meetings and had at least 50% attendance were selected for final data analysis. Research questions were formulated by incorporating relevant topics from previous studies and conducting a cross-sectional survey design to measure height, weight, blood pressure, mental health, and overall well-being between the training group and control group.

RESULTS: A total of 132 middle-aged or elderly golfers from Shenzhen city and Hong Kong, China, were recruited for this study, including 73 males and 59 females (age: 41.5 ± 12.5 years, height: 175.6 ± 8.5 cm, weight: 67.9 ± 17.6 kg, BMI (18.5-24.9). Among them, 29 were professional golfers, 61 were recreational golfers, and 42 were beginner golfers. The beginner group presents the lowest mean data (12.39).

CONCLUSION: This study aimed to identify effective strategies for monitoring the long-term physical mobility and mental health benefits of golf adherence in middle-aged and older adults. After six months of investigation and research, the study concludes that golf provides significant physiological benefits. However, it is worth noting that many recreational golf players start later in life. Chinas golf infrastructure was imperfect in the 20th century, with limited availability of professional golf coaches and training courses, resulting in significant disparities in the reported player data. The beginner group demonstrated the most substantial psychological and physical benefits. Future researchers could expand upon this preliminary study by exploring the relationship between on-course adventure golf participation and specific personality traits. This may reveal additional implications, potentially improving the social happiness index and addressing the life pressures faced by urban individuals, which is an area worth exploring.

HIGH-INTENSITY INTERVAL TRAINING IMPROVES SYSTEMIC AEROBIC CAPACITY AND LYMPHOCYTE BIOENERGETIC EFFICIENCY IN STROKE PATIENTS

LIN, Y.T., WANG, J.

CHANG GUNG UNIVERSITY

INTRODUCTION: Stroke is often accompanied by systemic inflammation, leading to immune dysfunction in the circulatory system. Mitochondrial bioenergetics of lymphocytes are crucial in maintaining the adaptive immune system. Therefore, lymphocyte mitochondrial bioenergetics may serve as predictive biomarkers for stroke prognosis. Exercise training may impact immune functions by affecting mitochondrial biogenetics. This study aimed to elucidate the effect of high-intensity exercise training (HIIT) on lymphocyte mitochondrial bioenergetics in stroke patients.

METHODS: Among the 12 stroke patients who underwent the traditional rehabilitation program (TRP), 6 were randomly assigned to have HIIT (40% to 80% of VO2peak at 3-minute intervals for 30 min/day, 5 days/week for 4 weeks), and those remaining received only the TRP (control group). Peak aerobic capacity and exercise endurance were evaluated by graded exercise testing and a 6-minute walking test (6MWT), respectively. Phenotype characteristics and mitochondrial respiratory capacity in blood lymphocytes were analyzed using flow cytometry and high-resolution respirometry, respectively.

RESULTS: The results demonstrated that stroke patients who underwent HIIT increased the value of VO2peak and the distance of 6MWT as well as enhanced the capacities of mitochondrial oxidative phosphorylation (OXPHOS) and electron transport chain (ETC) in blood lymphocytes. However, there were no changes in systemic aerobic capacity/endurance and lymphocyte mitochondrial respiratory capacity in stroke patients who only received TRP.

CONCLUSION: In conclusion, HIIT improves lymphocyte mitochondrial bioenergetic efficiency by increasing the OXPHOS and ETC capacities in stroke patients. Moreover, the exercise regimen also enhances systemic aerobic capacity and exercise endurance in stroke patients.

SENSORIMOTOR TRAINING AS A TOOL FOR MOTOR SKILLS IMPROVEMENT IN ELDERLY

VARJAN, M., BÖHMEROVÁ, L., SCHICKHOFER, P., HAMAR, D.
FACULTY OF PHYSICAL EDUCATION AND SPORT, COMENIUS UNIVERSITY

INTRODUCTION: Combining endurance activities and resistance training represents most frequently used approach to health oriented physical programs focused on improvement of physical fitness. Nevertheless, some individuals for various reasons may not feel comfortable with this form of exercise program. The present study aims at the evaluation of sensorimotor training as a tool to enhance motor skills in the female elderly population and comparing its effects with a traditional combined resistance-endurance training program.

METHODS: Altogether 34 active, healthy elderly women were randomly assigned to three groups, undergoing different 10-week interventions: the sensorimotor training (SMT, n = 12, age 73.8 ± 4.9 years, height 161.4 ± 5.4 cm, weight 66.4 ± 9.4 kg), the resistance-endurance training (RET, n = 11, age 73.9 ± 4.2 years, height 160. 4 ± 4.7 cm, weight 67.2 ± 8.8 kg), and the control group (CG, n = 11, age 70.4 ± 3.4 years, height 163. 1 ± 5.1 cm, weight 67.0 ± 7.6 kg). Program sessions were performed twice a week from 40 to 60 minutes. The test of 10-meter maximal walking speed and the stair climb test were performed prior to and after the intervention period.

RESULTS: Neither of groups improved significantly maximal walking speed. However, the SMT group improved significantly both, ascendent and descended time in the SCT (from 5.13 ± 0.45 s to 4.55 ± 0.46 s, $p \leq .001$ and from 4.67 ± 0.62 s to 3.99 ± 0.54 s, $p \leq .001$, respectively). On the other hand, no significant changes of ascendent and descendent time were observed in the RET group and event deterioration of descendent time were observed in the CG (from 3.44 ± 0.46 s to 3.78 ± 0.50 s, $p \leq .01$).

CONCLUSION: Results indicate that for untrained individuals in the early stages of intervention even sensorimotor training alone represents sufficient stimulus to improve motor skills. Therefore, particularly in untrained elderly individuals, sensorimotor training may be recommended as a suitable option to enhance motor skills.

TYPE 2 DIABETES MELLITUS EXASPERATED ATHEROSCLEROSIS IS IMPROVED BY AEROBIC EXERCISE THROUGH AMELIORATION OF ENDOTHELIAL FUNCTION

GAO, Y., LU, J., ZHANG, L., XIANG, M., YUAN, X., SUN, W., XU, Y., XIAO, H., ZHANG, Y., TANG, Q.
NANJING SPORT INSTITUTE

INTRODUCTION: Type 2 diabetes mellitus (T2DM) could promote the course of hypercholesterolemia induced atherosclerosis in clinic. Researches have showed chronic hyperglycaemia leaded to glycation reaction generating such as advanced glycated end products (AGEs), which might exacerbate the atherosclerotic plaques through disrupting endothelial function. Aerobic exercise is an important prevention of cardiovascular and metabolic diseases. Consequently, in this work we aim to explore the mechanism of aerobic exercise improves atherosclerosis induced by hypercholesterolemia and hyperglycaemia.

METHODS: Specific pathogen-free ApoE-/- (n=45) male mice were provided a high-fat diet containing 1.25% cholesterol and were subjected to intraperitoneal injection of streptozotocin (STZ, 60 mg/kg) or sodium citrate buffer for 3 consecutive days to induce T2DM and were randomly divided into the following three groups: ApoE-/-, ApoE-/-+STZ and ApoE-/-+STZ+EX. Mice in ApoE-/-+STZ+EX group ran on a treadmill for 8 weeks (5 days/week, 40-60 min/day, 15 m/min). The levels of glucose and lipid in plasma were measured by biochemical analyzer. Levels of nitric oxide (NO) and AGEs were determined by ELISA kits. Oil red O staining was performed to evaluate the formation of aortic plaque.

RESULTS: 1) T2DM worse blood lipid, endothelial function and atherosclerosis in ApoE-/- mice. Injection of STZ aggravated the serum levels of TC (19.92±1.16vs27.90±0.78mmol/L, $p<0.001$), LDL-C (11.24±0.93vs16.15±0.52mmol/L, $p<0.05$). T2DM also increased AGEs (626.00±25.10vs874.40±11.45pg/mL, $p<0.001$) and impaired NO (33.62±2.82vs25.28±1.38μmol/L, $p<0.05$). Mice in ApoE-/-+STZ group had considerably larger plaque areas than ApoE-/- mice in both the total aorta (11.28%±0.81%vs16.39%±0.17%, $p<0.01$) and aortic roots (3.30%±0.40%vs6.52%±0.68%, $p<0.01$).

2) Aerobic exercise improves atherosclerosis and endothelial function through amelioration of AGEs. No significant difference in serum lipid biochemical markers were observed after training. The expression of NO (25.28±1.38vs42.51±1.12μmol/L, $p<0.001$) was elevated while the AGEs (874.40±11.45vs653.10±8.84pg/mL, $p<0.001$) production in plasma was inhibited remarkedly by exercise. Compared with the ApoE-/-+STZ group, the proportion of aortic plaque areas of the ApoE-/-+STZ +EX group was proved to be down-regulated (16.39%±0.17%vs11.87%±0.93%, $p<0.01$, 6.52%±0.68%vs3.67%±0.23%, $p<0.05$).

CONCLUSION: T2DM aggravated hypercholesterolemia and impaired endothelial function through AGEs, which exacerbated atherosclerosis; Aerobic exercise did not ameliorate hypercholesterolemia, but attenuated atherosclerosis by improving endothelial function.

RELATIONSHIP BETWEEN PERFORMANCE IN THE STAND-UP TEST AND THE 5 TIMES SIT TO STAND TEST OF JAPANESE ADULTS

MIYAMOTO, R., OSAWA, Y., MURANAGA, S.

KAMEDA MEDICAL CENTER

INTRODUCTION: It is known that evaluating the lower leg muscle strength is one of the key components since previous studies found a relationship between the deterioration of the muscle strength in lower leg and ease of falling and ADL level. As methods to evaluate lower leg muscle strength, the Stand-up test (ST) and the 5 times Sit to stand test (SS-5) are widely used. However, there are a few problem with each method, for example, some individuals have difficulty to sit on low seats in ST and there are ceiling effects in SS-5.

METHODS: The purpose of this study is to investigate the relationship between ST and SS-5 among Japanese adults to select the suitable method dependent on their physical condition. This study was conducted for 703 Japanese adults (468 men and 235 women). All participants were measured height and weight and all completed ST and SS-5. ST is a test to assess lower leg muscle strength by having participants stand up on one or both legs once from four seats of different heights—40, 30,20, and 10cm. The result was evaluated by both leg standing (BLS) or single leg standing (SLS). SS-5 is also a test to assess lower leg strength by having them sit to stand from 40cm seat for five times as quickly as they can, and measures required time from the initial seated position to the final seated position. Spearman's rank correlation coefficient was calculated for the correlation between ST and SS-5. Furthermore, one-way analysis of variance was performed with SS-5 as the dependent variable and ST as the independent variable. Multiple comparison analysis was performed using the Bonferroni test subsequently. All statistical analyses were performed using SPSS (SPSS for WindowsVer.25, IBM, Japan). P value lower than 5% was considered statistically significant.

RESULTS: A weak correlation was observed between ST and SS-5 ($r=0.33$, $p<0.01$). In ST, there was statistical significance of average between BLS group and SLS group. However, no statistical significance was observed both among BLS group and among SLS group. The mean SS-5 in the ST groups of BLS20≦, BLS10, SLS40, SLS30, and SLS20≧ was 8.0±2.2 sec, 7.8±2.5sec, 7.0±1.6sec, 6.2±1,3sec, and 6.0±1.1sec respectively.

CONCLUSION: This study showed the slight correlation between ST and SS-5, indicating the possibility that they could be mutually available. This suggests the possibility of using different measurement methods for dependent on the physical condition of the subject, for example, SS-5 would be selected in case when the subject has difficulty to sit on low seat in ST and ST would be substituted in case for frail elderly who can not perform required 5 times standing motions and for active healthy population who is unsuitable due to the ceiling effects in SS-5.

ADHERENCE OF HOME-BASED VIDEO EXERCISE PROGRAMMES IN OLDER ADULTS: SYSTEMATIC REVIEW AND META-ANALYSIS

JANDOVA, T., RIHOVA, M., STEFFL, M., MACHACOVÁ, K.

CHARLES UNIVERSITY, FACULTY OF PHYSICAL EDUCATION AND SPORT, IC: 00216208

INTRODUCTION: Remotely delivered home-based exercise programmes became quite popular due to the imposed restrictions during the COVID-19 pandemic. A recently published meta-analysis (Rihova et al., 2023) showed that home-based video exercise programmes positively affect essential components of physical fitness, such as balance and strength, in older adults. This study investigated adherence rates to these programmes and identified key factors associated with adherence in older adults.

METHODS: PubMed, Web of Science, and Scopus databases were searched for articles addressing adherence to home-based video exercise programmes. The study was conducted following PRISMA recommendations.

RESULTS: 26 articles, including 1,292 participants (aged > 65 years), were included in the final analyses The weighted mean of the attendance rate was 85.0, with low $I2 = 3.5$, not significant $p = 0.409$ heterogeneity. A positive significant effect of session duration (ranging from < 20 min to > 60 min) was found ($p < 0.001$) along with a positive significant effect of the presence of live contact with the coach during the video-based exercise interventions ($p = 0.010$).

CONCLUSION: The results of this study indicate that home-based video exercise programmes lasting less than 60 minutes and under live supervision might be a potent and sustainable exercise mode to keep older adults fit and avoid sedentary behaviour, which is detrimental to health. Investigating adherence to exercise programmes is very important for evaluating the programmes efficacy and feasibility.

References:

1. Rihova, M., Jandova, T., Vetrovsky, T., Machacova, K., Kramperova, V., Jaklova Dytrtova, J., Steffl, M., & Holmerova, I. (2023). Effectiveness of home-based video exercise programmes on physical fitness in older adults - systematic review and meta-analysis. Acta Universitatis Carolinae – Kinanthropologica, 59(2), 93 - 112. https://doi.org/10.14712/23366052.2023.6

COMPARATIVE ANALYSIS OF UPPER LIMB MUSCLE ACTIVITY IN ADULT AND ELDERLY WOMEN DURING SMOVEY AND DUMBBELL EXERCISE

YEON, L.J., TAE DONG, K., GI DUCK, P.
KYUNGPOOK NATIONAL UNIVERSITY

INTRODUCTION: The purpose of this study is to provide basic exercise rehabilitation data necessary for improving muscle imbalance, movement control, and shoulder stability in adult and elderly women by providing verification and evidence for the effect of selecting specific muscles according to exercise tools using Smovey and Dumbbell. The subjects of this study were those who had no shoulder or upper limb instability and musculoskeletal diseases, and who had no history of shoulder joint surgery in the last year.

METHODS: All data were plotted by calculating the average and standard deviation between the group and the exercise on the muscle activity results of adult and elderly women using the SPSS 26.0 program, and two-way ANOVA with repeated measure was performed to verify the average difference. Paired sample t-test was conducted to find out the interaction effect between exercise, and independent t-test was conducted to find out the interaction effect between groups. In addition, one-way ANOVA was performed for each time point, and if there was a significant difference, post-verification was performed with a sketch. The significance level was set at $p<.05$.

RESULTS: First, the results of this study showed a significant difference in upper limb muscle activity during flexion-extension movement of shoulder joints using Smovey and Dumbbell ($p<.001$). Second, there was a significant difference in upper limb muscle activity during abduction-adduction movement of shoulder joints using Smovey and Dumbbell ($p<.001$).

CONCLUSION: Vibration generated by Smovey exercise affects not only the working muscles but also the cooperative muscles, strengthening the overall muscle activity of the upper extremities and the stabilizing muscles of the torso. A study comparing the muscle activity of Smovey and Dumbbell exercises helps to select the appropriate tool for the development of muscle function for each subject and provides basic exercise rehabilitation data necessary for improving muscle imbalance, movement control, and shoulder stability in adult and elderly women.

A POSSIBILITY TO PROMOTO RECOVERY FROM FATIGUE ON EXPOSURE PERIODIC HYPOBARIC NORMOXIA ENVIRONMENT WITH AROMATHERAPY AFTER EXERCISE

WADA, T.1, HIRANO, T.1, KASHIWAGI, Y.2, KAWAKAMI, Y.3, MASHIKO, K.4, TAKENOYA, F.5, YAMAMOTO, N.6
1 KOKUSHIKAN UNIVERSITY, 2 SENSHU UNIVERSITY, 3 SHINMEI-ROOM INC., 4 KYOWA KENSHO INC., 5 HOSHI UNIVERSITY, 6 JRC HOKKAIDO COLLEGE OF NURSING

INTRODUCTION: Aromatherapy is a therapy that uses essential oils containing aromatic components extracted from plants to achieve a better state of health, and its effects on physical and mental relaxation and stress relief have also been reported. Sleeping in low-pressure environments at altitudes of 1,500 m and 2,000 m has been shown to shorten slow-wave sleep time and reduce sleep quality. It was clarified that there is a risk of inducing sleep disorders and lowering the quality of sleep while staying at high altitude. In addition, exposure to periodic hypobaric normoxia environment (PHNE) increases post-exercise VO2 and respiratory quotient (R), and has been shown to improve ventilation efficiency and promote lipid metabolism. The purpose of this study was to investigate the recovery effects of aromatherapy aromas (two types) while exposed to a cyclical low-pressure hypoxic environment after exercise.

METHODS: The subjects were 12 healthy college students (6 males and 6 females). Before the experiment, the content was fully explained and consent was obtained from the subjects. The subjects performed 15 minutes of exercise before the test. After the exercise, they entered a periodic hypobaric normoxia environment for 50 minutes and were compared under three conditions: lavender scented, yuzu scented, and no scented conditions. Subjects were exposed to PHNE room (NR-100E-3, Shinmei-room Inc., Japan) for 50 minutes (PHNE). EEG measurement (EEG sensor ZA-X, Proassist, Japan) was performed during PHNE condition, and the EEG was analyzed. In addition, Heart rate, RPE and Visual Analog Scale (VAS) were measured before and after PHNE exposure. Statistical evaluation of the data was done by paired student's t-test. Significance level was set at the $p < 0.05$.

RESULTS: Post-exercise heart rate was 117.3 bpm, about 60%HRmax. In post-exercise recovery, lavender and yuzu scents were 10 beats lower than controls (no significant difference). It was suggested that the aromatics may help the heart rate recover more quickly. RPE during exercise showed 15 in all three conditions. Recovery under PHNE was significantly reduced in yuzu aroma compared to controls(10.7 vs 7.7, $p<0.05$). Visual Analog Scale tended to be higher for yuzu aroma. EEG results showed no difference in relaxation between controls and aromas. In EEG measurements, there were no significant differences in beta waves between unscented and lavender, or lavender and yuzu, but there were significant differences between scented and unscented and yuzu($p<0.05$).

CONCLUSION: EEG measurements showed no significant difference in alpha waves among the three conditions, but beta waves were significantly lower in the yuzu aroma condition than in the no aroma condition. Since β waves indicate the active state of the brain, it was hypothesized that the yuzu aroma under cyclic hypobaric hypoxia suppressed β waves and had a restorative effect on the brain.

RELATIONSHIP BETWEEN BINOCULAR VISUAL FUNCTION AND OUTDOOR AND INDOOR PLAY IN JAPANESE KINDERGARTEN STUDENTS AGED 4–6 YEARS

KOMORI, Y., KITADA, K., NAGAMATSU, M., KOMORI, Y., HOSHINO, S.
KYOTO KOKA WOMENS UNIVERSITY

INTRODUCTION: Several recent studies have highlighted a decline in the amount of time Japanese children spent playing outside and engaging in physical activity. According to the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT), there has been a decrease in various aspects of physical fitness among preschoolers, including running, jumping, throwing, flexibility, agility, and body balance [1].

Low visual acuity is a serious issue in many countries. A survey conducted by the MEXT revealed that the number of individuals with low visual acuity (less than 20/20) increases at about 6 years of age and continues to increase with age. Specifically, the survey found that 26.7% of Japanese preschoolers have low visual acuity.

While some reports have already indicated a correlation between visual function and physical fitness in children, only a limited number of studies have been conducted on preschool children, who undergo significant development in their nervous systems.

This study aimed to examine the relationship between binocular visual function, physical fitness, and outdoor and indoor play among kindergarten students.

METHODS: Twenty-two children attending kindergarten in Usa-city, Japan were recruited for this study. The visual function indicators included static visual acuity and depth perception. Physical fitness was measured using the MKS motor ability development tests [2] to calculate the overall score. The amount of physical activity in a 1-week period was calculated using the International physical activity (PA) questionnaire short version. Participants also completed a self-administered questionnaire to identify their favorite outdoor and indoor activities. Additionally, the participants were divided into two groups based on their preferred activity type: outdoor activity (OA) and indoor activity (IA).

RESULTS: There was a weak correlation observed between the scores of physical performance tests and the number of favorite types of outdoor activity ($r = 0.35$, $p = 0.10$). The most preferred outdoor activity among participants was play equipment such as slides and swings, followed by tag, hide and seek, and playing with balls. Comparatively, The OA group showed higher scores on physical performance tests, with scores of 20.9 ± 2.2 points and 13.6 ± 3.2 points in the OA and IA groups, respectively ($p < 0.05$). Moreover, The OA group demonstrated higher scores in depth perception, with measurements of 13.7 ± 5.0 cm and 34.2 ± 27.3 cm in the OA and IA groups, respectively ($p < 0.001$). There was no difference in weekly PA between the two groups.

CONCLUSION: These findings highlight a correlation between depth perception, physical fitness and outdoor play. In conclusion, the results of this study suggest that engaging in outdoor play, which encompasses a range of physical activities, may improve binocular visual function and physical fitness among children aged 4–6.

[1] The MEXT, 2018.

[2] Sugihara, T., et al., Int J Sport Health Sci, 4: 49-56, 2006.

VALIDATION OF A NEW STANDARD FOR THE ASSESSMENT OF BODY COMPOSITION: A PILOT STUDY

BUTTERICK, B., KASOFSKY, L., SIEGLER, J., DE CRISTOFARO, A., DE CRISTOFARO, P., SANTELLO, M.
ARIZONA STATE UNIVERSITY

INTRODUCTION: The gold standard for measuring body fat percentage is dual-energy X-ray absorptiometry (DXA), characterized by a 3% margin of error. The primary drawback of DXA is its reliance on expensive equipment, making it unsuitable for large groups of athletes, clinical outpatients, and/or routine patient management. Employing surrogate methods such as plicometry or bioelectrical impedance analysis, known to have measurement errors compared to DXA, does not offer reliability, which is integral to these populations. Recently, Nubentech SRL has developed a non-invasive algorithm-based measurement technique (MorphogramTM) that uses anthropometric measurements to estimate body composition and score risks of cardiovascular disease and metabolic syndrome risks. To date, however, this technique has yet to be validated against a gold standard.

METHODS: In a pilot study aiming to validate the accuracy of body composition estimation by Morphogram compared to DXA, we recruited 52 participants (mean age 39.42 ±8.6 years; 26 females) with a body mass index (BMI) between 25 and 34.9. On the same day, participants had body composition assessed via DXA and Morphogram techniques, with DXA assumed as the reference standard for comparing body composition (fat mass, fat-free mass) to Morphogram (Full and Smart Analyses, FA and SA, the difference between these two analyses being the use of 8 and 3 body circumferences, respectively).

RESULTS: In relation to DXA, Morphogram FA and SA under-estimated fat mass (on average –2.62 and –2.31 kg, respectively) and over-estimated fat-free mass (2.55 and 2.27 kg, respectively). The differences in measurement techniques between DXA and Morphogram were statistically significant (fat mass: $F = 28.693$, $p < 0.001$; fat-free mass: $F = 24.346$, $p < 0.001$). The comparison between Morphogram FA and SA revealed no significant difference in fat and fat-free mass estimation (both $p > 0.05$). Linear regression analysis was performed to examine body composition estimated by the three techniques (DXA, Morphogram FA, and SA) on a subject-by-subject basis. Both Morphogram analyses strongly agreed with DXA-estimated fat mass, with variances accounted for (R2) of 89% for FA and 87% for SA, respectively. Similar find-

ings were observed when comparing DXA-estimated fat-free mass with Morphogram FA and SA (R2 = 90% and 88%, respectively).

CONCLUSION: Further analyses of the DXA-Morphogram discrepancies of body composition estimation revealed that most of the differences (65%) were relatively small (within ±5% of body fat percentage) for both FA and SA. Ongoing work is examining factors underlying the larger discrepancies, including the presence of subcutaneous fat. In conclusion, the Morphogram technique has great potential for offering practical, accurate, and alternative estimates for fat-free and fat mass when compared to DXA.

SIMILARITIES AND DIFFERENCES BETWEEN CANADIAN AGILITY AND MOVEMENT SKILL ASSESSMENT (CAMSA) AND TEST OF GROSS MOTOR DEVELOPMENT - THIRD EDITION (TGMD-3)

SUM, K.W.R., LI, M.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: The Canadian Agility and Movement Skill Assessment (CAMSA) (Longmuir et al., 2015) and the Test of Gross Motor Development - Third Edition (TGMD-3) (Ulrich et al., 2017) are valid and reliable tools for assessing fundamental movement skills (FMS) in children and adolescents. The purpose of this study was to examine the similarities and differences between CAMSA and TGMD-3 in assessing FMS in Hong Kong children.

METHODS: A total of 539 children aged 6-16 years (M±SD=10.7±2.3, 60.1% boys) participated in this study. The CAMSA and TGMD-3 tests were administered to each child, and their scores were compared using Pearson correlation. When assessing the evidence of concurrent validity, both the total score of CAMSA and the locomotor and ball skill scores of TGMD-3 were analyzed. Additionally, items assessing the same six skills (including single-leg hop, skipping, slide, kicking, catching, and over-hand throw) between the two tests were also extracted for comparisons. An r value of 0 to .19, .20 to .39, .40 to .59, .60 to .79, and> .80 were interpreted as no, low, moderate, moderately high, and high correlation coefficients, respectively.

RESULTS: Results showed a positively significant correlation between the total score of CAMSA and locomotor skill of TGMD-3 ($r = .36$, $p<0.01$), and ball skill ($r = .34$, $p<0.01$). No significances were found in measuring single-leg hop ($r = .07$, $p=0.11$) and over-hand throw ($r = .07$, $p=0.14$). However, significant differences were found in the other four FMS components, such as skipping ($r = .29$, $p<0.01$), slide ($r = .12$, $p<0.01$), kicking ($r = .19$, $p<0.01$), and catching ($r = .17$, $p<0.01$).

CONCLUSION: These differences suggest that the CAMSA and TGMD-3 assess different aspects of FMS, highlighting the importance of using multiple assessments to obtain a comprehensive understanding of childrens motor competence. Further research is needed to explore the psychometric properties of CAMSA and TGMD-3 assessment tools to be employed among children and adolescents in Hong Kong.

METABOLIC RESPONSE DURING VARIATIONS OF WALKING SPEED AND STEP RATES AT VARIOUS SLOPES

SON, S., CHO, H., YUN, S., LEE, Y., JUNG, D.G., SHIM, E., LEE, D.T.

KOOKMIN UNIVERSITY

INTRODUCTION: The purpose of this study was to evaluate the metabolic responses during walking at a constant speed on uphill and downhill slopes while maintaining a preferred step rate (PSR, in steps per minute) or modified step rates.

METHODS: Participants were 10 healthy men in their 20s (26.8±1.6 yrs, 172.4±3.9 cm, 73.7±6.2 kg). They participated in 30 testing conditions; 3 slopes (Flat, 10% downhill (D10 %), and 10% uphill (U10 %)) × 2 walking speed (3.5 and 5 kph) × 5 step rates (80, 90, 100, 110, and 120 % of PSR). In each condition, they walked on a treadmill for 5 minutes, and their step frequency, heart rate (HR), and oxygen uptake (VO2) were measured. First, they were asked to perform in 6 conditions (3 slopes × 2 speed) at their self-selected step rates, and these were considered as PSR corresponding to 100 % of PSR. Based on their PSR, individual 80, 90, 110, and 120 % of PSR were calculated, and these step rates were utilized at the remaining conditions. The order of testing was randomly assigned. One-way ANOVA with repeated-measures was used for analysis of the effects of slopes and step rates, and Scheffe post hoc test was performed. The significance level was set at $\alpha=.05$.

RESULTS: PSR was highest at both 3.5 and 5 kph in D10 % (102.9±6.2 and 113.9±4.9) than Flat (96.4±5.4 and 111.3±4.6) and U10 % (92.1±6.1 and 107.5±6.7 spm, respectively, $p<0.001$). HR at PSR was highest at both 3.5 and 5 kph in U10 % (110.6±8.1 and 126.8±11.4) than Flat (88.3±6.0 and 94.5±7.4) and D10 % (85.4±6.8 and 88.8±8.1 bpm, respectively, $p<0.001$). VO2 at PSR was highest at both 3.5 and 5 kph in U10 % (24.7±3.2 and 30.6±3.5) than Flat (14.1±2.2 and 17.8±1.8) and D10 % (10.9±2.0 and 11.4±1.7 ml/kg/min, respectively, $p<0.001$). During 3.5 kph walking on flat, HR was higher in 120%-PSR (97.1±9.8 bpm, $p<0.001$) than 100%-PSR and VO2 was higher in 80%-PSR and 120%-PSR (15.5±2.2 and 15.5±1.8 ml/kg/min, respectively $p<0.05$) than 100%-PSR. HR during walking at 5.0 kph in all varied step rates (i.e., 80, 90, 110, and 120%-PSR) was higher in D10 % (ranged 93.2±9.7 ~ 98.3±10.5), Flat (101.9±10.4 ~ 109.2±10.9), and U10 % (133.4±10.6 ~ 145.5±13.7 bpm) than 100%-PSR ($p<0.001$). VO2 during walking at 5.0 kph in all varied step rates was also higher in D10 % (ranged 12.2±2.0 ~ 15.6±2.6), Flat (17.7±2.2 ~ 20.8±2.4), and U10 % (31.3±3.2 ~ 34.3±4.3 ml/kg/min) than 100%-PSR ($p<0.001$).

CONCLUSION: The preferred step rates were higher during downhill walking than the leveled and uphill walking, while HR and VO2 were higher during uphill than the leveled and downhill walking. As walking speed increased from 3.5 to 5 kph, HR and VO2 also increased as the step rates both increased or decreased from the preferred step rates.

PERSONALIZED BODY COMPOSITION MANAGEMENT FRAMEWORK OF SAMSUNG GALAXY WATCH

YUN, S., LEE, Y., SEO, Y., LEE, H., JUNG, A.R., LEE, H.R., LEE, D.T.
KOOKMIN UNIVERSITY

INTRODUCTION: Body composition monitoring using bioelectrical impedance analysis (BIA) techniques installed in wearable devices became easily and effectively accessible. This research aimed to develop a user derived body composition goal setting and management framework for the Samsung Galaxy Watch BIA function.

METHODS: Based on data collected from individual body composition measurement, gender (male, female) and body mass index (underweight, normal, overweight) was classified. And the user's body composition analysis was provided. Users could select goals to change their body composition, if there were any, under 4 categories such as physical component (total body weight, fat mass, or muscle mass), direction of change (to increase, to maintain, or to reduce), challenge level (recommended, hard, or as usual), and management period (2, 4, 6, or 8 weeks). Upon the user's goal setting, individual physical activity level and dietary adjustment requirements, which were achievable and realistic for the goal, were calculated and provided. For user's daily energy balance calculation and physical activity recommendation, physical activity compendium and daily step frequency were utilized.

RESULTS: According to the user's target physical components and direction of changes, body composition management recommendations were formulated under 11 realistic combinations for body weight, fat, and muscle mass and for changes and maintenance. The recommendation was subdivided for those who challenge at the level of recommendation (±1.1~4 %, ±1.1~6 %, and ±1.1~10 %) or hard (±2.1~5 %, ±3.1~10 %, and ±4.1~15 % changes from the baseline) for underweight, normal and overweight, respectively. Within the recommendations, daily caloric intake control (in ± kcal/day), energy expenditure based on metabolic equivalents (METs), and daily walking steps using a formula of [Steps = {target kcal / (METs * weight in kg * exercise duration in hours)}/{(walking speed in kph * 1000) / step length in m}] were included. To guide physical component of fat and muscle mass changes within the direction of total body weight changes, fat mass equivalent calories; [fat mass in kcal = body weight for change in kg * % contribution of weight change by fat mass * 7,700 kcal], and muscle mass equivalent calories; [muscle mass in kcal = body weight for change in kg * % contribution of weight change by muscle mass * 7,700 kcal] were provided.

CONCLUSION: Body composition management framework developed from this research will provide user friendly environments and promote practical implication for efficient weight and body composition management. A new advanced body composition information architecture and algorithms can be expected in the field of health management using wearable technology.

Supported by Samsung Electronics (KMU-2024-0010)

IMPACT OF AN EXERCISE INTERVENTION ON FATIGUE IN PATIENTS WITH INFLAMMATORY BOWEL DISEASE: A SYNTHESIS OF FOUR N-OF-1 TRAILS

ECKERT, K., SCHNABEL, R., KOEPPEL, M., ADAMEK, H.E.
IST UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Fatigue, a strong persistent tiredness that cannot be improved by sleep or rest, is one of the most common symptoms for patients with Inflammatory Bowel Disease (IBD). A recent meta-analysis identified a moderate effect (SMD = 0.54) of structured physical training (PT) on fatigue across multiple indications [1]. In IBD patients the effect of PT on fatigue is under investigated and was not considered in the mentioned meta-analysis. We hypothesize that an individualized, structured PT might be an effective approach for patients with IBD suffering from fatigue.

METHODS: To account for the heterogeneity of IBD patients, a series of 4 single case trials (n-of-1 trial) with wthdrawl design was conducted. To increase the validity, the study consisted of 2 sequences, in total 2 interventional and 2 control phases, 4 weeks each, 16 in total. PT consisted of resistance training with training machines and cardio training on an ergometer. The PT sessions took twice a week during I-Phases. Patients were asked to rate their fatigue daily (N=112 measurements / person) in 3 different dimensions (physical, emotional, mental) on a numeric-analog-scale from 0 to 10.

RESULTS: The posterior distribution for the time effect displays a mean of 0.010 (90%-HDI= -0.042, 0.558), indicating that physical fatigue will slightly increase during the C-period with a probability of 69%. The posterior distribution of the time-condition interaction is characterized by a mean of -0.017 (90%-HDI= -0.065, 0.029), indicating that there is a probability of 76% that the average patient would benefit from PT regarding physical fatigue.

Posterior distribution for time effect displays a mean of 0.026 (90%-HDI= -0.023, 0.071), emotional fatigue will slightly increase during the C-period with a probability of 85%. Posterior distribution of time-condition interaction, mean of -0.043 (90%-HDI= -0.077, -0.009), indicating that there is a probability of 97% that the average patient will benefit from PT in regards to emotional fatigue.

Posterior distribution for time effect displays a mean of 0.024 (90%-HDI= -0.025, 0.069), mental fatigue will slightly increase during the C-period with a probability of 83%. Posterior distribution of time-condition interaction, mean of -0.042 (90%-HDI= -0.076, -0.012), indicating that there is a probability of 98% that the average patient will benefit from PT regarding to mental fatigue.

CONCLUSION: N-of-1 trials are a systematic approach where the intervention is applied in a randomized order and thus results in evidence of much higher quality. The results show that PT can be an effective treatment for IBD patients suffering

from fatigue. In future studies, relevant clinical parameters should be analysed in addition to the subjective assessment of the effects.

1. Barakou, I. et al. Effectiveness of physical activity interventions on reducing perceived fatigue among adults with chronic conditions: a systematic review and meta-analysis of randomised controlled trials. Sci Rep 13, 14582 (2023).

EFFECTS OF AEROBIC EXERCISES WITH TRADITIONAL THAI DANCE COMBINED WITH A 9-SQUARE ON THE ABILITY TO BALANCE AND THE STRENGTH OF THE LEG MUSCLES OF THE ELDERLY

NEELAPAIJIT, N., NHUSAWI, K., KAESMAN, I., CHANTASORN, N., KLADKLEEB, S.

SILAPAKORN UNIVERSITY

INTRODUCTION: Aerobic Exercises with Traditional Thai Dance (ATTD) is a combination of Traditional Thai dance posture and movement with aerobic exercises. They were developed specifically to enhance Cardiorespiratory Systems

METHODS: The purpose of this research was to study and compare the results of Aerobic Exercises with Traditional Thai Dance with a square that affects the ability to balance. and the strength of the leg muscles of the elderly The sample group was 20 female elderly people between the ages of 60-65 years, obtained from simple random sampling. Test your balance and leg muscle strength. Before and after 6 weeks of training, the tools used were: Aerobic Exercises with Traditional Thai Dance with a 9-square balance tests and strength test. Practice 3 days per a week, 60 minutes per day. The results were analyzed using T-test dependent statistics.

RESULTS: The research results found that Test results before and after 6 weeks of training, balance was equal to (Mean= 18.42, SD= 6.75 and Mean= 16.69, SD= 4.85), respectively, and results of leg muscle strength test were equal to (Mean= 16.33, SD= 3.08 and Mean= 17.92, SD= 4.05), respectively. The balance comparison results were not different. But there is a better trend. As for comparing the strength of leg muscles The difference is statistically significant at the .05 level.

CONCLUSION: Aerobic Exercises with Traditional Thai Dance with a 9-square it can improve the balance and strength of the leg muscles of the elderly.

PHYSICAL ACTIVITY, PHYSICAL FITNESS AND INFLAMMATORY BIOMARKERS IN YOUNG ADULT MEN

VAARA, J.P., VASANKARI, T., RAITANEN, J., KYRÖLÄINEN, H.

NATIONAL DEFENCE UNIVERSITY

INTRODUCTION: Physical activity has been shown to have anti-inflammatory effects, which could counteract the increased risk regarding low-grade inflammation (Pedersen 2006) and its risk for future cardiovascular diseases. The purpose of the present study was to investigate the association of device based physical activity and physical fitness, including both cardiorespiratory and muscular fitness with selected inflammatory factors in young adult men.

METHODS: The study sample consisted of 415 participants with inclusion criteria as a minimum of four days with ≥10 hours wear time per day. Participants were 776 young (age mean:26, sd:7 yrs.) adult Finnish men, who were invited in the military refresher training. A waist-worn triaxial accelerometer (Hookie AM 20, Traxmeet Ltd, Espoo, Finland) was used to assess physical activity and sedentary time. Physical activity was stratified into three intensity categories regarding METs: light physical activity 1.5–2.9 MET; moderate physical activity 3.0–5.9 MET and vigorous physical activity ≥ 6.0 MET. Cardiorespiratory fitness (VO2max) was determined using an indirect graded cycle ergometer test until exhaustion. Muscular fitness tests consisted of push-ups, sit-ups, standing long jump and maximal isometric force of the lower and upper extremities. Muscular fitness index was calculated firstly converting muscular fitness test results to z-scores. Thereafter, these z-scores were summed together and then standardized as a final composition of muscular fitness index. Inflammatory factors (interleukin-6 [IL-6], C-reactive protein [CRP], adiponectin, fibrinogen and leptin) were analyzed from blood samples. Linear regressions were used to calculate β-coefficients with Holm-Bonferroni correction.

RESULTS: Sedentary time was positively and vigorous physical activity inversely related to IL-6 (β:0.10, β:-0.10, respectively) ($p<0.05$) and leptin (β:0.15, β:-0.20, respectively) ($p<0.05$). Light and moderate activity were inversely related to leptin only (β:-0.11, β:-0.13, respectively) ($p<0.05$). Neither sedentary nor physical activity were related to with adiponectin, fibrinogen and CRP. Aerobic fitness was inversely related to IL-6 (β:-0.21), leptin (β:-0.69), adiponectin (β:0.11), fibrinogen (β:-0.26) and CRP (β:-0.47), while muscular fitness index was related to IL-6 (β:-0.14), leptin (β:-0.45), fibrinogen (β:-0.17) and CRP (β:-0.34) but not to adiponectin.

CONCLUSION: Physical fitness was related to most of the inflammatory factors, while physical activity and sedentary time were only related to selected inflammatory factors. IL-6 and leptin had the most consistent relationship to both physical activity and physical fitness. Physical activity itself, and in particular vigorous physical activity that improves physical fitness, may improve low-grade inflammation as assessed by certain inflammatory biomarkers.

CHANGES IN PHYSICAL FUNCTION AND SUBJECTIVE FEELINGS AFTER PERFORMING THE SQUARE-STEPPING EXERCISE PROGRAM IN WOMEN WITH LONG-TERM CARE NEEDS

UCHIDA, R., SHIGEMATSU, R., SASAI H., KUROSAKI, T., HIKIJI, Y., NAKAGAICHI, M.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: Daycare service facilities in Japan provide recreational and functional training to those requiring nursing care. More effective functional training programs are required to maintain patients' physical function and reduce the

burden on staff at daycare service facilities. The Square-Stepping Exercise (SSE), an exercise regime in which participants step continuously on a felt mat with 4 x 10 squares (25 cm each) based on their memory of the step pattern demonstrated by the instructor, has been confirmed as an effective recreational program for healthy older adults [1][2]. The SSE program has thus been considered a potential exercise program for older adults with long-term care needs. This study investigated the changes in physical function and subjective feelings after engagement with the SSE program in older women with long-term care needs.

METHODS: The participants were 15 older women with long-term care needs (mean age: 87.7 ± 2.9 years) who attended a daycare service facility in a local city in Japan. The SSE was conducted once a week for 30 minutes over four weeks. The five elementary step patterns of SSE were implemented step by step across the four sessions. Physical function (Short Physical Performance Battery: SPPB, Timed Up & Go Test) and fear of falling (assessed using Japanese version of the Falls Efficacy Scale) were assessed before and after the SSE program. The participants were also interviewed regarding their feelings on the SSE after the last session.

RESULTS: The total SPPB score decreased significantly from 7.5 to 6.7 points. The balance score of the SPPB decreased significantly from 3.1 to 2.1 points. For the nine participants who completed the five-time sit/stand measurement, the time required was significantly reduced from 14.6 seconds to 11.2 seconds. Additionally, the results of interviews indicated positive feelings related to the physical and psychological aspects of the SSE, with participant stating, "It makes me feel physically better" and "I became calmer now."

CONCLUSION: Although there was a substantial decline in lower limb function, particularly balance, positive changes in physical function and well-being were observed following application of the SSE in older women using daycare service facilities. The structure of the SSE program (step pattern, frequency) could be modified to facilitate its application in other daycare service facilities.

References:

1. Shigematsu, R. and Okura, T. A novel exercise for improving lower-extremity functional fitness in the elderly. Aging Clin Exp Res, 2006. 18 (3): p.242-248.

2. Wang, YH. et al., Effects of square-stepping exercise on motor and cognitive function in older adults - A systematic review and meta-analysis. Geriatr Nurs, 2021. 42 (6): p.1583-1593.

EFFECTS OF EXERCISE PRECONDITIONING ON FAM134B IN MICE WITH MYOCARDIAL ISCHEMIA-REPERFUSION INJURY

GAN, C.

GUIZHOU INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The protective effect of exercise preconditioning in myocardial ischemia-reperfusion injury has been confirmed, but its specific molecular mechanism has not been fully elucidated. There is no related study on whether FAM134B is involved in the protective effect of exercise preconditioning on reperfusion myocardium. This study explored the effect of exercise preconditioning on endoplasmic reticulum autophagy and the mechanism of FAM134B in mice with myocardial ischemia-reperfusion, in an attempt to provide basis for clinical application and exercise practice.

METHODS: The models of exercise preconditioning and in vivo myocardial ischemia-reperfusion in mice were established respectively. They were divided into four groups: sham operation group, ischemia-reperfusion group, exercise preconditioning + sham operation group, exercise preconditioning + ischemia-reperfusion group. After the intervention of exercise preconditioning, 60 8-week-old SPF male C57BL/6J mice were randomly divided into two groups: control group and exercise group. The control group was routinely fed for 9 weeks; the exercise group was given 1 week of adaptive exercise, followed by 8 weeks of moderate intensity treadmill aerobic exercise preconditioning (6 days / week, 60min/ days, slope 0 °). The exercise load was determined by the incremental load treadmill test, and the exhaustion speed was used as the basis for determining the maximum load. The intensity of exercise preconditioning was 60-65% of the maximum intensity (16-20m/min). The model of myocardial ischemia-reperfusion was made in mice after exercise preconditioning. The morphology of cardiomyocytes was observed by HE staining, the infarct size was observed by TTC staining. Autophagy protein LC3 and endoplasmic reticulum autophagy receptor FAM134B were detected by qPCR and Western blot.

RESULTS: The myocardial ischemia-reperfusion model was established successfully. (1)The changes of the morphology and function of the central muscle in the myocardial protective effect of exercise preconditioning. Compared with I/R group, myocardial myofibril was neatly arranged, myocardial interstitial edema was significantly alleviated, inflammatory cell infiltration and small focus necrosis were occasionally seen in E+I/R group. The percentage of myocardial infarct area in E+I/R group were significantly lower than those in I/R group ($P < 0.05$). (2)The expression of endoplasmic reticulum autophagy protein in the cardioprotective effect of exercise preconditioning. The expression of FAM134B mRNA and protein in E+I/R group was significantly higher than that in I/R group, while the expression of LC3II/I mRNA and protein was significantly decreased ($P < 0.05$).

CONCLUSION: In the mouse myocardial ischemia-reperfusion model, the expression of FAM134B was down-regulated. 8-week exercise preconditioning played a protective role in mice myocardial ischemia-reperfusion injury, which was related to endoplasmic reticulum autophagy mediated by FAM134B.

CARDIORESPIRATORY FITNESS DOES NOT PROTECT AGAINST THE AGE-RELATED CHANGES IN ANGIOGENIC T-CELL NUMBER AND INFLAMMATORY PROFILE

STEPHEN, L., WRIGHT, G., MUGGERIDGE, D., GORDON, A., CHANDRAKUMAR, V., ROSS, M.
HERIOT-WATT UNIVERSITY

INTRODUCTION: T-cells are a key part of the adaptive immune system, whose primary role is to combat infection. However, T-cells also play a vital role on non-immune functions such as tissue repair and maintenance. A subset of T-cells which express the adhesion receptor, CD31 (platelet endothelial cell adhesion molecule; PECAM) are reported to possess angiogenic properties (Hur et al., 2007). These cells have been termed 'angiogenic' T-cells (TANG). With advancing age, our T-cell profiles are known to change towards a more pro-inflammatory phenotype, however high levels of cardiorespiratory fitness (CRF) can attenuate this immunological ageing, and therefore may alleviate any age-related effects on TANG cells. Therefore, this study aimed to determine whether CRF is protective against the age-related changes in TANG cell number and angiogenic vascular endothelial growth factor (VEGF)-A expression.

METHODS: Healthy males (n=32, 18-30yrs & 50-65yrs, BMI<30 kg·m2) were recruited for this study. Participants reported to the Human Performance Laboratory after an overnight fast. A small blood sample was taken, and peripheral blood mononuclear cells (PBMCs) were isolated using density gradient centrifugation. Participants underwent a V.O2max test on an electronically braked cycle ergometer (Lode Corival, Lode B.V., Netherlands) with simultaneous breath-by-breath gas analysis (Cortex Metalyzer, Germany). V.O2max was defined as an RER>1.15, plateau in oxygen consumption and within 10 beats per minute of their age predicted maximum heart rate. PBMCs were used to quantify TANG cells (CD3+CD31+, CD3+CD4+CD31+, CD3+CD8+CD31+) along with the expression of VEGF-A (angiogenic growth factor) and C-X-C chemokine receptor type 4 (CXCR4) (a key chemokine receptor involved in cell migration) using flow cytometry (BD FACSCelesta, BD Biosciences). After data acquisition, data were analysed using Flow Logic (FlowLogic Version 8.7, FlowLogic, Australia).

RESULTS: VEGF-A expression was significantly greater in CD3+CD31+ T-cells (TANG) than CD3+CD31- T-cells (13097 ± 10942 AU vs 12424 ± 11156 AU respectively, $t = 2.390$, $p = 0.024$). However, there was no difference in CXCR4 expression between CD3+CD31+ and CD3+CD31- T-cells (41 ± 16% vs. 48 ± 21%, $t = 1.521$, $p = 0.149$). Older adults demonstrated a significantly lower proportion of CD4+ T-cells expressing CD31, with no other alterations in CD31+ T-cell subsets. Moreover, TANG cells (all 3 defined subsets) from older adults displayed greater VEGF-A content than CD31+ T-cells from younger individuals, indicative of a hyper-inflammatory response. VO2max was not a significant covariate, and thus did not affect the age-induced alterations in TANG T-cell number, VEGF-A or CXCR4 expression.

CONCLUSION: In conclusion, older people display a lower proportion of CD4+CD31+ TANG cells and greater VEGF-A expression across all TANG subsets, which may reflect T-cell phenotypic shifts from naïve to differentiated, pro-inflammatory phenotypes with advancing age.

ELECTRIC PULSE STIMULATION ATTENUATES LIPOTOXICITY-INDUCED MUSCLE DAMAGES IN C2C12 MYOTUBES

LI, H.H., WU, Z.J., LIN, T.Y., HUNG, W.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: The prevalence of obesity and its associated complications, such as type 2 diabetes and cardiovascular disease, has significantly increased. Reactive oxygen species (ROS) and insulin resistance are well-known for their key roles in the development of these diseases, particularly in skeletal muscle. Regular exercise has emerged as one of the most effective therapeutic strategies for preventing and treating these conditions. Additionally, evidence supports the notion that ROS including exercise and muscle contraction, which are a necessary component for glucose cell transport and adaptation to physiological stress. Numerous studies have confirmed that exercise plays a crucial role in improving insulin signaling and attenuating oxidative stress, primarily in mitigating the impact of these diseases. However, the detailed molecular mechanisms underlying the effect of exercise on lipotoxicity-induced muscle damage such as insulin resistance and oxidative stress in muscle remain largely unclear. Electrical pulse stimulation (EPS) has been employed as an in vitro exercise model in skeletal muscle cells. This study aims to investigate the effects of EPS stimulation in attenuating free fatty acids (FFAs)-induced myotube lipotoxicity, which includes insulin resistance and oxidative stress.

METHODS: Mouse C2C12 myoblasts were differentiated into C2C12 myotubes. The myotubes were incubated with palmitic acid for 24 hours followed by treatment with electrical pulse stimulation (EPS) for 3 hours. The expression of myokines, notably interleukin-6 (IL-6), was evaluated using both RT-PCR and enzyme-linked immunosorbent assay (ELISA). Insulin resistance markers, such as pIRS-1 and pAkt protein expressions, were assessed via western blotting. Oxidative stress levels were determined using 2-7dichlorofluorescin diacetate (DCFH-DA) staining. Furthermore, the expression of antioxidants, including SOD1, SOD2, and HO-1, was analyzed using RT-PCR and western blotting.

RESULTS: The EPS stimulation resulted in increased expression of myokines, including IL-6, in C2C12 myotubes. Additionally, EPS stimulation attenuated FFAs-induced insulin resistance. Moreover, the expression of antioxidants, including SOD1, SOD2, and HO-1, was higher in EPS-treated myotubes compared to those exposed to FFAs-induced lipotoxicity in C2C12 cells.

CONCLUSION: The electrical pulse stimulation (EPS) was found to mitigate free fatty acid (FFA)-induced muscle damage in C2C12 myotubes, including the alleviation of insulin resistance and oxidative stress.

MISMATCH OF GENDER-SPECIFIC ISSUES BETWEEN THE EXISTING LITERATURE AND INTERNATIONAL LEADING EXPERTS` OPINIONS ON FEMALE SPORTS

NAGORNA, V., MYTKO, A., LORENZETTI, S.
SWISS FEDERAL INSTITUTE OF SPORT MAGGLINGEN

INTRODUCTION: Traditionally, sports science research has been predominantly male-centric, assuming that training approaches effective for men are equally applicable to women. However, there is a growing acknowledgment of the imperative for gender-specific research to tailor interventions to optimize the health and performance of female athletes. Female athletes exhibit unique physiological and psychological factors, such as variations in the menstrual cycle, considerations for breast support, pelvic floor health, and hormonal fluctuations. Establishing an equitable training environment for female athletes necessitates a customized approach that accommodates their distinctive needs and differences, rather than replicating the training regimen designed for male athletes.

METHODS: Bibliometric techniques were applied in this study to gather highly cited papers in sports sciences published during 2005-2023 (Scopus search, the Clarivate Analytics Web of Science Core Collection, Google Academy, webometrics, perplexity.ai). The method of expert surveying and evaluation was used to determine the modern problems of womens elite sports. From 160 respondents, an expert group of sports scientists and coaches of national teams (n=20) was selected, who had experience working with elite female athletes. The analysis of the experts analytical notes allowed us to obtain individual information about the state of womens sports in each country and different kinds of modern sports, as well as to identify general issues regarding the planning of training and competition loads for female athletes. Mathematical and statistical processing and data analysis were carried out using the computing and graphic capabilities of the computer programs "Statistica" (Statsoft, version 7.0) and Microsoft Excel 2010.

RESULTS: Content analysis of the literature-based information allowed us to identify the leaders in sports science in gender questions in the following countries: America, Canada, England, Switzerland, Norway, China, South Africa, Ukraine, and Poland. The officials and the national teams' coaches (n=20) of these countries were included in the expert group. The following factors were identified based on the experts` answers as the main problems in female sports: outdated systems of training female athletes without taking into account their biological cycles (80%); old injuries or illnesses that arose as a result of the incompetence of the previous/youth coaches (55%); transferring the training models of male athletes to the training of women (60%); insufficient pharmacological and medico-biological support of womens national teams during training, competitions and recovery (60%); load planning during special physical training is the same as for men (70%); less attention to womens sports in financial and organizational aspects (65%).

CONCLUSION: Employing the method of expert evaluation, it is evident that womens elite sports encounter disparities in both economic and organizational support when compared to their male counterparts. This imbalance has the potential to adversely impact the motivation of female athletes to pursue a competitive sports career. A comprehensive review of the existing literature affords a unique insight into the optimization of training preparation, offering valuable information to enhance the efficacy of competitive activities in womens elite sports. Acknowledging the gender-specific differences elucidated in this study is anticipated to exert a positive influence on the performance of female athletes in contemporary competitive sports. By addressing these issues, there is an opportunity to foster a more equitable and supportive environment, ultimately contributing to the advancement of womens elite sports on a global scale.

THE SITUATION OF INTERSEX TRACK AND FIELD ATHLETES IN TAIWAN DURING THE 1960S

WU, Y.T., CHIN, H.
NATIONAL KAOHSIUNG NORMAL UNIVERSITY

The first transgender athlete was included at the 2020 Tokyo Olympics and made a big splash in the international sporting world. Looking back at the controversy surrounding the participation of transgender athletes, in the 1960's of Taiwan, there was already a transgender athlete, Yao Li-li, competed on the athletic field. It is intriguing that this once highly publicized figure has largely been forgotten by the Taiwanese public.This research employs historical research methods to collect official documents, newspapers, magazines, visual materials, and interviews with relevant individuals. The aim is to compile and explore the brief yet legendary athletic career of intersex track and field athlete Yao Li-li. With our investigation, this research found: 1. Yao Li-li was born with intersex characteristics, raised as a girl by her parents, but also exhibited male traits. She then achieved remarkable results as her first appearance in the 1963 National High School Games (the 12th Taiwan Provincial High School Games), winning second place in the 200 meters and first place in the shot put. This marked the beginning of her track and field career. 2. In 1964, she won gold in both the 100 meters and 200 meters at the National Games (the 19th Taiwan Province Games), her name received recognition overnight. In 1966, Yao teamed up with Yeh Chiu-mei, Tien A-mei, and Lin Chun-yu, shattered the Asian Games 400 meters relay record with 47.70 seconds, astonished the Asian sport community. 3. In 1966, as she prepared to participate in the Bangkok Asian Games, the organizing committee required gender testing for all female athletes. This revealed Yao Li-lis intersex identity, leading her to withdraw from the Asian Games. Despite underwent treatment and surgery at the end of the year to become a female, the social mores and pressures pushed her to retire from sports permanently. To sum, the focusing and embrace of transgender athletes in the Tokyo Olympics is undoubtedly a perfect embodiment of the Olympic spirit. Regrettably, in Yao

Li-lis era of the 1960s, conservative social mores not only hindered the acceptance of intersex individuals in the society but also stripped them of the right to participate in sports, the hope in returning to athletic competitions was never realized.

2023 TAIWAN SUPER BASKETBALL LEAGUE (SBL) MATCH-FIXING SCANDAL

LEE, M.J., CHIN, H.
NATIONAL KAOHSIUNG NORMAL UNIVERSITY

The Taiwanese professional basketball world is overshadowed by the outbreak of a match fixing scandal in 2023, whereas players alleged to betting on illegal online gambling websites and attempting to manipulate game outcomes. Focusing on this scandal, this study applies a historical research method to collect official information, news articles, social media, and other relevant historical materials. This study aims to understand and investigate this match-fixing scandal involving players and coaches in the Taiwanese Super Basketball League (SBL) in 2023. The research findings include: 1. Taiwan currently has three professional basketball leagues: the SBL established in 2003, the P+LEAGUE (PLG) established in 2020, and the T1 LEAGUE established in 2021. In October 2023, news media reported suspicions of SBL players intentionally losing games and engaging in match-fixing. Following a police investigation, it was discovered that a player not only participated in match-fixing but also acted as a bookmaker. He also collaborated with an organized crime group to attract nine players and one assistant coach with cash bonus in controlling match outcomes. Subsequently, it was revealed that T1 league players were also involved in betting. In order to reform the sport culture in Taiwan, while the alleged persons in this scandal will be facing criminal charges, both the Chinese Taipei Basketball Association and the professional leagues have revoked the registration of the involved players for life. Teams will also take legal actions in terminating the contracts and pursue penalties and compensation damages.

THE FOREIGN POWER IN UBA: THE MONGOLIAN 1ST PICK SUGAR OCHIR ERDENETSEG （2016-2023）

HSU, S.Z., CHIN, H.P.
NATIONAL KAOHSIUNG NORMAL UNIVERSITY

By incorporating foreign student-athletes, the mens basketball team at Chien Hsin University of Science and Technology achieved a three-peat championship, solidifying their dominance in university basketball since 2016. This trend of recruiting foreign student-athletes has since gained momentum, influencing university basketball across Taiwan. Mongolias Sugar - Ochir Erdenetseg became the first foreign student named SBL no. 1 overall pick in 2023. However, behind all these glamorous, very few has delved into the reasons behind their leaving from home to Taiwan, as well as their adaptation to the different culture both inside the classroom and on the court as student athletes. This research applies semi-structured interview, focusing on Erdenetseg's personal experience, and supplements with documentary analysis, in the attempt to understand the athletic life stories of foreign student athletes in Taiwan. Through our investigation, we find that: 1. The basketball environment in Mongolia is still underdeveloped, posing challenges for players in terms of career development. 2. In 2016, Chung Chou University of Science and Technology contacted Erdenetseg through Monglia basketball association, making him eligible to compete in the UBA as foreign student athlete. Upon his initial arrival, the challenges of studying aboard and culture shock brought numerous adapting issues for Erdenetseg. Fortunately with the assistance of coaches and his own commitments, he eventually overcame the difficulties and played an important role in helping the team secure third place at the 2020 UBA division I baseball tournament. 4. Since 2021, Erdenetseg followed the coach in transferring to two different colleges where both won the championship of division II baseball tournament respectively. In the same year, he was elected as the first pick in the SBL draft. In summary, being foreign student-athletes studying and playing in Taiwan has proven to be a significant stepping stone for their athletic careers. It stands out as one of the most influential factors motivating them to choose Taiwan. By examining Erdenetsegs athletic life story, we gain insights into the challenges faced by foreign student-athletes and their relentless efforts in transitioning into professional players.

INVESTIGATING THE CHANGES IN THE IDENTITY OF THE CHINESE TAIPEI FOOTBALL ASSOCIATION (CTFA) PRESIDENTS DURING TAIWANS DEMOCRATIC TRANSITION

CHANG, Y.H., TAN, T.C., HUANG, Y.W.
NATIONAL TAIWAN NORMAL UNIVERSITY

A major contribution to the development of football in the world can be attributed to FIFA and its affiliated continental and national associations. Typically, the heads of these associations play a crucial decision-making role, influencing the development of football in their respective countries or continents. The purpose of this study is therefore to investigate the identity of the presidents of the Chinese Taipei Football Association (CTFA). As part of our qualitative content analysis, we gathered relevant literature, historical materials, and conducted interviews with 11 individuals, including CTFA council members, sports journalists, government officials, and sports scholars. In this study, the elite theory is utilized to investigate the composition of identity and power resources of successive CTFA presidents and their relation to political change in Taiwan. Following are the results of the study. 1. In the authoritarian era (1955-1987), presidents were primarily active-duty military elites affiliated with the Nationalist Party (KMT), which facilitated the close relationship between the military and the CTFA. 2. Following the democratic transition (1987-2000), retired military and political elites assumed leadership roles. 3. During the period of democratic diversification (2000 to the present), economic and political elites have dominated the presidency. As Taiwans political parties have switched, the Democratic Progressive Party (DPP) has expressed a strong interest in holding the position of CTFA presidency. It is clear that the presidency of the CTFA has a close and dy-

namic relationship with the development of Taiwans political system. During democratization, their sources of power undergo significant changes, and successive leaders often possess distinct elite statuses. This clearly resonates with the phenomenon highlighted in elite theory, where a minority category of power elites continues to dominate leadership regardless of political regime changes.

THE RISE OF THE TAIWANESE TABLE TENNIS NEW STAR LIN YUN-JU

WU, T.Y., CHIN, H.P.
國立高雄師範大學

After capturing a bronze medal in the mixed doubles, at the Tokyo 2020 Summer Olympics, Lin Yun-ju vaults into stardom in the world of table tennis. This study employs case study research method to investigate the upbringing, performance and playing style of Taiwanese table tennis paddler Lin Yun-ju. Through investigation we found that: 1. Both of Lin's parents work as educators. He started playing table tennis at the age of 10, and became the youngest representative in the national team at 2015 (14 years old). 2. In the 2019 T2 Diamond tournament, Lin defeated Jun Mizutani, Ma Long and Fan Zhendong consequently won the championship and make a name for himself. He then partnered with Cheng I-ching to win bronze medal at the Tokyo 2020 Summer Olympics, subsequently won the championship at WTT Champions Frankfurt 2023. His massive success shocked the world of table tennis. 3. Lin takes advantage on his left-handed dominance and coupled with balanced rhythm control as his major playing trait. He poses a more aggressive style in serving and attacking, his transition from the backhand flick after receiving serves to the seamless and accurate connection of forehand and backhand is highly smooth. To sum, Lin begins to learn the sport of table tennis at very young age, and different levels of trails and competitions brining him a solid foundation to stand out in the international stage, which able to showcase his talent in the sport. He rose from relative obscurity to worldwide recognition as a new star in the world of table tennis.

THE HISTORICAL DEVELOPMENT OF TAIWANS NATIONAL INDIGENOUS GAMES

CHEN, S., CHIN, H.P.
NATIONAL KAOHSIUNG NORMAL UNIVERSITY

There are sixteen distinct indigenous tribes in Taiwan with a number around 590 thousand people, 2.6% of the total population. Despite being a minority in society, Aboriginal athletes have represented Taiwan with excellent talents while delivering exceptional performances on the sporting field. Therefore, the government specifically organizes the National Indigenous Games to discover more athletic talents from aboriginals, and the Game is divided into two major categories of modern sports and traditional sports. This research employs historical research method, to collect the National Indigenous Games related archives and historical materials, aiming to investigate the historical trajectory of the Games. The research found: 1. The National Indigenous Games has been hosted since 1994, occurring once every two years. Being held for the 16th time today, it has become the essential sporting event for the aboriginal community and recognized as one of the three most important athletic games in Taiwan. In the traditional sports category, five competitions are included: hunting, traditional dance, traditional archery, traditional wrestling, and weight-carrying relay. 1 to 3 extra competitions are selected based upon living habits of aboriginals in the host city. In the modern sports, six competitions are included: track and field, taekwondo, judo, basketball, baseball and softball, along with 1 to 3 selective competitions. To sum, the National Indigenous Games not only feature modern sports to discover athletic talents for Taiwan, but also incorporate traditional sports, preserving the valuable traditions of aboriginal sporting culture.

A HISTORICAL REVIEW OF TAIWANESE FEMALE ATHLETES IN OLYMPICS IN THE POST WAR ERA（1945-2021）

CHIN, H.P.
國立高雄師範大學

In examining the evolution of Taiwanese womens sports in the post-war era, notable advancements are evident not only in the increasing number of female athletes but also in their remarkable achievements. Taiwanese women have emerged as a pivotal force for the nation in international competitions. Despite this significant historical development, there exists a notable gap in comprehensive documentation. The names, results, and performances of these athletes have largely been overlooked, underscoring the need for a more thorough record of their contributions to the sporting landscape. Hence, the focus of this research is to examine the involvement of Taiwanese female athletes in the Olympics during the post-war era. This study utilizes a historical research method to gather, organize, and analyze pertinent historical materials. The objective is to thoroughly investigate and offer explanations for the participation of Taiwanese female athletes in the Olympic Games. The results show: 1. Numbers of participants: till 2020 Tokyo Olympics (exclude the absence of 1976, 1980), the total numbers of Taiwanese female athletes is 305 persons, 35.63% of the total delegates. And the number of female participants not only shows a consistent increase over each Olympics, but also surpassed Taiwanese male athletes for the first time in 1996. In the 2000 Olympics, female participation even reached 61.81%. Since 2012, the ratio of male and female athletes maintains equal. 2. Results: Taiwanese female athletes have cumulated 5 Gold, 4 Silver and 12 Bronze medals at the Olympics, largely outweigh their male counterparts of 2 Gold, 7 Silver and 5 Bronze medals. Taiwanese female athletes have also secured medals in each Olympics since 1988. 3. Gold medalists: Taekwondo athlete Chen Shih-chin secured Taiwans first gold medal at the 2004 Athens Olympics. Weightlifters Chen Wei-ling, Hsu Shu-ching, and Kuo Hsing-chun further contributed a total of four gold medals between 2008 and 2021. In general, together

with the promotion and advancement of gender equality awareness in the Olympic Games, the gender distribution has become rather equal. The participants of Taiwan also reflect a similar trend. Meanwhile, upon deeper analysis, the results indicate that only at these Olympics games of 1948-1964 and 1984, the percentage of Taiwanese female athletes was slightly lower than the total ratio. At the year 2000 event, the percentage was significantly higher than the total of 38.20%. In addition, Taiwanese female athletes have demonstrated they have better chances to win medals at sports such as weightlifting, taekwondo, table tennis, badminton, and archery.

A HISTORICAL STUDY OF DIVING SPORT IN TAIWAN

LAI, Y.Y., CHEN, S.Q.
NATIONAL TAIWAN NORMAL UNIVERSITY

This research aims to investigate the origins of the diving sport in Taiwan and its history. It will begin by examining the introduction of the sport into Taiwan and then contextualize its development into a competitive sport. The research findings include: 1.The earliest development of diving in Taiwan can be traced back to the introduction of traditional Japanese swimming style during the colonial era. During this time, diving was frequently included in the swimming seminars, and as one of the categories in swimming assessment test. 2. From newspaper coverage in the 1950s, it is evident that the China Youth Corps began regularly hosting Youth summer combat training camps since 1952, which included diving training as part of its water training course. Additionally, diving was listed as a medal event in the Provincial Games starting from 1953. 3. Between 1961 and 1981, the United States of America diving team conducted multiple exhibitions in Taiwan. In 1981, the USA diving team actively assisted the Chinese Taipei Swimming Association in promoting the sport of diving. Subsequently, the association began to promote the sport more actively. 4. Since 1982, the Chinese Taipei Swimming Association and the Taiwan Physical Education Association began promoting diving. This initiative involved editing diving competition regulations, hosting competitions, and offering lectures for coaches and judges. Additionally, they established a diving team at the National Sports Training Center to nurture future diving talents. 5. After years of rigorous training, Taiwanese divers achieved breakthrough performances at international competitions. Notable accomplishments include Lee Yun-Ming winning a Bronze medal in the Beijing Asian Games in 1990, marking a significant milestone. In 1996, a Taiwanese diver qualified for the Olympic Games for the first time. Furthermore, Hsieh Pei-Huas outstanding performance led her to enter the final of the Womens 10-meter platform event. In summary, the foundation of diving in Taiwan was laid through promotion during the colonial era and collective efforts by various agencies post-World War II. With the support of the Chinese Taipei Swimming Association and the Taiwan Physical Education Association, the development of diving gradually stabilized. The remarkable achievements of Taiwanese divers in international competitions have brought pride to Taiwan on the global stage.

Mentoring/Coaching

ANALYSIS OF THE KNACK IN EXECUTING THE "HANDSPRING FORWARD ON STRETCHED SALTO FORWARD WITH 1 1/2 TWIST (540°) OFF" VAULT SKILL BY AN EXCEPTIONAL FEMALE GYMNAST

SHINTAKE, Y.
UNIVERSITY OF TSUKUBA

Introduction

The Handspring forward on stretched salto forward with 1 1/2 twist (540°) off, commonly referred to as "Chusovitina," is a Women's Vault skill with a difficulty score of 5.4 according to current scoring rules. Gymnasts who successfully execute this vault can attain a high score. However, because of its advanced nature, only a very few gymnasts worldwide are capable of performing the element. Furthermore, there is no documented technical information on the Chusovitina in instruction manuals or previous studies.

Therefore, this study aimed to phenomenologically analyze the attitudes of a former female gymnast who has mastered the Chusovitina, exploring her consciousness regarding her movements. Through this investigation, the goal of this study was to elucidate the essential knack that supported the subjects execution of the Chusovitina and provide basic insights into the consciousness of the skill.

Method

The study subject was a former Japanese national female gymnast who retired from competitive gymnastics in 2022 (referred to as "Gymnast A"). Gymnast A mastered the Chusovitina vault skill during her active career and successfully performed this technique numerously at national and international competitions, including the Olympic Games and World Championships.

In this study, interviews were conducted twice, on 2 February 2023 and 7 February 2023, totaling approximately three hours. During these sessions, the author extensively explored Gymnast A's consciousness of her movement, employing phenomenological deconstruction procedures during the interviews. All exchanges between the author and Gymnast A were recorded and later transcribed for analysis.

Results and Discussion

The interview and subsequent analysis revealed that Gymnast A identified 12 knacks throughout the entire sequence from the run to the landing, in the execution of the Chusovitina. Among these knacks, the movement of "swinging the legs strongly upward toward the landing side of the vault while maintaining abdominal muscle tension" during the repulsion phase and "waiting for the timing to start twisting until the body is in a standing position" during the second flight phase emerged to be the most important and indispensable for the success of the Chusovitina. Furthermore, these two knacks played a dual role in enhancing the height and rotation of the salto during the second flight phase and initiating the twist action. This valuable information can be applied in future coaching sessions for the execution of the Chusovitina vault skill, offering practical insights for gymnasts.

Funding

This study was supported in part by The Japan Society of Coaching Studies, Research Grant 2022.

A STUDY ON COACHING FOR GYMNASTICS BASED ON ECOLOGICAL DYNAMICS THEORY

MURAYAMA, D.

KYOTO UNIVERSITY OF ADVANCED SCIENCE

Introduction: For athletes, the skill acquisition is so important that it can directly affect the results of competitions. Ecological dynamics is a useful theoretical framework to guide how athletes design and perform practical tasks. Although this is effective in improving the "adaptive ability" of all athletes, it has not been well incorporated into current movement instruction field. The same is true in gymnastics. The purpose of this study was to clarify the problems with traditional coaching methods for gymnastics, and to use ecological dynamics theory to clarify the usefulness of the "adaptive ability" that athletes should possess through concrete example analysis.

Method: The method was as follows: 1) We clarified the problems with the traditional teaching methods for gymnastics by investigating previous studies and interviewing coaches in the field. 2) We showed that floor exercise training programs can be made more efficient by using the framework of the "Constraints-Led Approach (CLA) based on ecological dynamics. 3) Based on our results, we proposed a new coaching theory for gymnastics.

Result: The traditional learning method for technical training in gymnastics is to repeatedly practice specific movement patterns. With this practice method, practice tasks are fixed and coach-led, and gymnasts may end up believing that there are only a limited number of practice tasks. Such recognition includes the risk that the application of the exercise structure becomes less applicable as the athletes skill level increases. For example, differences in the elasticity of floor equipment used in floor exercises are important to athletes. There are devices that are very soft and easy to jump on, such as the trampolines used in trampoline competitions, and even hard floor devices, such as the floor of a gymnasium. Gymnast requires jumping movements that correspond to the hardness of the floor equipment. The framework of the Constraints-Led Approach (CLA), which is based on ecological dynamics, shows that perception and movement are greatly influenced by three elements: the environment, the person, and the task. By controlling the tasks, the coach can teach the Gymnast the ability to build an appropriate training program. The somersault kicking motion in floor tumbling must be properly adjusted by the elasticity of the floor (environment). Gymnast requires a practice program to help gymnasts adapt to the given environment. At first, the practice needs to be given specifically and individually to the gymnasts, but after that, the gymnasts must apply the practice steps themselves.

Conclusion: Through this analysis, we were able to incorporate motor learning theory using the CLA framework from the standpoint of ecological dynamics into gymnastics coaching, and obtained knowledge that could contribute to improving the efficiency of motor coaching.

SELF-RATINGS OF COACH AND ATHLETE PERFORMANCE-RELATED BEHAVIOURS IN ELITE JUDO

TANABE, Y., CLOAK, R., DEVONPORT, T., LANE, A.

NIHON UNIVERSITY

Self-ratings of coach and athlete performance-related behaviours in elite Judo

Yoko Tanabe 1, Ross Cloak 2, Tracey Devonport 2, Andrew Lane 2

1 Nihon University, Japan; 2 The University of Wolverhampton, UK

Introduction

The purpose of this study is to assess coach and players beliefs in terms of confidence and importance to key performance constructs. A second purpose is to compare and contrast beliefs of confidence and importance by elite vs non-elite coaches and players by male-female competition classification.

Methods

Participants were 158 Judo athletes and coaches which comprised 42 = elite athletes and 55 non-elite judo athletes, 31 elite coaches and 30 non-elite coaches. Participants completed a 15-item questionnaire (based on the UK Coaching Framework) designed to assess confidence and the importance of Physical Development, Psychological Preparation, Relationships, Skills, and Understanding You. Interview data was collected to conduct a deep-dive into the strengths of beliefs and as a sense-check of questionnaire data.

Results

Results from 3-way MANOVA results indicated a significant main effects for differences in coach-athlete and gender with no significant elite-non-elite effects. Results showed male coaches consider skills to be the most important category, where male athletes consider physical development the most and relationships to be the least important. Results show male coaches reported high confidence in skills but low confidence in psychological preparation. Male athletes reported high confidence in understanding you and physical development. Female coaches reported high confidence in relationships but low confidence in understanding you. Female athletes reported high confidence in relationships. Qualitative data unpacked the data and revealed differences were more about how male athletes emphasize strength as more of a key quality in performance than females. Qualitative data offers insight into why relationships are important and some of the key contexts were relying on a supportive environment is important.

Discussion

Judo coaching is a complex involving components such as technical, tactical, psychological, and physical aspects. Coaches play a significant role in the development of athletes, and their behaviours can have a profound impact on athlete outcomes. To produce high performance athletes, understanding the gap between what athletes consider important and what they actually have confidence in compared to what coaches consider important and have confidence in is vital for enabling the latter to change their coaching behaviour accordingly.

These results are part of research in 2022 overseas researcher by visiting scholar, Prof Yoko Tanabe from Nihon University, Japan.

Keywords: coaching behaviour, elite judo coach, high-performance coaching, mixed-methods approach.

FACTORS CONTRIBUTING TO DROP-OUT AND BARRIERS FACING PROGRESS TO ELITE LEVEL: THE VIEWS OF FEMALE COACHES

BAHDUR, K., OLAFSSON, K.

1 LUNEX UNIVERSITY, DIFFERDANGE, LUXEMBOURG 2 LUXEMBOURG HEALTH & SPORT SCIENCE RESEARCH INSTITUTE A.S.B.L., DIFFERDANGE, LUXEMBOURG

Introduction

Female participation in elite sport is growing. However, opportunities in elite sport for female coaches remain limited. Recognizing what obstacles, they face is essential for fostering equality. Lack of opportunities to reach the top might also be a factor in decreased retention of qualified and experienced female coaches. This study looked at barriers facing progression to elite sport and reasons for drop-out in female coaches.

Methods

An online questionnaire was completed by 42 female coaches from 15 Olympic sports. Respondents were from 15 countries across three continents. Questions regarding whether 22 factors were significant barriers to progress to elite sport were included. These factors were based on personnel, gender stereotypes, coaching/life relationships, support and financial components. Respondents also indicated whether 13 possible reasons contributed to sport drop out. These included elements related to authority, support, safety, opportunity and resources. Descriptive statistics were used to quantify obstacles for progression and elements contributing to drop out.

Results

Gender-related factors including gender stereotypes during recruitment (65%) and the perception that females don't make successful coaches (48%) were identified as major obstacles. Help with maintaining a work/life balance (63%) was also a key barrier. Interviewers are likely to select candidates like them (48%) and the lack of headhunters seeking female candidates (45%) also highlight bias within the recruitment system. Coaches also indicates that women don't pursue opportunities as aggressively as male counterparts (55%). Lack of support from federations (79%) was the main identified reason for dropping out. This was followed by financial related concerns included that the roles for female coaches tend to be volunteer positions (66%) and there is a lack of sustainable financial reward (79%). Female coaches also feel they lack a voice (53%), and authority (53%) in decision-making.

Discussion

Barriers to progress to elite sport had very little consensus with only 3 factors identified by more than 50% of coaches. This shows that the industry is not homogenous and further characteristics other than gender must also be considered when identifying trends. Support has not been qualified here but also does include financial support which has also been separately identified. Volunteer positions often can result in added costs associated by the coaches. Lack of financial sustainability also contradicts what is often a role that requires large time commitments. Coaching success also requires the voice and authority of the coach to be respected. When this is lacking it can create the belief that the coach has not earned the right to the position, or they lack the expertise and ability and are there only to make up numbers. Understanding these factors can help lead to adjustments in organization culture and result in equity for female coaches.

Molecular Biology and Biochemistry

ALTERATIONS OF HEPATIC LIPOPHAGY IN DIET-INDUCED NAFLD MICE UNDER FASTING AND ACUTE EXERCISE INTERVENTION

SUN, W., YE, X., XINMENG, Y., MENGQI, X., YARAN, G., HONGJIAN, X., JIAO, L., YUAN, Z.
NANJING SPORT INSTITUTE

INTRODUCTION: Nonalcoholic fatty liver disease（NAFLD）is primarily characterized by excessive triglyceride accumulation in lipid droplets within liver cells.Lipophagy is one of selective autophagy that specifically acts on degrading the lipid droplets.In this study, we investigated the changes in hepatic lipophagy levels during energy crisis produced by fasting and acute exercise in diet-induced NAFLD and provided theoretical bases for prevention of NAFLD.

METHODS: A total of 36 male C57/black mice were maintained on high-fat, high-fructose and high-cholesterol（HC）diet for 12 weeks.The mice were then divided into HC (n=12),HF(HC diet with 24h fasting,n=12),and HE(HC diet with acute exercise,n=12)groups.At the end of the experiment, serum was used to measure lipid levels, liver tissues were collected to observe lipid deposition or to extract primary hepatocytes and lipid droplet layer for detecting hepatic lipophagy level.Immunoblotting was performed to measure the expression level of lipid droplet metabolism-related proteins.

RESULTS: 1)Mice in HC group exhibited higher body weight, increased liver index and dyslipidemia,24h fasting significantly decreased the body weight(30.87±2.81g),liver index(4.73±0.41g/100g),and the levels of serum CHOL(4.23±0.43mmol/L),HDL-C(2.16±0.17mmol/L),LDL-C(0.41±0.05mmol/L),but markedly increased the serum TG content(0.66±0.12mmol/L).Acute exercise significantly reduced the body weight(32.94±2.73g) and liver index(4.86±0.34g/100g),and has not effect on serum lipid levels.

2)Compared to HC group,the number and area of lipid droplets were markedly increased by 826 and 12.01% respectively in HF group,however,the lipid droplet size was significantly decreased in HF (0.02±0.01%) and HE (0.02±0.01%) groups（$p<0.05$）.

3)The positive area of lipid droplet overlapping with lysosome was significantly greater in HF(0.57±0.19) and HE(0.61±0.21)group compared to HC group(0.22±0.16)($P<0.05$).The same results described above were also shown in primary hepatocytes in HF(0.20±0.13)group,but not in HE group($P<0.05$).In addition, WB results showed enhanced LC3 expression in HF mice (0.46±0.33vs1.13±0.74) and reduced p62 protein levels in HF(0.58±0.34)and HE(0.54±0.40) groups, compared to HC(1.08±0.44)group ($P<0.05$).

CONCLUSION: 1)Mice with a 12-week HC diet exhibited significant dyslipidemia and suppressed hepatic lipophagy activity,which resulted in lipid deposition in the liver.

2)24h fasting resulted in the accumulation of numerous small lipid droplets within the cytoplasm accompanied by increased lysosomes via improving the level of hepatic lipophagy.

3)Acute exercise significantly decreased HC diet-induced lipid droplet size, but showed non-significant effect on lipophagy, probably due to the stimulation intensity generated by a single exercise is relatively low.

EFFECT OF ACUTE FASTING AND EXERCISE ON DISTINCT MITOCHONDRIAL RESPIRATORY FUNCTIONS IN NAFLD MICE LIVER

XU, Y., LU, J., SUN, W., YUAN, X., XIANG, M., XIAO, H., ZHANG, Y.
NANJING SPORT INSTITUTE

INTRODUCTION: Mitochondrial function is crucial for hepatic lipid metabolism. Current research identifies two types: peridroplet mitochondria (PDM) excelling in fatty acid synthesis, and cytoplasmic mitochondria (CM) with superior oxidative metabolism. Yet, their roles in hepatic hyperenergetics and energetic stress are debated. This study examines CM and PDM respiratory changes in diet-induced NAFLD under fasting and acute exercise.

METHODS: C57BL/6J mice were fed a normal diet or high-fat, fructose, and cholesterol diet for 12 weeks.Then they were equally divided into four groups (n=8 each): Normal Diet (ND), High-Fat Control (HC), High-Fat Fasting (HF), and High-Fat Exercise (HE).Primary hepatocytes (n=4) were isolated and stained with BODIPY 493/503 and MitoTracker Red CMXRos to study lipid accumulation and lipid droplet-mitochondria interaction. Liver tissues (n=4) were processed to separate PDM and CM, which were tested for mitochondrial respiration and fatty acid oxidation (FAO) capacity by using the MitoXpress Xtra Oxygen Consumption Assay(MX-200-4) kit. Mitochondrial Respiratory Control Ratio (RCR) was calculated as StateIII/StateIV were evaluated, and FAO capability was measured as the rate of increase of probe emission intensity.

RESULTS: 1)Compared to the ND group, the HC group showed significant increases in lipid droplet total area (615.4 ± 172.7 vs 47.37 ± 21.96 μm², $p < 0.05$), number (99.57 ± 16.98 vs 39.33 ± 10.29, $p < 0.05$), and size (9.679 ± 3.346 vs 0.9479 ± 0.5336 μm², $p < 0.05$). The HC group had higher CM content (17.42 ± 3.815 vs 11.93 ± 1.994 mg/g, $p < 0.05$), CM RCR (5.900 ± 0.8549 vs 3.639 ± 1.31, $p < 0.05$) and elevated CM FAO level (1047 ± 147.6 vs 589.6 ± 49.00 RFU/min, $p < 0.05$).

2)Compared to the HC group, the HF group had significantly increased lipid droplet number (204.5±67.63, $p < 0.05$) and total area (946.4±111.9μm², $p < 0.05$), but smaller size (5.399±2.882μm², $p < 0.05$). The HF group also showed a significant decline in CM RCR (3.491 ± 1.056, $p < 0.05$), but a significant increase in PDM RCR (8.741 ± 2.448 vs 3.678 ± 0.4140, $p < 0.05$) and CM FAO (1671 ± 326.7 RFU/min, $p < 0.05$), with a significant decrease in PDM FAO (986.4 ± 171.2 vs 505.9 ± 321.5, $p < 0.05$).

3)The HE group, relative to the HC group, demonstrated a significant increase in CM RCR (9.614 ± 2.628, $p < 0.05$) and CM FAO (1608 ± 422 RFU/min, $p < 0.05$), but a significant decrease in PDM FAO (380.6 ± 159.9 RFU/min, $p < 0.05$).

CONCLUSION: 1)CM respiration and FAO were adaptability increased in response to the high-fat diet induced hepatic accumulation of excess lipids.

2)Fasting induces energy shortage in hepatocytes, prompting PDM to elevate RCR for ATP provision, facilitating lipid droplet decomposition, while CM increases FAO levels, meeting intracellular energy demands.

3)Hepatocyte energy expenditure increases under exercise stress, and CM increases fatty acid involvement in energy supply by increasing FAO and RCR levels.

EFFECTS OF EXERCISE ON HEPATIC AUTOPHAGY AND MITOPHAGY IN HFFC DIET-INDUCED NAFLD MICE

WU, J., ZHANG, Y., CUI, R., ZHENG, H., LUO, Y., SUN, W., XIANG, M.
NANJING SPORT INSTITUTE

INTRODUCTION: Impaired autophagy in hepatocytes may not only result in steatosis, but also lead to steatohepatitis. Mitophagy is an important part of autophagy and plays an important role in regulating liver homeostasis. This study aim to explore the effect of exercise on hepatocyte lipid deposition and autophagy in NAFLD mice, which to provide theoretical basis for NAFLD preventive treatment.

METHODS: 30 8-week male C57BL/6J mice were adaptively fed for one week, then randomly divided into normal diet group (NC, n=10) and high-fat, fructose, and cholesterol diet group (HFC, n=20). After 10-week feeding, 10 mice from HFC mice were randomly selected for 8 weeks of voluntary wheel running (HFE, n=10). Animal serum and fresh liver tissue were collected. Serum lipids level were detected. Liver mitochondria were isolated by gradient centrifugation.The supernate from the mitochondrial isolation step was removed and centrifuged at 35,000 g for obtaining the cytoplasm. HE and oil red straining were used to observe the histopathological changes and hepatic lipid deposition. Immunofluorescence co-localization of p62+LC3 and LAMP-2+LC3 was used to detect the formation and degradation of autophagosomes, and P62,LC3, mitochondrial PINK1, Parkin and cytoplasmic Parkin expressions were detected by western blot.

RESULTS: 1)The body weight(+30.56%)、liver weight(+93.04%)、and TG(+31.33%) content in HFC mice were remarkably higher than NC($P<0.05$).Compare to HFC, mice in HFE group showed decreased body weight (-14.07%),liver weight (-27.48%) and TG (-46.79%) ($P<0.05$) levels.

2)Oil red staining indicated that HFFC diet significantly increased the liver lipid area (XXfold,$P<0.01$), and the liver lipid area was significantly decreased after exercise intervention(-50%, $P<0.01$).

3)Compared to NC mice, HFC mice exhibited significantly reduced the level of co-localization in P62+LC3(4.00±0.32vs2.4±0.24) and LAMP-2+LC3(7.40±0.24vs3.6±0.51), as well as increased P62 expression (0.71±0.09vs1.47±0.13)($P<0.01$). Exercise markedly decreased the expression of P62 by 55.78%, accompanied by higher LC3II/LC3I ratio(0.74±0.13vs1.29±0.11, $P < 0.05$) and increased P62+LC3 (2.4±0.24vs6.4±0.51), LAMP-2+LC3 (3.6±0.51vs12.00±1.05) co-localization.

4)Mice in HFC demonstrated reduced mitochondrial PINK1(-33.53%) and Parkin (-39.60%)expression($P<0.05$), but increased the cytosolic Parkin content (+157.5%,$P<0.01$). Compared with HFC, mitochondrial PINK1 and Parkin levels in HFE mice were elevated by 42.48% and 80.33%, respectively.

CONCLUSION: 1)HFFC diet lead to hepatocyte structure damage and lipid deposition. Exercise intervention can reduce the body weight, liver index, and alleviate the liver lipid deposition of HFFC diet mice.

2)HFFC diet resulted in p62 protein accumulation and impaired autophagy flux in hepatocytes. Exercise significantly improved the autophagy flux via increasing p62+LC3 and LAMP2+LC3 co-localization, and enhanced mitophagy by up-regulating PINK1/Parkin signaling pathway.

Motor Learning and Motor control

A LONGITUDINAL STUDY OF THE EFFECT OF VISUOMOTOR LEARNING ON THE FRONTOPARIETAL NETWORKS

WANG, K.P., YU, C.L., SCHACK, T., HUNG. T.M.
BIELEFELD UNIVERSITY

INTRODUCTION: The neural adaptation in the frontoparietal circuit plays a crucial role in acquiring visuomotor skills. However, the dynamic neural connectivity in the circuit underlying the acquisition of visuomotor skills remains unclear.

METHODS: To achieve a more comprehensive understanding of the association between motor acquisition of visuomotor skills and neural connectivity, we used electroencephalographic coherence that can capture highly dynamic neural connectivity in the circuit in a longitudinal design. In addition, we recruited 60 male novices who were randomly assigned to either the experimental group (EG) or the control group (CG). Furthermore, we analyzed the connectivity by using 8-13 Hz imaginary inter-site phase coherence in the frontoparietal networks (Fz- P3 and Fz-P4) during a golf putting task (visuomotor task). To gain a deeper understanding of the dynamic nature of learning trajectories, we compared data at three time points: baseline (T1), 50% improvement from baseline (T2; the fast stage of motor skill learning), and 100% improvement from baseline (T3; the slow stage of motor skill learning).

RESULTS: We mainly observed that EG showed a progressively improved golf putting performance from Time 1 to Time 2 and Time 3. Furthermore, we observed an increase in the connectivity of the right frontoparietal circuit from T2 to T3.

CONCLUSION: We suggest that the cortico-cortical communication in the frontal- left parietal circuits in the slow stage of motor skill learning lead to the acquisition of motor skills. In addition, our findings partially support Hikosaka et al.s model and provide additional insight into the specific role of these circuits in visuomotor learning.

POSITION SENSE DIFFICULTIES AFFECT THE UPPER AND LOWER LIMBS IN YOUNG ADULTS WITH PROBABLE DEVELOPMENTAL COORDINATION DISORDER

TSENG, Y.T., LIN, Y., CHEN, Y., TSAI, C.

NATIONAL TSING HUA UNIVERSITY

INTRODUCTION: Proprioceptive deficits have been found to be associated with motor dysfunctions in young adults with probable developmental coordination disorder (pDCD). However, little is known if such signs of proprioceptive dysfunctions affect different body parts of the pDCD. Here, we aim to verify 1) whether position sense acuity is impaired in both upper and lower limbs in adults with pDCD, and 2) how upper and lower limb position sense acuity is associated with motor skills in young adults with and without pDCD.

METHODS: Twenty-five young adults participated in the study, comprising ten individuals with pDCD (aged 20.40 ± 1.01 years) and fifteen controls (aged 20.13 ± 0.92 years). Participants in the pDCD group exhibited total motor scores below one standard deviation on the Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition, Long-Form (BOT-2, LF), while the control group scored above the mean. All participants performed a joint position sense paradigm that consists of a contralateral position matching and an ipsilateral position reproduction task of the upper and the lower limbs (the wrist and the ankle). Position sense error (PE) and error variability (SDPE) of the two joints were calculated to examine upper and lower limb position sense acuity.

RESULTS: We observed that individuals with pDCD demonstrated a significantly higher SDPE in both contralateral and ipsilateral conditions at both the wrist and ankle ($p = .044$), in comparison to control adults. This suggests that those with pDCD exhibited decreased position sense precision in both the upper and lower limb position sense. No significant group difference was found for the PE measure. Correlation analysis indicated that ankle SDPE values in the ipsilateral condition significantly correlated with BOT-2 fine manual control (FMC), manual coordination (MC), strength and agility (SA), and total scores for the combined group ($n = 25$) ($rs = -0.51$ to -0.53, $p = .007$ to $.009$), indicating that young adults who had more decreased ankle position sense precision exhibited poorer motor skills.

CONCLUSION: Our study highlights the significant impact of upper and lower limb position sense dysfunction in young adults with pDCD. The elevated SDPE values observed in both contralateral and ipsilateral conditions at the wrist and ankle indicate decreased precision in position sense among individuals with pDCD compared to controls. The correlation analysis reveals a close link between decreased ankle position sense precision and compromised motor skills, emphasizing the critical role of position sense acuity in motor skill proficiency among young adults with pDCD.

POSTURAL STABILITY AT ACTIVATION AND DEACTIVATION OF THE COCHLEAR IMPLANT IN ADOLESCENTS WITH LATE LATERAL IMPLANTATIONS

ZWIERZCHOWSKA, A., GAWEL, E., KRUZYNSKA, A., SLOMKA, A., ZEBROWSKA, A., JURAS, G.

AKADEMIA WYCHOWANIA FIZYCZNEGO IM. JERZEGO KUKUCZKI W KATOWICACH

INTRODUCTION: Cochlear implantation (CI) surgery has become a prevalent method of hearing rehabilitation, since it has been acknowledged that it impacts effectively on the vestibular system. However, there is still no consensus among clinicians on the most appropriate age and area (lateral/bilateral) of CI surgery in terms of postural control.

METHODS: A direct-participatory observation method and experimental method were used in this study to assess the anthropometric profile of the participants and their postural stability performance with different visual and auditory perceptions. 27 adolescent students with hearing loss participated in the study. A force plate (Accu Gait AMTI) with computer software (NetForce) was used in the study to assess the postural stability with four different conditions(eyes open (EO)/closed (EC), CI activated/deactivated).

RESULTS: vCOP was found to have a significant growing tendency within the conditions of CI activated/deactivated.No statistically significant relationships were noted between the range of the displacement of feet pressure (Area) and both the visual and auditory conditions. Hearing loss etiology was statistically significantly related to the values of vCOP, within the conditions of EO, CI activated/deactivated ($p<0.01$), what did not occure with the condition of EC ($p>0.05$). Neuromuscular control with the condition of EC x CI deactivated was found to be based on the kinesthetic-tactual compensatory model.

CONCLUSION: Kinesthetic sensation and exteroceptors of the superficial sensation seem to be the predominant source of information to maintain postural control in late CI

adolescents, regardless of the visual and auditory conditions, thus in order to improve neuromuscular control in this population, it is recommended that the patients perform physical activity tasks, especially to develop core muscles, based on direct stimulation and rotational stability.

THE IMPACT OF ACUTE ISOMETRIC FATIGUE ON THE VERTICAL JUMP FORCE-VELOCITY PROFILE IN VOLLEYBALL PLAYERS

SLOMKA, K., HADYK, V., JURAS, G.
INSTITUTE OF SPORT SCIENCES, ACADEMY OF PHYSICAL EDUCATION IN KATOWICE

INTRODUCTION: Success in sports competition is determined by a variety of criteria that are always complex. These components are in constant interaction, so every activity in a sports fight, for example, combines fitness training, coordination ability, and volitional factors. The study sought to explore the effect of acute isometric fatigue on force-velocity profiles in vertical jumps in young volleyball players.

METHODS: The study involved 12 of volleyball players (aged 17.5 ± 0.52, body height 188.1 ± 5.8, body weight 79.6 ± 10.2) and 12 physical education course students (age 22.15 ± 1.86, body height 179 ± 5.59, body weight 74.08 ± 7.79). The participants task was to perform vertical jumps (CMJ) immediately after the fatigue protocol to the maximum height. For the correct determination and evaluation of the force-velocity profile for each of the conditions (before and after physical effort), it was necessary to perform 9 jumps, including 6 with additional load (9 kg and 27 kg) in each condition. A force platform were employed to gather force-velocity parameters and custom stabilization system for the fatigue protocol. Participants stood semi-squatting on the force platform and extended their lower limbs and bodies after installation modification. This assignment required isometric muscle contraction due to mobility restrictions. After analyzing the generated force during exercise, its drop by 50% for 7 seconds from maximum values defined the critical point and concluded the fatigue protocol, which was followed by the study method.

RESULTS: The results obtained in the study indicate no differences in the force-velocity profiles in the studied groups during jumps. At the same time, empirical data showed higher values of F0 and V0 in the group of volleyball players obtained during maximum jumps. The possibility of using the force-velocity profile to assess the maximum power in maximum CMJ was also investigated using the real platform data and F-V profile model data.

CONCLUSION: Higher parameters of muscle work are caused by the training regime of volleyball players. The force-velocity profile of the volleyball players did not differ from the force-velocity profile of the control group. The lack of the difference can be attributed to the difference in age. The jump height (HJ), average speed of the center of mass displacement (Vmean), and average generated power (Pmean) all decreased in response to the imposed physical effort; however, the amount of the average generated force remained unaffected (Fmean), meaning that the subject can introduce compensation mechanisms to mitigate fatigue and preserve performance. The general shape of the F-V was not affected by the fatigue. The actual maximum power of the subjects could not be determined using the method for calculating maximum power (Pmax) that utilized parameters (F0 and V0) extracted from the F-V profile of the study group. As a result, the F-V model data differs substantially from the Pmax calculated using the raw platform data.

THE IMPACT OF MAXIMUM VOLUNTARY ISOMETRIC CONTRACTION STRENGTH OF THE FLEXOR CARPI RADIALIS ON SHOOTING ACCURACY

CHENG, S.C., HUANG, T., CHANG, H.
NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Past studies have confirmed the correlation between grip strength and the stability, accuracy, and control ability of shooters. The flexor carpi radialis plays an important role in many sports that require grasping equipment and wrist stability and strength. This study aimed to further understand the impact of the flexor carpi radialis on the performance of shooters by analyzing the data of the maximum voluntary isometric contraction strength and the SCATT shooting system, confirming the correlation between flexor carpi radialis strength and shooting accuracy.

METHODS: Eleven shooters of 10m air pistol event in open category were recruited, including 7 male and 4 female. Electromyography signals were collected by Delsys Trigno Avanti Digital system (Delsys Incorporated, USA) with sensors. Participants were instructed to perform manual muscle testing of the flexor carpi radialis, and the test was repeated three times with a one-minute interval between each. Data were then processed, including filtering and amplitude analyses. Subsequently, the shooting simulator (SCATT Shooting system, SCATT Electronics, Russia) was used for 60 shots within 75 minutes (simulating competition conditions), and data such as aiming time, accuracy, and electromyography intensity were extracted for analyses using one-way ANOVA. Data analysis was performed using SPSS 20.0 (SPSS statistic, IBM Inc., USA).

RESULTS: From the one-way ANOVA test, it could be seen that the strength of the flexor carpi radialis has a significant effect on all dependent variables, including aiming time ($p = .000$), the percentage of time when the aim point stayed in the ring of 10 within the last second before the shot ($p = .001$), shooting score ($p = .024$), and the percentage of time when the aim point stayed within the "absolute" ring of 10 ($p = .000$).

CONCLUSION: Results showed that the strength of the flexor carpi radialis of shooters has a significant impact on various performance indicators of the shooting simulator. However, most domestic shooters focus on the shoulder and back muscles training, with less emphasis on the strength and endurance training of the flexor carpi radialis. This study suggests that stability and accuracy breakthroughs could be improved through further assessment and training of the radial flexor wrist muscle strength.

HUMAN PERIPHERAL NERVE CHARACTERISTICS THROUGH TRAINING-SPECIFICITY OF THE UPPER AND LOWER LIMBS

ISHIKAWA, M., NOBUE, A.

OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: The peripheral nerve conduction velocity (NCV) has specificity depending on the sports activities. Unlike reports from animal studies, in which muscle growth and nerve enlargement increase NCV, the mechanics of plasticity of peripheral nerve function in humans remain unclear. This study examined relationships between upper and lower limb morphology, nerve size, and NCV in sports athletes with characteristic upper and lower limb movements. If the plasticity of NCV is related to functional stress, NCV specificity exists in athletes characterized by upper and lower limb training status. However, NCV specificity does not exist in the lower limb because of the habitual stress of bipedalism.

METHODS: The subjects were recruited from a group of athletes with well-trained upper limbs (UP group: n=21) and a group of athletes with well-trained lower limbs (LOW group: n=28). Musculoskeletal ultrasonography was used to measure the cross-sectional area (nCSA) of the nerve trunks of the ulnar nerve in both arms and that of the tibial nerve in both legs. NCV was measured by evoked electromyography. Limb circumference was measured using a measuring tape.

RESULTS: In both arms, ulnar NCV was higher in UP than in LOW groups, but tibial NCV did not show any differences between LOW and UP groups. Unlike the upper limb, NCV of the lower limb cannot show lateral dominance. In addition, there were no significant differences in nCSA between the two groups in the upper and lower limbs, respectively. No relationship was found between nCSA and NCV in the upper and lower limbs, respectively. Lateral dominance was also found in the circumferences of the upper and lower limbs, respectively.

CONCLUSION: In humans, the lower limbs unique functionality may result in less plasticity of peripheral nerve morphology and function. The differences in NCV and nCSA between the upper and lower limbs and between the left and right limbs were not simply related to the differences in the limb circumference but specific plasticity in neuromuscular morphology and function.

THE IMPACT OF CEREBELLAR TRANSCRANIAL DIRECT CURRENT STIMULATION ON ISOMETRIC BENCH PRESS PERFORMANCE IN TRAINED ATHLETES

KENVILLE, R., BERKOW, S., RAGERT, P., MAUDRICH, T.

LEIPZIG UNIVERSITY

INTRODUCTION: Athletic development centers on optimizing performance, including technical skills and fundamental motor abilities, e.g., strength and speed. Parameters such as maximum contraction force and rate of force development, influence athletic success, although performance gains become harder to achieve as athletic abilities increase 1. Non-invasive transcranial direct current stimulation of the cerebellum (CB-tDCS) has been used successfully to increase force production in novices 2, although the potential effects in athletes remain unexplored. The present study examined the effects of CB-tDCS on maximum isometric voluntary contraction force (MVCiso) and isometric rate of force development (RFDiso) during a bench press task in well-trained athletes.

METHODS: 21 healthy, male, strength-trained athletes (aged 25.6 □ 3.7 years (mean □ SD)) participated in a randomized, sham-controlled, double-blinded crossover design. Each participant completed an isometric bench press (iBP) task on two separate days, with at least 5 days between sessions, while receiving either CB-tDCS or sham stimulation (SH-tDCS). The anode (35 cm², current density: 0.057 mA/cm2) was placed over the bilateral cerebellum, with the cathode (reference; 100 cm², current density 0.020 mA/cm2) being placed on the right musculus buccinator. Current was administered either for 20 minutes (CB-tDCS) or ramped up for 30 s and maintained for 30 s before being ramped down for 30 s and terminated (SH-tDCS). Electromyography (EMG) recordings of three muscles involved in iBP were acquired bilaterally to uncover differences in neuromuscular activation and agonist-antagonist interplay between conditions.

RESULTS: Contrary to our hypothesis, no significant differences in MVCiso and RFDiso were observed between CB-tDCS and sham conditions. Furthermore, no tDCS-induced differences in neuromuscular activation or agonist-antagonist interplay were revealed.

CONCLUSION: Here, we argue that the effects of CB-tDCS on force production appear to depend on the individual's training status. Future research should study individual differences in tDCS responses between athletes and novices, as well as the potential of high-definition tDCS for precise brain region targeting to potentially enhance motor performance in athletic populations.

REFERENCES:

1. Wernbom, M., Augustsson, J., & Thomeé, R. (2007). The influence of frequency, intensity, volume and mode of strength training on whole muscle cross-sectional area in humans. Sports medicine, 37, 225-264.

2. Kenville, R., Maudrich, T., Maudrich, D., Villringer, A., & Ragert, P. (2020). Cerebellar transcranial direct current stimulation improves maximum isometric force production during isometric barbell squats. Brain Sciences, 10(4), 235.

EFFECT OF ACTION-SCALED AND BODY-SCALED AFFORDANCES ON PERCEIVED WALL HEIGHT AND ANTICIPATED CLIMBING ABILITY IN PARKOUR

STRAFFORD, B., DAVIDS, K., STONE, J.A., NORTH, J.S.
SHEFFIELD HALLAM UNIVERSITY

INTRODUCTION: The coupling of perception and action, which emerges as Traceurs explore their Parkour environment seeking opportunities for action (affordances), forms the fundamental basis of skilled behaviour in ecological dynamics, established and refined by developing an athletes effectivities (movement/action capabilities) (1). The aims of this study were: 1) Examine the effect of action-scaled and body-scaled affordances on wall height estimation in Parkour, and 2) Examine the effect of wall height on anticipated climbing ability in Parkour.

METHODS: Fifteen experienced Traceurs (age:24.1±6.9years, body mass:75.5±9.6kg, experience:6.5± 5.1years; stature:178.1 ± 6.6cm) estimated the height of three walls (Small:100cm, Medium:190cm, Large:380cm). Participants estimated the wall heights from the position where they would initiate jumping. This estimation was intrinsic as it was related to how participants estimated the wall height relative to their selected start position and anticipated ability to climb (2), without being allowed to first explore the walls with their body (action-scaled affordances). Traceurs were then given time to explore the three walls before providing another estimation of wall height. This estimation was extrinsic as it was related to how participants estimated the wall height after exploring the walls with their body (body-scaled affordances). Paired sample t-tests examined differences in the perceived height of three walls between modes of object perception (intrinsic: action-scaled and extrinsic: body-scaled). The Friedman test examined interactions between wall height and the anticipated climbing ability. The alpha level was $p \leq 0.05$, with effect sizes calculated.

RESULTS: There were differences with large effects between intrinsic and extrinsic estimations of wall height for the small wall $t(14) = 6.461$, $p<.001$, $d=1.668$ and medium wall $t(14) = 5.020$, $p<.001$, $d=1.296$. Intrinsic estimations of wall height were greater than the actual height of small wall (147.80±18.58cm, Error:47.80cm) and medium wall (274.93±54.38cm, Error:84.93cm). Extrinsic estimations of wall height were greater than the actual height of the small wall (111±10.27cm, Error: 11cm), but lower than the actual height of the medium wall (173.40±36.73cm, Error:-16.60cm). There was a significant interaction with a moderate effect of wall height on anticipated ability $\chi2(2)=12.474$, $p=0.002$, $W=0.416$. Anticipated ability was significantly greater for the small wall (4.87±0.35) compared to the large wall (3.27±1.53) ($Z=2.803$,pbonf=0.005).

CONCLUSION: The practical applications are: 1) In practice landscapes, Traceurs should be afforded time to explore objects in the environment relative to their body, 2) Traceurs should appraise the risk of the wall or jump relative to their abilities, and 3) When designing practice Traceurs should manipulate the height of objects relative to their movement/action capabilities (effectivities). References:1) Strafford et al. EJSS, 2021, 2) Taylor et al. Perception, 2011

COMPARISON OF PREFRONTAL CORTEX ACTIVATION BETWEEN TREADMILL AND OVERGROUND WALKING DURING DUAL TASKING IN HEALTHY YOUNG ADULTS.

SHIMIZU, S., OGURA, M., SAKAMOTO, M.
KITASATO UNIVERSITY

INTRODUCTION: The dual task, including walking and cognitive activity, is used for predicting and assessing fall risk and training to improve cognitive and physical function in the elderly. In contrast, walking speed and cognitive task performance while performing dual tasks are reduced compared with those during the single task. This reduction is defined as dual-task interference. The influence is less on treadmill walking than on overground walking. The prefrontal cortex (PFC) activation during treadmill walking is higher than that during overground walking; however, PFC activity during dual tasking (walking and cognitive activity) is not known. This study compared PFC activation during treadmill walking and overground walking while performing cognitive tasks. This study aimed to investigate the effect of treadmill walking on PFC activation and dual-task performance in younger adults.

METHODS: This randomized crossover study included 10 healthy young adults (mean 21.3 ± 0.6 years, 7 males) and compared overground and treadmill walking under dual tasking. Each participant walked while subtracting on the overground and treadmill. The participant walked thrice for 60 s at a comfortable walking speed in both conditions. The subtraction task used during walking was to consecutively subtract 7 from a three-digit number. PFC activation was assessed as oxyhemoglobin (O2Hb) responses using a wearable functional near-infrared spectroscopy. O2Hb levels in each condition were calculated as the difference from the resting standing condition and used for analysis. Walking speed, stride length, and stride variation were measured as walking functions, and the number and percentage of correct subtraction responses were calculated as cognitive functions. Walking functions were measured using a treadmill (Gait Training System BDX-GTM; Biodex) and a gait analyzer (Walk Way MW 1000; Anima). Differences in O2Hb, walking speed, stride length, stride variation, and the number and percentage of correct responses between the overground and treadmill conditions were evaluated.

RESULTS: The number and percentage of correct responses were performed significantly better on treadmill. Variation in stride length was significantly higher during walking on the treadmill. There were no significant differences in walking speed and stride length between the two conditions. The O2Hb levels of PFC were significantly higher in the treadmill condition. O2Hb was significantly increased in the left PFC than in the right PFC under both conditions.

CONCLUSION: Treadmill walking with cognitive activity increased cerebral blood flow in the dorsolateral PFC and improved cognitive task performance compared with those during overground walking.

THE ACCURRACY AND RELIABILITY OF USING LOW-COST EYE TRACKING SYSTEM

GUO, L.Y., LIN, J.1, MAI, J.2, HSU, M.1, YAN, C.2

1 KAOHSIUNG MEDICAL UNIVERSITY 2 NATIONAL SUN YAT-SEN UNIVERSITY

INTRODUCTION: Cervical discomfort could lead to the transmission of abnormal signals, disrupting neck proprioception and potentially triggering dizziness. In previous studies, the smooth pursuit neck torsion test [1] had been used for the assessment of oculomotor control mechanism. Eye tracking systems were often associated with high costs [2]. This study aimed to assess the accuracy and reliability of the low-cost Tobii 5C eye tracker in gaze tasks.

METHODS: The study involved five male participants with an average age of 23 ± 1 years old. None of the participants wore glasses. Subjects were instructed to look at a red dot on the screen at a distance of 68 cm with their head stationary. After calibration, a red dot appeared at five positions: upper left (UL), upper right (UR), neutral (N), lower left (LL), and lower right (LR) on the screen, each displayed for five seconds. Participants were instructed to gaze at these targets in 20 repeated sessions. The definition of accuracy is the visual angle between the target and gaze point. The data processing removed blinks and saccades using I-VT filtering [4]. The accuracy and intraclass correlation coefficient (ICC) of the Tobii 5C were assessed. The learning effect analyzed by comparing the accuracy of the first 10 trials to the next 10 trials. All statistical analyses were performed using SPSS.20. Significance level was set at $p<0.05$.

RESULTS: The results showed average accuracy between 0.66° and 1.29°, consistent with previous research. Notably, performance at the central position was found to be the most stable. Our study found no significant differences between participants in their accuracy following horizontal (H) and vertical (V) movements for each gaze point location: UL(H: 1.33° ± 0.21°, V: 1.30° ± 0.20°); UR(H: 1.38° ± 0.16°, V: 1.28° ± 0.22°); N(H: 1.12° ± 0.29°, V: 1.29° ± 0.20°); LL(H: 1.19° ± 0.24°, V: 1.23° ± 0.24°); LR(H:1.37° ± 0.21°, V: 1.37° ± 0.20°). The ICC values, ranging from 0.20 to 0.75, indicated a moderate effect. Higher ICC values, particularly for positions N and LR, suggest increased stability when the gaze position is closer to the eye tracker. With 20 trials per participant to observe ocular learning effects, the difference was not statistically significant, but there was a trend toward improved accuracy with increasing number of trials.

CONCLUSION: The study assessed the accuracy of the Tobii 5C eye tracker and found it to be acceptable. Slightly oculomotor learning effects were observed over 10 trials. This study also confirms the reliability of the device for gaze tracking. However, further research is necessary to determine its ability to accurately capture pursuit movements.

REFERENCES:

1. Majcen Rosker Z. et al., Diagnostics (Basel) 2021

2. Ban S. et al., Biosensors (Basel) 2022

ACUTE INFLUENCE OF BLOOD-FLOW RESTRICTION EXERCISE ON SOMATOSENSORY EXCITABILITY

MAUDRICH, T., DEGENER, S., RAGERT, P., KENVILLE, R.

LEIPZIG UNIVERSITY, FACULTY OF SPORTS SCIENCE

INTRODUCTION: Blood Flow Restriction Training (BFRT) is an emerging method to stimulate strength and hypertrophy1. In BFRT, arterial inflow and venous outflow in the target muscle is restricted by proximally applying a tourniquet. In this context, it has been shown that the complete deafferentation of the median nerve by ischemic nerve blockade leads to a reduced response of the somatosensory evoked potentials (SEP)2. Arguably, with BFRT, using a proximally applied cuff and consequent attenuated compression of the target limb, similar modulations of SEP components might be observed. This study aimed at investigating the acute effects of BFRT on the excitability of the somatosensory system, by focusing on modulational capacities of SEP.

METHODS: In total, 12 healthy adults (mean age: 23.0 ± 3.2 yrs) were enrolled in this randomized crossover study consisting of 3 experimental sessions. During each of the experimental sessions, participants underwent one of three conditions: application of blood flow restriction (BFR) without strength training (CUFF), strength training (unilateral biceps curls) without BFR (TRAIN), strength training with BFR (BFRT). One BFR cuff was attached to the upper arm being trained (ACTIVE) to the most proximal region just below the m. deltoideus. The opposite arm (PASSIVE) served as the intraindividual control limb. Bilateral median nerve SEP were applied at the wrist (5 Hz, 300 pulses, 0.2 ms square wave pulse) before, during and after BFR. SEP responses after right median nerve stimulation were recorded peripherally and at the scalp with the following montage according to the international 10-20 system: right Erb's point – (A1+A2) for N9; C3' – (A1+A2) for P14; C3' – Fz for N20. The opposite montage was used for left median nerve stimulation. Amplitudes and latencies of short-latency components (N9, P14, N20) were calculated.

RESULTS: No differences in SEP amplitudes between conditions could be revealed for ACTIVE or PASSIVE (all $p > 0.05$). With respect to N9 latencies of ACTIVE, a significant difference between conditions CUFF and TRAIN could be observed (mean difference: 0.26 ms, SE = 0.06 ms, $p = 0.001$, $d = 0.348$). No such difference could be observed for PASSIVE.

CONCLUSION: In conclusion, our study provides evidence for the safety of blood flow restriction training (BFRT) within the somatosensory domain, according to current guidelines for both recreational and rehabilitative purposes. The observed negligible difference in N9 latencies between CUFF and TRAIN may not be of practical significance in healthy adults.

REFERENCES:

1 Patterson, S. D. et al. Blood Flow Restriction Exercise: Considerations of Methodology, Application, and Safety. Front Physiol 10, 533 (2019).

2 Hayashi, R., Ogata, K., Nakazono, H. & Tobimatsu, S. Modified ischaemic nerve block of the forearm: use for the induction of cortical plasticity in distal hand muscles. The Journal of Physiology 597, 3457-3471 (2019).

ASSOCIATIONS OF KNEE EXTENSORS MUSCLE FIBER CONDUCTION VELOCITY WITH MUSCLE STRENGTH QUALITIES IN ELITE FEMALE HANDBALL PLAYERS

KURZ, E., BREHME, K., GIZZI, L., PRÖGER, S., SCHWESIG, R., DELANK, K.S., BARTELS, T.

MARTIN-LUTHER-UNIVERSITY HALLE-WITTENBERG

INTRODUCTION: Recently it has been shown that in professional female handball players the muscle fiber conduction velocity (MFCV) of the vastus medialis (VM) muscle was at different contraction intensities consistently higher than its lateral counterpart. Higher MFCV suggests muscle fibers with a larger cross-sectional area being recruited. During fast ballistic contractions forces developed per unit time are determined by the recruitment of higher threshold motor units. Thus, the aim of this study was to prove the relationship between MFCV and the rate of force development (RFD). We hypothesized that the VM MFCV would predict the RFD but that the vastus lateralis (VL) MFCV would not.

METHODS: Twenty-two elite female handball players (age: 17-30 years, BMI: 21-28 kg/m²) participated in this cross-sectional study. MFCV of the VM and VL muscles was recorded in monopolar mode (EMG-USB2+, OT Bioelettronica, sampling rate: 2048/s) using a linear electrode array (ELSCH004, Spes Medica) at 100% contraction intensity concurrently with isometric force (SM-2000N, Forza, gain: 200), during the pre-season screenings, at their dominant side. The dominant lower limb was defined as the preferred side used for takeoff actions. After a brief warm-up and familiarization, two RFD trials were recorded followed by two maximum voluntary contraction (MVC) measurements, each after one minute pause. The maximum MVC values and RFD at 100 ms were scaled to athletes' leg length and body mass, resulting in maximum voluntary torque (MVT) or rate of torque development (RTD) per unit body mass. Linear regression analyses were applied to examine the relationships of VM or VL MFCV with MVT or RTD.

RESULTS: All variables were normally distributed ($p > 0.2$). The female handball players revealed on average a maximum strength of 3.2 (SD 0.5) Nm/kg. The explosive strength at 100 ms ranged from 1.1 to 2.3 Nm/kg. However, MFCV was not related to maximum (VM: $r = –0.07$, $p > 0.7$; VL: $r = 0.02$, $p > 0.9$) nor explosive strength (VM: $r = 0.08$, $p > 0.7$; VL: $r = 0.30$, $p = 0.2$).

CONCLUSION: The variation of the normalized maximum or explosive strength in elite female handball players cannot be explained with the MFCV of the knee extensors. The contraction type used or the diverse muscle fiber composition in team sport athletes possibly account for these results. In turn, these findings suggest that MFCV measurements alone are not appropriate to estimate muscle strength qualities, particularly in female handball players.

Nutrition

EFFECT OF MIXED (ANIMAL AND PLANT) PROTEIN SUPPLEMENTATION ON GOLF PERFORMANCE AND MUSCLE FUNCTION: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY

SONG, W., SEO, J., JIANG, S., AHN, S., KANG, Y., SUNG, Y., LI, X., JAMRASI, P.

SEOUL NATIONAL UNIVERSITY

INTRODUCTION: Golf is a demanding sport requiring both aerobic and anaerobic energy. Nutrition is of great importance in fueling athletes and improving their performance. Recent growing evidences highlighted that performance nutrition is a critical consideration for golfers while walking around the golf course. Mixing animal and plant proteins is a relatively new approach to enhance skeletal muscle health by optimizing acid availability and minimizing environmental impacts. To the best of our knowledge, no study has examined the impact of mixed protein supplementation on golfing performance. The primary purpose of this randomized, double-blind, placebo-controlled trial was to examine the impact of mixed protein supplementation on the swing performance and muscle strength of casual golfers.

METHODS: Sixty participants with a handicap of less than 20 were recruited and divided into two groups: a mixed protein group (MG) and a placebo control group (CG). The participants were instructed to ingest either a supplement containing casein calcium, whey protein, and isolated pea protein, or a placebo daily for 8 weeks. Pre- and post-tests consisted of anthropometric measurements using InBody720, muscle strength (isokinetic knee and trunk strength, and handgrip strength), 2-minute push-ups, balance, and golf swing performance. Golf swing performance was measured using SG Golf equipment (Seongnam, South Korea). The participants completed a series of five successive swings using a 7-iron and a driver. The distance, head speed, and ball speed were recorded. The average value of the best 3 swings was calculated and recorded.

RESULTS: Significant improvements in driver distance ($P = 0.046$) and driver ball speed ($P = 0.021$) were observed in the MG compared to CG. In addition, isokinetic knee flexion strength per body weight ($P = 0.012$), handgrip strength ($P = 0.004$), 2-minute push-up performance ($P = 0.004$), and balance ($P = 0.009$) were also significantly improved in the MG after 8 weeks of mixed protein ingestion compared to CG. However, there were no significant differences in body composition between the two groups ($P > 0.05$).

CONCLUSION: The major findings of this study were that mixed protein supplement intake for 8 weeks significantly increased all golf performance variables, including distance, head speed, and ball speed, for both drivers and 7-iron players compared with placebo. Additionally, mixed protein supplementation induced an increase in isokinetic knee flexion and handgrip strength. No safety concerns were reported. In conclusion, the intake of a mixed protein diet containing both animal and plant proteins had positive effects on golf performance and muscle function, although it did not increase muscle mass. Therefore, mixed proteins could be a safe and effective approach for golf players to overcome the environmental problems of animal proteins and the relatively low quality of plant proteins.

SEX-SPECIFIC DIFFERENCE IN PSYCHOMOTOR PERFORMANCE AFTER 2-DAY FASTING PARALLELS PERCEIVED PSYCHOLOGICAL AND PHYSIOLOGICAL STRESS RESPONSES

SOLIANIK, R., ZIDONIENE, K., EIMANTAS, N., BRAZAITIS, M.

LITHUANIAN SPORTS UNIVERSITY

INTRODUCTION: Fasting 2–3 days before the weigh-in is one of the most used nutritional strategies for rapid weight loss by combat sports (1, 2). However, the motor behavior changes that occur during acute fasting are not completely understood. It is well established that stress affects motor behavior following an inverted U-shaped relationship (3), and that fasting for 48 h evokes stress in both sexes, with greater stress in females than in males (4). Thus, we hypothesized that (i) fasting-induced stress would affect motor behavior in females and males, and (ii) a higher level of stress in females would result in greater changes in motor function. Therefore, the main purpose of this study was to determine if a greater fasting-induced stress in females would be accompanied with greater motor performance changes (i.e., improvement or decrement) in females than in males.

METHODS: Fourteen healthy, young, non-obese males and fourteen females underwent a 2-day water-only fasting trial. Changes in subjectively perceived stress, salivary cortisol and plasma catecholamine concentrations were measured. Eye–hand coordination and motor speed were assessed using Grooved Pegboard test.

RESULTS: Fasting increased plasma adrenaline concentrations in both sexes ($p < 0.05$). Meanwhile, concentrations of plasma noradrenaline and salivary cortisol, and subjectively perceived stress increased only in females ($p < 0.05$). Surprisingly, fasting decreased performance of task requiring eye–hand coordination and motor speed only in females ($p < 0.05$), whereas this task performance was maintained in males group.

CONCLUSION: Two-day fasting induced a greater psychological and physiological stress in females, and consequently this differences represent a plausible explanation for the sex-based differences observed in psychomotor performance. This sexual dimorphism requires further investigation of possible negative effects of fasting in sports related performance in females.

FUNDING:

This work was supported by the Research Council of Lithuania (Grant No. S-MIP-23–84).

REFERENCES:

1. Artioli GG et al. It is time to ban rapid weight loss from combat sports. Sports Med. 2016.46:1579–84.

2. Ranisavljev M et al. Rapid weight loss practices in grapplers competing in combat sports. Front. Physiol. 2022.13:842992.

3. Metz GA. Stress as a modulator of motor system function and pathology. Rev. Neurosci. 2007;18(3-4):209–22.

4. Solianik R et al. Fasting for 48 h induced similar glucose intolerance in both sexes despite greater perceived stress and decreased estradiol levels in females. Eur. J. Appl. Physiol. 2023.

THE CAFFEINE EFFECT ON TOLERANCE TO SPORT-SPECIFIC MAXIMAL INTENSITY EXERCISE IN YOUNG ELITE SOCCER PLAYERS

VAKHIDOV, T., BEZUGLOV, E., MALYAKIN, G., ACHKASOV, E., EMANOV, A., KOROLEVA, E., KAPRALOVA, E., TALIBOV, O., MORGANS, R.

I.M. SECHENOV FIRST MOSCOW STATE MEDICAL UNIVERSITY

INTRODUCTION: Modern elite soccer places extremely high demands on the athletes body, so it is of practical interest to study the effect of various dietary supplements on load tolerance and post-exercise recovery. There is a lack of research on the effects of caffeine consumption on commonly used indicators of load tolerance in soccer such as delayed onset muscle soreness (DOMS), rate of perceived exertion (RPE), and heart rate (HR) at different time points after the end of exercise.

METHODS: 54 soccer players (age 15.93±0.8 years, height – 180±8.28 cm, weight – 69.45±8.82 kg, BMI – 21.36±1.37 kg/m2, somatic maturation degree – 98.05±1.90), from a leading Russian soccer academy took part in a randomised trial using the balanced placebo design. In order to study the influence of the expected effect of caffeine intake on these indicators, this design was chosen. For 48 hours prior to the testing, the soccer players did not engage in high-intensity training or consume any pharmacological substances.

They were divided into 4 groups: 1 - told caffeine/given caffeine, 2 - told caffeine/given placebo, 3 - told placebo/given placebo, 4 - told placebo/given caffeine. All participants consumed two identical capsules 60 minutes before testing, each containing 200 mg of caffeine or placebo.

To create conditions for high-intensity sports-specific load tests such as 5, 10, 20 and 30 metre sprint, counter-movement jump, change of direction, dribbling, T-test and RSA test were used.

A visual analogue scale (VAS) was used to assess the severity of muscle soreness, with participants rating the intensity of muscle soreness before and 24 hours after the test. RPE was assessed using the Borg Rating of Perceived Exertion scale (Borg CR-10), which participants filled out 10 minutes after the end of the test. HR was measured using the Activio Sport Solution GPS tracking system. HR immediately post exercise (HRpe) (after the last test), HR after two minutes of passive rest (HRrest) and recovery HR (HRrec = HRpe - HRrest) were obtained.

RESULTS: The data obtained demonstrated that a single caffeine intake (400 mg) 60 minutes before testing had no effect on RPE ($p = 0.948$), HRpe ($p = 0.698$), and HRrec ($p = 0.920$) in any of the groups. DOMS severity 24 hours after the load was not statistically significant between the groups ($p=0.077$).

CONCLUSION: The acute caffeine ingestion of 400 mg does not affect the subjective and objective indicators of training load in young soccer players aged 15-17 years with a high degree of somatic maturation.

ORAL ARGININE-CITRULLINE SUPPLEMENTATION INCREASE BLOOD KETONE BODIES AND SKIN-GAS ACETONE CONCENTRATION FOLLOWING MAXIMAL RUNNING EXERCISE

YAMADA, K., MATSUDAIRA, H.1, IDE, D.1, IWATA, Y.1, TAKEHARA, K.1, HAGINO, Y.1, SATO, T.1, ITO, R.1, MIYAZAKI, M.2, TSUDA, T.1, ITOH, H.1

NAGOYA INSTITUTE OF TECHNOLOGY

INTRODUCTION: Oral L-arginine and L-citrulline supplementation immediately and synergistically increases plasma arginine and nitrite/nitrate (NOx) concentrations, therefore, during exercise arginine-citrulline increase blood flow in muscle tissues, muscle energy metabolism, mitochondrial respiration due to increased nitric oxide (NO) bioavailability (1). On the other hand, it is known that ketones (β-hydroxybutyrate, acetoacetate and acetone) are generated in mitochondria of the liver, mainly from the oxidation of fatty acids, and are exported to peripheral tissues, such as the brain, heart, kidney, and skeletal muscle for use as energy fuels (2). Therefore, previously studies demonstrated that exercise increased ketone levels in plasma (3), expired air (4) and skin-gas acetone concentration (4, 5). However, no one has reported whether arginine-citrulline supplementation would incresse blood ketone bodies and skin-gas acetone concentration during exercise or not. The present study demonstrated the effect of arginine-citrulline supplementation on blood ketone bodies and skin-gas acetone concentration following maximal running exercise.

METHODS: A double-blind randomized placebo-controlled 2-way crossover study was employed. Ten healthy male students (23.0 ± 1.5 years; mean ± SD) consumed arginine-citrulline supplement (VELOX Charge: Kyowa Kirin Co., Ltd., Japan) or placebo orally 1 h before incremental maximal running exercise exhausting within 30 min. The skin-gas samples were obtained from the dominant hand by covering with a polyethylene bag in which pure nitrogen gas (250mL) was introduced for 100 sec and collected in a sampling bag at rest and 0, 5, 10, 15, 30 min recovery of the exercise. Acetone concentration was analyzed by gas chromatography. Blood flow measured using a laser tissue blood flow meter (Omegaflo, Omega Wave, Japan). Blood samples were obtained from fingertip to measure β-hydroxybutyrate and glucose using Stat strips XP3 (NIPRO, Co., Ltd., Japan).

RESULTS: The arginine-citrulline supplement significantly ($p<0.01$) increased running time and distance compared to the placebo. Significant higher levels were observed in blood flow ($p<0.001$), blood β-hydroxybutyrate ($p<0.05$) and skin-gas acetone concentrations ($p<0.001$) following the maximal exercise.

CONCLUSION: Significantly higher levels of ketone bodies in blood and skin-gas acetone concentration have indicated that the arginine-citrulline supplement increased acetone production in mitochondria of the liver during the maximal exercise. These results suggest that increased NO bioavailability by the arginine-citrulline supplement improved not only blood flow in muscle tissues, muscle energy metabolism, and mitochondrial respiration, but also ketone production in the liver.

ASSOCIATIONS OF PROTEIN AND N-3 PUFA INTAKE WITH GRIP STRENGTH, FAT-FREE MASS AND ALL-CAUSE MORTALITY: A CROSS-SECTIONAL STUDY FROM THE UK BIOBANK

PHILLIPS, N., CELIS-MORALES, C., GRAY, S.

UNIVERSITY OF GLASGOW

INTRODUCTION: Sarcopenia, the age-related loss of muscle strength and mass, is a progressive and generalised skeletal muscle disorder that is associated with an increased risk of falls, fractures, physical disability, mortality, and worse quality of life. Both dietary protein and omega-3 fatty acids (n-3) have shown promise as potential interventions in the prevention and/or treatment of sarcopenia. The aim of this analysis was to determine the associations of protein and n-3 intake with sarcopenia sub-components and with all-cause mortality.

METHODS: This study is a secondary data analysis from the UK Biobank in adults over 60. Muscle strength was assessed by grip strength, and muscle mass was assessed by bioelectrical impedance measured fat-free mass (FFM). All-cause mortality was determined from the date of death collected from death registers. A Cox proportional hazard analysis investigated the association between relative protein and n-3 intake and all-cause mortality. Linear regression analysis was performed to investigate the associations of relative protein and n-3 intake with grip strength and FFM. Participants were stratified into people without (0) or those with multi-morbidities (>2) for analyses. Data are presented as β (95% CI) unless stated otherwise.

RESULTS: A 1 SD higher intake of n-3, equivalent to 0.85g/day, was associated with a 0.10 kg (95% CI: 0.00 - 0.21) and 0.24 kg (95% CI: 0.15 – 0.34) higher grip strength in those with, and without, multimorbidity respectively. Similarly, a 1 SD higher protein intake, equivalent to 0.28g/kg/day, was associated with a higher grip strength of 0.13 kg (95% CI: 0.01-0.24) and 0.22 kg (95% CI: 0.11- 0.33) in those with, and without, multimorbidity respectively. A 1 SD higher n-3 intake was associated with a 0.25 kg (95% CI: 0.20-0.30) and 0.24 kg (95% CI: 0.15-0.34) higher FFM in those with and without multimorbidity, respectively. No interaction effects between protein and n-3 intake were present for grip strength; however, a negative association (p<0.001) with FFM was seen in those with multimorbidity. A 1 SD higher protein intake was associated with a 0.23 kg (95% CI: 0.18-0.29) and 0.26 kg (95% CI: 0.21- 0.31) higher FFM in those with and without multimorbidity, respectively. In those without multimorbidity, a higher (>2.32g/day) n-3 intake was significantly associated with lower all-cause mortality (Hazard Ratio = 0.77 (95% CI: 0.63-0.93)) compared to the low (<1.64g/day) n-3 intake group.

CONCLUSION: Dietary protein and n-3 intake are positively associated with grip strength and FFM, with little evidence of any interaction between the two nutrients. Only n-3 intake was associated with lower all-cause mortality.

DOES 4-DAYS OF BLUEBERRY SUPPLEMENTATION INFLUENCE METABOLIC, HEART RATE, AND PERFORMANCE RESPONSES TO SUBMAXIMAL AND MAXIMAL INTENSITY EXERCISE?

BRANDENBURG, J., GILES, L.

UNIVERSITY OF THE FRASER VALLEY

INTRODUCTION: Blueberries, due to their rich polyphenol content, have antioxidant properties. Considering the excess production of reactive oxygen species is connected to the development of fatigue, supplementation with blueberries may serve to benefit performance. The potential ergogenic effect of blueberry supplementation is not well understood, as is the identification of any mechanisms underlying any performance-enhancing effect. The objectives were to examine the effect of 4 days of blueberry supplementation on metabolic and heart rate (HR) responses to three submaximal intensities of cycling as well as on the performance of 4 and 2 km cycling time-trials.

METHODS: Using a double-blind randomized cross-over design, 16 participants (11 M, 5 F) with cycling experience completed three sessions (height: 178.8 ± 9.0 cm, body mass: 77.0 ± 11.4 kg, age: 41 ± 10 years, VO2max: 49.7 ± 6.9 ml·kg-1·min-1). Following a familiarization session, participants completed two experimental sessions: one following 4 days of supplementation with freeze-dried highbush blueberry powder (BLU) and the other following 4 days of supplementation with a placebo (PLA). Participants performed 22 minutes of submaximal intensity cycling (4-min warm-up, 3 × 6 min at 40%, 55%, and 70% of power at VO2max), followed by a 4 km and a 2 km time-trial. HR, blood lactate (Blac), and expired gases were collected throughout the submaximal intensity cycling. HR and Blac were also assessed during each time-trial. A 2 x 3 (supplement x intensity [40%, 55%, and 70%]) repeated measures ANOVA was used to assess differences HR, VO2, RER, and blood lactate during submaximal cycling. Paired sample t-tests were used to assess differences in time trial performance, HR, and Blac during each time-trail.

RESULTS: There was a main effect of supplement for Blac, which was significantly lower following supplementation (p=0.024; BLU 3.8 ± 1.1 vs. PLA 4.7 ± 019). There were no differences in HR, VO2 or RER during submaximal cycling (p>0.05; BLU vs PLA: HR40 119 ± 11 vs. 120 ± 10; HR55 138 ± 12 vs. 139 ± 12; HR70 159 ± 12 vs. 160 ± 11; VO240 25.5 ± 3.3 vs. 26.3 ± 3.1; VO255 32.4 ± 4.9 vs. 32.9 ± 4.1; VO270 40.8 ± 5.6 vs. 40.8 ± 5.4; RER40 0.92 ± 0.04 vs. 0.94 ± 0.06; RER55 0.95 ± 0.04 vs.0.96 ± 0.05, RER70 1.01 ± 0.05 vs. 1.01 ± 0.05). There were no differences in 2 km and 4 km time trial performance between supplement conditions (p>0.05; BLU vs. PLA: 2km 206 ± 30 vs. 202± 23 s; 4 km 413 ± 53 vs. 413 ± 43) or the HR and Blac responses to either time-trial (p> 0.05).

CONCLUSION: Four days of supplementation with freeze-dried blueberry powder yielded a lower blood lactate response across all 3 submaximal cycling intensities. There were no other differences in any other physiological variables nor were there any differences in 2 or 4 km time-trial performance. Although the ingestion of blueberries appears to alter the metabolic response to submaximal exercise, there is no benefit to high-intensity exercise performance.

EFFECTS OF POST-EXERCISE CAFFEINE CO-INGESTED WITH CARBOHYDRATE ON SUBSEQUENT ENDURANCE PERFORMANCE

WANG, H.S., HUANG, I.H., LI, M.S., LI, Y.H.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Optimal strategies for supplementation during the short-term recovery period following exercise play a critical role in enhancing subsequent exercise performance. With the substantial depletion of muscle glycogen after exercise, supplementing carbohydrates along with caffeine can aid in the resynthesis of muscle glycogen. However, further investigation is required to determine whether the benefits of this glycogen synthesis translate into improved subsequent endurance exercise performance. Purpose: To investigate the impact of carbohydrate supplementation with caffeine during the post-exercise recovery period on subsequent endurance exercise performance.

METHODS: Twelve healthy, physically active men (26.9 ± 3.1 yrs) with regular exercise habits were recruited. They participated in two running treadmill sessions, separated by one week, consisting of 75 minutes of running at 70% VO2max at a fixed speed. After a 4-hour recovery period, they underwent an endurance exercise performance test (5-km time trial). Two experimental trials were administered during the recovery period in a randomized, double-blind, counterbalanced order: 1) Caffeine + Carbohydrate (CAF+CHO) trial, where participants consumed 4.8 g of carbohydrate per kg of body weight and 6 mg of caffeine per kg of body weight; 2) Carbohydrate (CHO) trial, where participants consumed 4.8 g of

carbohydrate per kg of body weight and a placebo. During the recovery period, respiratory gas data were collected, and abdominal discomfort (AD) was recorded. Blood samples were also collected at baseline, during the recovery period, and after the endurance exercise performance test.

RESULTS: 1) The 5-km time trial run performance was significantly better in the Caffeine + Carbohydrate (CAF+CHO) trial compared to the Carbohydrate (CHO) trial (1475 ± 215 sec vs. 1574 ± 276 sec, $p < 0.05$); however, heart rate and RPE (Rate of Perceived Exertion) showed no significant interaction between trial and time factors, and the main trial effects were not significant. 2) Blood glucose, lactate, insulin, free fatty acids, glycerol, carbohydrate oxidation rate, and lipid oxidation rate showed no significant interaction between trial and time factors, and the main trial effects were not significant. 3) The abdominal discomfort during the recovery period showed no interaction between trial and time factors, with only the main time factor being significantly higher at the 3rd hour than at previous time points, and significantly higher at the 4th hour compared to the 3rd hour ($p < 0.001$).

CONCLUSION: Following 75 minutes of endurance exercise at 70% VO2max, consuming carbohydrates (4.8 g/kg) in combination with caffeine (6 mg/kg) during the recovery period can enhance subsequent performance in the 5-kilometer time trial run. This suggests that carbohydrate supplementation with caffeine can be an effective post-exercise recovery strategy.

THE ACUTE CONSUMPTION OF ACIDIC ORANGE JUICE DOES NOT AFFECT BLOOD PH AND EXERCISE PERFORMANCE IN HEALTHY MALES

PASCHALIS, V., PROKOPIOU, N., KARYOFYLLIDOU, A.V., CHATZINIKOLAOU, P.N., MALLIOU, V.J., THEODOROU, A.A., MARGARITELIS, N.V., NIKOLAIDIS, M.G.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Research in sports nutrition has uncovered that chronic exposure to acidic nutritional interventions may induce an acidotic state in the blood, potentially impairing exercise performance (Greenhaff et al., 1987; Hietavala et al. 2017). However, there is a lack of data concerning the acute effect of consuming a highly acidic beverage on physical performance. Thus, the aim of the present investigation was to evaluate whether the consumption of a substantial, acute dose of a highly acidic beverage, such as orange juice, could affect blood pH levels and consequently result in decline in performance.

METHODS: Thirteen young, physically active males (n = 13; age 23 ± 3 years, body mass 74.3 ± 12.2 kg, height 175 ± 6 cm), volunteered in a randomized cross over design. During their first two visit to the laboratory, participants were randomly assigned to ingest 8 mL/kg body mass of either orange juice mixed with sodium bicarbonate ($NaHCO_3$; neutral/control beverage) or simply orange juice (acidic beverage). Venous blood samples were collected before beverage ingestion and then at three-minute intervals up to the 15th minute. Subsequently, samples were collected every five minutes until the end of the 40-minute collection period. Two days after the baseline measurements, subjects underwent a Wingate test and a cycling VO2max assessment, at 15- and 30-min after the consumption of both types of juice, respectively. Blood samples were collected at rest as well as three and five min after completing the anaerobic capacity assessment.

RESULTS: The pH of the neutral beverage (i.e., orange juice + $NaHCO_3$) was 6.72 ± 0.32 and the pH of the acidic beverage (i.e., orange juice) was 3.50 ± 0.99. Over the 40 min period following beverage ingestion, neither beverage caused any significant changes in blood pH, and there were no significant differences in pH between the two types of beverages at any time point. Peak power output during the Wingate test was 930 ± 116 W and 920 ± 129 W after ingesting the neutral and the acidic beverages, respectively. Similarly, the fatigue index was 49 ± 8 % for the neutral beverage and 49 ± 7 % for acidic beverage with no significant differences between the two conditions ($p>0.05$). Additionally, the measurement of VO2max did not reveal any significant difference between the orange juice + $NaHCO_3$ and orange juice alone (i.e., 49.8 ± 10.8 vs. 49.4 ± 11.7 ml/kg/min, respectively; $p>0.05$).

CONCLUSION: The present findings unequivocally indicate that the acute consumption of a highly acidic beverage, such as orange juice, had no impact on either blood pH or physical performance. The artificial challenge we attempted to create appears to be nonexistent in real-life scenarios, suggesting that neutral beverages of a low acidic load may not influence blood pH and, by extension, physical performance.

References

Greenhaff et al. Eur J Appl Physiol Occup Physiol. 56: 331, 1987

Hietavala et al. Appl Physiol Nutr Metab 42: 1330, 2017.

DIET SUPPLEMENTATION WITH CHLORELLA MICROALGAE DID NOT CHANGE MUSCLE FIBRE TYPE PROFILE, FIBRE MORPHOMETRY OR CAPILLARISATION IN THE MEDIAL REGION OF THE MUSCLE EXTENSOR DIGITORUM LONGUS OF TRAINED RA

ZUÑIGA, P., HIGUERA-CHAPARRO, Y., LORENZO, K., VILLAMIL-PARRA, W., CASTRO-ARIAS, M., VISCOR, G., TORRES, J.L., PAGÈS, T., MAGALHÃES, J., RAMOS-ROMERO, S., TORRELLA, J.R., SANTOCILDES, G.

UNIVERSITY OF BARCELONA

INTRODUCTION: Chlorella is a marine microalga rich in proteins and containing essential amino acids. It is an excellent dietary source of high-quality protein regarding physical exercise, since its macronutrients have antioxidant and anti-

inflammatory activity. We aimed to analyse the effects of a Chlorella-based diet supplementation during a protocol of aerobic exercise on the most oxidative part of a predominantly anaerobic muscle, the rat extensor digitorum longus (EDL).

METHODS: Twelve animals were trained 5 days/week for 10 weeks (beginning at 15 cm/s for 15 min and achieving 45 cm/s for 1 h the last week). Animals were divided into 2 groups: (1) STD, fed with standard chow (Teklad Global 14% Protein Rodent Maintenance Diet); (2) ALG, fed with a mixture of 10% of Chlorella dry mass and omega-3 fatty acids (eicosapentaenoic and docosahexaenoic in 1:2 proportion). Histological EDL slides were cut in a cryostat and stained to demonstrate the metabolic properties of fast oxidative glycolytic (FOG), fast intermediate glycolytic (FIG) and fast glycolytic (FG) fibres. Fibre cross-sectional areas (FCSA), individual fibre capillarization index (CCA, ratio between number of capillaries and FCSA) and total capillary density (CD) were measured in the medial EDL zone.

RESULTS: After the exercise protocol, similar fibre type distributions were found in the animals fed with different diets (STD vs ALG, %±SD): SO: 4±1 vs 5±3; FOG 25±4 vs 23±1; FIG 27±6 vs 28±6; FG 44±8 vs 44±5. No statistical differences were found in FCSA between both groups, with the smallest areas found in oxidative fibres (SO and FOG) and the largest in FG (STD vs ALG, μm2±SD): SO: 1,474±273 vs 1,208±321; FOG 1,595±259 vs 1,541±219; FIG 2,552±222 vs 2,687±372; FG 4,205±799 vs 4,289±612. The CCA index was greater in oxidative fibres and smaller in the anaerobic ones but also showed similar values in both groups (STD vs ALG, capillaries per 1,000 μm2 FCSA±SD): SO: 4.45±0.67 vs 5.15±0.96; FOG 4.35±0.36 vs 4.26±0.56; FIG 2.98±0.24 vs 2.89±0.46; FG 2.37±0.41 vs 2.37±0.35. The CD of the whole medial EDL region (capillaries·mm-2) showed no significant differences between both groups: 1,010±179 (STD) and 918±135 (ALG).

CONCLUSION: Chlorella supplementation during a protocol of aerobic exercise did not induce significant changes in muscle fibre morphometry, capillarisation or fibre type proportions in the medial EDL rat muscle. Although with a great proportion of FG fibres, the medial EDL is thought to prioritise oxygen supply for oxidative demand whereas the lateral compartment is hypothesized to optimise for metabolite removal (J Anat 240:700-710, 2022). However, we could not demonstrate, after diet supplementation with Chlorella, any endurance improvement in the oxidative demand for one of the muscles involved in the dorsiflexion of the ankle. Further research is needed to elucidate if nutritional supplementation could affect muscle endurance or resistance to fatigue at molecular or functional levels.

ACUTE OR SHORT-TERM L-CITRULLINE SUPPLEMENTATION DOES NOT AFFECT VASTUS LATERALIS OXYGENATION AT REST IN OLDER ADULTS.

THEODOROU, A., CHRISTODOULOU, F., PAMBORIS, G., CHRISTODOULIDES, S., TRYFONOS, A.

EUROPEAN UNIVERSITY CYPRUS

INTRODUCTION: L-citrulline is a non-coded alpha-amino acid, synthesized from ornithine and metabolized by argininosuccinate synthetase. It is commonly used in sports nutrition to enhance nitric oxide synthesis. Nitric oxide represents a potent vasodilator regulating blood flow and oxygen delivery. In older adults, skeletal muscle oxygenation is reduced due to endothelial dysfunction and decreased nitric oxide activity. Thus, supplementation with nitric oxide precursors such as L-Citrulline might have favorable effects on muscle oxygen metabolism. Considering that muscle oxygenation directly affects performance, the present investigation aimed to examine the acute and short-term impact of L-Citrulline on older adults muscle oxygenation.

METHODS: Following a counterbalanced crossover, double-blind, and placebo-controlled design, the researchers enrolled 12 older individuals in the present study [n=12, age 64 ± 5 years, body mass 78.4 ± 6.9 kg, height 173 ± 4 cm, body fat 26.8 ± 2.6 (mean ± standard deviation)]. Participants received 6 g of L-citrulline (Now, L-citrulline Pure Powder, Bloomingdale, IL) or a placebo (maltodextrin) daily for seven days. Using near-infrared spectroscopy, the microvascular concentrations of oxyhemoglobin and deoxyhemoglobin, which reflect the dynamic balance between muscle oxygen delivery and extraction, were measured at baseline 1 hour after the first intake of L-citrulline and at day seven after the end of the supplementation period. Additionally, total hemoglobin concentration was calculated as the sum of oxyhemoglobin and deoxyhemoglobin, representing changes in microvascular blood flow, and the tissue saturation index was also measured, reflecting muscle oxygenation and saturation balance at the same time points. For the statistical analysis of the data, a two-way repeated-measures ANOVA test [(condition (L-citrulline vs. placebo) × time (baseline, 1 hour after supplementation, and seven days post supplementation)] was performed.

RESULTS: No significant condition-by-time interaction or main effect of condition ($p>0.05$) was found in any of the examined muscle oxygenation parameters (oxyhemoglobin, deoxyhemoglobin, total hemoglobin, tissue saturation index).

CONCLUSION: As a nitric oxide precursor, we expected that L-citrulline supplementation would have enhanced nitric oxide bioavailability and improved muscle oxygenation. However, the results of the present investigation opposed our hypothesis, as acute and short-term L-citrulline supplementation had no effect on vastus lateralis oxygenation at rest in older adults. In the present investigation, muscle oxygenation indices were measured only at rest and not during a condition with an increased demand for oxygen for muscles, such as exercise. Perhaps this prevented us from finding any favorable impact of L-citrulline on muscle oxygenation. Thus, we suggest future studies to examine the effect of L-citrulline on muscle oxygenation during exercise.

ASSESSING CAROTENOIDS, VISUAL FUNCTION, AND SPORTS PERFORMANCE IN TARGET SPORTS ATHLETES

SIVAPERUMAN, P., GREEN-GOMEZ, M., STRINGHAM, J.M., ROCHE, W.J., NOLAN, J.M.

SINGAPORE SPORT INSTITUTE, SPORT SINGAPORE AND NUTRITION RESEARCH CENTRE IRELAND, SOUTH EAST TECHNOLOGICAL UNIVERSITY

INTRODUCTION: A target sport athlete's visual system is always under intense pressure to achieve the technical components that are partly dependent on visual stimuli. There is currently limited data on carotenoid status and visual performance for these athletes. In this study, we present baseline data for shooting and archery athletes affiliated with the Sport Singapore Institute (SSI), aiming to compare carotenoid levels, visual function (VF), and sporting performance between these two sports.

METHODS: Visual function was evaluated by measuring visual acuity (VA) and contrast sensitivity (CS) at 6 CPD and 12 CPD in photopic and mesopic conditions for the dominant eye; sporting performance was assessed using shooting score at the end of 60 shots taken at the shooting practice range; and carotenoid status was assessed by measuring dietary intake of Lutein (L) and Zeaxanthin (Z) as well as skin carotenoid concentrations.

RESULTS: A total of 29 shooters, mean (±SD) age 29 (± 9.09) years, and 22 archers, mean (±SD) age 25.8 (± 50692) years (p= 0.124), were assessed at the SSI. Mean ± SD dietary intake of L and Z for shooters and archers was 3,078 ± 3265 µg/day and 4564.3 ± 8643 µg/day, respectively (p=0.399). The mean ± SD skin carotenoid concentration for shooters was 31,379 ± 14,613, while for archers was 30,417 ± 9,999 (p=0.792). There were no significant differences between sports for VA (p= 0.406). There were statistically significant differences in Mesopic CS at 6 CPD (p= 0.027) and 12 CPD (p= 0.017), with moderate Cohen's effect size, d, of d=0.61 and d=0.63, respectively. The Mesopic CS at 6 CPD and 12 CPD for shooters and archers were as follows: 4.36 (± 2.63) and 2.96 (± 1.74), and 14.98 (± 20.69) and 5.14 (± 2.92), respectively, expressed as Mean ± SD. Significant difference was observed in total shooting score (p= <0.001), with shooters achieving a mean (± SD) score of 595.78 (± 47.09) compared to archers who scored 466.0 (± 92.61).

CONCLUSION: Despite having no differences in VA between sports, archers' visual function in dimly lighted condition was significantly better than shooters. Having the capacity to effectively perceive objects at a distance, particularly in outdoor environments spanning 50 meters with diverse weather conditions, is a vital skill in archery. This ability significantly aids in quick adaptation and enhanced performance in this sport. Similar ability was not found among shooting athletes due to the inclusion of both indoor and outdoor groups in this study. Our future research will investigate whether enhancing the carotenoid status will improve VF and performance in the athletes.

TRAINING RESPONSES IN UNTRAINED FEMALES WITH POST-EXERCISE PROTEIN SUPPLEMENTATION

MURRAY, M.1, BEST, A.1, SIMS, T.S.2, LOEHR, J.A.1, REHRER, N.J.1

UNIVERSITY OF OTAGO

INTRODUCTION: The aim of the study was to investigate the effects of post-exercise protein supplementation on training responses in untrained, healthy females.

METHODS: Participants (n = 27, 33.1 ± 9.2 y, mass 69.5 ± 13 kg, BMI < 30, VO2max. 27.3 + 3.7 ml/kg/min) completed 12 wk upper-body resistance training (2 x/wk) and HIIT cycling (3 x/wk). VO2max, 3RM (shoulder, row, bench) IGF-1 and 3-day dietary records were measured at wk 0 and 12. Participants consumed either a high- (24 g, P) or equicaloric low- (3 g, C) protein post-exercise supplement (510 kJ).

RESULTS: Average daily intakes of total energy for P and C (7225 kJ ± 1116, 7881 kJ ± 1138, resp. P = 0.170), protein (90.8 g ± 14.2, 84.8 g ± 12.1, resp. P = 0.278) were similar. Significant training effects were observed with a 17.2% ± 13.3 increase in VO2 max (P <0.001) and a 50% ± 15.7 increase in average 3RM (P <0.001). No significant differences between P and C were observed in VO2max (4.5 ml/kg/min ± 3.37, 4.6 ml/kg/min ± 3.42, resp. P = 0.935) or 3RM (P= 6.48 kg ± 1.28, C= 7.09 kg ± 2.30, resp. P = 0.386). IGF-1 did not change with training (Δ-3.83 ± 27.3) and was not different between treatments (ΔP= -2.05 ± 27.8, ΔC = -6.04 ± 27.7, resp. P = 0.714). Average number of total sessions for P and C were (85.5% ± 9.52, 86.0 ± 17.8, resp. P = 0.928). Average number of resistance sessions for P and C were (88.7% ± 7.67, 89.9 ± 7.49, resp. P = 0.697). Average number of aerobic sessions for P and C were (82.4 ± 13.2, 90.9 ± 7.38, resp. P = 0.069).

CONCLUSION: The lack of effect of post-exercise protein supplementation on training responses is likely due to the fact that total dietary protein intake was unaltered. This study highlights the fact that consuming a protein supplement does not necessarily alter overall dietary intake as compensation can occur. These results also highlight the fact that untrained females can tolerate and adapt to exercise loads that are typically recommended, based on data from male responses.

RELIABILITY OF THE COSMED Q-NRG AND QUARK CPET INDIRECT CALORIMETERS FOR ASSESSING RESTING METABOLIC RATE IN ATHLETES

HORNER, K., O'NEILL, J.E.R.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Resting metabolic rate (RMR) measurement is crucial for athletes to assess energy requirements and energy availability [1]. The ratio of measured to predicted RMR (RMR ratio), is being increasingly used as a proxy indicator of energy availability, with a ratio <0.9 suggesting low energy availability [2, 3]. A recent meta-analysis shows variability in RMR prediction equation accuracy, suggesting potential issues with using standard equations for RMR suppression detection [4]. A more suitable use may be in longitudinal monitoring, and interpretation of directly measured RMR and body

composition [4]. For accurate longitudinal monitoring, it is crucial that the indirect calorimeter exhibits exceptional reliability. This study evaluates the reliability of the Q-NRG (Cosmed, Italy) indirect calorimeter (IC) against the established Quark CPET (Cosmed, Italy) for RMR measurement.

METHODS: Thirty athletes from multiple sports (19M, 11F) underwent two RMR assessments a week apart using Q-NRG and CPET ICs, with the order randomised initially and then reversed. Outcomes were compared between test visits using paired t-tests and inter-day CVs were calculated. Additionally, RMR measurements were evaluated against recommended prediction equations for use in athletes [4] (Cunningham (1980) [5], Harris-Benedict (1918) [6], Ten-Haaf FFM (2014), Ten-Haaf BW (2014) [7].

RESULTS: Between testing sessions 1 and 2, there were no significant differences in Q-NRG RMR (P=0.80), VO2 (P=0.79), VCO2 (P=0.86) and RQ (P=0.47), or CPET RMR (P=0.96), VO2 (P=0.82), VCO2 (P=0.58) and RQ (P=0.45). Both ICs were highly reproducible between test days with a slightly lower CV of 2.4 ± 1.6% (range: 0.2-5.9%) for the Q-NRG, and 4.0 ± 3.6% (range: 0.1-13.7%) for the CPET. A significant mean bias of -148 ± 124 kcal/24h was observed for RMR with the Q-NRG compared to CPET (1684±239 kcal/24h, range: 1169-2385 vs. 1831±294, range: 1271-2511 kcal/24h, P<0.0001). Significant mean biases were also observed between Q-NRG and CPET VO2 (P<0.0001), VCO2 (P<0.0001), and RQ (P=0.03). When comparing measured RMR to predicted values, the CPET measured a greater percentage of participants to be within10% of predicted values versus the Q-NRG (CPET: 50% (30/60); M, 39.5% (15/38); F, 68% (15/22) vs. Q-NRG: 33% (20/60); M, 16% (6/38); F, 64% (14/22)).

CONCLUSION: The within-individual variability of both ICs was excellent, with the Q-NRG producing superior reproducibility, indicating that both are suitable for use in longitudinal athlete monitoring. The Q-NRG had a bias when compared to the CPET, highlighting that it is essential to use the same indirect calorimeter for repeated monitoring. Ongoing work is establishing the accuracy of the devices independently via ethanol burn testing and metabolic simulator.

[1] D. T. Thomas et al. 2016

[2] S. Staal et al. 2018

[3] T. Sterringer et al. 2022

[4] J. E. R. O'Neill et al. 2023

[5] J. J. Cunningham et al. 1980

[6] J. A. Harris et al. 1918

[7] T. ten Haaf et al. 2014

NUTRITIONAL ASSESSMENT BY 10 FOOD GROUP INTAKE FREQUENCY (10FGIF) IN JAPANESE MALE COLLEGIATE ATHLETES

NAGASAWA, T., MINATO, K.
WAYO WOMEN'S UNIVERSITY

INTRODUCTION: Dietary surveys are conducted in nutritional assessments for athletes. We have developed the 10FGIF, a simple food group intake frequency survey as a nutritional assessment method that is easy to use for athletes and observed that the 10FGIF score, which evaluated by dietitians from the athletes own dietary records, has a positive correlation with energy and some nutrient intakes. We investigated the 10FGIF scores evaluated by the athletes themselves in male collegiate handball players, and the relationship with energy and nutrient intake from a dietary survey conducted at the same time. The present study aimed to examine whether the 10FGIF score is useful as a simplified nutritional assessment for athletes.

METHODS: A total of 64 male university handball players from various competition levels of the Kanto Student Handball Federation participated in this study. The dietary survey was conducted over three consecutive days, including weekends, using photo documentation and estimated quantity food records. The questionnaire covered eating habits, food consciousness, and lifestyle habits on a Likert scale. 10FGIF surveyed 10 food groups (grains, seafood, meats, eggs, milk and dairy products, soy and soy products, green–yellow vegetables, seaweeds, tubers, and fruits) on a three-point Likert scale, awarding one point for selecting "eat every meal" for grains and "eat daily" for other food groups, with a total possible score of 10 points.

RESULTS: Nutrients showing a significantly positive correlation with a simple dietary balance assessment point included energy kcal, kcal/kg (r=0.392, 0.349), protein g, g/kg (r=0.436, 0.412), fats g (r=0.251), carbohydrates g, g/kg (r=0.398, 0.377), iron mg (r=0.305), retinol equivalents μg (r=0.273), vitamin B2 mg, 1,000 kcal/mg (r=0.354, 0.259), vitamin D μg (r=0.331), and dietary fiber g (r=0.288). The median simple dietary balance assessment point was 3. The participants were divided into two groups: a high-score group (≥3 points) and a low-score group (<3 points). The high-score group showed significantly better outcomes about a high competition level, breakfast frequency, consistent dinner time, frequent snack intake, high protein intake frequency, mindfulness of nutritional balance, active behaviors in accordance with the transtheoretical model, high self-evaluation of diet, and receiving dietary guidance from dietitians or other staff.

CONCLUSION: Self-evaluated 10FGIF score in male collegiate athletes had a positive correlation with some essential nutrient intakes for athletes, such as protein, iron, and vitamins, and athletes in the high-score group had good nutritional status compared to the low-score group. These results suggest that the 10FGIF score could be utilized for male collegiate athletes as a simple and basic screening evaluation in nutritional assessment before conducting detailed dietary surveys.

EFFECTS OF AEROBIC EXERCISE AND CALORIC RESTRICTION ON MACROPHAGE POLARIZATION IN LIVER TISSUE OF DB/DB OBESE MICE

WANG, S., XU, C.Y.
SCHOOL OF SPORT SCIENCE

INTRODUCTION: Obesity causes metabolic disorders in the body leading to chronic inflammation, with macrophage activation as the main feature at the site of inflammation. Abnormal accumulation of intrahepatic fat and infiltration of inflammatory cells form the pathological basis of liver inflammation. Aerobic exercise(AE) and calorie restriction(CR)can reduce intrahepatic fat deposition and decrease the degree of hepatocellular inflammation. Therefore, AE combined with CR may achieve better weight loss, and this effect may be consistent with improving the type of macrophage polarization. In the study, we intends to explore the possible mechanism of AE and CR for anti-inflammation and reduce weight from the perspective of macrophage polarization.

METHODS: 40 male 18 weeks db/db mice were randomly divided into four groups of 10 mice each: control group (OC),AE group, CR group, and AE combined with CR group (ECR). AE group used 50-55% VO2max intensity treadmill exercise for 12 weeks（60 mins,5 times per week）; the CR was given 70% of the intake of the OC daily; and the ECR was a combination of the two modalities with an intervention. Serum TC, TG LDL-C,HDL-C and Glu levels were measured in mice. The expression of iNOS, Arg-1, IL-1β, and IL-10 proteins in mouse liver tissues was detected by Western Blot.

RESULTS: Body weight was significantly lower in the CR, AE and ECR than OC after intervention ($P<0.01$). The liver tissue weight of mice in the CR, AE and OER was significantly lower ($P<0.01$) than OC and ECR was significantly lower ($P<0.01$) than AE . Compared to OC, CR and ECR had a significant decrease in serum TC and LDL-C levels ($P<0.05$, $P<0.01$), compared to AE group mice, ECR had a significant decrease in TC, LDL-C ($p<0.05$, $p<0.01$); compared with the OC, the iNOS content in the livers of CR, AE was significantly reduced ($p<0.05$), and the iNOS content in the ECR was very significantly reduced ($p<0.01$), and there was a trend towards a decrease in the iNOS content in the ECR compared with the CR and AE ($p>0.05$); and compared with the OC, Arg-1 in the livers of AE, ECR content was significantly higher ($p<0.05$), and there was a trend of higher iNOS content in the ECR compared to the CR and AE ($p>0.05$); and compared with the OC group, CR, AE IL-10 content in liver was significantly elevated ($p<0.05$), and IL-10 content in ECR group was very significantly elevated ($p<0.01$); IL-10 levels were significantly higher in the ECR group compared to the CR and AE groups ($p<0.05$);there was no significant change in IL-1β content of AE, CR, and ECR compared to the OC, but there was a tendency to decrease.

CONCLUSION: AE,CR, and the combined intervention of the two can reduce the weight gain of obese mice, reduce the weight of liver tissues, and improve lipid metabolism, probably by regulating the macrophage polarization status of liver tissues in obese mice, reducing M1 and increasing M2, thus reducing the inflammatory state of liver tissues.

Philosophy and Ethics

ON THE RELATIONSHIP BETWEEN MAN AND ANIMAL FROM THE PERSPECTIVE OF EQUESTRIAN SPORTS

HE, Q., LI, C., PAN, Z.
INNER MONGOLIA NORMAL UNIVERSITY

This paper analyzes equestrian sports by using the literature method, logical analysis method and Maslows Hierarchy of Needs Theory, and discusses the relationship between human and animal.The study found that about 12,000 years ago, humans began to domesticate horses in the Mesopotamia Valley, when the friendly relationship between humans and animals was initially established.Domesticated horses provide living materials for human beings and meet the basic physiological survival needs of human beings.Humans tamed horses and made them reliable means of transportation and effective labor, freeing the legs of humans.After equestrian riding was invented, it was combined with archery to form equestrian shooting technology, which became a symbol of personal ability to defend the home. Since then, people have obtained the basic needs of safety and belonging.This is a process of acquaintance and mutual understanding between humans and animals, and a great leap forward in the relationship between humans and animals.With the development of society, equestrian sports highlight the need of human social communication.In the folk horse racing, people communicate with each other, share experiences and emotions, and enhance social communication skills. In addition, the communicative function of equestrian sports also shows the interaction and communication between humans and animals. Riding requires the rider to communicate, train and empathize with the horse through language, body and feeling to establish a tacit understanding. Of all the animals first domesticated by man, horses move the fastest.Therefore, horses were selected to pull chariots and used in military operations. In history, Genghis Khan once used a bow and a horse to unify Mongolia and gallop across Europe and Asia. Therefore, the horse gives the nation and the country strong, gives the individual ability and status, so that the nation, the country and the individual can be recognized and respected; The process by which people obtain the above four needs of physiology, safety, communication and respect through equestrian sports is also the process of achieving their own self-realization.In addition,the physical and mental nurturing function of equestrian sports can also cultivate and temper the horses strength and temperament. Therefore, equestrian sports together achieve the all-round development of humans and horses.When equestrian sports meet the needs of human society, respect and self-realization, the labor value of horses to humans is greatly weakened, and the equal relationship between humans and animals is emphasized. This is a process of companionship, respect and mutual achievement between humans and animals, and another major leap in the relationship between humans and animals.This is a pro-

cess of companionship, respect and mutual achievement between humans and animals, and another major leap in the relationship between humans and animals.

WHAT IS NEEDED TO ELIMINATE CORPORAL PUNISHMENT AND HARASSMENT IN JAPANESE SPORT? CHANGE THE WAY WE PERCEIVE PHYSICAL EDUCATION IN SCHOOLS AND SPORT

MORITA, H.
OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: In Japan, extracurricular activities in schools play a major role in the development of competitive sports and athletes. However, in 2012, a high school student who participated in an athletic club activity committed suicide due to suffering from corporal punishment by his instructor. This incident brought corporal punishment and harassment in sports to the forefront as a significant social issue. Unfortunately, however, corporal punishment and harassment in sports continue to be major problems in Japan. Since then, similar incidents have occurred repeatedly. This study aims to investigate measures needed to alleviate this problem.

Discussion:

First, I review the history of the introduction of extracurricular activities to schools in Japan. Extracurricular activities in schools in Japan were modeled after those in public schools in England. Meanwhile, Japanese schools only adopted the system of extracurricular activities. They ignored the elements of student autonomy and independence. When it comes to performances in competitions, the overall performance of the school was considered more important than individual achievements. Even within schools, teams and teamwork are often prioritized over individuals. The post-war sports education system ended up reproducing the premodern pseudo-patriarchal community. In closed communities, the likelihood of people resorting to violence is often observed.

Differences in childrens sports between Japan and the United States include the (1) seasonal system, (2) tryout system, and (3) the number of games played. In Japan, coaches and athletes form extremely close relationships. Compared to the United States, it is said that there are fewer individuals in Japan who excel in both academics and sports. In the past, it was said in Japan that one could not excel as both a scholar and an athlete simultaneously. In contrast, in the United States, there are individuals known as scholar-athletes who excel in both academics and sports.

Result:

So, what should we do? Changing the current school system and athletic activities instantaneously is difficult. However, we need to assume that corporal punishment and harassment in sports can occur at any time under the current state. We also need to clearly distinguish sports from education.Cultivating a culture that promotes excellence in both academics and sports is essential. "Harassment happens all the time in competitive sports," and "Education through sports is unattainable, because sports are intended for ranking and differentiation."

Currently, schools are endeavoring to transition sports team activities in their schools to community-based programs. This transition could potentially allow athletes to choose their coaches in the future. This change is then expected to mitigate the excessive closeness between coaches and athletes and break down the closed nature of sports teams in schools.

RESEARCH HOTSPOTS AND CUTTING-EDGE ANALYSIS OF PUBLIC SPORTS FACILITIES IN CHINA AND ABROAD

ZHU, F., JIE, W.
WENZHOU UNIVERSITY

Introduction

The success of all health exercises cannot be achieved without comprehensive equipment and hardware. Public sports facilities are not only symbols of urban development, but also material support for peoples sports and fitness exercises, playing an important and special role in achieving the national fitness strategy.From the current research situation, there are many studies on public sports facilities both domestically and internationally, but there is a lack of relevant review and analysis. Based on this, this article aims to outline a research knowledge graph, systematically review literature related to public sports facilities, comprehensively analyze hot areas and trends in public sports facility research, and summarize current research shortcomings on this basis, propose future prospects, and provide reference for further promoting research in this field.

Methods

This article uses Cite Space (version 6.2. R5) to conduct knowledge graph analysis on literature data on public sports facilities. Based on the definition of the concept of "public sports facilities", a bibliometric analysis was conducted on 1178 public sports facility literature from 1983 to 2023 in the Cnki core database and Web of Science core database, aiming to identify the characteristics, research hotspots, and development trends of public sports facilities.

Results

The annual publication volume in the field of public sports facilities research both domestically and internationally is generally on the rise. Chinese authors and institutions mainly focus on cooperation, and current hot topics mainly revolve around sports economy, sports management, sports industry, etc. National fitness is currently a cutting-edge research

topic; Foreign authors and institutions mainly focus on independent research, with hot topics mainly focused on thermal comfort, wind tunnel testing, and economic impacts. Research on professional sports venues is currently at the forefront.

Discussion

By analyzing the publication trends, research authors, research institutions, research hotspots, and trends of public sports facilities literature, this article suggests that researchers can focus on the following issues related to public sports facilities in the future.The research on public sports facilities in foreign countries is relatively comprehensive. In the future, more possibilities can be explored by combining technologies such as the Internet of Things, artificial intelligence, and virtual reality, in order to seek more benefits for the public.Compared to foreign countries, China needs a more diverse range of disciplines and research methods, guided by sustainable development concepts such as green environmental protection and ecological technology, and emphasizing the integration of new technologies into public sports facilities to promote national fitness at a technology oriented level, which is the main trend of future research.

EVALUATION OF THE IMPACT OF THE 2018 ACTIVE HEALTHY KIDS HONG KONG REPORT CARD ON PHYSICAL ACTIVITY FOR CHILDREN AND ADOLESCENTS

WONG, S., HO, R.S.1, HUANG, W.H.2

1. THE CHINESE UNIVERSITY OF HONG KONG; 2. HONG KONG BAPTIST UNIVERSITY

INTRODUCTION: The Active Healthy Kids Hong Kong Report Card on Physical Activity for Children and Adolescents is part of the international knowledge translation initiative to synthesize and evaluate the evidence on physical activity-related indicators. Three iterations of Hong Kong Report Cards have been developed since 2016. The objective of this study was to evaluate the impact of the 2018 (the second) Hong Kong Report Card among stakeholders using a mixed method.

METHODS: A multidisciplinary group of stakeholders whose work relates to children's physical activity and health was invited to respond to an online survey between March and July 2022. Survey questions included the usefulness of each indicator included in the 2018 Report Card for promoting and facilitating opportunities for physical activity among children and adolescents and the extent to which the results assist their profession, using a 10-point Likert Scale (from 1 the lowest to 10 the highest). Seven focus group interviews (5-6 stakeholders each group) were conducted via Zoom meetings to gauge stakeholders' views qualitatively. During the focus group interviews, the participants discussed the understanding and the perceived usefulness of the 2018 Report Card regarding their professions. The discussions were recorded and then transcribed verbatim for subsequent coding and analysis.

RESULTS: A total of 164 respondents (92 males and 72 females) completed the online survey. Over 40% of them worked in the education sector, followed by sport coaching (26%), and non-government organizations (13%). Nearly half (49%) of the respondents were aware of the 2018 Report Card, while another 28% indicated that they would like to know more about the details and then were provided with a copy of the long form report card. The survey results indicated that the most common usefulness of the report card included facilitating physical activity research (mean score=8.2, SD=1.5), health policy development, and curriculum planning for physical education (mean score=7.9, SD=1.5), and guiding resource allocation in implementing physical activity programs (mean score=7.8, SD=1.5). The stakeholders reported strong agreement that the report card has positive impact on children's health in Hong Kong. Themes regarding the usefulness of the report card emerged from focus group interviews. Respondents expressed that the report card could assist them in writing proposals for acquiring funding related to physical activity, and it could serve as a reference when giving local educational lectures as well as designing school fitness tests.

CONCLUSION: Findings from the survey and focus group interviews indicated that the 2018 Report Card was beneficial to stakeholders involved in the field of physical activity research, physical education program development, and awareness raising for the public.

QUALITATIVE ANALYSIS OF FEEDBACK FROM A FAMILY-BASED FITNESS PROGRAM (

HO, R.1, WONG, P.1, HUANG, W.2, WONG, S.1

1 DEPARTMENT OF SPORTS SCIENCE AND PHYSICAL EDUCATION, THE CHINESE UNIVERSITY OF HONG KONG 2 DEPARTMENT OF SPORT, PHYSICAL EDUCATION AND HEALTH, HONG KONG BAPTIST UNIVERSITY

Qualitative analysis of feedback from a family-based fitness program ("F.I.T. Family") for primary school children and their families in local Hong Kong communities

Ho, R.S.,1 Wong, P.S.,1 Huang, W.H.,2,3 Wong, S.H.,1

1 Department of Sports Science and Physical Education, The Chinese University of Hong

Kong

2 Department of Sport, Physical Education and Health, Hong Kong Baptist University

3 Dr Stephen Hui Research Centre for Physical Recreation and Wellness, Hong Kong Baptist University

INTRODUCTION

Results of the Active Healthy Kids Hong Kong Report Cards have demonstrated that Hong Kong children have low physical activity (PA) levels, low physical fitness levels and high sedentary behaviours, with almost a quarter being overweight or obese. Of particular concern was our finding that family support for PA for children was poor in Hong Kong. Parental

factors have been shown to play important roles in promoting PA among children. A qualitative study embedded in a community-based healthy lifestyle program ("F.I.T. Family") was conducted in 2022-2023 with Hong Kong local families with primary school children as our target audience. The objective of this study was to explore the feedback of the family members who took part in the F.I.T. Family program.

METHODS: To obtain feedback from participants, a qualitative study was conducted among parents upon completion of all counselling and practical sessions of the F.I.T. Family program. Parents were invited to participate in a focus group interview via Zoom meetings. During the focus group interviews, the participants discussed about their experience and comments for the F.I.T. family based on a set of pre-designed semi-open questions. Participants were informed of the purpose of the interview, and their right to refuse to participate beforehand. Each focus group interview was conducted for approximately 30 minutes. Interviews were moderated by trained investigators of the F.I.T. Family program who had experience in conducting qualitative research. No other individuals were present in the focus group interviews. The focus group interviews were recorded and then transcribed verbatim for subsequent coding and analyzed using Microsoft Word.

RESULTS: A total of five focus group interviews were conducted (5 to 6 parents each group). Themes about the experience and comments from parents who took part in the F.I.T. Family program emerged from focus group interviews. Parents expressed that "parents' education and self-motivation", "PA video clips tutorials", and "reward mechanism" are important emerging main themes in helping them and their children to perform more PA. Subthemes within the main themes such as "the incorporation of competition in the PA session" and "role modelling" were also expressed to be helpful in promoting family PA as well.

CONCLUSION: Findings of the qualitative study indicated that parents could positively initiate family PA. The level of family PA could be maximized

BUILT ENVIRONMENT, PHYSICAL ACTIVITY AND SPORT PARTICIPATION IN SCOTLAND

DAVISON, L., DAVISON, R.
GLASGOW SCHOOL OF ART

Introduction

Physical inactivity is the 4th leading cause of death worldwide and is an important modifiable risk factor for several non-communicable diseases. The design of the built environment has the potential to have a significant impact on physical activity and sport participation. In general the availability of high quality green space and or sport and leisure facilities in close proximity to living accommodation provides appropriate space for physical activity and sport participation. The aim of this research was to investigate the relationship between the proximity of green space, use of leisure facilities with recreational sport and physical activity in Scotland using data from the Scottish Household Survey.

Methods

The Scottish Household Survey (2019) is based on a representative sample of the general population in private residences in Scotland. It has been undertaken annually since 1999 and has around 10,000 respondents each year. This survey provides data on proximity of green open space use of sports and leisure facilities and the perceived satisfaction with both. It also assesses levels of sport participation and walking for recreational purposes.

Results

Walking for at least 30 minutes in the last 4 weeks for recreational purposes was significantly impacted by distance from green space. An increase in distance from under 5 minutes to 6-10 minutes walk resulted in a 72% reduction in walking activity and a decrease of 89% if that was increased to 11-20minutes. There was also a strong relationship between use of Parks and open spaces and walking for at least 30 minutes in the last week for recreation. With 77% of those walking reporting use of most days, at least once a week or about once a month. More frequent use of parks and open spaces was was more often reported from individuals taking part in sport in the last 4 weeks compared to those who did not participate, even when walking was removed from the sport participation category.

Interestingly there was high satisfaction with both Parks and Open Spaces as well as Sports and Leisure facilities. Of those who used the Sports and leisure facilities at least once a week (17%) the majority were either very or fairly satisfied (87%). Likewise of those who used Parks and Open Spaces at least once per week (43%) the majority were either very or fairly satisfied (89%).

Conclusions

Overall this data demonstrates the clear links between proximity of green and open spaces and physical activity in particular walking but also wider sport participation. It provides further justification for the 5 minute neighbourhood design concept and certainly suggests a steep decline in physical activity as proximity to green and open spaces increases. This dataset is limited to revealing associations and not cause and effect although other literature does demonstrate this. Unfortunately this data set does not provide information on the proximity of the sport and leisure facilities.

ROWING AND INCLUSIVITY: DEVELOPING NEEDS-BASED OUTREACH PROGRAMMES THROUGH COMMUNITY ENGAGEMENT.

GRAHAM, L., CEREXHE, L.
UNIVERSITY OF THE WEST OF SCOTLAND

The sport of rowing is often associated with an image of elitism and lack of accessibility. This is particularly evident at Olympic level where athletes who were privately educated consistently take the majority of podium places (8 of 13 at Tokyo 2020), despite comprising less than 7% of the total pupil population in the U.K. Rowing outreach programmes aim to address this issue by introducing the sport to young people who may not have had previous opportunities to engage. This study examines the perceptions of key youth work professionals and volunteers on the accessibility of rowing, potential barriers to participation for their groups, and how outreach coordinators could design programmes which can best meet the needs of local young people.

Stakeholders from eight local youth groups in close proximity to a rowing club offering free outreach activities participated in online, semi-structured interviews. Data were thematically analysed and trustworthiness was addressed through researcher triangulation and member checking.

Participants had largely positive responses towards the proposed outreach activities, highlighting potential benefits including improved mental health, teamwork, and intergenerational physical activity. Areas requiring consideration when designing the activities included cost of travel, image of rowing as "upper class", pathways for sustainability, lack of English language skills, and inclusion of young people with disabilities.

Understanding the needs of young people and those engaged in youth work activities is essential in designing appropriately tailored rowing outreach programmes and in ensuring rowing is best placed to meet inclusivity objectives.

THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND SUBJECTIVE WELL-BEING AMONG ADOLESCENTS

SUN, S., XIONG, D., ZHANG, X., ZHANG, Z.
PEKING UNIVERSITY

The relationship between physical activity and subjective well-being among adolescents

Shiya Sun1, Deliang Xiong 2,Xingmei Zhang3, Zhanjia Zhang4

1Peking University, Beijing, China 2East China Normal University

Physical activity has been shown to have numerous benefits, including promoting overall well-being, preventing diseases, and improving cardiorespiratory health. However, there is limited research on how physical activity specifically relates to subjective well-being, a key concept in positive psychology, in adolescents.

Purpose: This study was to investigate the associations between physical activity and subjective well-being and mental health in adolescents. A cross-sectional study was conducted, involving a sample of 288 junior high school students from several public middle schools in Beijing and Shanghai. The average age of the participants was 13.97 years, with 56.3% of them being girls. Multiple psychological indicators were assessed including happiness by Subjective Happiness Scale (SHS), depressive symptoms by the Adolescent Depression Scale (KADS-11), and life satisfaction by the Student Multidimensional Life Satisfaction Scale (BMSLSS-PTPB) were used as dependent variables in the analysis. Physical activity was measured using the Physical Activity Rating Scale (PARS-3). Three multiple regression models were established with happiness, life satisfaction, and depressive symptoms as the dependent variables, respectively. Physical activity was treated as the independent variable in each model with age and gender controlled as covariates.

Methods: The results indicated that physical activity did not have a significant association with depression and happiness (p's > 0.05). In contrast, physical activity is positively associated with life satisfaction ($\beta = 0.119$, $p = 0.042$). Regarding the covariates, older adolescents showed higher levels of depressive symptoms ($\beta = 0.186$, $p = 0.002$) and lower levels of happiness ($\beta = -0.169$ $p = 0.005$) compared with their younger counterpart. In addition, girls reported higher levels of depressive symptoms than did boys ($\beta = 0.185$, $p = 0.002$).

Conclusion: This study suggests that physical activity has a selective association with the components of subjective well-being in adolescents. Particularly, increased engagement in physical activity is associated with greater life satisfaction but not with happiness and depressive symptoms in adolescents. Future research should explore the mechanisms behind this selective association and determine whether specific types of physical activity may impact happiness and depressive symptoms.

FROM ELIGIBILITY TO EXCLUSION: THE COMPLEXITIES OF INCLUSION IN WHEELCHAIR BASKETBALL AT INTERNATIONAL LEVEL

RAMSDEN, R., HAYMAN, R., HETTINGA, F.J.
NORTHUMBRIA UNIVERSITY, UK

This study builds upon the foundation laid by our previous research (Ramsden et al, 2023), which explored the transformative impact of incorporating able-bodied players into wheelchair basketball teams. It highlighted the advantages of reverse integration, offering social and health benefits. However, challenges arise at the international level due to the reclassification process, sometimes leading to athlete exclusion. This study aims to gather perspectives on inclusion and reverse integration across various levels of wheelchair basketball competition.

This study conducted 11 in-depth interviews with UK national-level wheelchair basketball players, including both able-bodied and disabled athletes, male and female, aged 18-41. Thematic analysis was used to explore insights into inclusivity and reverse integration in wheelchair basketball.

Current results revealed the reality of the unintended exclusion of players at international level, involving both able-bodied and disabled players. The theme of reverse discrimination was highlighted. An able-bodied player expressed their experience of exclusion due to the eligibility criteria for international-level competition and was no longer able to progress their playing career. This newly identified concept of reverse discrimination unveils insights into the complex dynamics of the sport, particularly regarding the balance between promoting inclusivity, creating opportunities for disabled athletes, and reducing ableism.

Our previous work emphasised the significance and advantages of reverse integration to promote inclusivity at club level. This process cultivates a more inclusive environment by dismantling barriers between various player groups. While reverse integration highlights many benefits, the concept of reverse discrimination was also identified in the present study, in particular at the higher competitive level. Able-bodied athletes who are essential for promoting the sport at club level, and often are engaged team members, may inadvertently face exclusion due to lack of a specific acquired disability for international competition under the reclassification process, without an opportunity to otherwise engage in their sport and with their team at international level.

Physical Education and Pedagogics

LINE BOT FOR BADMINTON SKILL LEARNING: AN E-PORTFOLIO-BASED WISER MODEL WITH COOPERATIVE LEARNING STRATEGY

LIN, K.C.
NATIONAL SUN YAT-SEN UNIVERSITY

Introduction

LINE is a leading mobile messaging app in Taiwan, renowned for its versatile daily applications. Due to its extensive usage, many educational studies have adopted this messaging app in their pedagogies and validated its effectiveness. Recognizing LINE's potential and strengths, the researcher developed a LINE Bot as a teaching platform where learners could access teaching materials instantly and upload their recordings for the system to create their e-portfolios. To fully utilize the LINE Bot, the researcher designed an "e-portfolio-based WISER model with cooperative learning strategy" to help students acquire the complex badminton front-court forehand and backhand lift with footwork variations over 14 weeks.

Methods

The study engaged 42 participants in a one-group pretest-posttest experimental design. The participants' performances were evaluated by two experts focusing on front-court footwork and lift skills. The experts' evaluation of both skills has Cohens Kappa Coefficient exceeding 0.7, indicating a positive correlation between the experts ratings. Besides, this study employs a paired-sample t-test to evaluate the effectiveness of the learning strategies on badminton learning performance.

Results

The results indicated that the LINE Bot integrated WISER model with the cooperative learning strategy significantly enhanced learners badminton skill acquisition. The statistical analysis demonstrated a substantial increase in the post-test scores relative to the pre-test (footwork: $p < .001$; lift: $p < .001$). The footwork score rose from 0.119 to 0.923, and the lift score surged from 1.956 to 3.335 on a scale of one and four, respectively.

Discussion

The e-portfolio-based WISER model conformed to the three-staged motor skill learning theory, comprising cognitive, associative, and autonomous stages. In the Cognitive stage, learners watched demonstration videos and imitated expert movements, fostering movement cognition. The Associative stage involved cooperative learning strategies. Learners self-examined and discussed their recordings in groups, compared their movements with the demonstration videos to refine their skills, and sought the instructor's feedback. Through the WISER model, learners gradually developed the correct badminton skills and reached the Autonomous stage, where they could perform the correct movements themselves. This was evidenced by learners' ability to identify and correct their practice errors before receiving the instructor's feedback in the latter half of the semester. Their progression signified a shift from passive instruction reception to active skill acquisition, crucial for mastering complex badminton skills and footwork variations.

DIGITAL COMPETENCE CENTRE FOR BASIC MOTOR COMPETENCIES - MOBAK DIGIKO

HEIM, C., VLCEK, P., SALLEN, J., ENNIGKEIT, F., SCHOLE, L., NIEHUES, M., EGERER, M., CZOGALLA, J., SCHWIER, J., GERLACH, E.
JOHANN WOLFGANG GOETHE UNIVERSITY

Introduction: In recent years, the MOBAK concept has yielded valid measurement tools (e.g., Herrmann et al., 2017) and established an internationally recognised approach to improving childrens basic motor competencies (cf. Scheuer & Heck, 2020). The project MOBAK DigiKo leverages these foundations and focuses on enhancing the qualification for motor

competence diagnostic procedures in primary schools while facilitating the use of digital tools in the planning, implementation, and assessment of physical education lessons.

Objective: The primary objective is to establish a collaborative digital competence centre consolidating and applying various resources with an initial focus on three federal states in Germany – Hessen, Hamburg, and Schleswig-Holstein.

Methods: The project focuses on adapting, utilising, and implementing existing digital tools developed by the project partners in the past: an application for test data collection and digital evaluation of basic motor competencies (University of Frankfurt), an app-based modular toolkit for lesson planning and teacher training (University of Hamburg), and digital teaching scenarios focusing on planning, implementation, and evaluation of p.e. lessons (University of Flensburg).

Results: Collaboration with state teacher training institutes is intended to ensure the sustainable integration of computerised applications and digital resources into school practices through three modules with the following objectives: 1. To enable teachers to conduct a reliable and accurate diagnosis of basic motor competencies. 2. To empower teachers to design, test, and implement instructions supported by digital technologies. 3. To implement existing teaching and learning scenarios in the training, further education, and professional development of physical education teachers in a blended learning format (Hinternesch et al., 2021).

Conclusions: The consortium project aims to enhance data literacy among physical education teachers and foster collaboration among institutions involved in teacher education and professional development. The transfer of digital tools into practice will be achieved through sustainable integration into university-level physical education teacher training and state institute programmes. Professionalisation components, digitally supported teaching materials, and learning scenarios will be offered as open educational resources through consortium platforms with ongoing development.

References:

Herrmann, C., Heim, C. & Seelig, H. (2017). Diagnose und Entwicklung motorischer Basiskompetenzen. Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 49 (4), 173–185.

Hinternesch, S., Schwier, J. & Seyda, M. (2021). Digitalisierung meets Internationalisierung. Blended Learning im Praxissemester. Zeitschrift für Studium und Lehre in der Sportwissenschaft, 4 (3), 19–25.

Scheuer, C., & Heck, S. (2020). Modular support toolkit forteachers. Zenodo. https://doi.org/10.5281/zenodo.3725901

PEDAGOGIES OF AFFECT IN PHYSICAL EDUCATION AS A POTENTIALLY VALUABLE WAY OF WORKING WITH STUDENTS INTRINSIC MOTIVATION

SAINCHUK, M., KIRK, D.

UNIVERSITY OF STRATHCLYDE

INTRODUCTION: Neglecting or not understanding the value of affects in the process of teaching physical education (PE) trivialises and dilutes this discipline, and thus has an impact on student motivation. PE lessons should be child-centred to create love, interest, and intrinsic motivation for exercise, and the pedagogies of affect are very helpful for this. Focusing on pedagogies of affect requires special training of the teacher, he/she must be open-minded and prone to constant reflexive analysis of both his/her own approaches and students behaviour.

METHODS: Descriptive and deductive reasoning to substantiate the research project "Developing and enacting pedagogies of affect in PE".

RESULTS: The research project "Developing and enacting pedagogies of affect in PE" is an opportunity to develop pedagogies that address issues of motivation, perseverance and resilience and is a response of PE to the growing prevalence of mental health problems among children and young people. The concept of " pedagogy of effect" for PE was proposed and substantiated by Kirk [1]. Pedagogies of affect in PE aligns teaching, learning and assessment in such a way that PE is inclusive, fair, and equitable as an embodied experience for young people and, as such, empowers them. The project is being implemented among PE students, and their understanding of such an aspect as Personal Qualities (motivation, confidence and self-esteem, determination and resilience, responsibility and leadership, respect and tolerance, communication), officially approved for PE [2], is currently being studied.

DISCUSSION:

Formation of motivation for physical exercises is a long-term and at the same time constantly relevant task for scientific research in pedagogy and psychology of PE. Many motivational theories have been tested in practice and, in recent years, some scientists have already substantiated and promoted the affective-reflective theory as an alternative to others (in particular, self-determination) [3] that explain the hidden reasons for peoples desire to be active or inactive.

The affective-reflective approach to teaching students opens new opportunities to influence motivation to engage in PE, as the focus shifts to the everyday learning process, which considers the needs and circumstances of students to build mutual trust in relationships and develop their interest and motivation for learning activities.

REFERENCES:

1. Kirk, D. "Precarity, critical pedagogy and physical education", London, UK: Routledge, 2020.

2. Education Scotland. "Benchmarks physical education", 2017.

3. Ekkekakis, P. and R. Brand. "Exercise motivation from a post-cognitivist perspective: Affective reflective theory." In Motivation and self-regulation in sport and exercise, edited by C. Englert, and I. Taylor, New York: Routledge, 2021: p. 20–40.

FACULTY MEMBERS' PERCEPTIONS OF IMPLEMENTING ASSESSMENT RUBRICS FOR PHYSICAL EDUCATION IN A JAPANESE HIGHER EDUCATION INSTITUTION

MURAYAMA, M., NAGATA, N.1, SHIMIZU, K.1, TERAOKA, E.2, INAMI, T.1, FUKUSHI, N.1, HIGASHIHARA, A.1, OKUYAMA, S.1, SASAKI, R.1

1 KEIO UNIVERSITY, 2 NIPPON SPORT SCIENCE UNIVERSITY

Purpose: In 2018, the Japanese Ministry of Education, Culture, Sports, Science and Technology outlined the Grand Design for Higher Education Toward 2040, aiming to achieve student-centred education. Subsequently, in 2020, guidelines for the Management of Teaching and Learning were introduced, urging universities to proactively engage in administrative efforts to achieve educational objectives. An integral aspect of managing the quality of teaching and learning involves the assessment and visualisation of student learning outcomes, with an emphasis on employing rubrics for effective assessment criteria. However, the implementation of assessment rubrics in practical physical education at the university level is limited. This study investigates the perceptions of faculty members regarding the implementation of assessment rubrics for physical education classes.

Method: A survey was conducted with 54 faculty members responsible for practical physical education classes at Keio University in Japan. The respondents (40 out of 54; response rate, 74.1%) included 16 full-time faculty members and 24 adjunct instructors. It should be noted that the use of rubrics for assessment purposes has not been systematically established in the institution hosting the physical education curriculum at Keio University.

Results: The findings revealed that 52.5% of participants acknowledged being aware of assessment rubrics. Of interest, none expressed a desire to actively utilise rubrics in the future, 73.7% indicated an interest in using them alongside current assessment criteria, and 21.1% did not express much interest in future use. Participants provided justifications for incorporating rubrics alongside existing assessment criteria, citing reasons such as clarifying the objectives and meaningfulness of the class, utilising specific assessment criteria, and aligning perceptions between instructors and students regarding what is being assessed and the expected levels of achievement. Furthermore, participants highlighted the necessity for faculty training in rubric creation skills to facilitate effective implementation.

Discussion: Some respondents recognised the efficacy of assessment rubrics for class improvement and establishing authentic assessment systems; however, 47.5% were unaware of rubrics, indicating a remarkable gap in awareness among faculty members. Moreover, the willingness to actively utilise rubrics remained limited, with a focus on integrating them with existing assessment practices. In conclusion, there is a pressing need for faculty training to enhance understanding and encourage the systematic integration of assessment rubrics, promoting authentic assessment practices and educational improvements in physical education.

THE LEARNING EFFECTS OF INTEGRATING SOCIAL AND EMOTIONAL LEARNING INTO PHYSICAL EDUCATION CURRICULUM

PAN, Y.H.1, HUANG, C.H.1, ZHANG, Y.Y.1, LIN, C.P.2, LIU, Y.C.1, YEH, W.H., HSU, W.T.3

1. NATIONAL TAIWAN SPORT UNIVERSITY, 2. MING-DAO HIGH SCHOOL, 3. NATIONAL DONG HWA UNIVERSITY

Introduction: Sport can improve positive youth development. Internationally, there is a growing trend to explore social and emotional learning (SEL) in physical education. It is an important research topic to examine which curriculum and teaching models integrating social and emotional learning can improve better learning effects for affective domain. The purpose of this study was to examine learning effects of affective domain integrating SEL into different physical education curriculum. Method: This study adapted the research method of quasi-experimental design. A high school physical education teacher taught both the experimental group and the control group. The experimental group was " SEL integrated with Teaching Games for Understanding, SEL-TGfU", and the control group was "SEL integrated with Traditional Teaching Model, SEL-TTM)". A total of 89 students in the experimental group with two classes (Mage=15.37±0.49 years); a total of 89 students in the control group with two classes (Mage =15.45±0.56 ± 0.50 years). The " Social and Emotional Learning Scale for Physical Education" (SELS-PE)" has 5 components including self-awareness, self-management, social-awareness, relationship skills, responsible decision making, which was used to measure students' learning effects for SEL, and data analysis was carried out through dependent sample t-test and analysis of Covariance (ANCOVA). Results:1. The posttest scores of the SEL-TGfU (experimental group) and SEL-TTM(control group) were both significantly higher than those of the pretest in all components of SEL. 2. The posttest scores of the experimental group were higher than those of the control group in all components of SEL, it meant that SEL-TGfU model had significantly higher learning effects than SEL-TTM for social and emotional learning. Conclusion: This study confirmed that integrated SEL into physical education lessons, whether SEL-TGfU with empowerment teaching approach or SEL-TTM with direct teaching approach, both of which could improve students' SEL, and TGfU with empowerment teaching approach has higher learning effect of SEL than those of traditional direct teaching approach.

CHAIN-MEDIATED EFFECTS OF RESILIENCE AND CAREER DECISION-MAKING SELF-EFFICACY ON THE RELATIONSHIP BETWEEN FAMILY FUNCTIONING AND PRE-SERVICE PHYSICAL EDUCATION TEACHER IDENTITY

WANG, Y.

BEIJING SPORT UNIVERSITY

Introduction

This investigation probes the complex interplay between familial dynamics and the formation of professional identity in pre-service physical education teachers, underscoring the overlooked roles of resilience and career decision-making self-

efficacy as mediating factors. It aims to bridge a gap in current literature concerning the influence of family environments on the professional identity development of future educators.

Methods

Engaging 515 students from diverse educational programs across three universities, this study collected data via questionnaires, subsequently analyzed through structural equation modeling. This methodology scrutinized the interplay between family functioning, resilience, career decision-making self-efficacy, and teacher identity, focusing particularly on mediation effects to unravel the complex web of relationships among these key variables.

Results

The analysis revealed a notably positive influence of family functioning on teacher identity. Importantly, resilience and career decision-making self-efficacy emerged as sequential mediators in this relationship. These findings illuminate the intricate dynamics linking family environment with the evolution of professional identity, emphasizing the critical role of both individual and environmental factors in shaping future physical education educators professional self-concept.

Discussion

This research underscores the pivotal role of family functioning in shaping the professional identity of pre-service physical education teachers. A direct correlation is observed between strong family bonds and a robust teacher identity, facilitated through increased resilience and career decision-making self-efficacy. These findings illuminate how familial relationships and individual psychological attributes collaboratively influence educational career paths. Resilience, fostered within family environments, emerges as essential for navigating teaching challenges, while career decision-making self-efficacy highlights the significance of self-confidence in career choices on teacher identity formation. These mediators suggest that enhancing family connections and fostering resilience and decision-making skills could substantially strengthen pre-service educators professional identities. The implications for education are significant, advocating for programs that emphasize family engagement and the development of resilience in teacher education. By incorporating strategies to improve decision-making self-efficacy, future educators can be better prepared for professional hurdles. This study highlights the importance of integrating family and personal factors into teacher training, aiming to develop a resilient, empowered, and competent teaching workforce, essential for the advancement of physical education teaching.

ROLE OF ENTERTAINMENT HEALTH EDUCATION IN IMPROVING BOTH ADOLESCENT ATHLETE AND NON- ATHLETE STUDENT'S KNOWLEDGE OF DOPING AND HEALTH

NAKAJIMA, R., KATO, K.2, MATSUO, E.1, KATO, Y.1, ONUMA, N.1, WATANABE, F.1

1 NIHON UNIVERSITY; 2 NATIONAL INSTITUTE OF TECHNOLOGY, ICHINOSEKI COLLEGE

INTRODUCTION: Japan's high school curriculum guidelines include an item on anti-doping education, that clearly states the need for anti-doping education for the general public. Although elite athletes receive extensive anti-doping education through their affiliated sports organizations, young athletes who do not have the opportunity for such education lack knowledge about the same. Therefore, in this study, we focused on entertainment education that is effective in health education for young people, both athletes and non-athletes, and thereby developed health education materials in the form of comics. We conducted entertainment health education in the form of comics for the general public and young student athletes and evaluated the effectiveness of the educational materials by measuring their knowledge about doping and health before and after the education.

METHODS: We conducted health education using cartoon-style health educational materials for students enrolled in colleges of technology (non-athlete students) and University of sports science (athlete students) in Japan. The education content included knowledge about anti-doping, nutrition, and supplements, among other topics. A health education module and initial questionnaire was conducted, and a follow-up questionnaire was conducted after three months of education.

RESULTS: Health education was provided to 136 non-athlete students (82% male, average age 18.3 years) and 116 athlete students (86% male, average age 19.7 years). Respondents' answer that they "understand well about doping and can teach others about doping" increased from 3.8% to 16.3% for non-athletes and from 7.2% to 14.3% for athletes before and after the education. Regarding the evaluation of dietary diversity, which indicates nutritional balance, improvements were seen only for non-athletes. The percentage of respondents who strongly agree with the question, "Supplements are food, and anyone can take them safely," changed from 10.3% to 2.9% for non-athletes and from 8.7% to 4.8% for athletes before and after the education.

CONCLUSION: Improvement was observed, in areas like understanding of doping, and knowledge regarding supplements, as a result of entertainment health education using cartoon-style health educational materials. Health education using cartoon-style health educational materials was thus suggested to improve the health knowledge including the understanding of anti-doping for both non-athlete and athlete students.

EFFECTIVENESS OF AI UTILIZATION TO PROMOTE LEARNING IN JUNIOR HIGH SCHOOL PHYSICAL EDUCATION CLASS

NAKAJIMA, T., UMEMURA, T., SATO, H.

HOKKAIDO UNIVERSITY OF EDUCATION SAPPORO

INTRODUCTION: The advent of pioneering technologies exerts influence on pedagogical methodologies and educational paradigms. The swift evolution of artificial intelligence (AI) technology in recent times has underscored the increasing prominence of its integration within educational frameworks. In recent years, case study-based research results have

been reported on the potential of AI utilization even in physical education (PE) classes [1, 2]. However, there are few reports on how students learning activities are deepened using AI in PE classes. Thus, the purpose of this study was to clarify the relationship between the application of AI in PE classes at junior high schools and learning outcomes based on the students reflective descriptions.

METHODS: The subject was an 8th grade class at a Japanese junior high school. OpenAI ChatGPT was used as part of an activity to think about strategies in PE softball classes. At first, the students considered strategies themselves, and then checked ChatGPT to see what kind of example strategies were available. After the class, we asked the students to reflect and describe what they learned from using ChatGPT in the strategy thinking activity. The use of ChatGPT in the classroom followed the "Tentative Guidelines for the Use of Generative AI in the Primary and Secondary Education Stage" [3].

RESULTS: Text-mining analysis of the students descriptions revealed that the use of AI in situations where students consider strategies in PE classes leads to learning outcomes in the following major categories: "confirmation of own thinking," "opportunity for gaining valuable realizations," and " sense of actual learning."

Discussion:

In a previous study, it was reported that the use of generative AI can contribute to the improvement of athletic performance in PE classes at universities [4]. In this study, beyond improving athletic performance, generative AI in PE classes for middle school students has the possibility of contributing to the promotion of student learning.

References:

1. Yuan Jingjie. Application of artificial intelligence in physical education and future prospects. Journal of Sport Psychology, 2023. 31(4): p. 271-278.

2. Hyun Suk Lee & Junga Lee. Applying Artificial Intelligence in Physical Education and Future Perspectives. Sustainability, MDPI, 2021. 13(1) : p.1-16.

3. Japanese Ministry of Education, Culture, Sports, Science and Technology. Tentative Guidelines for the Use of Generative AI in the Primary and Secondary Education Stage. 2023. https://www.mext.go.jp/content/20230710-mxt_shuukyo02-000030823_003.pdf.

4. Zihaoa Li & Hejinb Wang. The effectiveness of physical education teaching in college based on Artificial intelligence methods. Journal of Intelligent & Fuzzy Systems, 2021. 40(2): p.3301-3311.

EFFECTS OF EXTRA-CURRICULAR PROGRAMS ON STUDENTS PHYSICAL ACTIVITY LEVELS IN THE MIDDLE SCHOOL PHYSICAL EDUCATION

PARK, H.

JEJU NATIONAL UNIVERSITY

The purpose of this study was to examine the effects of extracurricular activities on students'activity levels in the middle school physical education classes. The ultimate goal of physical education is to improve health through physical activity. Therefore, despite schools providing various educational programs for participation in physical activity, many adolescents do not participate in physical activity. In order to develop educational programs to promote physical activity, we need to understand the physical activity level of adolescents from various aspects. Physical activity engagement is one of the main health-related goals of physical education and sports and it is needed in order for participants to become physically fit and physically skilled. A total of 678 middle school students participated for this study. Using the Transtheoretical model, students were asked to complete a survey designed to determine personal, behavioral and environmental characteristics associated to exercise behaviors and intentions. Using the SOFIT (System for Observing Fitness Instruction Time), students' activity, lesson context, and teacher behaviors were observed during the physical education class. SOFIT has been validated in several ways and studies have shown that it can be used reliably in diverse instructional settings, including with those with preschoolers and adults. SOFIT is a comprehensive tool for assessing physical education (PE) classes by providing for the simultaneous collection of data on student activity levels, the lesson context, and teache behavior. Results of this study showed that students who participated in PA related extracurricular programs were active, were in maintenance stage, and were more confident in their ability to exercise significantly more than students in other extracurricular activity programs (i.e., art, music, math activity) and students who did not participated in any extracurricular activities. Schools with professionally prepared teachers along with the adequate time and facilities have the potential to effectively influence students' health by promoting student participation in physical activity and to establish the continuing involvement of students in physical activity for life. There is, however, little research on effects of extracurricular activities (i.e., sports, games, etc.) on students'engagement in physical activities. The results of this study provide an understanding of the effects of physical activity related extracurricular activities that could be helpful in developing health promotion strategies for middle school students.

EXPLORING LEARNING COMMUNITIES AND PHYSICAL EDUCATION PROFESSIONAL DEVELOPMENT IN FUNDAMENTAL MOVEMENT LEARNING COMMUNITY (FMLC) IN HONG KONG

HO, Y.K.K.

THE EDUCATION UNIVERSITY OF HONG KONG

Fundamental Movement Learning Community (FMLC) is a Community of Practice (CoP) that focuses on learning, knowledge sharing, and research to improve the teaching of fundamental movement skills in Hong Kong. FMLC was

established in 2013 in response to the challenges Hong Kong teachers face in teaching fundamental movements in schools and the diverse interpretations of the latest curriculum.

By reviewing the governance data from the Education Bureau of the Hong Kong Special Administrative Region (HKSAR) and the annual public reports of the Fundamental Movement Learning Community (FMLC), this study explored the significant growth of the FMLC over ten years. Initially implemented in only 3 out of 456 schools (0.6%), the FMLC expanded its reach to 257 out of 456 schools (56.3%) by 2023. Particularly noteworthy is the significant increase in the number of participating schools in 2015, the year prior to the publication of the teaching materials, from 12 schools in 2014 to 150 schools, an impressive 11.5 times increase in comparison. This upward trend continues with an annual growth rate of at least 3.5% through 2023.

This study provides an overview of FMLC from 2013 to 2023, specifically focusing on the notable surge observed in 2015 and the ongoing growth leading up to 2023. Additionally, the study addressed future directions and considerations for those countries that will develop a Learning Community in the Fundamental Movement.

Physiology

EFFECTS OF TRAINING LEVEL ON CORE BODY AND SKIN TEMPERATURE AFTER CYCLING EXERCISE AT FUNCTIONAL THRESHOLD POWER (FTP) IN A TERMONEUTRAL ENVIRONMENT.

TIMON, R., VILLARINO, J., UTRERO, J., OLCINA, G.

SPORT SCIENCES FACULTY. UNIVERSITY OF EXTREMADURA

INTRODUCTION: Monitoring core body temperature after exercise is important to avoid heat stroke and to plan appropriate cooling strategies (1). Thermoregulatory response to exercise could be influenced by the training level of athletes via augmented sweating and improved cardiovascular function (2). The aim of the study was to analyze core body and skin temperature after a high-intensity steady-state cycling exercise, comparing the response of individuals based on their level of training.

METHODS: 18 triathletes (28.9 ± 4.8 years, 70.6 ± 5.4 kg, 10.1 ± 2.8 % Fat mass) were divided into two groups based on the watts achieved in an functional threshold power (FTP) test (≥ 4 W/Kg Vs < 4 W/kg). All participants performed a 20-minute steady-state cycling exercise at FTP intensity and in a thermoneutral environment (21.9 ± 0.9 ºC ; 38.5 ± 4.2 % relative humidity) Core body and skin temperature were measured with a non-invasive sensor (CORE, green TEG AG, Switzerland) placed on the chest at different timepoints after exercise.

RESULTS: The less trained triathletes reached a core body temperature (Post: 37.8 ± 0.3 vs 37.5 ± 0.2 ; 5min: 38.0 ± 0.3 vs 37.8 ± 0.4; 10min: 38.1 ± 0.4 vs 37.9 ± 0.4; 15min: 38.1 ± 0.4 vs 37.8 ± 0.5; 20min: 38.0 ± 0.3 vs 37.8 ± 0.3) and skin temperature (Post: 35.1 ± 0.7 vs 33.9 ± 0.9; 5min: 34.5 ± 0.5 vs 33.1 ± 1.1; 10min: 33.9 ± 0.5 vs 32.1 ± 1.0; 15min: 33.5 ± 0.4 vs 31.6 ± 1.0; 20min: 33.2 ± 0.6 vs 31.8 ± 0.8) significantly higher than the most fit triathletes at all time points after exercise. Likewise it was observed in both groups that core body temperature remained elevated up to 20 minutes after exercise, however, skin temperature decreased progressively after 5 minutes, even below the baseline values.

CONCLUSION: In conclusion, the results showed that training level influences the thermoregulatory function of athletes, observing a better response to dissipate heat by more fit individuals in termoneutral environment. This research has been supported by the Government of Extremadura (Spain).

1. Périard JD, Eijsvogels TMH, Daanen HAM. Exercise under heat stress: thermoregulation, hydration, performance implications, and mitigation strategies. Physiol Rev. 2021 Oct 1;101(4):1873-1979. doi: 10.1152/physrev.00038.2020. Epub 2021 Apr 8. PMID: 33829868.

2. Kenney WL, Wolf ST, Dillon GA, Berry CW, Alexander LM. Temperature regulation during exercise in the heat: Insights for the aging athlete. J Sci Med Sport. 2021 Aug;24(8):739-746. doi: 10.1016/j.jsams.2020.12.007. Epub 2020 Dec 25. PMID: 33358656; PMCID: PMC8222413.

THE EFFECTS OF COMBINED COOLING DURING BREAK TIMES IN SIMULATED MATCH-PLAY TENNIS IN HOT OUTDOOR ENVIRONMENTS.

NAITO, T., HAYASHI, S., OHHASHI, M., NAKAMURA, M.

HOKKAI-GAKUEN UNIVERSITY

INTRODUCTION: Tennis is often held in hot outdoor environments, which the high solar radiation and ambient temperature impose an additional stress on players and resulting in high core and skin temperatures. Therefore, to prevent the development of hyperthermia, combined cooling by both internal and external cooling may be more effective strategy than the conventionally used internal cooling alone. The purpose of this study was to investigate the effect of combined cooling during break times in simulated match-play tennis in hot outdoor environments.

METHODS: Eight healthy males (age: 21 ± 2 years, height: 170.8 ± 4.1 cm, body mass: 63.84 ± 3.84 kg) performed two trials in outside (ambient temperature: 32.3 ± 0.6°C, relative humidity: 60.2 ± 3.4%, solar radiation: 921 ± 108 W/m2), each time completing 4 sets of simulated match-play. During International Tennis Federation-mandated breaks (90-s between odd-numbered games; 120-s between sets), either ice slurry ingestion (INT) or ice slurry ingestion + wearing fan cooling

jacket (COM) were conducted. The estimates core temperature, mean skin temperature, heart rate, rating of thermal sensation, comfort, and perceived exertion and total sweat loss were measured.

RESULTS: In each trial, the different one participant did not complete the COM (up to 4 sets 3 games) or INT (up to 4 sets 1 game) trials. There were no significant differences in estimates core temperature, mean skin temperature, heart rate, and total sweat loss between trials. Rating of thermal sensation and comfort were significantly lower in the COM trial than that in the INT trial.

CONCLUSION: The results of this study showed that the combined cooling by internal and external cooling did not change the physiological strain compared with internal cooling alone, although perceptual sensation was improved by combined cooling. Therefore, in order to reduce the physiological strain, it is necessary to consider the more powerful external cooling garments in addition to ice slurry ingestion.

EFFECT OF ACUTE DIETARY NITRATE SUPPLEMENTATION ON THE CHANGE IN CALF VENOUS VOLUME DURING POSTURAL CHANGE AND THE TIPTOE MANEUVER IN HEALTHY YOUNG ADULTS

OUE, A., IIMURA, Y., MIYAKOSHI, Y., OTA, M.

TOYO UNIVERSITY

INTRODUCTION: Postural change from supine to upright causes translocation of blood from the upper body and thorax to the lower body due to the hydrostatic effects of gravity, causing decreases in venous return and cardiac preload. On the other hand, because these decreases can be counterbalanced by some compensatory responses (e.g., the elevation of sympathetic nerve activity and skeletal muscle pump activity), blood pressure (BP) and cardiac output can normally be maintained. Recently, dietary nitrate (NO3−) supplementation with beetroot juice (BRJ) has been used to increase nitric oxide (NO) production via chemical reduction from NO3− and nitrite (i.e., the NO3− → nitrite → NO pathway). It has been reported that enhanced NO activity via this pathway could attenuate sympathetic nerve activity and act as a dilator at rest or during exercise, contributing to control of blood pressure and tissue blood flow. However, it is not clear the extent to which increased NO via the NO3− → nitrite → NO pathway contributes to the venous vascular response during postural change and subsequent skeletal muscle pump activity. Thus, the purpose of this study was to clarify the effects of acute intake of BRJ on venous blood pooling due to postural change from supine to upright and subsequent venous return by the tiptoe maneuver.

METHODS: Fifteen healthy young adults (9 men, 6 women, 22.1 ± 1.5 years, 166.7 ± 9.5 cm, 65.8 ± 15.1 kg) volunteered for this study. At 2.5 h after intake of BRJ or prune juice (control beverage: CON), the postural change from supine to upright and the subsequent tiptoe maneuver on the right side (skeletal muscle pump test) were carried out. During performance of the protocol, the change in right calf volume was measured by venous occlusion plethysmography. The change in calf volume from supine to upright position was defined as the total venous volume (VV), which is an index as the volume of venous blood pooling. The decrease in calf volume during the tiptoe maneuver was defined as the venous ejection volume (Ve).

RESULTS: Plasma nitrate concentration was higher in the BRJ group than in the CON group at 2.5 h after beverage intake ($p < 0.05$). Postural change in both the groups caused significant increases in BP and heart rate and a decrease in stroke volume (all $p < 0.05$). However, these parameters did not differ between the CON and BRJ groups. Cardiac output did not differ between the supine and upright positions in either the CON or BRJ group. Ve (CON: 3.91 ± 0.80 mL/dL of tissue; BRJ: 4.04 ± 1.01 mL/dL of tissue, $p > 0.05$) and VV (CON: 5.95 ± 1.18 mL/dL of tissue; BRJ: 6.06 ± 1.36 mL/dL of tissue, $p > 0.05$) was not different between CON and BRJ.

CONCLUSION: The increase in NO activity with intake of BRJ did not alter calf venous pooling during postural change from supine and upright or the subsequent calf venous return by skeletal muscle pump activity in healthy young adults.

EXPLORING THE TRANSFERABILITY OF EXERCISE INTENSITY BASED ON MUSCLE OXYGENATION FROM NORMOXIA TO HYPOXIA: A REALITY CHECK IN SKI-MOUNTAINEERING ATHLETES

REBIS, K., KOWALSKI, T., KLUSIEWICZ, A.

INSTITUTE OF SPORT - NATIONAL RESEARCH INSTITUTE IN WARSAW

INTRODUCTION: Ski-mountaineering (SKIMO) is an endurance winter sport that combines skiing and mountaineering. As the participants ascend and descend snow-covered mountains, it requires continuous effort in various hypoxic conditions. The frequent changes in altitude and oxygen levels limit the practical application of traditionally derived thresholds or training zones based on heart rate (HR) or lactate concentration (bLa). The state-of-the-art literature reports that the maximal metabolic steady state may also be identified based on the muscle oxygenation (SmO2) kinetics during exercise (Cayot et al., 2021), providing a foundation to define exercise intensity. However, research regarding practical applications of SmO2-derived thresholds and training zones remains scarce. Therefore, we investigated the transferability of SmO2-based intensity prescription between different hypoxic conditions to assess the suitability of real-time SmO2 measurements for SKIMO athletes.

METHODS: A group of well-trained male SKIMO athletes (n=15, age 29.7±11.5 years, VO2max 60.9±8.1 mL/kg/min) participated in the study. In normoxia (87m ASL, FiO2=20.8%), they performed a graded-intensity run test on a treadmill to determine the anaerobic threshold (AnT) with the mod-Dmax method. The following week, they performed maximal lactate steady state (MLSS) run assessments in acute normobaric hypoxia (3000m ASL, FiO2=14.4%) with the intensity aligned to 90-105% of SmO2 at the normoxia-determined AnT. SmO2 (Moxy Monitor at the vastus lateralis, Moxy Monitors, USA), HR

(Polar H10 chest strap, Polar Electro Oy, Finland), and bLa (Super GL 2, Dr. Müller Gerätebau GmbH, Germany) were monitored during both efforts. The number and percentage of MLSS assessments without bLa increase over 1 mmol/L were reported. Paired t-tests with Cohen's d effect sizes and ICC were computed to compare bLa and HR at AnT in normoxia and MLSS averages in hypoxia, as both corresponded to equivalent SmO2.

RESULTS: 11 out of 15 MLSS assessments (73.3%) were performed without bLa increase over 1 mmol/L. Statistically significant differences at equivalent SmO2 in normoxia and hypoxia were found for HR (175±11.7 vs 160±14.2 bpm, p=0.005, d=1.02), but not for bLa (4.9±1.2 vs 5.1±2.4 mmol/L, p=0.845, d=-0.05). ICC(2,k) for HR and bLa were 0.56 (95% CI: -0.24, 0.85) and 0.40 (95% CI: -0.75, 0.80), respectively.

CONCLUSION: The results indicate fair transferability of SmO2-based intensity prescription between different hypoxic conditions in well-trained SKIMO athletes. The practical significance of our observations depends on the required accuracy of the exercise intensity determination. Considering the exploratory design of the study and substantial individual variability in analyzed indices, further research is necessary. All the participants were accustomed to exercise in hypoxia, therefore our findings may not apply to different populations, ie. recreationally active tourists.

EXAMINATION OF MAXIMAL FAT OXIDATION (MFO) DURING SUBMAXIMAL (RER=1) BICYCLE ERGOMETER EXERCISE

SZMODIS, M., PÁL, L., GYÖRE, I.

HUNGARIAN UNIVERSITY OF SPORTS SCIENCE

INTRODUCTION: With increasing intensity, the energy supply shifts from fatty acids to carbohydrates. During a spiroergometric test, the RER (Respiratory Exchange Ratio) values can be used to infer substrate utilization. RER is the VCO2/VO2 ratio measured during gas exchange tests. During the oxidation of fats, the RER value is 0.7, in the case of carbohydrates is 1.0. The maximum oxidation rate of fatty acids (FATmax) is between 40-60% of VO2max.

The aim of our study is to clarify the substrate utilization under increasing load in recreational and elite athletes, as well as to determine the individual maximum fat oxidation (MFO) and thus the amount of metabolizable lipids.

METHODS: In our study, 13 sports university students (23.2±1.9 years; 181.9±4.2 cm; 78.4±6.5 kg - recreational athletes) and 7 elite road cyclists (17.0±0.7 years; 175.6 ±8.0 cm; 61.5±9.6 kg) participated. The test consisted of a multi-stage, spiroergometric (Jaeger CPX Vyntus) and cycle ergometer (Monark Ergomedic 839E) load. The initial intensity started from 0 Watts and the load was increased by 35 Watts every 3 minutes. We calculated the current energy and substrate consumption, the MFO value and the VO2MFO/VO2RER=1 ratio from the 30-second averages of the gas exchange values. In addition to basic statistics, the groups were compared with a two-sample t-test and U-test, the significance level was $p<0.05$.

RESULTS: Resting parameters did not differ between the two groups. Compared with literature data, the MFO values of our study subjects and several athletes, mainly ball players, were almost identical (0.59±0.18 vs 0.57±0.16 g/min).

In sports university students and in elite cyclists the maximum fatty acid oxidation was at 0.75±0.27 vs. 1.91±0.83 Watt/kg relative power with 17.8±3.4 vs 35.1±8.7 ml/kg/min oxygen uptake, respectively. The O2 uptake associated with the MFO value was 56.6±15.2% vs 64.6±10.7% compared to the value of VO2RER=1.

The MFO value of the competitive athletes was (0.68±0.16 g/min), which was related to a better restitution, while the MFO value of the recreational athletes was (0.52±0.14 g/min). Elite cyclists returned to RER=1 almost 2.5 minutes earlier than sports university students (326" vs. 542").

CONCLUSION: The elite road cyclists achieved their higher performance on average with a higher oxygen uptake and higher consumption of fatty acids and carbohydrates. By determining the athletes individual MFO value, we can infer their aerobic fitness level, which is one of the key elements of both training planning and progress in sports.

(Randell et al., 2016; Maunder et al., 2018)

PATTERN OF SARCOMERE LENGTH VARIATION IN RAT TIBIALIS ANTERIOR MUSCLE DUE TO DIFFERENCES IN ANKLE JOINT ANGLE

NITA, Y., OGA, R., CHEN, Y.C., NISHIYAMA, H., TAMAKI, H.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: Sarcomere length fluctuates with muscle stretching and shortening. There may also be variability in the lengths of individual sarcomeres because of differences in skeletal muscle regions and joint angles. Mechanical stress applied to locations with nonuniform sarcomere lengths is likely to induce muscle damage. Therefore, understanding the joint angles and regions associated with sarcomere nonuniformity is important for protection against skeletal muscle damage. We examined the nonuniformity in sarcomere lengths associated with various ankle joint angles and muscle regions in the rat tibialis anterior (TA) muscle.

METHODS: Nine-week-old male Fischer 344 rats (n = 9) were subjected to perfusion fixation with their ankle joints at 40 degrees, 110 degrees, and 180 degrees on the left and right legs, respectively. The TA muscle was equally divided into three regions (proximal, middle, and distal), and longitudinal thin sections were stained with hematoxylin and eosin (HE). The sections were observed under an optical microscope and the lengths of 30 consecutive sarcomeres each from 10 muscle fibers per muscle were measured. The coefficient of variation (CV) was calculated to assess the nonuniformity of sarcomere length. Means and CVs of sarcomere length were compared between ankle joint angles and regions, using two-way analysis of variance followed by the Bonferroni post hoc test, with a significance level of 0.05.

RESULTS: There were significant differences in sarcomere lengths in each region between the 40 and 110 degree ankle joint angles and between the 40 and 180 degree joint angles, but no significant differences between the 110 and 180 degree joint angles. The CV tended to be highest for the 40 degree ankle joint angle.

CONCLUSION: In the rat TA muscle, the degree of change in sarcomere length when the ankle joint angle is changed and the skeletal muscle is stretched or shortened differs, implying that sarcomere nonuniformity is greater when the muscle is shortened. These findings may underlie the mechanisms of muscle injury and provide clues to effective methods of protection against it.

EFFECTS OF ECCENTRIC MUSCLE CONTRACTION INTERVENTION NOT INDUCING MUSCLE DAMAGE ON MUSCLE FIBER HYPERTROPHY, MYOFIBROSIS, AND FORCE PRODUCTION IN RAT SKELETAL MUSCLE

OGA, R., NAKAGAWA, K., CHEN, Y.C., NITA, Y., TAMAKI, H.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: Eccentric training has been shown to lead to more muscle hypertrophy than concentric training, while also producing more muscle damage. The magnitude of muscle damage and hypertrophy is influenced by muscle length and the intensity, number, velocity, and range of lengthening of the eccentric contractions (ECC). The objectives of the present study were to characterize the histomorphological appearance and quantify the contractility of skeletal muscle followed by small- versus large-range ECC interventions.

METHODS: Nineteen male Fischer 344 rats were assigned to three groups: age-matched control group (Control), small-range ECC group (SR-ECC; 135–140 degrees), and large-range ECC group (LR-ECC; 80–180 degrees). For the ECC groups, the left tibialis anterior (TA) muscle was subjected to eccentric exercise bouts of direct muscle electrical stimulation (ES) consisting of 80 forced ECCs twice a week for four weeks. We measured the twitch and tetanic contraction forces in the TA evoked by direct ES immediately before muscle sampling. We also performed immunohistochemical staining against Dystrophin, Pax7 and Ki67 of frozen transverse sections of the TA, as well as Evans blue and picrosirius red staining for histopathological observations.

RESULTS: The number of damaged muscle fibers identified using Evans blue dye was greater in the LR-ECC than in the SR-ECC group. The myofiber cross-sectional area (CSA) distribution was somewhat larger in the SR-ECC group than in the Control group, although the difference was not significant. Concurrently, the number of double-positive (Pax7+/Ki67+) cells per Pax7+ cells increased in both ECC groups, but no collagen area expansion occurred in the SR-ECC group. In addition, TA muscle force profiles were smaller in the SR-ECC group than in the Control and LR-ECC groups.

CONCLUSION: These data suggest that a small-range ECC intervention induces muscle fiber hypertrophy and satellite cell proliferation without triggering myofibrosis. Notably, this intervention also altered the muscle contraction profiles.

THE RELATIONSHIP BETWEEN SHORT SLEEP AND SUBJECTIVE AND OBJECTIVE FATIGUE INDEX

SHIODA, K., NISHIDA, M.

KANAZAWA SEIRYO UNIVERSITY

INTRODUCTION: Sleep is important for restoring the physiological processes that keep the body and brain properly functioning. Although there have been many reports on the relationship between sleep and fatigue, it is unclear that the details of the mechanism of recovery from subjective and objective fatigue in short sleep. The interpolated twitch technique (ITT) is widely used to assess voluntary activation (VA) of skeletal muscles (Merton, 1954). In addition, the reduction of VA in maximal efforts is the sign of central fatigue (Gandevia, 2001). The critical flicker fusion frequency (CFFF) test is useful for assessing the arousal level, and the value of CFFF decreases with fatigue (Curran et.al., 1990). Therefore, the purpose of this study was to investigate the effect of short sleep on recovery from fatigue using ITT and CFFF.

METHODS: Eight healthy young adults who did not have sleep problem were recruited. They participated in two experimental conditions in random order: short sleep (1 hour) and rest conditions. They performed isometric maximum voluntary contraction (MVC) of elbow flexor muscles for assessing VA using ITT before and after condition. In addition to ITT and CFFF, subjective fatigue and sleep index were measured using Stanford Sleepiness Scale and visual analogue scale. A two-way repeated measures ANOVA was performed for each variable. All data are expressed as mean±SD.

RESULTS: Subjective fatigue and sleep index were significantly decreased in sleep condition (VAS fatigue: 32.13±23.01 vs 22.38±19.62 %, VAS sleepiness: 36.00±24.04 vs 16.63±17.60 %, $p<0.05$). However, there was a significant trend toward a decrease in MVC in rest condition (67.52±13.65 vs 61.53±16.04 Nm, $p=0.058$). In addition, there was a significant trend for CFFF to decrease in both conditions (sleep: 37.47±1.95 vs 36.74±1.41 Hz $p=0.055$, rest: 37.12±1.25 vs 36.84±1.16 Hz, $p=0.099$).

CONCLUSION: It was suggested that subjective and objective index of fatigue may have different effects in short sleep durations of 1 hour.

References

Merton PA. (1954). Voluntary strength and fatigue. J Physiol, 123, pp. 553-564.

Gandevia SC. (2001). Spinal and supraspinal factors in human muscle fatigue. Physiol Rev, 81(4), pp. 1725-1789.

Curran S. et al., (1990). Critical flicker fusion in normal elderly subjects; a cross-sectional community study. Curr Psychol, 9(1), pp. 25-34.

A CHARACTERISATION OF THERMOREGULATORY RESPONSES IN ELITE OPEN WATER AND POOL SWIMMING COMPETITION

MARKEY, K., GALAN-LOPEZ, N.1, ESH, C.1,2, CHRISMAS, B.1, BARRY, L.3, CONSTANTINI, N.W.4, ADAMS, W.M.5,6, MOUNTJOY, M.L.7, TAYLOR, L.1,8

1>LOUGHBOROUGH UNI 2>ASPETAR SPORT MEDICINE HOSPITAL 3>UNI LIMERICK 4>SHAARE ZEDEK MEDICAL CENTER 5>USOPC 6>US COALITION PREVENTION ILLNESS AND INJURY IN SPORT 7>MCMASTER UNI 8>UNI TECHNOLOGY SYDNEY

INTRODUCTION: Elite open water swimming (OWS) competitions are conducted in divergent water temperatures (Tw; limits: 16-31°C) thus presenting hypo- and hyper-thermic risk [modest deviations (± 0.5-2°C) in core temperature (Tc) have proven fatal]. Despite OWS specific risk, limited: (i) Tc data in competition-relevant Tw; and (ii) knowledge of real-world and athlete adopted thermoregulatory (Treg) aligned preparations for competition, are seen. In contrast, elite pool-based swimming (PBS) competition exposes swimmers to multiple albeit different (compared to OWS) Treg challenges. PBS competition can span ≥ 8-10h across multiple days (e.g., heats and events) including multiple cycles of warm-ups (WU), priming and cool-downs within and between days/races including an often-prolonged transition phase (TP; >30 minutes) between warm-up end and race start. Thus, attaining and sustaining warm-up derived elevations in Tc until race start can be challenging. Treg-focused strategies in land-based sports are successful and well-evidenced however, such attention is not present in elite swimming.

METHODS: Tc was characterised for 25 (9 females, 19.4 ± 2.7 y) elite, national, European, or World/Olympic pool (n=6) and open water swimmers (n=19) using ingestible thermometry. In-race data was collected at the 2023 LEN European Swimming Championships, Leg 4 of the LEN Open Water Cup (18.2°C, COLD event), and the LEN Jnr European OWS Championships (25.5°C, WARM event). Tc in OWS and fluctuations during PBS WU and TP were calculated. Tc change (delta/min) was determined within time period (WU, TP) for PBS and relative to race start for OWS. A preparation and competition aligned knowledge survey was completed within COLD/WARM, including heat acclimation/acclimatisation (HA) preparation use.

RESULTS: Divergent Tc responses [mean (min-max); mean Δ/min] were evident (COLD: 37.6°C, 35.0-39.0°C, Δ/min -.001°C; WARM: 38.2°C, 35.8-39.5°C, Δ/min .003°C). 22% (WARM) used HA pre-competition. Of those who adopted HA in WARM, 11% suffered from negative symptomology related to Tc in-race, compared to 33% who did not HA. Tc increased pre to post PBS WU (37.8°C, 36.7 – 38.7°C, Δ/min .009°C). However, 90% of swimmers saw a reduced Tc (37.8°C, 36.7-38.7°C, Δ/min -.108°C) across TP, from WU end to race start. 3/6 PBS swimmers had a pre-race (mean ± SD; 37.4 ± 0.3°C) Tc lower than that at warm-up onset (37.6 ± 0.3°C; Δ/min -.002°C).

CONCLUSION: Divergent Tc responses were evident within COLD/WARM. HA appears to offer some protection against undesired body temperature related symptomology in OWS. Therefore, individualised Treg competition practises would be favourable to protect athlete health and optimise performance in OWS. PBS WU derived increases in Tc have generally dissipated by race start due to practices adopted in TP (3/6 swimmers had a lower Tc at race start compared to WU onset). Increasing Tc further during PBS WU and adopting passive heat maintenance strategies (e.g., insulative/heated clothing) would be prudent.

DIET SUPPLEMENTATION WITH CHLORELLA MICROALGAE DID NOT CHANGE MUSCLE FIBRE TYPE PROFILE, FIBRE MORPHOMETRY OR CAPILLARISATION IN ANAEROBIC MUSCLE GASTROCNEMIUS OF TRAINED RATS

TORRELLA, J.R., HIGUERA-CHAPARRO, Y.A., LORENZO, K., VILLAMIL-PARRA, W., CASTRO-ARIAS, M.E., ZÚÑIGA-VERGARA, P., VISCOR, G., TORRES, J.L., PAGÈS, T., MAGALHÃES, J., RAMOS-ROMERO, S., SANTOCILDES, G.

UNIVERSITAT DE BARCELONA

INTRODUCTION: Chlorella is a marine microalga with bioactive macronutrients with antioxidant and anti-inflammatory activity meaning that consuming Chlorella improves aerobic exercise performance and reduces fatigue. To delve into the subjacent mechanisms responsible for Chlorella benefits in aerobic exercise, we aimed to assess the possible effects of a Chlorella-based diet on the fibre morphometry and capillarity of the anaerobic region of the muscle gastrocnemius (GAS) in exercised rats.

METHODS: Twelve animals were trained 5 days/week for 10 weeks. Training was incrementally increased beginning at 15 cm/s for 15 min (first week) until achieving 45 cm/s for 1 h (last week). Depending on their diet, animals were divided into 2 groups: (1) STD, fed with a standard chow (Teklad Global 14% Protein Rodent Maintenance Diet); (2) ALG, fed with a mixture of 10% of Chlorella microalgae dry mass and omega-3 fatty acids (eicosapentaenoic and docosahexaenoic in 1:2 proportion). After the training period, GAS was excised, frozen and stored. Histological slides were cut in a cryostat and stained to demonstrate fibre oxidative and contractile properties of fast oxidative glycolytic (FOG), fast intermediate glycolytic (FIG) and fast glycolytic (FG) fibres. Fibre cross-sectional areas (FCSA), individual fibre capillarization index (CCA, ratio between number of capillaries and FCSA) and total capillary density (CD) were measured in the white zone of GAS.

RESULTS: No significant differences were found in fibre type proportions between animals fed with the different diets (STD vs ALG, %±SD): FOG 9±3 vs 15±6; FIG 34±10 vs 24±11; FG 57±8 vs 61±8. Fibre sizes (FCSA) were also similar in both groups with the smallest areas found in FOG and the largest in FG (STD vs ALG, μm2±SD): FOG 2,953±278 vs 2,961±452; FIG 4,402±718 vs 4,591±195; FG 5,038±562 vs 5,242±597. Individual fibre capillarization (CCA) was greater in FOG and smaller in FG fibres showing similar values in both groups (STD vs ALG, capillaries per 1,000 μm2 FCSA±SD): FOG 2.57±0.41 vs 2.65±0.30; FIG 1.85±0.32 vs 1.83±0.18; FG 1.68±0.33 vs 1.80±0.34. Finally, the total capillarisation (capillaries·mm-2) of white GAS showed also no significant differences between groups with CD of 771±155 (STD) and 776±123 (ALG).

CONCLUSION: Chlorella supplementation during a protocol of aerobic exercise did not induce significant changes in muscle fibre morphometry, capillarisation or fibre type proportions in the anaerobic zone of rat GAS muscle. The high percentage of FG fibres in white GAS and the low recruitment of this anaerobic zone of GAS during endurance exercise could explain these results. We are conducting additional work to elucidate if the eventual benefits of Chlorella supplementation on muscle structure and function could be restricted to the red or intermediate regions of the GAS. Further research seeking molecular and functional evidence is also underway.

ACUTE INFLAMMATORY RESPONSE FOLLOWING LOWER-AND UPPER-BODY WINGATE ANAEROBIC TEST IN ELITE GYMNASTS IN RELATION TO IRON STATUS

WALDZINSKI, T., KOCHANOWICZ, A., NIESPODZINSKI, B., BRZEZINSKA, P., KOCHANOWICZ, M., ANTOSIEWICZ, J., MIESZKOWSKI, J.

LOMZA STATE UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Artistic gymnastics is one of the most demanding sport disciplines, with the athletes demonstrating extremely high levels of explosive power and strength. Currently, knowledge of the effect of gymnastic training adaptation on exercise-induced inflammatory response is limited. The aim of the study was to evaluate inflammatory response following lower- and upper-body high-intensity exercise in relation to the iron status in gymnasts and non-athletes.

METHODS: Sixteen elite male artistic gymnasts (EAG, 20.6 ± 3.3 years old) and 16 physically active men (PAM, 19.9 ± 1.0 years old) participated in the study. Venous blood samples were taken before, and 5 min and 60 min after two variants of Wingate anaerobic test (WAnT), upper-body and lower-body WAnT. Basal iron metabolism (serum iron and ferritin) and acute responses of selected inflammatory response markers [interleukin (IL) 6, IL-10, and tumor necrosis factor α] were analyzed.

RESULTS: EAG performed significantly better during upper-body WAnT than PAM in terms of the relative mean power and peak power. The increase in IL-6 levels after upper-body WAnT was higher in EAG than that in PAM; the opposite was observed after lower-body WAnT. IL-10 levels were higher in EAG than those in PAM and tumor necrosis factor α levels were higher in PAM than those in EAG only after lower-body WAnT. The changes in IL-10 correlated with baseline serum iron and ferritin in PAM.

CONCLUSION: gymnastic training is associated with the attenuation of iron dependent post-exercise anti-inflammatory cytokine secretion.

CIRCULATING GROWTH HORMONE, CORTISOL AND TESTOSTERONE IN RELATION TO VITAMIN D STATUS: INFLUENCE OF LOWER AND UPPER BODY WINGATE ANAEROBIC TEST (WANT) IN ELITE ARTISTIC GYMNASTS

DURZYNSKA, A., BRZEZINSKA, P., KOCHANOWICZ, M., NIESPODZINSKI, B., GARD, R., ANTOSIEWICZ, J., KOCHANOWICZ, A., MIESZKOWSKI, J.

LOMZA STATE UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: It is well known that professional physical training may be one of the factors modifying s circulating serum level of growth hormone, testosterone and cortisol. However, the effect of high-intensity upper and lower body Wingate Anaerobic Test on the serum hormone levels in association to vitamin D status is controversial . The aim of the current study was to verify hypotheses: that long lasting gymnastic training induces adaptation changes in hormonal homeostasis during upper and lower body anaerobic exercises, and presented changes are depend on the muscle involvement during different types of activities and are regulated by the vitamin D status.

METHODS: Sixteen elite male artistic gymnasts (21.4 ± 0.8 years-old) and 16 physically active men (the control group, 20.9 ± 1.2 years-old) voluntarily participated in this study. Blood was collected using venipuncture procedures (antecubital vein) in tree timepoints: before, 5 min and 60 min after Wingate anaerobic tests. Hormone measurements consisted of levels of free growth hormone, testosterone and cortisol in blood serum. Measurement was made using chemiluminescence method. Vitamin D active metabolites, 25-hydroxyvitamin D2 [25(OH)D2] and 25-hydroxyvitamin D3 [25(OH)D3], as a proportion of the total serum concentration of 25-hydroxyvitamin D [25(OH)D], were analyzed using the commercially available Total 25OH Vitamin D ELISA kits.

RESULTS: Significantly higher performance during upper lower body WAnT were observed in professional gymnasts' groups, for mean power, peak power and mean power normalized to body mass. Furthermore, gymnasts showed higher serum concentration for hGH, and testosterone. An inverse relationship was observed in cortisol, whose concentration changes were greater in the control group. Additionally, significantly negative correlations between the initial concentration of vitamin D3 and baseline cortisol were noted in both populations,

CONCLUSION: Gymnastic training affect the anaerobic performance hormonal status changing the serum concentration of hGH, cortisol and testosterone induced by anaerobic exercise. Moreover, hormonal status is associated with vitamin D concentration, and shows its significant regulating properties in post exercises response.

BETWEEN-DAY RELIABILITY OF A CLUSTER OF MEASURES USED TO INDIRECTLY ASSESS THE PROPERTIES OF THE HUMAN RETICULOSPINAL TRACT

ABU-TALIP, N.K., ŠKARABOT, J., BALSHAW, T.G.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Muscular force production is mediated by descending pathways including the corticospinal (CST) and reticulospinal (RST) tract. Whilst the CST has been extensively investigated within the context of neural adaptation to resistance training, RST adaptability has received less attention. RST fibres originate in the reticular formation, a deep lying structure within the brain stem, precluding non-invasive stimulation in humans. The development of methodologies assessing voluntary reaction time (RT) or evoked electrophysiological responses preceded by loud auditory startles (AS; >110 dB) relative to those without prior AS has provided a cluster of indirect techniques that can allow RST adaptability to be experimentally tested. However, the between-day reliability of these indirect RST measures remains under investigated. The purpose of this study was to determine between-day reliability of RST properties derived from voluntary (StartReact paradigm) and evoked (motor evoked potential [MEP] and cervicomedullary motor evoked potential [CMEP]) measures in elbow flexors.

METHODS: Healthy young adults (n=6; 4 males, 2 females) completed a familiarisation session and 3 identical main measurement sessions on separate days at a consistent time to establish between-day reliability of: (i) elbow flexion isometric maximum voluntary force (MVF); (ii) surface EMG of the biceps brachii long head during MVF (BBL-EMGMVF); (iii) peak-to-peak BBL Mmax amplitude; (iv) BBL RSTgain ratio ([visual cue RT - visual auditory cue RT] ÷ [visual cue RT – visual starling cue RT]) produced from the StartReact paradigm; (v) the BBL conditioned/control MEP ratio (conditioned MEP preceded by a 50 ms AS); and (vi) the BBL conditioned/control CMEP ratio (conditioned CMEP preceded by a 70 ms AS). CMEP and MEP were superimposed during submaximal contractions whilst a rectified and smoothed (0.5 s epoch) real-time EMG signal was matched to a target of 10%BBL-EMGMVF. Between-day reliability was assessed using within-participant coefficient of variation (CVw; [SD ÷ Mean] x 100) and one-way ANOVAs.

RESULTS: There were no differences between test days 1, 2 and 3 for the included variables (ANOVA, $0.33 \leq p \leq 0.96$). The CVw for MVF, BBL-EMGMVF, BBL Mmax, BBL RSTgain ratio (Day 1: 0.78 ± 0.10, Day 2: 0.76 ± 0.12, Day 3: 0.85 ± 0.08), BBL conditioned/control MEP ratio (Day 1: 0.86 ± 0.16, Day 2: 0.76 ± 0.14, Day 3: 0.75 ± 0.11), and BBL conditioned/control CMEP ratio (Day 1: 1.47 ± 0.54, Day 2: 1.38 ± 0.37, Day 3: 1.56 ± 0.28) was 5.2 ± 2.6%, 20.8 ± 14.8%, 15.1 ± 10.6%, 8.6 ± 7.6%, 17.0 ± 5.0%, and 21.4 ± 9.3%, respectively.

CONCLUSION: The results of this study provide a preliminary indication of between-day reliability for a cluster of indirect measures for assessing the properties of the human RST within an isometric elbow flexion model and have implications for the interpretation of RST adaptability within the context of subsequent longitudinal resistance training intervention studies.

Physiotherapy

HIGH-INTENSITY INTERVAL TRAINING IMPROVES LONG-TERM SURVIVAL BY MEDIATING LEFT VENTRICULAR REMODELING IN PATIENTS WITH HEART FAILURE

WANG, J.S., HSU, C.
CHANG GUNG UNIVERSITY

INTRODUCTION: This study aimed to assess the left ventricular (LV) remodeling response and long-term survival after high-intensity interval training (HIIT) in patients with HF during a 10-year longitudinal follow-up.

METHODS: Among 214 patients with HF receiving guideline-directed medical therapy, those who underwent an additional 36 sessions of aerobic exercise at alternating intensities of 80% and 40% peak oxygen consumption (VO2peak) were considered HIIT participants (n=96). HF patients who did not undergo HIIT were considered participants receiving guideline-directed medical therapy (n=118). VO2peak, serial LV geometry, and time to death were recorded.

RESULTS: The 10-year survival was better for participants who underwent HIIT (80.3%) than for participants on guideline-directed medical therapy (68.6%) ($P=0.044$). An increased VO2peak, decreased minute ventilation carbon dioxide production slope, and reduced LV end-diastolic diameter were protective factors against all-cause mortality ($P<0.05$). Causal mediation analysis showed a significant mediation path for LV end-diastolic diameter on the association between HIIT and 10-year mortality in all included patients with HF ($P<0.001$). HIIT also had a significant direct association with 10-year mortality in patients with HF ($P=0.027$).

CONCLUSION: Reversal of LV remodeling after HIIT could be a significant mediating factor for long-term survival in patients with HF.

THE CORRELATION BETWEEN THE HIP ROTATIONAL RANGE OF MOTION AND THE MEDICINE BALL ROTATIONAL THROW ABILITY OF YOUTH BASEBALL PLAYERS

CHANG, H.Y., CHIU, C.W., LO, C.L.
NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: A baseball player needs adequate hip joint mobility to perform throwing or hitting techniques. The hip joint is located at the core of the human body and also connects the lower leg and trunk which allow the force transfer from the lower extremities to the upper body and upper extremities. The purpose of this study was to understand the correlation between the hip rotational range of motion and the medicine ball rotational throw ability of youth baseball players.

METHODS: Thirty-six Taiwan national WBSC U18 baseball players (mean height 179.9 ± 7.0 cm, mean weight 80.8 ± 10.8 kg, mean age 17.1 ± 0.6 years) participated in this study. The Goniometer was used to measure the hip internal and external rotation range of motion (ROM) of the leading leg (non-dominant side) and axial leg of the players. All participants also hold a smart medicine ball (A2P Ballistic Ball, abbreviation: MBP) with a sensor built into the ball to perform medicine ball turning and throwing movements for a total of 2 repetitions, and collected the values of MBP peak velocity, average velocity, and power. The Pearson correlation coefficient was used to analyze the relationship between medicine ball rotation throwing parameters and hip internal and external rotation ROM. The Paired-T Test was used to compare the difference between leading and axial leg in hip internal and external rotation.

RESULTS: There are significantly fewer degrees in the leading leg (25.5±5.3°) than axial leg (34.4±6.0°) for hip Internal rotation ROM ($p<.05$). However, the hip external rotation ROM results are opposite (leading leg: 30.9±5.6°, axial leg: 24.3±4.2°). The hip external rotation ROM of the leading leg of the players (30.9±5.6°) was negatively correlated with the MBP power (2173.4 ± 662.9 watts) (ICC = -.367, $p=.028$, $p < .05$), and there was no significant difference in the rest.

CONCLUSION: The large hip external rotation ROM of the leading leg for baseball players may negatively affect the transmission of the power output when performing the medicine ball rotation throwing movement for the baseball players.

EFFECT OF PRESS TACK ACUPUNCTURE NEEDLE ON DELAYED ONSET MUSCLE SORENESS

KANEKO, Y., KAYOKO, N., OKAMOTO, K., AIZAWA, I., MITSUYAMA, Y.
KURETAKE COLLEGE OF MEDICAL ARTS AND SCIENCES

INTRODUCTION: Delayed onset muscle soreness (DOMS) typically begins to develop 12-24 hours after the exercise and may increase between 24-72 hours. Many symptoms are observed with DOMS such as swelling, temporary reduction in a joint's range of motion, tenderness to the touch, and temporary reduction in strength of the affected muscles that may interfere athletes' performance. Recently acupuncture is known to alleviate pain (e.g. lower back pain) as treatment modality and we hypothesized that it may alleviate DOMS as well. The aim of this study was to investigate the effect of press tack acupuncture needle on DOMS induced by elbow flexion/extension exercise.

METHODS: Subjects were 15 healthy male and female (38+/-10.1yrs) and randomized to press tack acupuncture needle (Ac) group, sham acupuncture (Sm, no needle, only adhesive tape) group, and no treatment (NT) group. Ac (length: 0.6mm) were applied with adhesive tapes on 6 sites of biceps brachii. Sm were applied on same sites as Ac. NT received no intervention. Both practitioner and subjects were asked which intervention they were applied or received. The maximum voluntary construction (MVC) of elbow flexion on non-dominant arm was measured by strain gauge in order to determine exercise load to induce DOMS. The subjects performed 2 sets of elbow flexion/extension exercise at 70%MVC until they could not continue the exercise with 2 minutes interval between each set. Ac and Sm were removed after the exercise. Subjects were measured their DOMS at 24, 48, and 72 hours after the exercise by visual analog scale (VAS). Kappa coefficients were used to evaluate whether blinding was successful, and the change of VAS was analyzed by repeated 2-way ANOVA.

RESULTS: Kappa coefficients of practitioner and subjects were -0.12, -0.19 respectively which meant the blinding was almost perfectly successful. Every group had the most pain at 24 hours after the exercise, then decreased as time passed; NT: 41.2+/-31.2(24h), 34.0+/-31.2(48h), 12.8+/-16.2(72h), Sm: 19.2+/-13.1(24h), 16.7+/-6.0(48h), 7.3+/-2.3(72h), Ac: 20.8+/-12.1(24h), 11.3+/-8.3(48h), 4.5+/-4.2(72h). VAS of DOMS decreased significantly as time passed ($p<0.001$) while there were no differences among 3 groups. For Intra-group analysis, there were significant changes between VAS of 24h vs 72h and 48h vs 72h in NT group ($p=0.018$, $p=0.003$, respectively) while no change was observed in Ac and Sm group.

CONCLUSION: Neither practitioner nor subjects recognized which intervention they were applied/received. It seemed both Ac and Sm intervention suppressed the increase of DOMS at 24h which lead no significant difference between later evaluation (48h and 72h) while there was a significant decrease of VAS in NT group. It is suggested that phycological effect, or tactile sensation evoked by adhesive tape may influence subjective pain of DOMS.

ANALYSIS OF PLANTAR LOAD DURING TOE-IN LANDING DURING FORWARD LUNGE IN BADMINTON

ARIYOSHI, K.
OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: In badminton, forward lunges usually use a straight toe landing (STL) to prevent injury. However, in recent games, some players have used a toe-in landing (TIL) depending on the rally situation. We hypothesize that this is a new

skill to cope with faster rally speeds. but its effects and mechanical burden on the body are not clear. Therefore, the purpose of this study was to compare the contact time and plantar load of STL and TIL.

METHODS: The subjects were 10 male players (age 19.9 ± 2.1 years, height 171.3 ± 11.7 cm, weight 65.0 ± 12.0 kg) who had been playing badminton for 7 years or more. The starting position was the center of the short service line on the badminton court, the player touched the shuttlecock hanging on the court with his racket and returned to the original position. The type of attempt was STL and TIL with the leg brought forward. Each measurement was performed three times, and the value with the shortest ground contact time was adopted. The analysis items were ground contact time and plantar load force. The plantar loading force was measured using Pedar-X in-shoe pressure measurement system (Novel, USA) , and defined in areas hallux, lesser toes, medial forefoot, middle forefoot, lateral forefoot, medial midfoot, lateral midfoot and rearfoot. The ground contact time was defined as the time when any sensor had 10N or more. Statistics were compared between STL and TIL for ground contact time, plantar load/body weight, and plantar load distribution, and a paired t-test was used ($p<0.05$).

RESULTS: Ground contact time was significantly faster for TIL (0.31±0.02sec) than for STL (0.36±0.02sec) ($p<0.001$).

The plantar load force/weight of TIL was significantly higher in hallux ($p=0.045$), medial forefoot ($p=0.003$), middle forefoot ($p=0.049$), and lower in lateral midfoot ($p=0.028$) and rearfoot ($p=0.005$). [hallux: STL 1.48±0.69N/kg, TIL 2.06±0.64N/kg; lesser toes: STL 1.64±0.46N/kg, TIL 1.79±0.62N/kg; medial forefoot: STL 1.31±0.43N/kg, TIL 3.00±1.29N/kg; middle forefoot: STL 1.85±0.42N/kg, TIL 2.50±0.96N/kg; lateral forefoot: STL 1.32±0.27N/kg, TIL 1.49±0.43N/kg; medial midfoot: STL 1.13±0.37N/kg, TIL 1.45±0.62N/kg; lateral midfoot: STL 1.20±0.52N/kg, TIL 0.83±0.28N/kg; rearfoot: STL 4.43±1.59N/kg, TIL 2.45±1.09N/kg.]

The plantar pressure distribution of TIL was significantly higher in medial forefoot ($p=0.007$), and lower in lateral midfoot ($p=0.023$) and rearfoot ($p=0.002$).

A similar trend was observed for force/weight and plantar pressure distribution for plantar load work.

CONCLUSION: It was suggested that the forward lunge at B shortens the ground contact time and may speed up the movement to the next shot. It was confirmed that the ratio of the plantar load force shifts from rearfoot to medial forefoot.

CASE STUDY: STREAMLINING MUSCLE CRAMP PREVENTION - A TIME-EFFICIENT HOME-BASED APPROACH THAT WORKS

SKUTSCHIK, C., BEHRINGER, M.
GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: Muscle cramps, characterized by sudden, involuntary muscle contractions often accompanied by intense pain, affect a vast majority of the population including athletes. While most individuals experience these painful episodes irregularly, certain groups, particularly those affected by nocturnal cramps, endure significant impairment to their quality of life, not least due to sleep disturbances. In previous studies, the efficacy of neuromuscular electrical stimulation (NMES) under controlled laboratory conditions has been demonstrated to reduce the frequency of muscle cramps and susceptibility to cramping [1,2]. Aim of this case study was to test the feasibility of a NMES cramp training conducted at home.

METHODS: A 56-year-old female (BMI: 25.5) underwent a 4-week NMES cramp training of 8 sessions (2 per week) in a home-based setting.

All other measurements were conducted in the laboratory both before and after the training intervention.

The training comprised 3 sets, each consisting of 6 stimulation trains lasting 5s, 10 s pause. The frequency was set to 30 Hz above the cramp threshold frequency (CTF). The CTF of the m. gastroc. med. was measured by NMES using trains of rectangular biphasic pulses of 200 ms width, amplitude: 40 mA, increasing the frequency from 4 – 40 Hz until cramp occurrence. Cramp onset was detected via electromyography (EMG).

Frequency, intensity, and locations of spontaneous muscle cramps were recorded by the participant in a cramp diary before and during the intervention. A questionnaire evaluating quality of life (SF12), sleep quality (PSQI), muscle cramp characteristics, and cramp score was administered during two distinct laboratory visits, with a 4-week intervention period separating them.

RESULTS: Prior to the intervention the participant reported daily (mostly nocturnal) muscle cramps with a mean frequency of 4.2 cramps/day, range: 3-5.

During the 4-week intervention period the cramp frequency was reduced by ~74%: mean: 1.1 cramps/day, range 0-5.

The CTF increased from 14 Hz (Pre) to 22 Hz (Post). Cramp intensity decreased by ~6,4% and sleep quality increased tremendously: PSQI score: 14 (Pre) to 5 (Post).

The participant didn´t report any negative outcomes or problems regarding the intervention period.

CONCLUSION: The results of this case study show that the positive effect of previous laboratory studies on NMES cramp training can also be achieved in a self-administered home setting. Both the cramp threshold and the frequency of spontaneous muscle cramps were reduced, leading to a better quality of life and better sleep.

This approach promises a practical and efficient alternative, allowing participants to undergo training at home with minimal time impact, while also optimizing resource allocation for researchers.

REFERENCES:

1) Behringer et al. Neuromodulation, 2018

2) Harmsen et al. Neuromodulation, 2021

EFFECTS OF TAI CHI PUSHING HANDS TRAINING ON PAIN, PHYSICAL FUNCTION AND MENTAL HEALTH OF PATIENTS WITH KNEE OSTEOARTHRITIS

CHEN, Y., MA, C.Q., ZHENG, S.B., LI, Z.W.

GUANGZHOU UNIVERSITY OF CHINESE MEDICINE

INTRODUCTION: Knee osteoarthritis(KOA) is one of the most common degenerative bone and joint diseases. In recent years, Tai Chi has been widely used in the exercise therapy of patients with knee osteoarthritis because it can effectively reduce the symptoms, improve function, and reduce anxiety, depression and other negative emotions of KOA patients. As an essential antagonistic training in traditional Tai Chi training, Tai Chi pushing hands(TCPH) is rarely studied as part of the intervention program. The purpose of this study is to explore the intervention effect of Taiji push hand on middle-aged and elderly patients with knee osteoarthritis.

METHODS: Fifty patients with KOA (age: 56.84±8.45 years, height: 159.40±4.95 cm, mass: 61.76±9.16 kg) were randomly divided into control group (CON group) and Tai Chi push hand group (TCPH group). CON group used the arthritis exercise prescription recommended by ACSM for 12 weeks of unsupervised home exercise rehabilitation; TCPH group conducted 12 weeks of collective rehabilitation training with Tai Chi pushing hands as the main content, 3 times a week, 90 minutes each time. The test data of pain visual analogue scale (VAS), Lysholm knee function score (LKSS), lower limb strength, Y-balance test (YBT) and Depression Anxiety Stress Scale (DASS-21) were collected before and 12 weeks after the intervention. T-test or two-way ANOVA with repeated measurements were used for statistical analysis in accordance with normal distribution; Rank sum test was used to analyze the data that did not conform to the normal distribution.

RESULTS: (1) The VAS of TCPH group before intervention was 4.47 ± 1.58, and the score after intervention was 1.00 ± 0.94, which was significantly decreased ($P<0.001$). (2) The LKSS of the TCPH group was 70.16 ± 6.77 before intervention and 92.68 ± 6.06 after intervention, with significant difference ($P<0.001$). (3) In the lower limb strength and YBT, there were significant differences between the two groups ($P<0.001$); The scores of the three dimensions of DASS-21 were significantly different before and after treatment ($P<0.05$); (4) There was no significant difference in the indexes of the CON group before and after treatment ($P>0.05$). (5) Sports participation: the average attendance rate of the hand pushing group was 75.74%. In the control group, two subjects maintained exercise habits during the intervention, but the time, frequency and intensity of exercise did not meet the standard. The rest of the subjects stopped exercising within two weeks after the end of teaching.

CONCLUSION: (1) Tai Chi pushing hands intervention program can reduce knee pain, improve knee function, improve dynamic balance ability, and improve the mental health level of patients with KOA. (2) The control group showed no significant improvement in all indicators, indicating that exercise compliance may be an important factor affecting the effect of KOA exercise therapy.

THE EFFECTS OF HEEL LIFT INSOLES ON FUNCTIONAL ABILITY, LOWER EXTREMITY MOBILITY, AND PAIN PERCEPTION IN FIREFIGHTERS WITH LOW BACK PAIN

CHEN, C.L., LI, C., WANG, H., CHANG, H.

HUNGKUANG UNIVERSITY

INTRODUCTION: The firefighting profession encompasses three primary tasks: emergency rescue (ER), emergency medical service (EMS), and conventional fire suppression (FS). Firefighters (FFs), due to the nature of their work and training, experience greater demands on their physical fitness. Strains, sprains, and muscular pain account for 56% of all non-fireground injuries. Low back pain (LBP) is a prevalent musculoskeletal injury among firefighters, often correlated with heavy physical labor involving tasks such as carrying heavy objects and rapid twisting and bending of the waist. Eighty-six percent of American career FFs have reported a history of LBP, with 55% experiencing current LBP. In a survey conducted at a South Korean fire station, 41.5% of FFs experienced work-related LBP within a year, and 12.3% of FFs reported chronic LBP. Additionally, more than 60% of firefighters in Taiwan annually experience pain and discomfort in the lower back. These injuries may result in significant lost time and medical expense. Previous studies have shown that heel lift insoles can effectively reduce the angle of trunk inclination and lumbar spine shear forces during squatting. The aim of this study was to determine the effect of heel lift insoles on the functional ability, mobility, and pain perception in firefighters with LBP.

METHODS: This study recruited 16 firefighters who self-reported LBP and randomly divided them into two groups: one group received heel lift insoles as intervention, while the other group served as the control. The intervention with the heel lift insoles lasted for 4 weeks. Participants work shifts were scheduled for 8 to 12 hours per day. Each participant was required to work for at least 10 days within the 4-week period and to wear the heel lift insoles for a minimum of 6 hours daily. The range of motion of trunk inclination, hip joint, knee joint, and ankle joint was measured while participants were squatting, and the Oswestry Disability Index and Visual Analogue Scale (VAS) of pain were measured before and after the 2-week and 4-week insole intervention. Mixed-design two-way ANOVA was used to determine the significant difference in measured parameters between the two groups.

RESULTS: The results of the study indicated that there were no significant differences in trunk inclination, hip, knee, ankle range of motion, Oswestry Disability Index, and visual analogue scale of pain between the control group and the intervention group after the intervention with heel lift insoles for two or four weeks. Additionally, no significant differences were observed within the two groups.

CONCLUSION: Short–term intervention of heel lift insoles do not have significance in improving trunk inclination, hip, knee, ankle range of motion, Oswestry Disability Index, and visual analogue scale of pain on firefighters while performing tasks.

IS THE DISTANCE BETWEEN THE POSTERIOR BORDER OF THE ACROMION AND THE TABLE USEFUL FOR ESTIMATING THE LENGTH OF THE PECTORALIS MINOR MUSCLE?

YANASE, K., OKUDA, Y.
DOSHISHA UNIVERSITY

INTRODUCTION: Shortening of the pectoralis minor is often a concern as it can lead to abnormal position and movement of scapula. In clinical practice, the distance between the posterior border of the acromion and the table (DistanceAT) is used to assess the length of pectoralis minor (1). An increase in the DistanceAT indicates the pectoralis minor shortening. Only a caliper is needed to measure this distance, hence, the measurement is highly practical in the rehabilitation field. However, this method does not directly measure the pectoralis minor length, therefore, it is unclear whether the measurement can measure the pectoralis minor length accurately. The purpose of this study was to clarify the validity between DistanceAT and shear modulus of pectoralis minor muscle.

METHODS: Twenty-seven healthy young males participated in this study (21.4 ± 2.2 years, 173.4 ± 4.9 cm, 67.7 ± 8.1 kg). In the measurement of DistanceAT, they lay in a supine position with both arms placed alongside their body. One examiner confirmed their acromion of scapula by palpation, and measured the distance from the posterior border of the acromion to the table using a caliper. The validity was assessed against ultrasonic shear wave elastography (the gold standard), and shear moduli of the pectoralis minor and pectoralis major muscles (clavicular, sternal, and abdominal regions) were measured in supine position. The DistanceAT and the shear modulus were measured both left and right sides. Pearson correlation coefficient or Spearmans rank correlation coefficient were used to determine the association between the DistanceAT and the shear moduli of all muscles.

RESULTS: The average values and standard deviations for each data were as follows: DistanceAT (left: 5.7±1.3cm, right: 5.8±1.7cm), shear modulus of pectoralis minor (left: 7.4±2.9kPa, right: 7.9±3.8kPa), shear modulus of pectoralis major (clavicular) (left: 20.1±6.1kPa, right: 17.3±3.7kPa), shear modulus of pectoralis major (sternal)(left: 16.8±4.6kPa, right: 15.8±3.7kPa), and shear modulus of pectoralis major(abdominal) (left: 15.7±4.3kPa, right: 15.2±4.1kPa). No significant correlations were found between the DistanceAT and the shear moduli of all muscles.

CONCLUSION: The findings of this study suggest that the DistanceAT cannot estimate pectoralis minor shortening. The DistanceAT is probably influenced by various factors, such as muscle mass and skeletal size. Therefore, further research is necessary to adjust for these factors.

EFFICACY OF INTEGRATING CAPACITIVE AND RESISTIVE ELECTRIC TRANSFER THERAPY WITH FUNCTIONAL TRAINING IN CHRONIC ANKLE INSTABILITY

LIU, Z., SONG, L., YE, J., PAN, Z.
UNIVERSITY COLLEGE LONDON

INTRODUCTION: A multimodal rehabilitation programme is recommended for patients with chronic ankle instability (CAI), emphasizing joint mobility, balance, strength, and overall activity. However, current rehabilitation protocols have limitations, necessitating the selection of optimal interventions for effective and efficient management. Capacitive and Resistive Electric Transfer (CRET) is a non-invasive electrothermal therapy utilizing high-frequency electromagnetic waves to generate heat in deep muscle tissues, aiming to enhance blood circulation and tissue recovery. While CRET is commonly employed in treating muscle, bone, and tendon injuries, its efficacy in ankle injury rehabilitation lacks sufficient research. Thus, this study aims to investigate the effectiveness of combining CRET with functional training for CAI. Efficacy will be evaluated using subjective questionnaires and objective outcome measures.

METHODS: Forty-one individuals with unilateral ankle instability were recruited and randomly assigned to one of four groups: a control group (n=10), a functional training group (n=10), a physiotherapy group (n=10), and a training plus physiotherapy group (n=11). The control group received no intervention to ensure comparability. The training plus physiotherapy and functional training groups utilised identical manoeuvres. Meanwhile, both the training plus physiotherapy group and the physiotherapy group used the capacitive mode first, followed by the resistive mode. The intervention groups received three interventions per week for a total of four weeks. Pre- and post-intervention assessments were conducted using the Ankle Joint Functional Assessment Tool (AJFAT) for subjective evaluation, along with the One Leg Standing Test (OLST), modified Star Excursion Balance Test (mSEBT), and Sargent Jump Test (SJT).

RESULTS: (1) The study revealed significant differences ($P<0.05$) between training plus physiotherapy and the other groups in the disparity between AJFAT and OLST scores pre- and post-intervention. (2) Furthermore, significant differences ($P<0.05$) were observed between all intervention groups and the control group in the variation of mSEBT composite and SJT scores before and after the intervention. (3) Notably, all outcomes showed significant improvement post-intervention in all intervention groups ($P<0.05$), except for the control group, as determined by within-group comparisons.

CONCLUSION: The innovative CRET therapy technology stands out for its ability to transfer high energy levels without substantially elevating the temperature. This unique feature enhances cell proliferation and tissue reconstruction, leading to superior treatment outcomes. When combined with four weeks of functional training, CRET therapy effectively enhances ankle function in chronic ankle instability patients. This synergistic approach proves more effective than functional training or CRET therapy alone.

Psychology

EXPLORING FACTORS AFFECTING HIGH SCHOOL STUDENT-ATHLETES' CAREER DECISIONS FROM THE PERSPECTIVES OF THE SCCT SATISFACTION MODEL AND CALLING

CHAN, C.C.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction

High school student-athletes are at a critical stage in their career development. The primary career tasks involve exploring potential paths, clarifying career goals, and making decisions. Many high school student-athletes, however, tend to focus solely on athletic achievements, neglecting the learning and development of other professional skills. This emphasis on athletic performance can lead to more severe career confusion and psychological stress during career transitions than the typical high school student faces. Due to this, they often struggle to make timely career decisions, negatively impacting both their athletic training performance and academic learning. Additionally, it has adverse effects on their overall subjective well-being. Therefore, exploring the factors influencing the career decisions of high school student-athletes and implementing systematic counseling strategies to enhance their career decision-making abilities is crucial. This not only helps reinforce their commitment to sports training but also facilitates a smoother transition into their post-high school careers. The purpose of this study was to examine the career decisions of high school student athletes and factors influencing the process by integrating the concept of calling in a social cognitive model of satisfaction model.

Methods

This study conducted data collection through a questionnaire survey. We adopted a cross-sectional research design, and 600 high school student athletes participated in this study. In total, 505 valid questionnaires were returned. The data obtained were statistically analyzed using structural equation modeling.

Results

The results show that our career decision model for high school student athletes has an acceptable fit with the sample data. Affect traits, calling, career self-efficacy, and outcome expectations positively influence career decisions.

Discussion

Career self-efficacy is the most significant factor on high school student-athletes' career decisions. High school student-athletes with high career self-efficacy have a broader range of career choices, believe in their ability to overcome obstacles, and contribute to an increased expectation of positive outcomes in their future. Moreover, positive emotional trait is not only beneficial for enhancing the confidence of high school student-athletes in achieving career goals and success expectations but also contributes to an increased intention for career decision-making. The research also suggests that when high school student-athletes consider potential educational or career decisions, they are influenced by their expectations of success in certain educational or future career paths. The research findings reveal that enhancement in calling not only helps individuals clarify their career goals but also boosts motivation and confidence in making career decisions. Additionally, individuals with a higher sense of calling tend to be more proactive in exploring possibilities within different professions. Finally, the research findings indicate a positive correlation between calling and outcome expectations. High school student-athletes can derive a sense of purpose and meaning in career development from their life and learning experiences. This not only enhances motivation to pursue career-related tasks but also contributes to an increased sense of direction and achievement in their careers. Importantly, it is a key factor influencing the expectations of outcomes in their career pursuits.

COACH PRESSURE, BASIC PSYCHOLOGICAL NEEDS AND CONCENTRATION IN COLLECTIVE SPORTS

PINEDA-ESPEJEL, H.A., ROMERO-GARCÍA, T., TREJO, M., MORQUECHO-SÁNCHEZ, R.
UNIVERSIDAD AUTÓNOMA DE BAJA CALIFORNIA; 1 UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN

Introduction

Concentration is an important psychological skill in performance sport. Concentration of attention is the process that allows the "Focusing of all attention on the relevant aspects of a task, ignoring or eliminating everything else" [1]. It is an important aspect during the competition, as well as in the learning phase and in training, since it allows attention to be focused on the relevant stimuli [2]. Then the concentration can contribute to the projection of future sporting talents. This variable has been theorized as a psychological need of the athlete [3], so it can be related to the basic psychological needs (BPN), innate and universal, proposed by the self-determination theory [SDT (4)], that is, autonomy, relatedness and competence. In turn, the satisfaction and frustration of BPN will depend on interpersonal influence. In sport, one of the main social agents is the coach, who through his or her behavior could also influence the athletes concentration. One of the interpersonal constructs extracted from the multidimensional theory of perfectionism [MPT (5)] is the coachs tendency to impose high goals and put pressure to achieve them, as well as to critically evaluate (PPC).

The objective of this work was to link the MPT and SDT, to investigate the relationships that exist between the PPC, NPB frustration and concentration in sport.

Methods

Forty-six soccer and field hockey athletes (25 men and 21 women) with a chronological age between 12 and 23 years (M=8.45; SD=2.16), answered a set of questionnaires that measured the study variables.

Results

The sample showed low autonomy (M=2.01; SD=1.10), competence (M=2.52; SD=1.43), and relatedness frustration (M=1.90; SD=0.79), as well as high concentration (M=4.15; SD =0.97), and moderate PPC (M=3.34; SD=1.44). The data were normally distributed (asymmetry and kurtosis between -1 and 1), so the Pearson correlations indicated that PPC was not significantly related (p>.05) witho the needs frustration (autonomy r=-.08; competence r=.09; relatedness r=.13) nor with concentration (r=.20); concentration was negatively and non-significantly related to NPB frustration (autonomy r=-.10; competence r=-.21; relatedness r=-.03).

Discussion

The perception of PPC is not related to concentration, perhaps because these behaviors are not focused on the work of said skill. Furthermore, the lack of relationship between NPB and concentration supports the assumption that the latter could not be considered as a NPB. These results may be due to the measurement of the variables in a training situation in team sports, where concentration could be less relevant.

References

1. Lorenzo, J. (1992).

2. Cañizares, M. (2008).

3. Dosil, J. (2005).

4. Deci, E.L., & Ryan, R.M. (2000).

5. Stoeber, J., & Otto, K. (2006).

RELATIONSHIP BETWEEN PSYCHOLOGICAL STRESSORS AND STRESS RESPONSE IN JAPANESE REFEREES

MURAKAMI, K.

TOKYO UNIVERSITY OF SCIENCE

Introduction

Sports referees are responsible for ensuring that the competitive efforts of athletes occur within the rules of the game, and that match results are obtained fairly. Referees must continuously endure physical pressure; however, they should also be willing to endure various psychological stressors. Professional referees, particularly in football, function in difficult psychosocial environments, and are exposed to both physical and psychosocial stressors such as physical load, injuries, social pressure, and media scrutiny (Arnold et al., 2012), and hence, are likely to experience mental health problems. Therefore, this study aimed to examine the relationship between psychological stressors and stress response in Japanese referees, and explore referees' views on health-related support and needs.

Methods

Study participants included all 252 referees from the fields of baseball, football, and tennis from respective federations in Japan (Mage= 45.9 ± 12.7 years, with an experience of national level refereeing of 2 to 37 years). A questionnaire was prepared to assess the referees' psychological stressors (Murakami, 2021), with items on the following five factors: expectation and pressure from others, interpersonal conflicts, lack of cooperation among referees, fear of judgement error, and family-work conflicts. Furthermore, a stress response scale for referees was administered to assess referees' mental health status.

Results

Multiple regression analysis showed that a certain specific psychological stressor tended to be strongly connected with a certain specific stress response. Family-work conflict was found to have a strong effect on all stress responses. Moreover, interpersonal conflicts strongly correlated with irritability-anger, distrust of people, and depression.

Discussion

Our findings confirmed that referees' mental health was influenced by interpersonal and family-work conflicts. Hence, referee associations should be more proactive in teaching more than the laws of the game and mechanics of officiating, in their training courses. Providing resources, materials, and guest lectures, in addition to continual evaluation and follow-up for referees can better assist them in improving not only their officiating duties but also their quality of life through reduced job and life stress. Data from this work can prove to be instrumental in providing insights into the creation of better stress management programs for this population.

Reference

Arnord et al (2012) A research synthesis and taxonomic classification of the organizational stressors encountered by sport performance. Journal of Sport Exercise & Psychology, 34, 397-429.

Murakami, K. (2021) Development and evaluation of the stress management program of the referee in sport. Grants-in-Aid for Sci Research Report, 1-5.

A COMPARATIVE STUDY OF TALENT DEVELOPMENT ENVIRONMENT BETWEEN THE SCOTTISH PROFESSIONAL FOOTBALL CLUB AND THE CHINESE PROFESSIONAL FOOTBALL CLUB

YANG, L., MCEWAN, H.
UNIVERSITY OF STIRLING, UNIVERSITY OF THE WEST OF SCOTLAND

Abstract

Environmental factors are considered to significantly impact football players in the Talent Development process. By using a holistic ecological approach, previous studies mainly focused on the European context. This research compared two youth academies of a Chinese and Scottish football club. The objective set out to explore the differences and similarities between the two academies, and the causes behind the scene.

Methods

The research took the form of a case study. Given the restrictions of the pandemic, semi-structured interviews and document analysis were the main methods used to collect data. Three participants (i.e. coaches, supporting staff, and managers) from each club were interviewed for one to two hours about the different facets of the environments of Talent Development in each club. Thematic analysis was used to analyze data from interviews and documents. Trustworthiness was ensured through several processes (i.e. a tested theory, member reflection, triangulation). The comparison was conducted after the summary of the results from each case.

Results

Utilizing a holistic ecological approach, it revealed that the Scottish football club exhibits six key characteristics within its academy: experienced coaches for players of different age groups, strong family support, a national culture promoting football, community-oriented club culture, robust sports science support, and a commitment to long-term player development. In contrast, the Chinese football club features eight characteristics: consistent youth academy investment, collaboration with Japan in football, a long-term player development focus, emphasis on academic learning, administrative support from the club, opportunities for youth players in the first team, limited sports science support, and a lack of family support.

Discussion

The results highlight a significant similarity in well-structured youth academies between the Scottish and Chinese football clubs. Considering the complex and dynamic process of Talent Development, a well-structured youth academy sets up a solid foundation for players to be trained under the long-term development principle, thus enabling players a consistent pathway and smoother transitions between stages. However, differences in family support and sports science utilization stem from distinct social contexts, including the geographical proximity of families to clubs and the varying developmental levels of sports science in universities between Scotland and China. These disparities influence the level of support available to players in each club. Future research could explore the macro-environmental factors contributing to football disparities between Scotland and China.

A COMPARATIVE STUDY ON THE PORTRAYAL OF WOMEN IN CHINESE AND BRITISH SPORTS FILMS

LIU, C.Y., ZHAO, Y.Y.
QUFU NORMAL UNIVERSITY

Purposes: This study compares the development of sports films in China and the United Kingdom over the past century. Using metrological filmography software, the study analyzes the rhythm and editing rate of sports films and examines how they portray womens bodies in different social systems. This research is based on the body theory of Foucault and Merleau-Ponty, as well as the gaze theory. The study delves deep into the portrayal of female bodies in sports movies from China and Britain over the last century. It examines how sports culture has been expressed under the social development of both countries.

Methods: 1) Utilize literature websites and resource libraries to search for female images in Chinese and British sports movies from the past century, and classify and screen them using relevant keywords. 2) Use expert interviews to examine the most focused sports movies and female images in China and the UK over the past century. 3) This study uses Cinemetrics software to analyze the editing rate, rhythm, and color of Chinese and British sports movies. 4) Content analysis method: This study conducts an in-depth analysis of female images in Chinese and British sports movies and explores the different expressions of sports culture in different countries. 5) Conduct a comparative analysis of female characters in sports movies from China and Britain, and examine the differences in sports systems and cultural expressions under different social systems.

Conclusion: 1) In the context of the sports system based on Chinas national system, the female characters and bodies displayed in Chinese sports movies are social mirror narratives, showing the grand feelings of family and country. 2) The representation of women in British sports films is characterized by post-feminist image displays of the female body. 3) Different cultural backgrounds have varying interpretations of the core values of sports culture, which are reflected in sports-related films and television shows.

THE EFFECT OF STRESS MANAGEMENT EXERCISE PROGRAM ON MENTAL HEALTH AND AUTONOMIC NERVOUS SYSTEM OF ADULTS EXPOSED TO CHRONIC STRESS

WOO, M., LEE, S.
UNIVERSITY OF ULSAN

Stress is a strong risk factor of mental health. Stress causes various psychological, physiological, behavioral reactions, and muscle pain. One of the effective ways to relieve the stress is exercise. Especially yoga not only improves stress-related mental disorders, but also helps maintain balance in the autonomic nervous system. In present study, stress management exercise program was developed using Iyengar yoga. The purpose of the study was to investigate the effects of the exercise program on mental health, muscle pain, and autonomic nervous system.

Women raising children with disabilities are exposed to chronic parenting stress. Therefore, the participants in the study were 27 women aged 40-59 years old with disabled children without any heart-related or musculoskeletal disease. They were randomly assigned to exercise group and the control group. To measure the mental health, the Beck Depression Inventory, State and Trait Anxiety Questionnaire, Parenting Stress Questionnaire for Disabled Parents, Psychological Stress Response Scale, and Resilience Questionnaire were used. A visual analogue scale was used to track pain changes in the neck, shoulder, back, and lower back muscles. The stability of the autonomic nervous system was measured through heart rate variability. The main sites of stress-induced muscle pain are the trapezius, sternocleidomastoid, masticatory, and erector spinae. Therefore, the exercise program for neck, shoulder, back, and waist was developed to relax and strengthen those muscles and correct posture. The exercise program consisted of 1) preparation, 2) muscle relaxation and posture correction, 3) finish stages. The exercise group participated in Iyengar yoga for 60 minutes at a time, twice a week for 8 weeks, a total of 16 times, and the control group was allowed to maintain their daily life. Mental health, muscle pain, and heart rate variability were measured before and after yoga, and were also measured before and after each yoga session.

As a result, participation in 8 weeks Iyengar yoga leads to reduce depression, stress response, fatigue, frustration and decrease the pain in neck, shoulder, back and waist. Heart rate variability after yoga was higher than one before yoga. The result implies that stress management exercise program reduces muscle pain and improves mental health and stability of autonomic nervous system. Exercise program using Iyengar yoga might be an effective alternative medicine to improve stress.

ACUTE EFFECTS OF HIGH-INTENSITY FUNCTIONAL TRAINING ON INHIBITORY CONTROL

WU, C.T., GUERRA, G.1, KAO, S.C.2, BRISEBOIS, M.F.3, WANG, C.H.4
1: ST. MARY'S UNIVERSITY, 2: PURDUE UNIVERSITY, 3: UNIVERSITY OF SOUTH CAROLINA UPSTATE, 4: NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Based on findings from systematic reviews and meta-analyses, acute exercise (e.g., aerobic or resistance exercise) improves inhibitory control. However, a popular fitness trend, CrossFit®, has not been widely studied regarding its effect on inhibitory control. CrossFit® is a high-intensity functional training (HIFT) program that stresses the cardiorespiratory and muscular systems through complex, multi-joint movement patterns with minimal rests in-between sets. Wilke (2020) found that a 15-minute HIFT exercise bout improved working memory. However, the effect of HIFT on inhibitory control remains unclear. The purpose of the current study was to assess inhibitory control after a single bout of HIFT exercise.

METHODS: Fifteen healthy young adults (age: 20.6 ± 1.3 yr., female n = 8) underwent two 15-minute sessions: (1) HIFT condition, which was comprised of 6 exercises commonly practiced in most CrossFit® gyms: burpees, inverted rows, dumbbell push presses, squat jumps, dumbbell snatch, and leg raises. These were performed in a circuit with repeating 20-second all-out training bouts and 10-second rest periods; and (2) a control condition involving reading neutral magazines provided by the investigator. Before and after the sessions (counterbalanced), the flanker task was applied to evaluate the differential changes in inhibitory control across conditions. Statistical analyses were conducted for response accuracy (ACC) and reaction time (RT) using a 2 (Time: pre-intervention, post-intervention) × 2 (Treatment: rest, HIFT) × 2 (Congruency: congruent, incongruent trials of the flanker task) multivariate repeated-measures ANOVAs.

RESULTS: Analysis on ACC showed a main effect for Congruency, with higher ACC for the congruent trials (99.4 ± 0.5%) than incongruent trails (96.9 ± 2.1%). Analysis of RT revealed a Time effect ($F(1, 14) = 10.5$, $p = 0.006$, $\eta 2 = 0.43$) and a Congruency effect ($F(1, 14) = 58.6$, $p < 0.001$, $\eta 2 = 0.81$) which was superseded by an interaction of Time × Treatment × Congruency ($F(1, 14) = 5.6$, $p = 0.032$, $\eta 2 = 0.29$). Decomposition of this three-way interaction showed an interaction of Time × Congruency ($F(1, 14) = 4.9$, $p = 0.043$, $\eta 2 = 0.26$) only for the CrossFit treatment, with decreased RT at post-intervention relative to pre-intervention for both congruent trails ($t(14) = 2.8$, $p = 0.006$) and incongruent trials ($t(14) = 3.1$, $p = 0.004$) .

CONCLUSION: These results suggest that HIFT may benefit cognitive function, specifically the overall processing speed involving inhibitory control, in healthy young individuals. Incorporating HIFT into routine physical activity regimens may offer cognitive benefits in addition to traditional fitness improvements.

References:

Wilke, J. (2020). Functional high-intensity exercise is more effective in acutely increasing working memory than aerobic walking: an exploratory randomized, controlled trial. Scientific Report, 10, 12335.

COMPETITION MAKES THE DRIVE TO BE SUPERIOR EVEN MORE URGENT: PSYCHOLOGICAL ENTITLEMENT AND ACHIEVEMENT GOAL

LIN, S.H., LU, W.C.
NATIONAL PINGTUNG UNIVERSITY; NATIONAL TAIWAN UNIVERSITY

Introduction

Psychological entitlement refers to an individual's tendency to have a highly favorable self-perception and a tendency to feel worthy of high praise and rewards. Employees with higher psychological entitlement tend to seek and maintain achievements more than others because achievements can provide individuals with more resources and interpersonal influence in order to actually be entitled in the workplace. Attribution theory focuses on an individual's perception of the causes of success and failure. When employees internally attribute their success or failure in the workplace, they will ultimately attribute it to their personal abilities and efforts. Furthermore, when looking back at their achievements, employees generally spend the most time focusing on how smart they are and hard they worked in the process. Therefore, this study aimed to examine the moderating effect of perceived environmental competitiveness on the relationship between psychological entitlement and achievement goal with attribution theory.

Methods

152 employees from sports and leisure-related companies took part in this study. Through a cross-sectional design, data was collected in the form of questionnaires. The measurement of psychological entitlement, perceived environmental competitiveness, and achievement goal were all adopted scales from published academic journal articles, which have good validity and sufficient reliability. In this study, all Cronbach's alpha values were above .7, indicating acceptable reliability.

Results

The results of hierarchical regression analyses demonstrated that psychological entitlement was positively related to achievement goals. In addition, perceived environmental competitiveness would strengthen the positive relationship between psychological entitlement and achievement goal.

Discussion

The findings in the study revealed that the higher the psychological entitlement of employees, the better their achievement goal. And the higher the perceived environmental competitiveness, the stronger the relationship between employees' psychological entitlement of employees and achievement goal. Since competition always involves winners and losers, competitors will have a sense of inferiority in their own abilities and status. Previous studies have stated that people with higher psychological entitlement tend to respond actively to self-threats. As a result, psychologically entitled employees tend to value their own contributions more than others and respond to threats of failure to perform tasks. Desire to reverse the self-perception of being poor or incompetent through actual performance, eliminate threats that conflict with a positive self-view, and maintain inner self-harmony.

A CAUSAL MEDIATION ANALYSIS OF THE BASIC PSYCHOLOGICAL NEEDS AND MOTIVATION FACTORS AFFECTING PHYSICAL EXERCISE EXECUTION

HORII, D., KANEDA, H., MURAKI, Y.
OSAKA ELECTRO-COMMUNICATION UNIVERSITY

Introduction: Recent advances in Self-Determination Theory (SDT) have highlighted the critical role of basic psychological needs—competence, autonomy, and relatedness—in shaping human motivation and behavior. Within the context of physical activity, Deci and Ryans seminal work (2002) underscores the importance of these needs in fostering exercise motivation. Their findings suggest a significant correlation between the satisfaction of these needs and various types of motivation, ranging from amotivation to intrinsic motivation. Building on this foundation, the study aims to extend this understanding by exploring how these psychological needs influence exercise engagement, either directly or indirectly, through their effects on various motivational dimensions.

Method: A total of 223 College students (114 male and 109 female) participated in this study. Measures involved the use of scales for assessing the satisfaction of basic psychological needs, as well as various forms of motivational regulations (amotivation, external, introjected, identified, integrated, and intrinsic motivation). Causal mediation analysis was conducted to investigate the mediating role of motivational regulations in the relationship between psychological needs satisfaction and exercise behavior. The analysis calculated Average Causal Mediation Effects (ACME) and Average Direct Effects (ADE) for both genders, using statistical software R.

Results: For Male Students: The results indicate that autonomy and relatedness have both substantial mediating effects (ACME) and direct effects (ADE) on exercise motivation. Specifically, autonomy emerged as having a stronger direct influence on motivation compared to competence and relatedness. The statistical findings were as follows: for competence, ACME = 0.09 and ADE = 0.45; for autonomy, ACME = 0.14 and ADE = 0.50; and for relatedness, ACME = 0.19 and ADE = 0.21. For Female Students: The analysis showed that relatedness had a pronounced mediating effect on motivation, while autonomy and competence both exhibited significant direct effects on exercise behavior. Notably, relatedness had the highest ACME (0.59), underscoring its critical role in mediating exercise motivation through motivational regulations. The detailed outcomes were: for competence, ACME = 0.18 and ADE = 0.76; for autonomy, ACME = 0.24 and ADE = 0.87; and for relatedness, ACME = 0.59 and ADE = 0.30.

Discussion: For male students, the findings suggest a relatively even impact of psychological needs on motivation. In contrast, for female students, the significant role of relatedness as a mediator underscores the importance of social connections, suggesting that strategies to enhance exercise participation among women should focus on building community and support. Additionally, the direct effect of autonomy highlights the value of self-directedness in motivating exercise, indicating that allowing personal choice in exercise activities could be particularly motivating.

WHY DOESNT SHE PARTICIPATE IN SPORTS? A STUDY ON INFLUENCING FACTORS AND GENDER DIFFERENCES OF PHYSICAL ACTIVITY LEVELS OF JUNIOR HIGH SCHOOL STUDENTS ——TAKING X CITY, ZHEJIANG PROVINCE AS AN EXAMPLE

HUANG, Y.1, LI, M.2

1. BEIJING SPORT UNIVERSITY, 2. BEIHANG UNIVERSITY

INTRODUCTION: The study of gender differences plays an important role in enhancing the harmony of physical education. This study focuses on the influencing factors and gender differences of teenage physical activity levels, trying to explore: 1.Are there gender differences in junior high school students physical activity levels and related factors? 2.What are the influencing factors? 3.Are there different influencing factors for male and female groups?

METHODS: Questionnaire survey method and interview method were used. The research invited junior high school students in X City, Zhejiang Province, China, and 1123 valid questionnaires were obtained (625 male students and 498 female students). The scales had good reliability and validity. A total of 33 interviewees were sampled, with good representativeness in the identity categories covering students, parents, physical education teachers, and class teachers.

RESULTS: 1.The differences between boys and girls in the dimensions of peer support, exercise adherence, internal motivation and physical activity level are very significant ($p<0.001$), with boys significantly higher than girls. Compared with boys, girls participation in sports relies on the schools requirements more ($p<0.001$).

2.Logistic regression model analysis reveals that peer support for sports(OR=1.143), exercise adherence(OR=2.353), and sports participation mainly from school requirements(OR=0.892) are the facilitators of physical activity levels improvement ($p<0.05$), and internal sports motivation is not a significant facilitator.

3.Logistic regression modeling analysis of boys data only finds exercise adherence (OR=2.556) to be a facilitator of physical activity levels improvement ($p<0.05$), and internal motivation to do sports, peer support for sports, and sports participation mainly from school requirement to be non-significant facilitators. Logistic regression modeling analysis of the girls data only finds that exercise adherence (OR=2.057) and sport participation mainly form school requirement (OR=0.838) are facilitators of physical activity levels advancement ($p<0.05$), and internal sport motivation, peer sport support are not significant facilitators.

Discussion:

Due to the influence of gender role stereotypes, girls physical education tends to be overlooked. Additionally, influenced by aesthetic concepts, girls exhibit lower interest and internal motivation towards sports, resulting in decreased participation rates. Conversely, boys demonstrate greater initiative and are not solely reliant on school requirement.

SPRINGBOARD EFFECTS ON THE ABILITY TO OVERCOME DIFFICULTIES:THE RELATIONSHIP BETWEEN SPORTS PEER SUPPORT AND EXERCISE ADHERENCE IN ADOLESCENTS AND THE MEDIATING ROLE OF PSYCHOLOGICAL RESILIENCE

LI, M.1, HUANG, Y.2, GUO, L.1

1. BEIHANG UNIVERSITY, 2. BEIJING SPORT UNIVERSITY

INTRODUCTION: Peer support plays an essential role in adolescents long-term physical activity. This study tries to explore: 1.What is the current status of peer support, psychological resilience, and exercise adherence among adolescents? 2.Are there differences in these three dimensions by gender and periods of study? 3.Does psychological resilience mediate the effects of peer support on exercise adherence?

METHODS: Questionnaire survey method and interview method were used. The research invited primary and secondary school students in X City, Zhejiang Province, China, and 2137 valid questionnaires were obtained (1076 male students and 1061 female students). The scales had good reliability and validity. A total of 21 interviewees were sampled with good representativeness.

RESULTS: 1.There are significant differences between male and female students in peer support and exercise persistence, among which male students are significantly higher than female students($p<0.05$).

2.High school students are significantly lower than junior high school and elementary school students on the dimensions of peer support, exercise adherence, and psychological resilience, and junior high school students are significantly lower than elementary school students($p<0.001$).

3.Sports peer support and psychological resilience significantly predict exercise adherence. Psychological resilience partially mediates the relationship between peer support and exercise adherence. The percentage of mediating effect is 21.518%. Peer support can influence exercise adherence directly ($\beta=0.568$, $p<0.001$) or indirectly ($\beta=0.252$, $p<0.001$) by influencing psychological resilience ($\beta= 0.485$, $p<0.001$).

Discussion:

1.As a result of gender role stereotypes, there are certain differences in the way that families and schools nurture boys and girls in sports from an early age. At the same time, the stereotypes require male to take on more social responsibilities, which in turn builds more psychological resilience to face setbacks.

2.Elementary school students have more time to devote to sports participation due to lower academic pressures compared to junior high school. Secondary school students have less attention of psychological problems from parents and teachers due to higher academic pressures and relatively mature.

3.According to self-determination theory, substantive support and emotional support can be provided during physical exercise, which satisfies the need for relationships as one of the basic human needs, and thus promotes active participation in physical exercise.

4.The role of sports peer support is not limited to the sports participation aspect, but acts as a transferable competency, developing ability to persevere in the face of difficulties.

THE IMPACT OF BRAND CONSISTENCY ON ADVERTISING MEMORY IN SPORTS BROADCASTS

CAI, C.

TONGJI UNIVERSITY

INTRODUCTION: Advertising in sports broadcasts is a crucial means for companies to promote their brands, and the memorability of advertisements is essential for brand promotion. Brand consistency is one of the key factors influencing advertising memorability. Previous studies have shown that the memorability of advertisements is influenced by various factors, including the consistency of advertisement content with the broadcast program. However, the specific impact of brand consistency on advertising memorability in sports broadcasts has not been thoroughly studied. Therefore, this study aims to investigate the effect of brand consistency on advertising memorability in sports broadcasts.

METHODS: The study sample consisted of 60 university students living in Shanghai (30 women and 30 men). The participants ages ranged from 18 to 25 years (20.3 ± 1.2 yrs), all of whom were sports enthusiasts. The participants were randomly divided into two groups, with 30 participants in each group. One group watched advertisements with high brand consistency, while the other group watched advertisements with low brand consistency. There were no significant differences in gender and sports interests between the two groups. After watching the program, the participants were evaluated for their advertising memorability through questionnaires and brand recall tests. The advertisements watched by the high brand consistency group included commercials from well-known brands such as Nike, Adidas, and Coca-Cola. The advertisements watched by the low brand consistency group included commercials that were less well-known or less related to sports events.

RESULTS: Statistical analysis revealed a significant difference in advertising memorability between the high brand consistency group and the low brand consistency group ($F=8.92$, $p<0.01$). Specifically, participants in the high brand consistency group demonstrated better memorability of advertisement content and brand information, with a brand recall rate of 65.2% ± 4.5%, compared to 50.6% ± 3.8% in the low brand consistency group. Additionally, participants in the high brand consistency group showed more positive attitudes and cognition towards the advertisements, with attitude scores of 7.7 ± 0.5 and cognition scores of 8.2 ± 0.7, compared to attitude scores of 5.3 ± 0.7 and cognition scores of 6.1 ± 0.9 in the low brand consistency group.

DISCUSSION: This study confirms the significant impact of brand consistency on advertising memorability in sports broadcasts. Watching advertisements with high brand consistency can significantly improve participants memorability of advertisement content and brand information, as well as enhance their positive attitudes and cognition towards the advertisements. This finding has important implications for advertisers in formulating advertising strategies in sports broadcasts, and can help improve the effectiveness of advertising dissemination and brand promotion.

VISUAL SEARCH BEHAVIOR OF OFFENSIVE PLAYERS IN 3 VS 2 SITUATIONS IN HANDBALL

UMEZAKI, S., TANOUE, K., MATSUKI, U.

TENRI UNIVERSITY

In this study, we analyzed the visual search behavior of 14 male handball players (7 skilled players and 7 unskilled players) focusing on 3 vs 2 situations from the initiation of the center players pass to the completion of the return pass. The results indicated that both in "passing" and "penetrating" situations, skilled players exhibited a higher proportion of visual fixations on "Defender 2," who plays a role in pressuring the subjects, compared to unskilled players. Additionally, in "penetrating" situations, the proportion of visual fixations on "Offense A," the teammate, was lower. Furthermore, skilled players demonstrated a higher proportion of visual fixations on "Defender 2" in "penetrating" situations compared to "passing," suggesting that they adjust their gaze according to various defensive formations. Skilled handball players spent more time gathering essential information, such as the movements of defensive players pressuring the subjects, compared to less essential information like the position of Offense A, in order to accurately evade the defense and create numerical advantages without wasting time. These findings suggest that appropriately collecting information about defensive movements is crucial for creating numerical advantages in handball.

PETTLEP IMAGERY TRAINING AND SPORT PERFORMANCE: A SYSTEMATIC REVIEW AND META-ANALYSIS

CHIEN, T.H., CHEN, J.Y., CHI, L.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction

Holmes and Collins (2001) developed a PETTLEP imagery training model based on the functional equivalence hypothesis, suggesting that there is a similar neural network involved in both motor imagery training and the actual execution of movements. From this point forward, numerous studies have been conducted by using PETTLEP imagery training model to examine the effects of imagery on performance. Previous research has also confirmed the significant effects of PETTLEP imagery training on sports performance, cognitive functions, rehabilitation, and fitness activities. Researchers have conducted systematic literature reviews on PETTLEP, but there has yet to be an integrated analysis specifically focusing on competitive sports. Consequently, it remains unclear the magnitude of its effectiveness and the optimal intervention frequency to enhance performance.

Methods

This study conducted a systematic literature review combined with integrated analysis following the PRISMA process. The data base of the articles: PubMed, PsycINFO, Scopus, Web of Science and Airiti Library (Mandarin).Systemic Literature review, meta-analysis article and qualitative researches wouldn't be recruited. Also, single case studies, studies with single subject / A-B designs and with other intervention were excluded (i.e. physical practice, action observation). A total of 17 articles were recruited.

Results

The total 17 articles include Archery, Basketball, Hockey, Hulder, Soccer, Volleyball, Tennis. Meta-analysis revealed that PETTLEP imagery training yielded a significant effect size of d = 1.12, 95% CI [0.80, 1.44] in enhancing competitive sports performance. It was found that PETTLEP imagery interventions significantly enhanced sport performance. The results showed that twice session a week had significant effect size of d = 0.98, 95% CI [0.57, 1.39] in improve sport performance.

Discussion

The Based on previous integrated analyses of psychological practices and theoretical and applied aspects of imagery, practical implications were discussed. Coaches, athletes, and sports psychologists are recommended to incorporate PETTLEP imagery training into training sessions at least twice a week for 10 minutes each session, which is expected to benefit athletes sport performance.

NEURAL CORRELATES OF SPORT-SPECIFIC MOTOR IMAGERY IN PEAK PERFORMANCE: AN FMRI STUDY OF TAIWANESE ELITE ATHLETES

CHI, L., CHIEN, T.H., HUNG, H.W., CHIANG, C.T., YAO, Z.F.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction

In the past, most studies used interviews or questionnaires to subjectively examine the mental state and psychological characteristics of athletes for their peak performance. This study used a more objective cognitive neuroscience approach by using functional MRI to explore the neural correlates of motor imagery in elite athletes by examining their brain activity as they visualized themselves performing at two distinct levels: their peak performance during the most prestigious competition they had participated in and their habitual performance during routine training.

Methods

Twenty-eight elite Taiwanese athletes who competed in either Olympic Games or Asian Games were recruited. One athlete could not complete the motor imagery tasks during the scan. The study design involved capturing images during three blocks of sport-specific and customized cues, which prompted athletes to recall and visualize their personal performance milestones under peak, regular, and baseline conditions. Before and after the imaging sessions, we conducted physiological assessments, measuring systolic and diastolic blood pressure and arthrometric variables, while also accounting for each athletes highest level of achievement and years of training. The standard fMRI data preprocessing was performed, including motion correction, slice timing adjustment, spatial smoothing, and standard brain template normalization.

Results

The within-subject block design analysis revealed consistent activation in the frontal lobe and caudate nucleus during the recall and visualization of performances across all conditions when compared to baseline. Notably, regular performance visualization was associated with increased BOLD (blood oxygenation level dependent) signal fluctuations in the superior temporal gyrus, whereas peak performance visualization predominantly engaged the parietal cortex. Furthermore, during peak performance imagery, we observed significantly enhanced BOLD signals in the frontal brain regions, including the orbitofrontal cortex and frontal pole, suggesting a heightened involvement of executive functions during high-stakes performance visualization.

Discussion

In conclusion, our findings indicate that imagining peak performance primarily recruits higher-order cognitive processes in frontal brain areas, which may underpin the more automated and optimal execution of motor actions. In contrast,

regular performance imagery appears to involve additional, possibly redundant, activity in visual areas, suggesting a reliance on more explicit visualization of the motor actions. These insights contribute to our understanding of the cognitive and neural strategies employed by elite athletes during motor imagery and could have implications for enhancing sports performance through imagery training.

THE INFLUENCE OF ADOLESCENT FOOTBALL PLAYERS INTERNAL PARTICIPATION MOTIVATION ON PSYCHOLOGICAL WELL-BEING: THE MEDIATING ROLE OF INTERPERSONAL RELATIONSHIPS

MA, W.1, LI, M.2

1. BEIJING SPORT UNIVERSITY, 2. BEIHANG UNIVERSITY

INTRODUCTION: This study attempts to reveal the influence of internal motivation of young football players on psychological well-being under the effect of interpersonal factors, trying to explore: 1.What is the current status of youth football players internal participation motivation and psychological well-being? 2.Does the psychological well-being differ according to sex and gender role? 3.Do interpersonal relationships (with family, teammates, and coaches) mediate the effects of participation motivation on psychological well-being?

METHODS: A questionnaire survey was conducted on young players from 3 high schools in X City, China. A total of 110 valid questionnaires were collected. The questionnaire was combined with the Sports Motivation Scale, 12-Item Bem Sex Role Inventory, Psychological Well-being Scale, etc., which had good reliability and validity.

Results and discussion:

1.Male students are significantly higher than female students in the dimensions of internal motivation ($p<0.05$, $d=0.458$), relationship with coach ($p<0.001$, $d=1.011$) and psychological well-being ($p<0.01$, $d=0.612$). This may be because boys are more likely to pursue the happiness brought by football, and football coaches are dominated by men. And girls under the influence of gender role stereotypes may be subjected to social expectation pressure.

2.Gender role: In the dimension of psychological happiness($p<0.05$, $\eta^2=0.400$), androgynous students($M=5.619$, $SD=0.441$) are significantly higher than masculine ($M=5.131$, $SD=0.341$) and feminine($M=5.003$, $SD=0.754$) and undifferentiated students($M=4.522$, $SD=0.723$). This is consistent with previous studies that androgyny is more likely to experience life satisfaction and happiness.

3.Interpersonal relationships plays a mediating role in the influence of football participation internal motivation on psychological well-being.

Fathers creation of a learning-oriented climate plays a partial mediating role. The internal motivation of football participation can directly affect psychological well-being ($\beta=0.271$, $p<0.001$), or indirectly affect psychological well-being ($\beta=0.507$, $p<0.001$) through the influence of fathers creation of a learning-oriented atmosphere ($\beta=0.412$, $p<0.001$). This indicates that when students have a strong internal motivation, they will notice more fathers guidance on learning orientation. And fathers are more likely to support children in grasping goals, which is a coupling interaction, forming the family support. The direct promotion may be because students with higher internal motivation have more fun and self-realization in sports, which also indicates the transfer effects of sports.

Similarly, the relationship between students and coaches plays a completely mediating role and the teams joint efforts plays a partial mediating role.

IMPACT OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON THE CAPACITY TO PERFORM BURPEES

GARCIA DE FRUTOS, J.M., CHEN, T., KAUSHALYA-FERNANDO, S., COLOMER-POVEDA, D., MÁRQUEZ, G., ORQUÍN-CASTRILLÓN, F.J., ROMERO-ARENAS, S.

UNIVERSIDAD CATOLICA DE MURCIA

Transcranial direct current stimulation (tDCS) has emerged as a potential intervention to improve physical performance. This study investigates the effects of tDCS applied to the primary motor cortex (M1) and dorsolateral prefrontal cortex (DLPFC) on performance in a maximal effort task, specifically the No jump Burpee exercise.

Twenty healthy male subjects (26.0±4.91 years) completed three experimental conditions (a-DLPFC, a-M1, SHAM) in a double-blind crossover design. Prior to the performance of burpees to exhaustion, tDCS (2 mA, 20 min) was administered. Total number of repetitions, vastus lateralis muscle oxygen saturation, heart rate, and subjective perception of exertion (RPE) during exercise were measured.

Repeated ANOVAs showed a significant effect of condition on the number of repetitions ($p<0.001$). Subjects performed more repetitions under the M1 condition (68 ± 19.5) compared to DLPFC (63 ± 17.9) and SHAM (58 ± 18.0), with significant differences between all conditions.

This study demonstrates that tDCS, can improve performance in a physical endurance task such as the No Jump Burpee. The findings suggest that tDCS may be a viable ergogenic tool for improving athletic performance. Future research should explore the underlying mechanisms and the practical application of these results in long-term physical training programmes.

IS THE SELF-REGULATION OF STRESS DEPENDENT ON THE STRENGTH OF INDIVIDUAL'S MOTIVES?

WEGNER, M., PIESCH, L., MARION-JETTEN, A.S.

UNIVERSITÄT HAMBURG, INSTITUTE OF EXERCISE SCIENCE

Introduction

Different recent theories point to the fact that self-regulation might not be independent from other people. Yet, several conceptualizations operationalize self-regulation primarily as an individual process although other people might be, more or less, strongly involved in the regulation of behavior. For the present study, we empirically investigated whether self-regulation of stress might not be independent of the strength of people's motives that vary with regard to how strongly they are concerned with others.

Methods

N = 291 German individuals aged M = 33.7 years (SD = 12.4) working primarily in the social and care sector participated in the study (n = 66 men). Participants' implicit motives (dimensions: achievement, affiliation, power) were measured using the PSE. Self-regulation competencies were operationalized using the VCQ (subscales: self-regulation, self-control, self-access, volitional development). Individual stress regulation strategies were measured using the Tend-and-Befriend questionnaire (strategies: flight, fight, tend and befriend). A cluster analysis was conducted to identify motive-regulation patterns in the data. Mediation analyses were used to test the hypothesis that the effect of motives on stress regulation is mediated by general self-regulation strategies.

Results

Results of the cluster analysis propose two clusters: Cluster one involved people high in the power motive and individuals tending to use flight as well as fight strategies for stress regulation. The second cluster involved people high in the achievement or affiliation motive and tend to use tend-and-befriend strategies for stress regulation. The mediation analysis did not indicate a full mediation as hypothesized. However, results indicate that people with stronger access to the self are more likely to use tend-and-befriend strategies to regulate stress and tend to avoid flight or fight strategies.

Discussion

The results of the present study suggest that implicit motives and self-regulation competencies influence stress regulation patterns, that is, people's tendencies to use fight, flight, or tend-and-befriend in reaction to stressors. People working in the social and care sector might show different motivational and self-regulatory profiles and might not benefit as much from classic stress-regulation interventions which utilize more individual-focused strategies of regulation. The present research intends to contribute to the understanding of how motives and general self-regulation competencies are intertwined with stress-regulation strategies.

EATING DISORDER SYMPTOMS AND PERFECTIONISM IN FEMALE ATHLETES

DONTI, O., PANIDI, I., GASPARI, V., DONTI, A.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, GREECE

INTRODUCTION: Eating disorders are complex psychiatric disorders impairing everyday life, health, and development (1). For athletes of aesthetic sports, in addition to physical and psychosocial health, eating disorders may also be detrimental for sports performance (2). Among personality traits implicated in the etiology of eating disorders, perfectionism is a central variable in adults (3). However, evidence is lacking in adolescent athletes. Thus, the aim of this study was to examine eating disorder symptoms and perfectionism in adolescent rhythmic gymnasts.

METHODS: Sixty-two female rhythmic gymnasts (34 international and 28 recreational level gymnasts), aged 13-15 years, completed the Eating Attitudes Test 26 (EAT-26), the Sport Perfectionism Questionnaire (SPQ), the Social Desirability Scale (SDS) and a questionnaire which included age, weight, height information as well as training and competition details.

RESULTS: Twenty of the 62 athletes (32.26%) scored ≥20 in EAT-26. International level gymnasts scored higher than recreational in EAT-26 ($p = 0.002$) and the Dieting subscale ($p = 0.034$), with no differences between groups in the Perfectionistic Strivings ($p = 0.610$) and Perfectionistic Concerns factors ($p = 0.680$). Multiple regression analysis of all gymnasts showed that Perfectionistic Strivings and Negative Reactions to Imperfection, accounted for 22.5% of the variance in EAT-26 (adjusted $R2 = 0.225$, $F = 18.219$, $p < 0.001$).

CONCLUSION: International level adolescent rhythmic gymnasts exhibit higher prevalence of eating pathology than recreational level gymnasts, suggesting that participation in sports where leanness is associated with performance is an important risk factor for developing eating disorders, and especially in adolescent athletes. Although striving for perfection is generally considered an adaptive dimension of perfectionism, the present study shows that Perfectionistic Strivings and Negative Reactions to Imperfection seem relevant for gymnasts dieting behavior.

REFERENCES:

1. Steinhausen, et al., Int J Eat Disord, 2005

2. Sundgot-Borgen, et al., Scand J Med Sci Sports, 2010

3. Schmidt, et al., Br J Clin Psychol, 2006

CHILDRENS NUTRITIONAL HYDRATION AND COGNITIVE OUTCOMES - A SYSTEMATIC REVIEW OF TRADITIONAL AND GREY LITERATURE.

BOAK, K., ROBERTS, C., RUMBOLD, P., TEMPEST, G.D., GREEN, B., JAMES, L., BRUCE-MARTIN, C.
NORTHUMBRIA UNIVERSITY

INTRODUCTION

Children are at increased risk of dehydration due to their higher surface-to-mass ratio, different thirst sensitivities and body cooling mechanisms (1). A mild state of dehydration is associated with reduced cognitive performance such as attention, psychomotor and immediate memory skills (2). It has been found that children are in a hydration deficit for the majority of the school day - many of them arriving to school dehydrated (3). Therefore, in this systematic review, we examined nutritional hydration and cognition in children from traditional and grey literature resources.

METHODS

A literature search (conducted March 2023) of seven academic and three grey literature sources including handsearches and citation pearl growing was conducted. Search terms included: Children AND (Nutrition OR Hydration) AND (Cognition OR Learning). The sifting process involved a three-stage approach aligned to the PRISMA guidelines (4). Inclusion criteria were children aged 9-11 years, healthy populations, a drink-based intervention and acknowledgement of cognitive outcomes. Exclusion criteria were studies not available via open access.

RESULTS

Thirty-one papers were included in the final systematic review (26 from academic and 5 from grey literature sources). Included papers compromised of controlled trials (55%) and reviews (16%), plus other intervention and pilot studies and online articles. Seven overarching themes were identified through thematic analysis. The main findings indicated that children are at risk of dehydration, and their nutritional hydration habits are influenced by a variety of barriers and motivators within the school setting - such as access to drinks. Methodological findings included the use of objective and subjective methods to measure hydration and cognitive outcomes, with schools identified as an appropriate setting for intervention. Interventions predominantly featured water supplementation but several other drinks options were identified and tested for cognitive outcomes such as milk, fortified beverages, glucose beverages and wild blueberry drinks. Cognitive outcomes were described with using a plethora of psychology terminology highlighting the multidisciplinary input within the literature.

CONCLUSION

These findings contribute to the existing literature regarding nutritional hydration in children and the cognitive outcomes associated with several drinks options. The review highlighted differences and commonalities between the implementation of drinks-based interventions through motivators and barriers of nutritional hydration habits within the school setting. The unique inclusion of both academic and grey literature provides an overall representation of what information is available to influence school nutrition and hydration policy.

REFERENCES

1.D'Anci et al., In Nutrition Reviews, 2006

2.Adan, A. J American College of Nutrition, 2012

3.Fuchs et al., J Sch Health, 2016

4.Page et al., International J of Surgery, 2021

EMBEDDING BODILY-KINESTHETIC CREATIVITY IN TEAM SPORTS – THE CASE OF 'FUTMANOBOL' IN BRAZIL

HOPPE NAVARRO, C.A., SILVA, A.R., BARROS, J.F., SOARES, J.L., HORA, V.S., FERREIRA, V.M.
UNIVERSITY OF BRASÍLIA

Introduction

A statement by Howard Gardner four decades ago established the scope of the body culture of movement: "two capacities, first to control the movements of one's own body and second the capacity of manipulating objects, these are the domains of bodily-kinesthetic intelligence". If intelligence is the ability of materializing best choices and creativity means the invention of new solutions for challenges, then bodily-kinesthetic creativity might be evaluated in the body culture of movement.

Most team sports are exciting in particular because of their inherent creativity. They require collaboration and "flow", or a state of total commitment. They create an immense array of unexpectedness and aggressive creativity and are prone to multiple potentialities because of their limitless scope within a given set of rules. As an illustration, a football player on average needs 2.5 thousand decisions in a normal game and they are vastly variable, combining both improvisation and trained movements – all of them, however, are unique and unrepeated in action and thus creative in their essence.

Research question

If most facets of distinct team sports are intertwined in order to amplify creativity, would it be possible to build a new set of rules and a new sport modality aimed at maximizing the bodily-kinesthetic creativity?

Methods

They focused on action research after one decade of practices developed on "futmanobol" ("footmanoball") in the city of Brasília. Training exercises, competitions and activities related to a formal course at the University of Brasília. Intense observation and analysis of empirical data.

Results

The main result was a compilation of rules that allow players of "futmanobol" to exercise greater space for (individual and collective) creativity. It is a game of four players in each team, trying to score goals and the field is similar in size to basketball. Playing with feet is free like in football. A game imposes three norms for playing with hands. First, similar to volleyball, it is not accepted to hold and carry on the ball. Second, the player cannot touch the ball on the ground. Third, players can touch not more than three times with hands and arms, without trading passes, bouncing or touching the ball with another part of the body.

Discussion and final remarks

Team sports display a great variety either if the use of arms and hands is concerned or the use of feet and other parts of the body. When "futmanobol" does not allow a player to hold the ball, it equals the efficacy and proportional distribution of hands and feet. Under a context of sport transdisciplinarity and polymathy, it shares the gestures and movements of several sports (football dribbling, passing and shooting, volleyball bumps and serves, handball dribbling, etc.). So, it becomes even more unpredictable, immersive, collaborative, ample and fast – and pleasurable. As such, "futmanobol" for sure could be a phenomenal inductor of bodily-kinesthetic creativity.

THE RELATIONSHIP BETWEEN SLEEP BELIEFS AND SLEEP QUALITY IN COLLEGE STUDENTS: THE MEDIATING ROLE OF NEGATIVE EMOTIONS

WANG, P., WANG, K., XIE, C.

SHANGHAI JIAO TONG UNIVERSITY

Introduction

Undergraduate students often experience poor sleep quality, which may adversely affect their physical health, cognitive functions, and academic performance. Previous research has uncovered a noteworthy association between sleep beliefs and sleep quality. Additionally, a relationship seems to exist between negative emotions and both sleep-related beliefs as well as sleep quality. However, it remains uncertain whether beliefs concerning sleep can impact sleep quality through negative emotions and the mechanisms involved. The objective of this study was to investigate the relationship among sleep beliefs, negative emotions, and sleep quality in undergraduate students.

Methods

A simple random sampling method was utilized to distribute three questionnaires to 864 undergraduate students [males = 629 (72.8%), age = 18.81 ± 1.00 years] in China. Individual negative sleep-related beliefs, negative mood, and sleep quality were measured by the Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16), Pittsburgh Sleep Quality Index (PSQI), and Depression, Anxiety, and Stress Scale-21 (DASS-21), respectively. The Cronbachs alpha coefficient of the DBAS-16 and PSQI are 0.91 and 0.80, respectively. The Cronbachs alpha coefficient of the DASS-21 is 0.95, and the Cronbachs alpha coefficients of the depression, anxiety, and stress subscales are 0.88, 0.82, and 0.88, respectively. With SPSS 27.0, descriptive, correlational, and regression analyses of the data were carried out. The mediation model was tested using Hayes PROCESS v3.5 application. The bias-calibrated nonparametric percentile Bootstrap method was used to examine the significance levels of mediated effects.

Results

There were significant negative correlations among sleep beliefs, negative emotions, and sleep quality for each pair of variables. Each of the three sub-dimensions of negative emotions (depression, anxiety, and stress) was significantly positively correlated with sleep quality ($r=0.450$, $p=0.01$; $r=0.463$, $p=0.01$; $r=0.482$ $p=0.01$). Positive correlations exist among each pair of variables within the sub-dimensions of depression, anxiety, and stress. Notably, sleep beliefs have both direct negative predictive effects on sleep quality ($\beta = -0.147$, $p< 0.001$) and indirect influences through three pathways: independent mediation by depression ($\beta = -0.186$, $p< 0.001$), anxiety ($\beta = -0.180$, $p< 0.001$), and stress ($\beta = -0.199$, $p< 0.001$). Additionally, they operate via two chain-mediated pathways involving depression with stress ($\beta = -0.052$, $p< 0.001$), and anxiety with stress ($\beta = -0.043$, $p< 0.001$).

Discussion

Depression, anxiety, and stress independently mediate the association between undergraduate students sleep beliefs and sleep quality, with additional chained mediation involving depression and stress, anxiety and stress.

Sociology

IMPLEMENT A GUIDE RUNNING PROJECT WHICH FACILITATES COOPERATION BETWEEN A DIVERSE RANGE OF PEOPLE - DEVELOPMENT OF CLASSES RELATED TO THE PERIOD OF INTEGRATED STUDY IN Y JUNIOR HIGH SCHOOL-

KONDO, K., MORIOKA, Y.1, OGATA, M.2

1 NIHON UNIVERSITY, 2 UNIVERSITY OF TSUKUBA

The Right of Persons with Disabilities adopted by the U.N. General Assembly in 2006 can be regarded as the foundation for taking concrete actions to move towards an inclusive society. The development of the Olympic and Paralympic education programme accelerated by the Tokyo 2020 Olympic and Paralympic Games (hereafter Tokyo2020 Games) is an example of the approach toward the realization of an inclusive society in our country, through sports.

This study aims to consider the issues of the enrichment of education methods and the education curriculum by examining the possibility of introducing "guide running"as a learning tool of "health and physical education classes" and "special activities" with middle school teachers in order to achieve more substantial "cooperation with a diverse range of people", as stipulated in junior high school curriculum guidelines.

To this end, the project was launched in Y municipal junior high School in H city situated in western Tokyo. This project was implemented from April to December in 2023. In getting the project under way, the following phases were set prior to the start of the project : start-up period (from end of April to end of May) – planning period (from beginning of June to middle of July) – practice period for teachers (from end of October to middle of December) – practice period for students (from beginning of September to end of October) – evaluation period (from end of October to middle of December). The findings are to be analysed by means of Action research (Akita,K et al., 2005 ; Sato,K et al., 2004).

In start-up period, based on the educational policy of Y Junior High School as subject of this project and the H city education board, the objective was set to develop the classes to realise an inclusive and also diverse society through sports. In practice period for teachers, the objective was to encourage the discussion about the standpoints of evaluation and the expected issues in actual operation when the teachers giving classes is actually doing "guide running" to be introduced as learning tool.

To do this, a summer workshop for teachers of health and physical education of H city in cooperation with H city education board was held. The participants were 13 teachers from H city junior high school. In this workshop, firstly the basic points of "guide running" were lectured in a didactic manner to the participants, then practical session and wrap-up discussion were followed. During the discussion, positive comments such as "it is necessary to remain in constant communication, which is good" were made. Also, there was a comment which should be reviewed such as "careful consideration will be required to pair up as men and women are learning together".

In light of two previous periods, in the next practice period for students, the teachers of health and physical education in Y Junior High School gave a unit of Athletics for sprint including theory of physical education consisting of 9 classes.

THE IMPACT OF NATURALIZED PLAYERS ON THE DEVELOPMENT OF BASKETBALL: A COMPREHENSIVE ANALYSIS

YANG, B.Y., LIU, J.

SOUTHWEST JIAOTONG UNIVERSITY, CHENGDU, SICHUAN PROVINCE, CHINA

The globalization of basketball has introduced a dynamic shift with the inclusion of naturalized players, presenting a multifaceted impact on the sports development. This paper aims to address the key challenges and opportunities associated with the integration of naturalized players in the realm of basketball, emphasizing the significance of comprehending this phenomenon.

The primary challenge tackled in this study is the nuanced adjustment of team dynamics and playing strategies necessitated by the presence of naturalized players. Historically, traditional team structures have been built around local talent, and the incorporation of foreign players demands a delicate balance to optimize team cohesion and performance. Understanding these challenges is vital for coaches, team managers, as it directly influences a teams competitiveness on the international stage.The involvement of naturalized players in a basketball team can have various impacts on the overall team dynamics, depending on factors such as the degree of integration of these players with the existing team, leadership styles, and team culture. Currently, most countries around the world have been utilizing naturalized players, all with impressive results. Previously, Spain introduced Serge Ibaka, forming an impenetrable defense, dominating the paint at the Beijing Olympics. More recently, the Philippines started to shine in the Asian Cup after acquiring Jordan Clarkson. In recent days, the Chinese mens basketball team has also begun exploring the utilization of naturalized player Li Kaier.

Through international basketball events, not only can basketball be popularized globally, but they also provide a platform for players from various countries to showcase their talents and athletic abilities.Naturalized players play multiple roles in international basketball events. Firstly, they bring more international elements to the team, showcasing the multicultural characteristics of basketball as a global sport. Secondly, naturalized players often possess rich experience and high-level skills, adding strength and depth to the team. Such players can play a decisive role in critical moments, enhancing the teams competitiveness on the international stage.In promoting basketball globalization, naturalized players serve as bridges. They not only demonstrate their strength on the court but also serve as a medium for cultural exchange between different countries and regions. Through this, basketball events become not only sports competitions but also platforms for

promoting international understanding and friendship. The participation of naturalized players enables fans to more widely identify with the team, allowing basketball to transcend into more cultural and social dimensions.

In conclusion, the paper explores the impact of naturalized players on basketball development. It addresses challenges, stresses the importance of understanding this phenomenon, and offers actionable solutions.

EXAMINING THE CHARACTERISTICS OF JAPANESE ONLINE SPORTS NEWS

OHHASHI, M.
KURUME UNIVERSITY

Background: The aim of this study was to delineate the characteristics of sports content disseminated through Yahoo! News Japan. Previous research in media sports studies has primarily focused on mass media content, thus overlooking the interaction between producers and audience user experiences. With the advancement of user engagement functionalities, notably the ability for users to comment on news articles on websites, this study aims to elucidate the interaction between traditional media content and citizens' media comments, especially within the sports domain, within the realm of online media.

Methods: This study drew upon quantitative analysis of articles within the sports category on Yahoo! News. Given the prominence of Yahoo! News as the largest online news platform in Japan, all online coverage spanning from January 1st to December 31st, 2023, was scrutinized.

Results: The dataset encompassed various parameters including publication date, title, article content, authorship, comment count, and additional relevant information. A total of 4061 articles were collected, averaging 566 comments per article. Approximately half of the articles pertained to baseball, with an equivalent proportion sourced from sports newspapers. Content derived from sports newspapers primarily fell into categories such as "match results" and "player and team gossip." Conversely, while content from daily newspapers exhibited minimal divergence from that of sports newspapers, instances arose where issues such as "corporal punishment" and "covert photography" within the sports realm were addressed, serving as platforms for issue advocacy. The average number of reader comments on such articles, which transcended mere match results or player-related topics, stood at 627, a figure surpassing the average of 570 comments observed for articles typically found in sports newspapers.

Conclusions: One defining feature of sports news in Japanese online media is the prominence of articles related to baseball, centering predominantly on subjects such as "Japanese professional baseball," "high school baseball," and "MLB." Moreover, around half of the disseminating agencies are sports newspapers. This prevalent focus on baseball may signify a profound cultural attachment among the Japanese population. Furthermore, it is believed that the staging of the World Baseball Classic (WBC) in 2023 and Japans victory in the tournament have influenced this trend. The publication of such targeted articles is perceived to augment viewership, evident in the high readership and comment rates. Consequently, media outlets exhibit a proclivity towards disseminating content conducive to comments and easily comprehensible, potentially shaping the dynamic interplay among content, viewership, and comments. While the bias in reported content within Japanese online media sports news is discernible, a nuanced analysis warrants comparison with articles from years beyond 2023.

Sport Management and law

Sport Technology

ANALYSIS OF THE EFFICACY OF FUTUR K6AM BUTTSTOCK IN TERMS OF RECOIL REDUCTION AND PERFORMANCE IMPROVEMENT

MONZONI, R., VITA, A., SIDERI, M.
UNIVERSITY OF URBINO CARLO BO

INTRODUCTION: In the sport of clay pigeon shooting, shooters are required to fire numerous shotgun rounds both in training and competition, which may lead to chest discomfort and a potential decline in sports performance. To address this issue, through the use of thermography and sports performance analysis, we examined the effectiveness of the Futur K6AM buttstock, comparing it with traditional wooden stocks commonly used in clay pigeon shooting.

METHODS: A simulated TRAP competition was conducted using an over-and-under shotgun (Sporting model, Franchi). Six male and female subjects were recruited (age 28.4±3.2 years; BMI 21.7±1.8 kg/m2) with a minimum of 4 years of shooting experience. Each shooter fired with the same shotgun and cartridges in the first and second trials, with the only modification being the buttstock. Shooting sessions were separated by 60 days of rest. As injuries are related to variations in blood flow reflected on the skin [1], infrared thermographic technique was used to analyze the upper trunk, comparing temperature changes before and after four shooting series (100 clay pigeons, 25 pigeons/series). Performance was assessed as the percentage of hits on the clay pigeon, using the ISSF Trap scheme 1. One-way ANOVA was used to compare temperature variations within the region of interest (the area of interface between the shotgun and the shooter was previously identified in the infrared images).

RESULTS: The use of the Futur K6AM buttstock resulted in a significantly lower temperature increase (0.63±0.26°C, p<0.01) compared to the standard buttstock (1.17±0.6°C). Performance showed a statistically significant result (p<0.04) during the fourth shooting series, where shooters achieved a higher score (23±1.1) using the Futur K6AM buttstock, compared to the standard buttstock (21.5±1.05).

CONCLUSION: The Futur K6AM buttstock reduces the temperature increase in the anatomical area in contact with the buttplate and improves performance, especially in the latter part of the competition.

Bibliography:

[1] Hildebrandt C., Raschner C., Ammer K. (2010). An Overview of Recent Application of Medical Infrared Thermography in Sports Medicine in Austria. Sensors; 10(5):4700-4715

PERCEPTION DISPARITIES AMONG BASKETBALL REFEREES: ANALYZING REFEREE UTTERANCES REVIEWING GAMES RECORDED WITH FIXED VIDEO CAMERAS VS. 360-DEGREE OMNIDIRECTIONAL CAMERAS

YASUYUKI, N.

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

INTRODUCTION: The study aims to explore the disparities and characteristics in how referees perceive a basketball game. This has been achieved by analyzing utterances of referees who watched videos captured with fixed video cameras and those recorded with 360-degree omnidirectional cameras.

METHODS: The study involved two certified referees from the Japan Basketball Association. A college basketball practice game was recorded using a fixed video camera (equipped with a wide-angle lens covering all players) and a 360-degree omnidirectional camera. These cameras were positioned at three locations: on the bench side (Point A), on the side opposite the bench (Point B), and under the goal (Point C). The two referees observed videos captured by the fixed video cameras (referred to as "fixed videos") and the videos recorded with the 360-degree omnidirectional cameras ("VR videos") while making utterances. Referee A initially watched the fixed videos in the sequence of Point A, Point B, and Point C, while Referee B began with the VR videos, following the order of Point C, Point B, and Point A. The referees had the freedom to express their thoughts while reviewing the recorded game videos.

RESULTS: The utterances were categorized into six groups: "situation description," "prediction," "retrospect," "foul judgment," "question," and "delegation (delegating to another referee's judgment)." The total number of utterances was greater when reviewing fixed videos compared to VR videos. By category, the number of utterances in the "situation description" category was higher when watching fixed videos than when viewing VR videos. This is likely due to fixed videos being observed more objectively from a bystander's perspective compared to VR videos. The number of utterances in the "question" category was also higher while watching fixed videos compared to VR videos. This is probably because viewers cannot control the focus at their own discretion during fixed video viewing, unlike VR video viewing, resulting in more obscured elements. In contrast, the number of utterances in the "foul judgment" category was higher when viewing VR videos than when watching fixed videos. This is likely because the VR videos more accurately represented the actual game. By location, the number of utterances in the "situation description" and "prediction" categories was higher at Points A and B than at Point C. This is likely because viewers can observe all the players from Points A and B, enabling them to perceive the game more objectively as bystanders. In the "foul judgment" category, more utterances were made at Point C than at Points A and B during the viewing of VR videos. Given that many violations occur under the goal (Point C) in actual games, it is probable that this area can be observed in VR videos in a situation similar to that in real games.

CONCLUSION: The following two conclusions were drawn from the results and discussion:

- While watching fixed videos, viewers tend to perceive events objectively, adopting the perspective of bystanders rather than that of referees.

- While watching VR videos, viewers tend to make decisions as referees in situations resembling those in actual games.

OPTIMAL PLACEMENT OF WEARABLE SENSORS FOR TRAINING LOADS IN BADMINTON SINGLES AND DOUBLES

LIN, Y.C.1, CHEN, W.H.2, LIU, T.H.3, CHANG, S.S.4, SHIANG, T.Y.5

1 TUNGHAI UNIVERSITY, 2 NATIONAL DONG HWA UNIVERSITY, 3 VICTOR RACKETS IND. CORP, 4 NATIONAL TAIWAN OCEAN UNIVERSITY, 5 NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: To assess athletes' external training load, accelerometers are often attached to their trunks (upper back) to calculate player load (1). According to previous studies, it is necessary to separately evaluate the load of the racket hand and the body to accurately reflect the real load status of the player (2). The purpose of this study was to identify the optimal location (racket hand and lower back) for wearable sensors to enhance the correlation between external loads (player load [PL]) and internal loads (training impulse [TRIMP] and session rating of perceived exertion [sRPE]) during singles and doubles badminton games.

METHODS: Fifteen collegiate male badminton team players (age: 21.2 ± 1.6 years, training experience: 7.5 ± 3.7 years) participated in the study. Each player was equipped with inertial sensors (Capture.U) on the wrist of the racket hand and the lower back, a Polar H10 heart rate sensor on the chest, and a Goalgo T1 local positioning system sensor on the shoulder (3). Each player participated in simulated badminton singles and doubles games, which followed a 21-point rally scoring rule, to collect data on the players' training load during the games. The Pearson product-moment correlation was

used to analyze the correlation (r) between external load (PL) and internal load (TRIMP, sRPE) during simulated badminton games. All statistical analyses were conducted with a significance level set at $\alpha = 0.05$.

RESULTS: The results indicate that during singles simulated games, TRIMP showed a significant large correlation with PLRH (racket hand) ($r = 0.53$, $p < 0.05$) and a significant large correlation with PLLB (lower back) ($r = 0.52$, $p < 0.05$). sRPE showed a significant large correlation with PLRH ($r = 0.67$, $p < 0.01$) and a significant very large correlation with PLLB ($r = 0.72$, $p < 0.01$). In doubles simulated games, TRIMP showed significant large correlations with PLRH ($r = 0.58$, $p < 0.05$) and PLLB ($r = 0.63$, $p < 0.05$). sRPE had a significant large correlation with PLRH ($r = 0.58$, $p < 0.05$).

CONCLUSION: The lower back proved to be the optimal location for placing an inertial sensor to monitor the external training load in badminton. This study demonstrates that the lower back is an appropriate location for a single accelerometer.

REFERENCE:

1) James et al., Journal of Sport Science and Medicine, 2021

2) Liu et al., Sports Biomechanics, 2021

3) Fuchs et al., Sports Biomechanics, 2023

ASSOCIATION BETWEEN BODY COMPOSITION AND EXTERNAL LOAD DATA VARIABLES IN MALE PROFESSIONAL FOOTBALL MATCHES – A CASE STUDY

SPENCER, M., MOEN, H.P., BYRKJEDAL, P.T.

UNIVERSITY OF AGDER

INTRODUCTION: Traditionally, studies investigating body composition (via Dual-energy X-ray Absorptiometry; DXA) in professional football have not assessed changes related to external load markers in training or matches, via global navigation satellite systems (GNSS) integrated with inertial measurement unit (1). Recently, GNSS derived training load data has been associated with changes in body composition in the various phases of the football season (2). However, currently there is limited research examining the relationships between GNSS derived data in actual matches and measures of body composition. Therefore, the aim of this study was to investigate the association between body composition and external match load data variables in male professional footballers.

METHODS: Thirteen professional male football players (24.7 ± 3.2 yrs, 184.2 ± 4.8 cm, 78.1 ± 4.3 kg) from one Norwegian club participated in this study. Body composition was measured with two DXA scans separated by 5 weeks and 7 official matches were played during this period. To be included in the analysis, participants needed to complete both DXA scans and play ≥ 3 matches with ≥ 60 minutes. DXA scan variables included: whole body and leg measures of total tissue mass, lean mass, fat free mass and fat mass %. The mean of the two scans was used in the analysis. External match load variables were presented relative to playing time (minutes per match) and included: total distance, peak speed, high (19.8-25.2 km/h) and sprint (>25.2 km/h) intensity running distance, PlayerLoad*TM*, and high intensity events (>2.5 m/s) consisting of accelerations, decelerations and change of directions. A nonparametric Bayesian correlation analysis was performed to investigate the relationships between DXA variables and external load match performance variables. The Kendall tau correlations in combination with Bayes Factors (BF) were calculated for each comparison (3).

RESULTS: The mean (± SD) number of matches and playing time were 6.4 ± 2.0 and 86.6 ± 8.0 minutes respectively. Meaningful associations were only evident in leg variables and a measure of accumulative acceleration load. Specifically, there was moderate evidence (BF >3 to <10) for the association between legs lean mass and PlayerLoad*TM*/min ($\tau = -0.56$), in addition to the association between legs total mass and PlayerLoad*TM*/min ($\tau = -0.56$). The remaining BF comparisons between the selected body composition and external load match performance variables were deemed anecdotal.

CONCLUSION: Our findings suggest that there are limited associations between selected body composition and external load match performance variables in a condensed, in-season period in one team of professional footballers. Further research, with larger data sets, is required to understand the potential relationships between body composition and external load match performance in male professional footballers.

1. Milanese et al. J Sports Sci, 2015

2. Varley et al. Bone Reports, 2023

3. van Doorn et al Am Stat, 2018

CONVERSION OF INERTIAL MEASUREMENT UNIT DATA TO JOINT ANGLES OF LOWER LIMBS DURING UNLOADING AND LOADING JUMPING TASKS USING ARTIFICIAL NEURAL NETWORKS

LIN, Y.C., HSU, W.1, TANG, L.1, LIN, Y.2

NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: During the training of athletes, explosive power training is essential. This ability is often being trained or evaluated by countermovement jump(CMJ), jump shrug(JS), and hang power clean(HPC) [1]. In previous research, joint angles have been found related to energy absolution and the performance of weightlifting[2]. However, due to the cost of the analysis of biomedical indexes, underfunded athletes find it hard to obtain trustful results to benefit from.[3] Also, the embedded system and its algorithms developed in this study only aimed to detect good or incorrect squats. Converts

inertial measurement unit(IMU) data to joint angles of lower limbs by using artificial neural networks(ANN) is required to reduce analysis costs and provide a trustable result [4]. We aim to use ANNs to provide a trustable low-cost analysis solution for joint angle feedback on the CMJ, JS, and HPC.

METHODS: A total of 37 subjects have performed the CMJ, JS, and HPC, and the weight of the barbell is set at 60%, 75%, and 90% of their one-repetition HPC maximum. The data collection was completed within a motion laboratory, using a passive motion capture system(Qualisys AB, Göteborg, Sweden) and wireless physiological feedback systems(Delsys Trigno®, Boston, MA, USA). For ANN training, using a supervised algorithm with ground truth provided by the motion capture system, and prediction input from IMUs within physiological feedback systems, for validation using leave-one-subject-out cross-validation.

RESULTS: During the training of the ANN model. The mean absolute error(MAE) and normalized root-mean-square error(NRMSE) have been monitored, indicating that the MAE and NRMSE maximum average didn't exceed 6.6099(degree) and 15.2819%. Also, it shows a good correlation with ground-truth data that the minimum average wasn't lower than 0.8626 for all the tasks.

CONCLUSION: This study shows that our models achieve lower NRMSEs compared to recent literature findings. Future research should explore if our models generalize well to new, independent data, and show the potential of using ANNs for complex movements such as weightlifting training in athletes.

REFERENCES:

1. Ebben, W.P. and D.O. Blackard, Complex training with combined explosive weight training and plyometric exercises. Olympic coach, 1997. 7(4): p. 11-12.

2. Kipp, K., et al., Weightlifting Performance Is Related to Kinematic and Kinetic Patterns of the Hip and Knee Joints. Journal of strength and conditioning research / National Strength & Conditioning Association, 2011. 26: p. 1838-44.

3. Fonseca, S.T., et al., Considerations for working with professional athletes versus nonprofessional amateur athletes during Olympic events. Handbook of Sports Medicine and Science: Sports Therapy Services: Organization and Operations, 2012: p. 79-90.

4. Rapp, E., et al., Estimation of kinematics from inertial measurement units using a combined deep learning and optimization framework. Journal of Biomechanics, 2021. 116: p. 110229.

Acknowledgments

Funding: Thanks to the support from NSTC-111-2410-H-011-006-MY3, CTU-TAIWAN TECH-2022-06, and CTU-NTUST-2024-0

A STUDY ON EXERCISE LOAD OF AR SPORTS DURING PHYSICAL EDUCATION CLASSES FOR UNIVERSITY STUDENTS

ISHIZAKI, S., MANABE, Y., NAKAMURA, Y., YAGETA, S., SAEKI, Y., MATSUBARA, T., YAMASHIGE, J., KANEI A., ABE, T., IJIRI T., FUKANO, M., HAMANO, M.

SHIBAURA INSTITUTE OF TECHNOLOGY

INTRODUCTION: In recent years, diversification has led to a marked increase in the population playing e-sports as well as real sports. In particular, with the advancement of technology, augmented reality (AR) sports are also being implemented. However, the introduction of AR sports in school physical education has not yet been sufficient, and it is not yet clear what kind of exercise load is involved.

Therefore, the purpose of this study was to determine the exercise load of AR sports during physical education classes for college students and to compare it with other sports.

METHODS: Twenty-four healthy college students (age; 20.5±0.9years) volunteered to participate in this study. Subjects participated in practical physical education once a week (100 min./times). Subjects were divided into two groups: an AR sports group and a normal exercise group. The AR sport used was HADO (mealeap inc.), the worlds first competitive AR sport. HADO was played with arm sensors on the arms and a head-mounted display (HMD) on the head. In a HADO match, players can shoot "energy balls" and block the other team's attack with a "shield". At the end of the match, the team with the higher scores wins. HADO was prescribed as a single 80-second game and was played 3 vs. 3. On the other hand, as regular sports, the subjects played basketball, futsal, and badminton. In both classes, the first 15 minutes were performed stretching. In the class, subjects participants wore a heart rate (H10, polar) sensor and recorded their heart rate.

RESULTS: The average heart rate during HADO (AR sport) was 131.7+/-4.3 bpm, while the average HR for regular sports was 147.3+/-9.6 bpm, significantly lower for HADO ($p<0.05$). On the other hand, no significant difference was observed between HADO (197.2+/-3.0 bpm) and regular sports (192.8+/-9.0 bpm) in terms of HR max. Calorie consumption was significantly higher for regular sports (553.3+/-69.1 Kcal) compared to HADO (375.5+/-52.3 Kcal) ($p<0.05$). Because of the short duration of its game method (80 seconds), HADO was found to have an impact on average heart rate and calorie consumption compared to other regular sports due to the longer waiting time.

CONCLUSION: It was suggested that HADO (AR sports) as a PE class is less demanding than regular sports because it requires less physical activity.

Sports Medicine and Orthopedics

NEUROPROTECTIVE EFFECTS OF VOLUNTARY EXERCISE AND YISAIPU AFTER TRAUMATIC BRAIN INJURY IN MICE

OUYANG, W., GAN, T.T., LIAO, Q., WANG, J.H., FAN, Z.H., CAO, J., PAN, H.J., LOU, G.F., DONG, X.F.
ZHEJIANG NORMAL UNIVERSITY

INTRODUCTION: While studies have shown exercise to improve cognitive performance and provide neuroprotection in animal models of traumatic brain injury (TBI), understanding the effects of exercise on autophagy, astrogliosis, and inflammation in TBI remains limited. Additionally, the effectiveness of TNF inhibitors like etanercept in treating TBI patients is unclear. This study aimed to evaluate the effects of preconditioning exercise (PE) and/or post-TBI TNF inhibitor Yisaipu on neurological and motor function, including locomotion coordination, balancing and gait deficits in a TBI mouse model.

METHODS: Seventy-six male C57BL/6J mice were divided into six groups: Sham, TBI+Saline, TBI+Yisaipu, Sham+Exercise, TBI+Exercise, and TBI+Exercise+Yisaipu. Exercise group mice performed a voluntary exercise regimen for 6 weeks, and TBI was induced with 2.5–2.8 atm percussion force on the right motorsensory cortex. Yisaipu was administered intraperitoneally immediately following the injury and 24 hours post-injury. Various behavioral, molecular, and biochemical approaches were used to evaluate neurological function, motor coordination, gait, cytokine levels, autophagy, astrogliosis, and neuronal injuries.

RESULTS: At 2 h post-TBI, the neurological severity score (NSS) in TBI+Exe mice was significantly lower ($p<0.01$) than in TBI+Sal mice, and it consistently remained lower than that in TBI+Sal mice at 1- and 2-days post-injury. Compared to TBI+Yis mice, TBI+Exe and TBI+Exe+Yis mice showed increased fall latency on the rotarod. The improved beam and grid walk performance was more evident in TBI+Exe+Yis mice than in TBI+Exe or TBI+Yis mice. The maximum speed of foot, ankle, and knee joint movement in TBI+Exe+Yis mice was significantly larger than in TBI+Yis and TBI+Exe mice and notably larger than in TBI+Sal mice (foot: $p<0.01$, ankle: $p<0.01$, knee: $p<0.05$). Both PE and Yisaipu treatments reduced post-TBI TNF-α levels, and the beneficial effect of the combination of the two treatments was more evident than with Yisaipu alone. The serum levels of IL-4 in TBI+Yis and TBI+Exe mice increased compared with sham and sham+Exe mice, respectively, and were significantly elevated in TBI+Exe+Yis mice ($p<0.05$) compared with sham+Exe mice. The combination of PE and Yisaipu treatment remarkably improved autophagic flux evidenced by reduced LC3-II levels, reduced astrogliosis evidenced by reduced LC3-II and GFAP levels, and mitigated injured cortical volume [(18.4 ± 7.1) mm3] compared to either TBI+Sal mice [(59.9 ± 13.8) mm3, $p<0.001$)] or TBI+Exe mice [(50.3 ± 11.8) mm3, $p<0.01$].

CONCLUSION: The combination of PE and post-TBI Yisaipu treatments was more effective than single treatments in reducing sensorimotor and gait deficits in mice. These functional improvements were associated with reduced systemic inflammation, mainly via serum TNF-α, improved autophagic flux, and mitigated lesions after TBI.

PREVALENCE OF JAPANESE TOP-LEVEL COLLEGIATE ATHLETES RECEIVING IRON INJECTIONS AND ITS RELATED FACTORS

TSUKAHARA, Y., TORII, S., KAMADA, H., YAMASAWA, F.
TOKYO WOMENS COLLEGE OF PHYSICAL EDUCATION

INTRODUCTION: In 2017, Japan Association of Athletics Federations published a guideline to ban unnecessary iron injection, which has been suspected to be an ongoing practice for a long time, particularly in Japanese long distance (LD) runners, because many coaches consider it a performance-enhancing aid. Athletes with intense training regimes, including LD runners, are at risk of developing anemia, defined as blood hemoglobin levels below 14 g/dL and 12 g/dL in men and women, respectively, which requires treatment. However, needless to say, receiving iron injections without being diagnosed with iron deficiency anemia is not appropriate from both health and ethics standpoints.

METHODS: An anonymous survey was conducted on male and female athletes competing at the national level. Athletes answered questions related to their personal background and whether they had previously received iron injections. Chi-squared test was performed to assess the differences between athletes who had received iron injections and those who had not. Logistic regression analysis was performed to investigate the factors associated with receiving iron injections.

RESULTS: In total, 15.4% and 10.7% of the female and male athletes, respectively, answered that they had received iron injections in the past. Further, 38.0 % and 25.6 % of the female and male athletes, respectively, had a history of anemia. The body mass index was lower in both female and male athletes who had received iron injections than in those who had not. Logistic regression analysis revealed that having been diagnosed with anemia and getting blood tests at least once a year were factors related to receiving iron injections in male athletes, whereas taking nutritional supplements was the only related factor in female athletes.

CONCLUSION: Athletes and coaches should be aware of iron deficiency and anemia treatments and acknowledge that receiving iron injections without a blood test is inappropriate and could expose athletes to risks. Sports medicine physicians and sports organizations should raise awareness related to these problems to protect the athletes. A total of 15.4% and 10.7% of female and male Japanese track and field athletes, respectively, competing at a national level, stated that they had received iron injections. Since some received the injection without any blood tests, athletes and coaches should be aware of the risks of receiving iron injections without proper diagnosis.

LONG-TERM CARDIOVASCULAR OUTCOMES AMONG COVID-19 SURVIVORS AFTER EXERCISE-BASED CARDIAC REHABILITATION: A NATIONWIDE COHORT STUDY

LU, J.W., CHEN, T., LIANG, C.
HUALIEN TZU CHI HOSPITAL

INTRODUCTION: Coronavirus disease 2019 (COVID-19) is associated with poor cardiac outcomes and increased risks of long-term cardiovascular diseases. Previous small case series have shown that exercise-based rehabilitation could benefit COVID-19 patients by decreasing symptoms such as dyspnea or fatigue. Nevertheless, the long-term cardiovascular outcomes among COVID-19 patients after exercise-based cardiac rehabilitation were largely unknown. Therefore, we aimed to investigate the long-term cardiovascular outcomes among COVID-19 survivors after exercise-based cardiac rehabilitation using real-world data.

METHODS: In this retrospective nationwide study, we analyzed data from the US Collaborative Network of the TriNetX Research Database. Adults aged ≥ 18 years diagnosed with COVID-19 between 2020 and 2022 were enrolled for inclusion. We excluded patients who died within 30 days after COVID-19 diagnosis to ensure that all enrollees were COVID-19 survivors. The comparison comprised a cohort of patients receiving exercise-based cardiac rehabilitation and a cohort of 1:1 propensity score-matched control patients. Multiple covariates, such as age, sex, race, ethnicity, comorbidities, and baseline medication use, were incorporated to calculate the propensity score. We excluded participants with a history of outcomes of interest. A Cox regression model with considering inverse probability weighting was used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for the outcomes. Stratified analyses according to age, sex, race, and ethnicity were also performed.

RESULTS: Overall, a total of 17,340 participants were included. During the follow-up, COVID-19 survivors that received exercise-based cardiac rehabilitation had a lower risk of myocardial infarction (HR = 0.75, 95% CI = 0.61-0.89), stroke (HR = 0.81, 95% CI = 0.68-0.94), myocarditis (HR = 0.81, 95% CI = 0.70-0.94), heart failure (HR = 0.73, 95% CI = 0.65-0.83), pulmonary embolism (aHR = 0.78, 95% CI = 0.63-0.92), and mortality (aHR = 0.75, 95% CI = 0.63-0.89) compared to those without rehabilitation. The decreased risks remained significant among men, white people, and those aged more than 65 years.

CONCLUSION: In conclusion, COVID-19 survivors receiving exercise-based cardiac rehabilitation are associated with decreased risks of incident myocardial infarction, stroke, myocarditis, heart failure, pulmonary embolism, and mortality. Exercise-based rehabilitation may be considered among patients with patients after COVID-19 infection.

ISOKINETIC EVALUATION OF PROFESSIONAL SOCCER PLAYERS FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION (ACLR).

PARPA, K., PALUDO, C.A., MICHAELIDES, M.
UCLAN UNIVERSITY OF CYPRUS

INTRODUCTION: The management of ACL ruptures involves surgical intervention and the implementation of comprehensive rehabilitation programs. Nevertheless, athletes reintegrating into regular activities post-ACLR confront a greater risk of recurrent ACL injury, especially if they fail to satisfy established return-to-play criteria. These criteria include assessments of knee stability, isokinetic strength, the duration since ACL surgery, hop performance, and self-reported questionnaires. This study aimed to evaluate isokinetic peak torque, hamstring to quadriceps torque rations and bilateral strength (torque) differences in professional soccer players who underwent ACLR compared to healthy soccer players as a control group.

METHODS: A total of 150 professional soccer players (75 ACLR and 75 aged-matched controls, age 26.25±4.96 and 25.12±5.00 yrs., height 177.77±21.69 and 179.76±5.58cm, body weight 76.89±8.71 and 77.95±6.43 kg, respectively) participated in the study. The time after surgery was 185.31±9.44 days, with 44 players undergoing the procedure on the left leg and 31 players on the right leg.

RESULTS: Statistical analysis indicated significant differences ($p<0.01$) in the quadriceps torque of the ACLR leg compared to the control group (203.51±35.81 vs 244.85±26.02 m/s) along with the ACL leg and the non-ACL leg of the experimental group (203.51±35.81 vs 249.29±35.64 m/s) at an angular velocity of 60 degrees/sec. Similarly, significant differences were demonstrated in the hamstring torque between the ACLR leg and control (171.07±27.30 vs 183.88±25.30 m/s) as well as the hamstring to quadriceps ratio of the ACLR leg and control (85.12±11.52 vs 75.48±10.28) at an angular velocity of 60 degrees/sec. No significant differences were identified in the quadriceps torque of the non-ACL leg and control. Also, significant bilateral differences ($p<0.01$) were indicated in the quadriceps torque production between the experimental and control groups (Q-Q difference 18.64±5.94 vs 5.45±3.54 for the experimental and control groups, respectively). The aforementioned significant differences persisted even when the players were tested at an angular velocity of 300 degrees/sec.

CONCLUSION: Our results demonstrated noteworthy differences among the soccer players (ACLR-leg vs control) in all isokinetic strength parameters, except for the non-ACL leg (quadriceps). Based on our results, clinicians and rehabilitation experts should take into account the isokinetic parameters when assessing the players' readiness for a return to sports following ACLR.

INJURIES IN STREET DANCERS – A DESCRIPTIVE EPIDEMIOLOGICAL STUDY

MUKHERJEE, S., YEE, C.T.E.

NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY, SINGAPORE

INTRODUCTION: Street dance (hip-hop dance) has rapidly grown in popularity and practiced by millions worldwide. Street dance can be performed in varied environments and can be combined with other dance styles. Owing to repetitive movements in asymmetrical positions, street dancers are at a high risk of musculoskeletal overload and injuries. However, there is a dearth of research on injuries in this population.

METHODS: A retrospective, cross-sectional design was adopted. An online questionnaire was distributed via social media platforms, mobile platforms, posters, and word-of-mouth. The questionnaire included questions on anthropometric, demographic, training, and injury characteristics of subjects. Eligible participants reported all injuries related to dance training and competition for the past twelve months. Clear definitions of the nature and type of injuries, anatomical locations and prompts regarding medical attention and time loss were provided in the questionnaire.

RESULTS: Injury prevalence rate was determined as the number of injuries per 1000 training hours. 199 eligible participants (male 80; female 119) responded to the questionnaire. 119 (59.9%) reported sustaining injury(s) in the past 12-month period. However, only 91 dancers that reported 100 injuries provided further details on the injury. Total yearly training time was 73,424 hours and the prevalence rate was 1.62 injuries/1000 training hours. Females had higher injury prevalence rate than males (1.75 vs 1.44). Dancers with 4-5 years of experience had higher injury rates compared to new dancers. Dancers with highest weekly training load (>12 hours) had the highest injury rates (82.1%). Most injured body parts were the knee (27.5%), ankle (18.7%), and lower back (14.3%). The more common types of injury sustained were muscle-tendon strains (33.0%) and ligament sprains (23.1%). 52.7% injuries were acute in onset, while 46.9% injuries were overuse in nature. 82.8% of injuries occurred during training, of which the majority of injuries (39.6%) were caused by bending and twisting movements. 58.2% dancers continued to train despite being injured. 48 dancers (52.7%) sought medical attention and 15 (16.5%) dancers missed events like auditions, performances, dance jobs and competitions due to injury.

CONCLUSION: Street dancers are at a high risk of injury with prevalence rates similar to that reported in competitive sports like soccer, basketball and field hockey. Females tend to be a greater risk of injuries. Most injuries were acute in nature with knee, ankle and lower back at a higher risk. Training load had a direct relationship with the risk of injuries. A substantial proportion of injuries requiring medical attention suggests a high severity potential of injuries sustained in street dancing. Findings of this study can inform the street dancers on injury risks, common injuries and the possible strategies to prevent injuries in street dancing.

UNREPORTED INJURIES AND ON HOW FACTORS INFLUENCE JAPANESE HIGH SCHOOL BASEBALL PLAYERS. - HOW TO DEAL WITH INJURIES, METHODS OF MITIGATION AND HELP-SEEKING BEHAVIOR-

MITSUI, K., IWAMOTO, S.

GRADUATE SCHOOL OF TOYO UNIVERSITY

INTRODUCTION: Baseball in Japan is one of the worlds top-class sports, and the national high school baseball tournament is very popular. On the other hand, it is known that there are many non-time-loss injuries high school baseball players [1], and many players continue to play without consulting others even though they are aware of their injuries [2]. The prevalence and severity of these injuries are underestimated since they continue to practice in this manner [3]. This study will clarify the reality of unreported pain and injury, and on how factors influence Japanese high school baseball players.

METHODS: A web-based questionnaire was administered to players (619 players) who have been members of the baseball clubs of member schools of the Prefectural High School Baseball Federation for at least one year. The 579 players who had experienced an injury were surveyed about their experience of concealing the injury. Players classified into two groups: a group of players who answered "never" or "rarely" (rare group) and "often" or "always" (frequent group). The following factors were investigated: knowledge of how to deal with injuries, methods of mitigation, persons familiar with mitigation methods, and assist in mitigating injuries.

RESULTS: With each increase in the knowledge scale, the higher the risk of concealing injuries (odds ratio (OR) = 1.41, 95% confidence Intervals (CI) : 1.07-1.86, p=0.015). Furthermore, methods of mitigation "massage" (OR = 2.24, 95% CI: 1.42-3.51, p<0.001), persons familiar with mitigation methods "doctor" (OR = 1.62, 95% CI: 1.02-2.57, p=0. 039), "therapist" (OR = 1.55, 95% CI: 1.00-2.40, p=0.049) and assist in mitigating injuries "therapist" (OR = 1.92, 95% CI: 1.21-3.03, p=0.005) had a significantly higher risk of concealing injuries. On the other hand, methods of mitigation "dietary content and quantity" (OR = 0.51, 95% CI: 0.28-0.93, p=0.027), persons familiar with mitigation methods "coach" (OR = 0.52, 95% CI: 0.33-0.80, p=0.004) and assist in mitigating injuries "coach" (OR = 0.55, 95% CI: 0.34-0.92, p=0.021) had a significantly lower risk of concealing injuries.

CONCLUSION: Players who did not report injuries among high school baseball players were seeing their doctor and receiving massages from therapist. The results of this study suggest that an educational program increase 'coaches understanding, and knowledge of injuries might be effective in reducing the number of players who do not report injuries.

REFERENCES:

1. Z. Y. Kerr, et al., Descriptive Epidemiology of Non-Time-Loss Injuries in Collegiate and High School Student-Athletes. J Athl Train, 2017. 52(5): p.446–456.

2. E. C. Makhni et al., Arm pain in youth baseball players: a survey of healthy players. Am J Sports Med, 2015. 43(1): p.41–46.

3. R. Bahr, No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. Br J Sports Med,2009. 43(13): p.966–972.

NITRIC OXIDE CONCENTRATION IN SKIN GAS AS A MARKER OF EXERCISE-INDUCED SKELETAL MUSCLE DAMAGE

IDE, D.1, YAMADA, K.1, MATSUDAIRA, H.1, MIYAZAKI, M.2, ITOH, H.1

NAGOYA INSTITUTION OF TECHNOLOGY

INTRODUCTION: Muscle damage-induced reduction in force generation is accompanied by increased nitric oxide (NO) content in human skeletal muscle (Radák et al. 1999). We (Ohkuwa et al. 2006) previously have been detected NO emanating from human skin (skin-gas), however, there is very little data concerning with skin-gas NO concentration on the surface of damaged muscle in human. Therefore, we examined whether skin-gas NO would be as a marker of damaging muscle inflammation or not.

METHODS: Seven healthy male students (22.1 ± 0.3 years; mean ± SD) volunteered as the subjects. None of them had performed muscle- damaging exercise at least six months prior to the experiment. The subjects performed 8 sets of 15 repetition-maximum (RM) knee flexion-extension exercise (left leg only) consisting of predominantly isokinetic eccentric contractions. The skin-gas samples were obtained from the surface of the belly muscle of the rectus femoris before exercise and 1, 2, 3, 7 days after exercise. The skin-gas NO concentration was measured by a chemiluminescence analyzer (Pico-Device Co., Ltd., Nagoya, Japan). Knee extension muscle strength (1RM), circumference of the thigh, muscle soreness (visual analog scale; VAS) of exercised left leg, and serum nitrites, creatine kinase activity were also measured.

RESULTS: The skin-gas NO concentration significantly increased 2 days after the exercise compared to pre-exercise values ($p<0.01$) and returned to pre-exercise levels 7 days after exercise. The peak skin-gas NO concentration (16.1 ± 0.6 ppb) of each subject was about 1.4 times more than pre-exercise value (11.8 ± 0.9 ppb). Although no significant difference was found in the circumference of the exercised thigh during experimental period, muscle strength significantly ($p<0.05$) decreased, and VAS significantly ($p<0.05$) increased compared to the pre-exercise values 1-3 days after exercise. Serum CK activity increased significantly at 3 days after exercise compared to pre-exercise values ($p<0.05$) and returned to pre-exercise levels 7 days after exercise. Serum nitrate concentration also significantly ($p<0.01$) increased 2 days after the exercise compared to pre-exercise values.

CONCLUSION: Eccentric exercise induces mechanical muscle damages and pathological changes such as fiber necrosis and inflammatory cell infiltration that become apparent a few days later (Maruhashi et al. 2007). It is known that delayed reactive oxygen species (ROS) production to inflammatory reactions induced in damaged muscle (Close et al. 2004). Therefore, increased skin-gas NO concentrations in this study may be due to activation of induced NO synthase in the damaged muscle cells or in activated macrophages.Exercise-induced muscle damage increases skin-gas NO concentrations, and skin-gas NO concentrations on the surface of damaged muscle may be a useful index for determining decreasing muscle strength and muscleinflammation

THE EFFECTS OF A NOVEL NEUROMUSCULAR TRAINING PROGRAMME ON RECREATIONAL FEMALE HOCKEY PLAYERS DURING A SAGITTAL PLANE HOP, HOP AND TWIST AND UNANTICPATED SIDECUT

JOHNSTON, T., BROWN, S., KALIARNTAS, K.

EDINBURGH NAPIER UNIVERSITY

INTRODUCTION: Females are at greater risk than other populations to sustain a noncontact injury especially the knee, hamstring and ankle (Lin et al., 2018). This may be, in part, associated with muscle activation, landing technique leading to greater ligament strain via higher ground reaction force (Hewett et al., 2010). Multi-component neuromuscular training can significantly reduce noncontact injury (Brunner et al., 2019) by altering muscle activation, significantly reducing injuries and modifying landing technique (Zebis et al., 2016; Steinberg et al., 2017; Khayambashi et al., 2015 respectively). The aim of this study was to assess the effects of a sport-specific neuromuscular training programme (NMTP) on EMG, kinematics and kinetics during a sagittal plane hop, hop and twist and an unanticipated sidecut.

METHODS: This controlled-trial with female recreational hockey players who either performed the NMTP or their usual warm-up (CON = 18, INT = 20). The intervention (INT) performed the NMTP 3x/week before their training sessions or matches for 8 weeks. The control (CON) group performed their normal warm-up at all times. The players were biomechanically tested (3-D motion capture system, force plates and electromyography (EMG)) while performing sagittal plane hop, hop and twist and an unanticipated sidecut each time. The EMG activity was measured Gluteus Maximus (GMax), Gluteus medias (GMed), Semitendinosus (HamMed), Biceps Femoris (HamLat), Vastus Medialis (VM) and Lateralis (VL), Gastrocnemius Lateralis (GasLat) and Medialis (GasMed) at 100ms and 30ms prior to initial contact (IC), 50ms post landing, IC to maximum knee flexion (MKF) and time to peak. Peak vertical ground reaction force (PvGRF), rate of force development (RFD) and trunk, hip, knee and ankle kinematics in all 3 planes was also measured.

RESULTS: EMG: There was a non-statistically significant trend of greater muscle activation in all time points following NMT. There was significantly greater gastrocnemius (medialis and lateralis) muscle activation in both groups at 100ms prior to IC, IC to 50ms and IC to MKF, with a greater increase in the INT group. Further, there was an overall greater reduction in time to peak in INT compared to CON. Kinematics: There were significant decreases ($p = 0.009$) in maximum knee abduction (CON = 9.89 to 9.93°; INT = 10.89 to 8.47°) and knee excursion ($p = 0.011$) for INT (CON = 10.07 to 11.3°; INT = 10.79 to

8.04°). Kinetics: There was significant reduction (p= 0.002) in RFD (CON = 19.53 to 21.75; INT = 18.88 to 12.83 BW/s) after the intervention period for the intervention group.

CONCLUSION: The sports-specific NMTP showed some significant alterations on the kinematics and kinetics following 8 weeks of NMT. There were significantly greater increases in the muscle activation of the Gastrocnemius for INT groups than CON. There were significant reductions in knee abduction and excursion and rate of force development following this NMTP. These adaptations could reduce the risk of injury.

MULTIFACTORIAL BACKGROUND FOR THE ACUTE SPORTS INJURIES IN YOUNG JAPANESE ATHLETES—A SEMI-STRUCTURED INTERVIEW STUDY.

KIMOTSUKI, Y., OGASAWARA, I., IWASAKI, S., NAGAI, K., NISHIDA, K., KANZAKI, N., MATSUSHITA, T., HOSHINO, Y., KURODA, R., UCHIDA, R., TAKE, Y., NAKATA, K.

OSAKA UNIVERSITY GRADUATE SCHOOL OF MEDICINE, FORT LEWIS COLLEGE, KOBE UNIVERSITY GRADUATE SCHOOL OF MEDICINE, KANSAI ROSAI HOSPITAL, DAINI OSAKA POLICE HOSPITAL

INTRODUCTION: To prevent sports injuries, it is necessary to understand the context behind those occurrences.[1] We believe that an effective prevention strategy can be achieved by clarifying how the physical, psychological, social, and situational factors affect injury development. The purpose of this study was to examine the physical, psychological, social, and situational factors that may contribute to sports injuries through athlete interviews.

METHODS: This research was a qualitative study design. The semi-structured interviews were conducted with 10 athletes. Ten consenting participants (3 males and 7 females) aged 16 to 23 years with a history of acute sports injury were interviewed. Athletes were asked about the physical condition, psychological, cognitive, social condition, and competition situation when the injury occurred. We employed the Steps for Coding and Theorization (SCAT) to extract meaningful themes from the interview data of injured athletes. [2]

RESULTS: The types of injuries were anterior cruciate ligament injury, meniscus injury, and shoulder dislocation. SCAT revealed that 14 themes emerged: 1. "The possible discrepancy between perceived physical condition and actual condition", 2. "Ignoring the signs of injury", 3. "Lack of knowledge of injuries", 4. "Narrowing attention", 5. "High-stress conditions", 6. "Highly motivated", 7. "Strong Confidence", 8. "Low skill", 9. "Movement at the time of injury is neither good nor bad or good movement", 10. "Ego involving the environment", 11. "Team excitement before the game", 12. "Important role in the team", 13. "Unfamiliar position", 14. "Absence of instructor or lack of guidance".

CONCLUSION: The findings suggest that sports injuries result from highly motivated athletes who lack knowledge about playing sports safely, have poor athletic skills, and do not have a good team environment. The reasons for the low overall knowledge of sports science among athletes is considered due to the lack of coaching staff and educational opportunities.

To improve athletic performance and prevent injuries, acquiring and integrating knowledge of sports science in their practice are essential for all athletes and coaches, regardless of their level of competition. Fostering athletes' self-assessment ability may be required to help athletes and coaches understand their effort requirements and reduce the risk of injury.

References:

[1] Bolling C, Mechelen W van, Pasman HR, Verhagen E. Context Matters: Revisiting the First Step of the 'Sequence of Prevention' of Sports Injuries. Sports Med. 2018;48(10):2227-2234. doi:10.1007/s40279-018-0953-x

[2] Otani T. "SCAT" A Qualitative Data Analysis Method by Four-Step Coding : Easy Startable and Small Scale Data-Applicable Process of Theorization. the Graduate School of Education, Nagoya University (Educational Sciences). 2008;54(2):27-44. doi:10.18999/nueduca.54.2.27

LIGHT AEROBIC EXERCISE SUPPLEMENTED WITH A WEIGHTED VEST IMPROVES PULMONARY FUNCTION, TRIGLYCERIDE LEVELS AND PHYSICAL PERFORMANCE IN OLDER ADULTS.

KHAENGKHAN, C., MANIMMANAKORN, A., MANIMMANAKORN, N., SANG-ARTIT, W., HAMLIN, M.J.

KHON KAEN UNIVERSITY

INTRODUCTION: Aging is associated with progressive changes and unavoidable processes characterized by functional, biochemical, and structural deterioration of the human body. Specifically, pulmonary function which is strongly related with morbidity and mortality, decreases with age . Importantly, regular exercise is well-recognized as at strategy for delaying the risk of age-associated diseases. However, a high proportion of the older population may not achieve sufficient exercise particularly at an intensity that is sufficient to result in positive adaptation. Therefore, this study aimed to find a more practical way of increasing exercise intensity by adding weighted vests to light exercise on the pulmonary function, triglyceride levels and physical performance in elderly participants.

METHODS: This randomized controlled trial was conducted on 36 female participants aged 60 to 79 years. The participants were randomly assigned to either a control (CON; n=17 received 40-minute light aerobic exercise program 3 days per week for 8 weeks), or a weighted vest group (WV; n=19 completed the same exercise program with participants wearing a vest filled with sand equivalent to 5% (first 2 weeks) then 10% (last 6 weeks) of their body weight). Outcome variables including pulmonary function, physical performance and lipid profile were assessed before and after the 8 week experimental period.

RESULTS: As a result of the training, the WV participants showed a significant increase in FEV1/FVC (3.51 ± 4.51 %, P = 0.012) and Vt (0.24 ± 0.28 L, P = 0.012), but these increases were not significant between groups. Compared to the CON group, the WV group showed significant increased in VE (CON; 0.82 ± 2.16, WV; 4.36 ± 2.31 L/min, P = 0.003) and MVV (CON; -6.59 ± 4.67, WV; 4.17 ± 5.54 L/min, P = 0.000). Only the WV showed significant reductions in triglyceride (-40.25 ± 47.95 mg/dL, P = 0.004) from baseline. While performance in the timed up and go test and the single leg to stand test increased in both groups, there was no significant difference between groups. However, compared to the CON group the WV group increased their performance in the 6-min walk test (CON; 4.77 ± 39.17, WV; 89.48 ± 68.90 m, P = 0.000).

CONCLUSION: Using a combination of light exercise supplemented with a weighted vest may be a practical way of increasing exercise intensity sufficiently to improve pulmonary function, physical performance, and triglyceride levels in the elderly.

EFFECT OF AN 8-WEEK STRENGTH TRAINING PROGRAM ON ANKLE FLEXIBILITY AND EXPLOSIVE STRENGTH FOLLOWING FIBULA FRACTURE: A CASE STUDY OF A FEMALE VAULTING ATHLETE.

SMOLIGA, J.E., HAJDUOVÁ, K., VAVÁK, M.

COMENIUS UNIVERSITY - FACULTY OF SPORT AND EDUCATION

INTRODUCTION: Returning to training post-injury presents challenges, especially with mobility restrictions in affected musculoskeletal areas.

METHODS: This study aimed to assess the effects of lower limb 8-week strength training program on fitness and angle parameters post-fibula fracture rehabilitation of a 22.2-year-old female. Exercises were divided into three groups: main, supplementary, and compensatory. Input diagnostics of 6 RM in main exercises gradually increased load from 50% of 1RM to 90-95% of 1RM during the 8-week program. Trainings were performed 3 times a week. Parameters included maximum isometric strength (FMAX) in the 90° back squat, ankle angular range (ROM), and bilateral and unilateral countermovement jump (CMJ) were measured every week during baseline and intervention. Ankle angular range was measured using the TiltMeter app for the weight-bearing lunge test. FMAX was measured using FiTRO Force desk and CMJ was measured using OPTOJUMP next. Statistical analysis utilized non-parametric C analysis for single-subject research design for assessing elite athletes.

RESULTS: Bilateral CMJ improved by 9.6 cm from a baseline of 35.9 cm to 45.5 cm after intervention, with statistical significance at the 1% level (C = 0.752). Unilateral CMJ of the left lower limb improved from a baseline of 19.5 cm to 23.9 cm after intervention, and the right lower limb improved from a baseline of 15.8 cm to 23.4 cm after intervention. The discrepancy between left and right lower limb CMJ reduced from 3.7 cm to 0.5 cm. ROM of the left ankle increased by 8.7° and ROM of the right ankle increased by 18.3° during the strength mesocycle, with a statistically significant improvement in the right lower limb at the 1% level (C = 0.819). FMAX in the back squat showed a significant increase from a baseline of 2036.3 N to 2391.1 N after intervention, with statistical significance at the 5% level (C = 0.500).

CONCLUSION: Our study demonstrates the effectiveness of targeted lower limb strength training in improving fitness and angle parameters during fibula fracture rehabilitation. These findings underscore the importance of incorporating strength-focused interventions to optimize recovery outcomes and facilitate return to physical activity post-injury.

ATHLETES WITH A HISTORY OF HAMSTRING STRAIN INJURIES RETURN TO COMPETITION WITH KINESIOPHOBIA

SHIOTA, Y., TOGASHI, I., AOYAGI, M., UCHINO, S., SUGIBAYASHI, T., YAMAZAKI, K., TAKAZAWA, Y.

JUNTENDO UNIVERSITY

INTRODUCTION: Muscle strain is a traumatic injury in which muscle fibres are damaged owing to eccentric contraction. Hamstring strain injury (HSI) occurs at a high rate in track and field athletes and in football, in which athletes repeatedly run, turn, and jump at full speed. Such injuries have attracted the attention of many researchers and clinicians. HSI has a high recurrence rate, with a reported 30.6% chance of re-injury within one year of initial injury. While mild-to-moderate HSIs require a minimum of 4 weeks of tissue recovery before a return to competition, actual returns within 11–25 days have been reported. During recovery from athletic diseases with joint instability, such as post-anterior cruciate ligament reconstruction, psychological readiness is considered important in the course and treatment of the disease. In HSI, early return to competition without psychological readiness may be a factor in the risk of re-injury. However, there have been no studies on muscle–tendon trauma such as HSI and psychological preparedness, and whether patients with previous HSI experience associated psychological anxiety is unclear. Therefore, in this study, we aimed to evaluate the psychological factors among patients with previous HSI.

METHODS: The HSI history and Japanese version of the Tampa Scale for Kinesiophobia (TSK-J) scores were obtained from 62 university student athletes in a track and field club. Athletes with at least one previous HSI were classified into the group with injury history, and athletes with no previous HSI were classified into the group without injury. An independent t-test was conducted with significance set at less than 5%.

RESULTS: The TSK-J score of the group with injury history (N=31) was 37.8±7.14, and that of the group without (N=31) was 34.0±6.13. The TSK-J score was significantly higher in the group with injury history (p=0.028).

CONCLUSION: In this study, athletes with at least one previous HSI had higher TSK-J values than those without, even though they were able to return to competition. These results suggest that HSI causes fear of exercise and psychological anxiety. Furthermore, this fear may have an impact on competitiveness and recurrence of injury.

SPORTS INJURIES IN DEAF JAPANESE NATIONAL SOCCER PLAYERS

SOMEYA, Y., ANZAWA, Y., SHIOTA, Y., NAGAO, M., TAKAZAWA, Y.
JUNTENDO UNIVERSITY

INTRODUCTION: Studying sports injuries is crucial to their prevention and plays a role in the continuation and promotion of sports activities. However, few studies of sports injury have been conducted on sporting events for parasports athletes, especially deaf athletes. A clear understanding of the difference between sports injuries in deaf and hearing athletes is important for prevention of injuries in deaf athletes. This purpose of this study was to clarify the incidence and characteristics of sports injuries in deaf soccer players.

METHODS: Twenty-six participants (27.3±4.9 years old) who attended the Japanese national training camp for deaf soccer players in 2022–2023's season were included in the study. The number of injuries, incidence (injuries/1000 player-hours [PH]), severity (number of days that the injured player can't play), and injury burden (injury incidence × mean severity) were investigated over the one-year period. In addition, injury location, re-injury incidence, mode of onset, and injury mechanism were classified according to the definitions recommended by the International Olympic Committee and the Fédération International de Football Association.

RESULTS: A total of 59 injuries occurred during the study period, with an incidence, severity, and injury burden of 10.1/1000 PH, 5.0 days, and 50.5 days/1000 PH, respectively. With respect to location, 89.8% of the injuries occurred in the lower extremity, with the ankle having the highest incidence and injury burden (2.7 injuries/1000 PH and 15.2 days/1000 PH). The most common diagnosis was ankle sprain, 68.8% of which were re-injuries or aggravation. The mode of onset of ankle sprain was a 50:50 ratio of contact to non-contact injuries.

CONCLUSION: The characteristics of sports injuries in deaf Japanese national soccer players were similar to those in hearing soccer players, with a high incidence in the lower extremity. Ankle sprain had the highest incidence in deaf soccer players. To clearly characterize sports injuries in deaf soccer players, effects of intrinsic factors, such as balance performance, should be evaluated in future studies.

ASSESSING LOWER LIMB MUSCLE RESPONSE TO DYNAMIC NEUROMUSCULAR STABILITY (DNS): A PILOT INVESTIGATION WITH ULTRASOUND SHEAR WAVE ELASTOGRAPHY

CHEN, K.L., LIN, T., TAUN, C., CHANG, K., LI, H., HUNG, W.
NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: The Dynamic Neuromuscular Stabilization (DNS) approach provides practical techniques for assessing and activating intrinsic spinal stabilizers, aiming to enhance the movement system for both pre-habilitation and rehabilitation in athletic injuries, thus optimizing performance [1]. Shear-wave elastography (SWE), an emerging ultrasound technique, enables the quantification of mechanical and elastic properties specifically within muscle tissue [2]. We hypothesize that after DNS training, there will be changes in lower limb muscle stiffness, detectable through SWE.

METHODS: Twelve healthy volunteers, including 2 males and 10 females, underwent DNS training. We conducted SWE measurements of bilateral lower limb muscles (vastus medialis obliquus [VMO], vastus lateralis obliquus [VLO], biceps femoris [BF], and semimembranosus [SM]) before and after the training. Differences in shear wave speed between pre-training (PRE) and post-training (POST) for each muscle were assessed using the paired t-test. Additionally, Pearson correlation analysis was performed to examine the correlation of shear wave speed changes between muscles. A P-value <0.05 was considered statistically significant.

RESULTS: At baseline, shear wave speeds were 2.03± 0.53 m/s in VMO, 1.91± 0.17 m/s in VLO, 2.92± 1.00 m/s in BF, and 3.82± 1.54 m/s in SM. Following Dynamic Neuromuscular Stabilization (DNS) training, no significant differences in shear wave speeds were observed in VMO, VLO, or SM. However, shear wave speed significantly increased in right biceps femoris (BF) after training ($p=0.028$). Additionally, a high correlation(0.821) of shear wave speed change between right VMO and right BF was noted ($P=0.001$).

CONCLUSION: Our pilot investigation utilizing ultrasound shear wave elastography to assess lower limb muscle response to Dynamic Neuromuscular Stabilization (DNS) training revealed significant increases in shear wave speed in the biceps femoris (BF), indicating elevated muscle stiffness. These findings highlight the specificity of muscle adaptations to DNS training and emphasize the importance of individualized assessment and targeted interventions in optimizing lower limb muscle function. Further research with larger sample sizes and longitudinal follow-up is warranted to confirm these preliminary findings and elucidate the underlying mechanisms of muscle response to DNS training.

References:

1. Frank C, Kobesova A, Kolar P. Dynamic neuromuscular stabilization & sports rehabilitation. Int J Sports Phys Ther. 2013 Feb;8(1):62-73.

2. Taljanovic, M. S., Gimber, L. H., Becker, G. W., Latt, L. D., Klauser, A. S., Melville, D. M., Gao, L., & Witte, R. S. (2017). Shear-Wave Elastography: Basic Physics and Musculoskeletal Applications. Radiographics : a review publication of the Radiological Society of North America, Inc, 37(3), 855–870.

SLEEP REGULARITY IN ATHLETES: COMPARING SEX, COMPETITIVE LEVEL AND SPORT TYPE

MELLO, M.T., FACUNDO, L.A., BRANT, V.M., GUERREIRO, R.C., ANDRADE, H.A., LOUZADDA, F.M., SILVA, A.
FEDERAL UNIVERSITY OF MINAS GERAIS

INTRODUCTION: This study aims to describe the athletes' sleep regularity using the Sleep Regularity Index (SRI) and determine whether factors, such as sex, competitive level and sport type, could affect the sleep/ wake rhythm.

METHODS: It is a descriptive, cross-sectional study consisting of 172 athletes (25 ± 7 y old; 45 women). Seventy-three competed in team sports and 99 in individual sports. Furthermore, 56 competed in the international level, 95 in the national and 21 in the regional. We recorded the SRI values for at least 5 d via continuous actigraphy.

RESULTS: We recorded a mean SRI value of 73 ± 12. We found no significant differences between athletes' sleep parameters in relation to sleep regularity. Furthermore, SRI data showed no correlations (Spearman's ρ) with sleep parameters, bed time and wake time. Female athletes ($p = 0.001$) and individual sport athletes ($p = 0.001$) reported better sleep regularity than their counterparts. International-level athletes reported better sleep regularity than those in other competitive levels (national: $p = 0.001$; regional: $p = 0.024$).

CONCLUSION: Our study showed that international level athletes, female athletes and individual sport athletes reported better sleep regularity. Additionally, SRI data showed no correlation with athletes' sleep parameters, bed and wake time. In conclusion, we observed better sleep regularity para-meters in female athletes, international-level athletes and individual sport athletes. Additionally, the SRI showed no correlations with the athletes' sleep parameters, BT and WT. Our results also showed that athletes have inade-quate sleep duration for their specific goals. Acknowledgements: This study is supported by Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG), Conselho Nacional de Desenvolvimento Científico e Tecnológio (CNPq), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Centro de Estudos em Psicobiologia e Exercício (CEPE), Centro Multidisciplinar em Sonolência e Acidentes (CEMSA), Pro - Reitoria de Pesquisa (PRPq) - UFMG - Universidade Federal de Minas Gerais, Fundação de Apoio ao Ensino, Pesquisa e Extensão (FEPE/UFMG), Centro de Treinamento Esportivo (CTE/EEFFTO/UFMG, Ministério da Cidadania do Governo Federal (Brasília, Brazil - Protocol Numbers: 58000.008978/2018 - 37 and number: 71000.056251/2020 - 49), Comitê Olímpico Brasileiro (COB), Academia Paralímpica Brasileira do Comitê Paralímpico Brasileiro (APB/CPB) and Instituto Tecnológico Vale (ITV).

CANNABIS CONSUMPTION AMONG ELITE ATHLETES IN GERMANY

UDELHOVEN, T., BRIXIUS, K.
GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Cannabis is increasingly consumed by elite athletes, leading to a surge in doping sanctions in Germany. The prelude to the 2024 Olympic Games introduces specific challenges and regulatory changes related to cannabis. This study investigates cannabis consumption among elite athletes in Germany to identify opportunities for more targeted education among at-risk target groups and to enhance protection against inadvertent doping violations within the context of anti-doping efforts.

METHODS: Through an online survey with elite athletes, this research provides insights into cannabis consumption behaviour and competence regarding the topic of cannabis among elite athletes. 380 out of 512 participants completed the online survey and were included in the analysis; 259 (68.2%) of them were male, and 121 (31.8%) were female. Among the participants, 175 (46.1%) were u19 years old, 61 (16.1%) u23 years old, and 144 (37.9%) o23 years old.

RESULTS: Depending on factors such as age group, gender, migration background, and/or sport, athletes are at an elevated risk of unintentional rule violations and subsequent doping sanctions related to cannabis. Over a quarter (28.1%) of German elite athletes report lifetime cannabis consumption. In group comparisons, the prevalence of cannabis consumption is significantly higher among athletes over 23 years (o23: 51,4%; u23: 28,3%; u19: 8,3%), male athletes (m: 31,6%; f: 20.8%), and athletes from the sports of basketball (76,2%), and American football (68,2%). The frequency of cannabis consumption is lower than lifetime use, with 9.6% of elite athletes using THC occasionally to regularly, and 5,7% for CBD consumption. Higher rates of THC consumption are observed among athletes from the sports American football (36,4%), basketball (28,6%), and baseball/softball (26,7%), athletes over 23 years old (o23: 16,6%; u23: 13,3%; u19: 2,4%), male athletes (m: 11,8%; f: 5,0%), and team athletes (t: 13,4%; i: 5,2%). CBD consumption rates are generally lower, with the highest prevalence observed in athletes from American football at 22,7%. Cannabis consumption is primarily motivated by pleasure (52,2%). The survey indicates a notable 85,8% knowledge deficit on cannabis among athletes, with a marked disparity in prevalence between those with and without migration background (wm: 93,7%; nm: 82,5%).

CONCLUSION: The growing prevalence of cannabis use among athletes, coupled with its extended detectability and existing knowledge gaps, may collectively contribute to the emerging doping issue in elite sports. Implementing targeted education for the risk groups, including (1) athletes over 23 years old, (2) male athletes, and athletes from the sports of (3) basketball, (4) American football, (5) rowing, and (6) baseball/ softball, is recommended to mitigate future doping violations related to cannabis consumption.

SUBJECTIVE HEAT SENSATION AND HEAT COMFORT VERSUS OBJECTIVE MEASURES OF BODY CORE TEMPERATURE: DIFFERENCES DEPENDING ON FITNESS LEVEL

GILGEN-AMMANN, R., SCHWEIZER, T.
SWISS FEDERAL INSTITUTE OF SPORT MAGGLINGEN

INTRODUCTION: Environmental heat stress and physical activity (PA) interact synergistically to increase strain on physiological systems [1]. Heat acclimatization is an important precaution as it induces biological adjustments that reduce these negative effects of heat stress. The adaptations achieved through endurance training also have a major influence on thermotolerance [2]. But what about the individual perception of heat stress? We aimed to investigate whether the subjective perception of heat sensation and heat comfort differed according to fitness level with increasing core body temperature (CBT). .

METHODS: 16 healthy volunteers (7 female, 27 ±6 years, 174 ±9cm, 69 ±9kg) performed 6 activities for 8 minutes each: lying, walking, housekeeping, jogging, strength training, cycling and high intensity interval training (HIIT). Immediately after each activity, subjects reported perceived exertion (Borg scale, 6-20), heat sensation (very cold - very hot, 7-Likert scale) and heat comfort (pleasant - extremely pleasant, 5-Likert scale). The protocol was carried out under normal conditions (average 19.4°C) and again under hot conditions caused by wearing several layers of (nonpermeable) clothing. The group was divided into untrained subjects doing <150min of moderate PA (N=4), and trained subjects doing >150min of moderate PA per week. The rectal thermistor (MSR Electronics GmbH, Henggart, Switzerland) measured CBT and was self-inserted to a depth of 10cm beyond the anal sphincter.

RESULTS: With increasing PA intensity and under hot conditions, CBT was significantly higher (average 36.9°C vs. 37.7°C, p=.009). The maximum CBT was 38.8°C in both groups and the average Borg values after HIIT activity were 19.0 and 18.8 for untrained and trained subjects, respectively. Subjective heat sensation (p=.002) and heat comfort (p=.003) were significantly higher with increasing CBT. There was neither a difference in CBT nor a difference in perceived heat sensation, heat comfort or heat sensation*comfort interaction depending on fitness level.

CONCLUSION: Endurance training leads to adaptive changes to the physiological, immunological, and neuroendocrine systems [2]. However, there was no difference between untrained and trained subjects in terms of subjective heat sensation and heat comfort with increasing CBT. As our sample of untrained subjects was small and the ethical upper limit for CBT was not reached, further research is needed to understand differences in subjective heat perception.

References:

1. Sawka MN, et al. (2011). Integrated physiological mechanisms of exercise performance, adaptation, and maladaptation to heat stress. Compr Physiol 1, 1883–1928.

2. McLellan TM, et al. (2012). Influence of Aerobic Fitness on Thermoregulation During Exercise in the Heat. Exerc Sport Sci Rev 40(4), 218-219.

THE WOLFF-PARKINSON-WHITE SYNDROME IN ASYMPTOMATIC ATHLETES, AN AVOIDABLE SUDDEN CARDIAC DEATH ?

STOIAN, I.M., IONESCU, A., STOIAN, I., GEORGESCU, M., DRAGOMIR, A.
EMERGENCY INSTITUTE OF CARDIOVASCULAR DISEASES "PROF.DR.C.C.ILIESCU" BUCHAREST, ROMANIA

INTRODUCTION: Introduction:The Wolff-Parkinson-White (WPW) Syndrome, a dynamic heart condition present at birth, often asymptomatic, consists of an accessory pathway (AP) for signals to travel between the heart's upper and lower chambers, by-passing the normal way and causing sometimes a fast heart rhythm (150-220/min), regular (supraventricular tachycardia,SVT) or irregular (atrial fibrillation,AF) responsible for severe ventricular arrhythmias and sudden cardiac death (SCD). Athletic activity, through exercise related adrenergic activation, accentuates the risk of SVT/AF and SCD during exercise (1,2). Asymtomatic or no, WPW may be diagnosed in otherwise healty athletes (ath)and treated accordingly.

Aim:A retrospective study:2018-2023. In asymptomatic ath the potentially lethal arrhythmic events associated to WPW may be the first 'presentation'. To recognize the incidence of WPW in the Pre-Participation Cardiac (PPC) screening and in yearly follow-up.To assess the medical indications including electrophysiological study (EPS) indications according to the condition's severity and SCD risks.

METHODS: Method:1523 ath; 16-32 yo; male 65%. Sports: football, rowing, athletics. Initial PPC and yearly follow-up:all ath. PPC Protocol: Focused history (palpitations, pre-syncope /syncope).Clinical exam.Resting electrocardiography (ECG)-WPW and high risk SVT/AF criteria (3).EPS and specific AP- EP criteria for SCD high risk(4) in all WPW ath.

RESULTS: Results: PPC: 1523 ath; 24 (1.57%) WPW ath. Study Group (WPW-EPS):24 ath age 16-32;14 M; H 174+/-3 cm; W 75+/-3 kg. Asymptomatic: 14 (58.3%) ath: EPS-WPW high risk, 9 (64%). Symptomatic: 10 (41.6 %) ath: EPS-WPW high risk, 10 (100%). Catheter Ablation (AP): 23 (95.8%); one postponed.

CONCLUSION: Discussion&Conclusions: WPW was diagnosed in 1.57% ath. As a very dynamic condition, WPW is diagnosed sometimes solely by repeated ECGs (2, 8.3% ath). WPW with high risk of SCD while intense exercise is a real threat to ath even in those without symptoms. In the Study Group, the real free-symptoms were in 14 (58.3%) ath and 10 (41.6%) had few palpitations before the WPW-ECG is diagnosed. Severe arrhythmias/ SCD risk stratification by EPS as a mandatory procedure was indicated in all ath, followed by AP ablation when necessary.

WPW diagnosis must rely on the ECG in PPC and follow-up.EPS is mandatory.The life threatening AP catheter ablation is the only way of treatment.

References.

1.Jose A Joglar et al.2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis Management of Atrial Fibrillation.J Am Col Card 2024;Vol 83 No1:109-279.

2.Melhotra A et al. Outcomes of cardiac screening in adolescent soccer players.New Engl J Med.2018;379 (6):524-534.

3.Lisa W.M Leung, Mark M Gallagher.Review paper on WPW and athletes: Let sleeping dogs lie? Clin Cardiol 2020;43:897-905.

4.Brugada J et al.2019 ESC Guidelines for the Management of Patients With Supraventricular Tachycardia.Eur Heart J.2020;41:655-720.

Statistics and Analyses

A FACTOR ANALYTIC STUDY OF THE IMPRESSION OF DESIRABLE PE CLASS TEACHERS AMONG JAPANESE JUNIOR HIGH SCHOOL STUDENTS

TAKETO, M., AOYAGI, O.1

1 FUKUOKA UNIVERSITY

INTRODUCTION: Teachers are expected to have not only the talent and skills to impart the knowledge and skills that students desire through their classes but also human qualities to aspire to (Inagaki et al., 1988; Kadoya et al., 2021). Again, they could be evaluated from various perspectives rather than the typical impression of a teacher. They are also likely to be affected in diverse ways such as gender and grade level. Therefore, this study classified the desired impression of PE class teachers among Japanese junior high school students into various patterns in a factor-analytic way and examined the relationship between these patterns and the gender and grade level of the students.

METHODS: A total of 209 junior high school students (117 boys and 92 girls) from K Prefecture in Japan were asked to rate their desirable impression of PE class teachers based on 35 items using a 5-point scale, including 13 items related to "Learning and teaching innovations," such as "Teaching tips and intuition" and "Use of ICT," 8 items related to "Learning management," such as "Teaching with a sense of urgency" and "Tolerance of students failure." At the same time, subjects were also asked about their gender and grade level. Principal Component analysis was performed on the five-level rating data obtained, factors with eigenvalues greater than 1.0 were extracted, orthogonal rotations were performed using the Varimax criterion, and factor scores were estimated using the full estimation method. In addition, these factor scores were subjected to a one-way ANOVA.

RESULTS: From the factor loading matrix obtained, Factor 1 was interpreted as the "F1: Desirable impression of a PE class teacher who excels in teaching to improve skills" because it showed significant factor loadings for "Q3. Easy to understand explanations (factor loading = 0.570)" and "Q5. Provides a good example (0.765)." In the same way, as factors common to question items that showed significant factor loadings, Factors 2 to 6 were interpreted as "F2 Desirable impression of a PE class teacher who excels in the basic design of the class," "F3: Desirable impression of a PE class teacher who can develop activities in a relaxed manner," "F4: Desirable impression of a PE class teacher displaying excellent enthusiasm," "F5: Desirable impression of a PE class teacher who demonstrates solid learning and results," and "F6: Desirable impression of a PE class teacher who is good at motivating students," respectively. Furthermore, the mean factor scores corresponding to each factor were examined by gender and grade level, and the results showed that significant mean gender differences were found in Factor 1 ($F=4.31$, df=[1,206:], $p=0.039$) and Factor 2 ($F=8.35$, df=[1,206], $p=0.004$). Then, significant mean difference among grade levels in Factor 1 ($F=4.11$, df=[2,205], $p=0.018$), Factor 3 ($F=3.16$, df=[2,205], $p=0.044$), Factor 5 ($F=4.08$, df=[2,205], $p=0.018$), and Factor 6 ($F=9.01$, df=[2,205], $p<0.0001$).

HAS COVID-19 INFLUENCED THE PERFORMANCE OF TOP-CLASS ATHLETES IN THE ITU WORLD AQUATHLON CHAMPIONSHIP?

GARCÍA-GONZÁLEZ, P., GONZÁLEZ-JURADO, J.A.

UNIVERSITY PABLO DE OLAVIDE

INTRODUCTION: World Championships are attractive to the scientific community and have been investigated in a wide range of sports (De La Rubia et al., 2020), sometimes related somehow to triathlon (Haupt et al., 2013). The ITU World World Aquathlon Championship is the top championship for aquathlon. Sex differences in multi-sports performance have been found to depend on discipline and distance, as previous studies have shown (Lepers, 2019). Lepers & Stapley (2010) have asserted that the sex gap is narrower in the Olympic distance when compared to other larger distances. Some studies provide overwhelmingly positive evidence of COVID-19 pandemic in sport regardless of the influence of lockdown. For instance, it has been demonstrated that lockdown was beneficial in maintaining the physical fitness of gymnasts in the United Kingdom and was perceived as time for rest and recovery (Patel et al., 2022). The influence of COVID-pandemic on aquathlon is not yet clear. The aim of the present study is to provide a comprehensive analysis of the effect of COVID-19 pandemic on performance in the World Aquathlon Championship focusing on the male and female categories.

METHODS: The dataset for this study was obtained from the ITU World Triathlon Series (WTS) website (http://wts.triathlon.org/). Individual discipline times and overall times from 2018 and 2022 were collected for analysis, excluding 2020 due to the COVID-19 outbreak. The total number included athletes in this study was 280 subjects (176 males and 106 females). The mean age of subjects overall was 23.20 for males and 22.44 for females. The Students t-test

for independent samples comparing sex was used for normal variables, whereas the Mann-Whitney U-test was used for non-normal variables.

RESULTS: European men were the 83.52% of the total amount un participants whereas it was the 91.5% for women. Non-African women participated. The analysis displayed several significant changes in performance after COVID-19 pandemic. For men, two significant differences were found in ST and FT, enhancing the first one and worsening the second one (p-values 0.010; 0.027). Women experienced a 3.65% improvement in ST (p-value 0.001). When all participants were analyzed irrespective of sex, only ST and T1 displayed significant differences (p-values = 0.045; < 0.000). When comparing the relative changes between sex in, two significant differences were observed in both relative running time and relative final time (p-values = 0.014; <0.000), with women showing better results in performance changes.

CONCLUSION: Women reacted better than men to the running and final performance after COVID-19. These findings validate the necessity of considering each discipline when assessing the impact of the COVID-19 pandemic on the performance of elite aquathlon athletes in the World Championship.

A FACTOR ANALYTIC STUDY OF DECLARATIVE KNOWLEDGE IN SAILING COMPETITIONS: ON SAILING

SAKAGUCHI, H., IMAMURA, K.1, AOYAGI, O.2

1> JAPAN UNIVERSITY OF ECONOMICS., 2>FUKUOKA UNIVERSITY.

INTRODUCTION: In sailing competitions, situational judgment/decision-making in various situations is important. Situational judgment is not only cultivated but also is based on a wealth of declarative and procedural knowledge. Therefore, the presence of declarative knowledge is also important in sailing competitions as a basis for situational judgment/decision-making. In this study, we examined the factor structure of the knowledge of sailing, its central knowledge, and the relationship among these factors and various conditions.

METHODS: Sailing tests consisting of 28 items were conducted on 165 yachtsmen who participated in various national sailing competitions and high school sailing competitions in Japan and understood the purpose of this study. Tetrachoric correlation coefficients were calculated on the data, which was transformed into 1 for correct answers and 0 for incorrect answers, and the factor pattern matrix was obtained by performing a Promax oblique rotation with the principal factor solution. After interpreting the factors, the relationships between factor scores and various factors, such as gender, position, boat type, age, and years of competition experience, were examined.

RESULTS: The scree plot of eigenvalues obtained showed an elbow between factor 3 and factor 4, so the factor 3 solution was adopted. We interpreted "F1: Sail trim factor," "F2: Sailing theory related to mast control," and "F3: General sailing theory" according to the characteristics common to the items that showed significant loadings on each factor. Furthermore, the results of the association between these factors and various factors showed that "F1: Sail trim factor" was significantly related to "Boat type" (F=9.407, df=[1,151], p=0.003) and "Two-seater (mean=0.328)" was superior to "Single-seater (-0.541)". "F2: Sailing theory related to mast control" showed significant relationships in "Years of sailing experience (r=0.289, p<0.001);" "Age (r=0.234, p=0.004);" "Gender (F=13.05,df=[1,152], p<0.001);" "Positions (F=4.28,df=[1,144], p=0.040);" and "Boat type (F=5.36, df=[1,151], p=0.022), in which superiority was considered to be "Years of sailing experience" and "Age" increased, and "Boys (0.261)" more than "Girls (-0.319)" for "Gender;" "Skippers (0.140)" more than "Crew (-0.238)" for "Position;" and "Two-seaters (0.328)" more than "Single-seaters (-0.541)." There was also a significant negative association in "F3: General sailing theory " for "Years of sailing experience (r=-0.221, p=0.007)" and "Age (r=-0.198, p=0.015)," and a significant difference (F=6.38, df=[1,144], p=0.013) was also found for "Position," and that "Crew (0.218)" was superior to "Skipper (-0.134)."

CONCLUSION: We can assume that in general, sailing theory is not acquired through the number of years of experience and age, but that the theory on sail trim is special and that this knowledge is important and is not only related to years of experience and age, but also developed with experience in gender, position, and boat type.

RESEARCH ON PHYSICAL FITNESS CHARACTERISTICS OF OUTSTANDING MALE LONG JUMPERS IN CHINA

WEI, P., YUAN, T., GAO, D., HAN, D.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: With the development of competitive sports, physical fitness has been increasingly valued, especially in track and field, a discipline heavily reliant on running and jumping abilities. In China, physical fitness testing is conducted for athletes based on the characteristics of their respective events to assess their physical fitness levels. This study aims to investigate the correlation between various physical fitness indicators and the performance of male elite jumping athletes.

METHODS: Eight male elite athletes from the Chinese national track and field jumping team were selected for physical fitness testing, which included 30-meter sprint, 60-meter sprint, shot put, 1-repetition maximum (1RM) for bench press, 1RM for squat, 1RM for deadlift, 3000-meter run/2000-meter ergometer, weighted one-legged stance, back muscle endurance, and standing broad jump. The scores of the ten physical fitness test items were quantified uniformly according to the standards set by the Chinese Athletics Association. Pearson correlation coefficient was used to examine the correlation between the experimental data, exploring the relationships among the various indicators to gain new insights.

RESULTS: The Pearson correlation coefficients (r) for 30-meter sprint, 60-meter sprint, shot put, and bench press maximum strength were all ≥0.8, showing a significant positive correlation, indicating a higher correlation between the performance in these four exercises and event-specific performance. The r values for relative strength in bench press, maximum

strength in squat, and weighted one-legged stance were ≥0.5, indicating a moderate positive correlation with event-specific performance. The r values for 2000-meter ergometer/3000-meter run and standing broad jump were ≤0.3, indicating a weak correlation between these test scores and event-specific performance, statistically interpreted as unrelated. The r value for total physical fitness test score was ≥0.8, indicating a high positive correlation between overall test score and individual performance.

CONCLUSION: Among the physical fitness test items, 30-meter sprint, 60-meter sprint, shot put, and bench press maximum strength show higher correlation with the performance of elite jumping athletes. Relative strength in bench press, maximum strength in squat, and weighted one-legged stance exhibit moderate correlation with athlete performance. The performance in 2000-meter ergometer/3000-meter run and standing broad jump shows weak correlation with event-specific performance. The results of physical fitness testing can to some extent reflect the physical fitness level and event-specific performance of athletes.

Training and Testing

THE IMPACT OF FOUR-WEEK "LIVING HIGH-TRAINING LOW " ON SLEEP AND FATIGUE STATES IN MALE ROWING ATHLETES

SHUQIANG, L., YAN, A., SHILEI, L., JUN, Q.
SHANGHAI INSTITUTION OF SPORTS SCIENCE

INTRODUCTION: The Research Objective is to explore the effects of a 4-week living high-training low regimen on rowers sleep, fatigue, and emotional states.This work is part of founding 22dz1204601,Study on exercise fatigue evaluation and recovery based on special environment.

METHODS: The study involved 18 male rowing athletes, aged 19.3±2.9 years, including 2 national-level athletes, 14 first-level athletes, and 2 second-level or lower athletes. The athletes were randomly divided into a hypoxic sleep group and a control group. The hypoxic sleep group underwent a 4-week intervention with reduced oxygen levels (set at 15.8% oxygen content, equivalent to an altitude of 2500 meters) using a hypoxia generator. The control group had normal oxygen levels during sleep. Both groups followed the same training regimen. A mixed experimental design was used: 2 (hypoxic sleep group, control group) × 3 (one week before the experiment, the second week of the experiment, the fourth week of the experiment). EEG tests of 18 minutes were conducted at these three time points, followed by the Pittsburgh Sleep Quality Index (PSQI), Athletes Sleep Screening Questionnaire AIS-nca, Athlete Burnout Questionnaire ABQ, and Profile of Mood States (POMS) tests to analyze changes in various indicators.

RESULTS: 1.The AIS-nca questionnaire results showed significant main effects for testing time ($F=47.372$, $p<0.001$, $\eta p2=0.748$) and intervention ($F=17.693$, $p=0.001$, $\eta p2=0.525$) in both groups, with no significant interaction between time and intervention ($F=1.969$, $p=0.159$, $\eta p2=0.11$). PSQI analysis revealed significant intervention main effects in total score ($F=8.207$, $p=0.012$, $\eta p2=0.37$), sleep latency ($F=4.778$, $p=0.046$, $\eta p2=0.254$), and use of sleep medication ($F=17.5$, $p=0.001$, $\eta p2=0.556$), with a marginal effect on daytime dysfunction ($F=4.516$, $p=0.052$, $\eta p2=0.244$).

2.Pre- and post-experiment EEG analysis showed no significant differences in neurotransmitter indicators between the two groups during the 4-week period. However, in the hypoxic sleep group, inhibitory neurotransmitter (INH) and norepinephrine (NE) levels tended to rise, while serotonin (5-HT), acetylcholine (ACh), dopamine (DA), and excitatory neurotransmitters (EXC) tended to decrease. No such trends were observed in the control group.

3.The ABQ and POMS results indicated significant intervention effects in the negative evaluation of exercise ($F=10.316$, $p=0.006$, $\eta p2=0.424$) and a marginal effect in the reduced sense of achievement ($F=4.495$, $p=0.052$, $\eta p2=0.243$) in the ABQ. Significant effects were also observed in the self-related emotional components of POMS ($F=9.543$, $p=0.008$, $\eta p2=0.405$), with other tests showing no significant results.

CONCLUSION: The 4-week living high-training low regimen significantly enhanced the athletes aerobic and anaerobic capacities, positively influencing their athletic performance. However, it negatively impacted sleep quality, increasing fatigue and negative emotions in the athletes.

COMPARATIVE STUDY ON THE PAP EFFECTS OF SQUAT JUMP AND HEAVY LOAD BACK SQUAT ON VERTICAL JUMP PERFORMANCE IN WRESTLING ATHLETES

MANYING, R., YUCHEN, W.
BEIJING RESEARCH INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Heavy load squat[1,2]and light load plyometrics training[3] are two common conditioning strategies to elicit PAP response. Although previous studies supporting the notion that both heavy weight resistance training and plyometric training can elicit the PAP effect, to our best knowledge, very few studies have directly compared the effects between these 2 types of conditioning activities. The aim of this study was to investigate whether the Weighted Jump (WJ) and Back Squat (BS) could enhance the subsequent jumping performance and the difference between 2 conditions for inducing PAP effects.

METHODS: Fifteen male wrestling athletes were recruited to conduct two different intervention strategies to observe the posttest CMJ performance of each strategy. The protocols consisted of 1 baseline Counter Movement Jump (CMJ) followed by 4 CMJs at 15 seconds, 2 minutes, 4 minutes, and 8 minutes after completing BS with 90% 1 Repetition Maximum (RM)

or WJ with 10% of body weight. Two-way factorial analysis of variance (ANOVA) with repeated measures were used to examine the differences between WJ and BS groups in jump height, Reactive strength Index (RSI) and contact time.

RESULTS: The CMJ heights and RSI were significantly increased($p<0.05$) in both groups, but the PAP effect in BS group was later than that of WJ group. The contact time was significantly decreased ($p<0.05$) only in the WJ group and no significant difference was found in the BS group($p>0.05$).

CONCLUSION: It would seem that the WJ and BS both can be an effective stimulus for CMJ performance, but the WJ was better in contact time, RSI and the time to reach the peak jump height as a PAP stimulus. Our results suggested that the WJ may be a better pre-game warm-up protocol in order to increase the performance in the game.

THE EFFECTS OF VELOCITY-BASED RESISTANCE TRAINING WITH REACTION AND VISUAL FEEDBACK ON PLANNING PERFORMANCE AND REACTIVE PERFORMANCE IN ELITE TAEKWONDO ATHLETES

WANG, H.H., TANG, H.T.

NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Providing reaction and visual feedback during sports training has been shown to improve reactive performance. Velocity-based resistance training Resistance training has also been proven to enhance rapid strength. However, whether velocity-based resistance training with reaction and visual feedback is a more effective training method for elite athletes remains to be verified. The aim of the present study was to identify which of three training methods leads to the best training effects on sport performance in elite Taekwondo athletes.

METHODS: Eight-teen elite taekwondo athletes were recruited and divided into free -weight resistance training group (FWRTG, n=6), velocity based resistance training group (VBRTG, n=6), VBRT with reaction and feedback group (VBRT-RFG, n=6). All subjects completing 6 weeks,3 times a week training program which consisted of 3-5 sets of 10-20repetitions. Intensity was 30-50%1RM. Mean propulsive velocity (MPV) were monitoring during VBRT and VBRT-RF. Beside, 15% and 20% of Velocity loss were standard for arranging longer rest periods or stopping training. Before and after training, velocity, power, RFD, kicking ability were collected for statistical analysis. Data of baseline and percentage of training effects among groups were analyzed with Analysis of Variance, ANOVA and Bonferroni post hos test. The Paired Samples t-Test was used to compare the difference between pre-test and post-test. The level of significance was set at $\alpha = .05$.

RESULTS: FWRTG showed a significant enhancement effects in MPV of 40%1RM, MPV of 50%1RM, height of three times CMJ, strength of three times kicks ($p<.05$). MPV of 30%1RM, MPV of 40%1RM, strength and velocity of three times kicks increase significantly in VBRTG ($p<.05$)。 MPV of 30%1RM, MPV of 40%1RM, 50ms RFD, strength and velocity of three times kicks increase significantly in VBRT-RF ($p<.05$). Compare percentage of training effects among three groups found that MPV of 30%1RM of VBRTG was significantly higher than that of FWRTG.

CONCLUSION: All three training methods can enhance the muscle strength of Taekwondo athletes. FWRT can strengthen the performance of heavier loads and longer movements, as well as the strength of kicks. VBRT and VBRTRF can enhance the performance of lighter loads and shorter movements, as well as the strength and velocity of kicks. Among the three training methods, only VBRT-RF has a significant enhancement effect on 50ms RFD. Besides, light load of MPV, VBRT-RF is the most efficient training method among the three training methods.

LACTATE THRESHOLD AS AN INDICATOR OF PHYSICAL FITNESS READINESS IN SOCCER.

MICHAELIDES, M., PARPA, K.

UCLAN CYPRUS

INTRODUCTION: It is important to regularly monitor the aerobic endurance performance of professional soccer players throughout the season. Sub-maximal blood lactate assessment is a useful tool for detecting changes in endurance fitness, with lactate threshold determination possibly being a more sensitive indicator of aerobic endurance performance than VO2 max. Many studies and practitioners are showing particular interest in the changes in velocities that are needed for the onset of blood lactate accumulation (OBLA), specifically at the 4 mmol/l threshold (v-4Mm). In this study, we investigated the v-4Mm before the preseason preparation, followed by a post-preseason preparation submaximal test up to 14 km/h.

METHODS: A total of twenty-one elite soccer players participated in the study. The treadmill running protocol began with a velocity of 8 km/h, followed by 3-minute increments of 2 km/h. The Lactate Plus analyzer (NOVA Biomedical, USA) was used for blood analysis, requiring 0.7 μL of blood, and the measurement time was 13 seconds for every increment change.

RESULTS: Repeated measures analysis demonstrated a significant difference in La++ accumulation ($F(1.74,70) =192.69, p<0.001$) across the 4 velocity increments. The analysis demonstrated no significant interaction, indicating a significant decrease in blood La++ accumulation for all 4 incremental velocities following the preseason preparation. Particularly before the pre-season preparation, only 35% of the athletes had blood lactate accumulation below the 4 mmol/l threshold after running the 3min 14km/hour increment. During the follow-up testing, 95% of the athletes accumulated less than 4 mmol/l La++ running the 3-minute 14km/hour increment. According to the literature and the results of this study, the v-4Mm is less than 14 km/h before the pre-season preparation, while the v-4Mm after the preseason preparation is at higher velocities.

CONCLUSION: To avoid unnecessary overloading of the professional football players just before the beginning of the season, we propose a submaximal test that includes a final stage of 3 minutes at 14km/h run. Failure to induce 4 mmol/l OBLA could be considered an indicator of aerobic physical fitness readiness. This should apply especially to professional soccer players who have a 4 mmol/l OBLA threshold at velocities below 14km/h.

EFFECTS OF BODYWEIGHT-BASED HIGH-INTENSITY CIRCUIT TRAINING WITH BLOOD FLOW RESTRICTION ON AEROBIC AND MUSCULAR FITNESS

CHENG, C.F., YANG, Y.R.2, GOH, C.M.1, LIN, C.Y.1, CHAN, K.H.1

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The 7-min workout (7MW) is a bodyweight-based high-intensity circuit training that has become widely popular and proposed to improve aerobic fitness and fat loss [1]. However, limited studies have examined the effects of 7MW on fitness and health, with one previous study reporting cardiovascular responses to 7MW at the low bound of the vigorous intensity spectrum [2]. Blood flow restriction (BFR) has been reported to increase neuromuscular and metabolic stress, thus improving aerobic and muscular fitness [3]. This study examined the effects of 7MW combined with BFR on aerobic capacity, muscular fitness, and body composition in healthy adults.

METHODS: Thirty-three active and healthy males were recruited and randomly assigned into 7MW, 7MW+BFR, and control (CON, no intervention) group. The 7MW and 7MW+BFR groups performed a 6-wk (3 sessions/week; 1 set in the first 3-wk, 2 sets for the rest of weeks) of 7MW training program. The vascular occlusion (150 mmHg) was administered on both thighs in 7MW+BFR group during exercise. Session rating of perceived exertion (s-RPE) was obtained 30-min after each training session. Participants performed countermovement jump (CMJ), isometric mid-thigh pull (IMTP) test, graded cycling exercise test (GXT), and measurements of skinfold thickness (chest, abdomen, thigh) and thigh circumference (TC) before and after intervention. The blood lactate levels were measured before and after GXT.

RESULTS: The s-RPE in the last 3-wk was significantly higher in 7MW+BFR (8.9 ± 1.0) than in 7MW (8.3 ± 1.0, $p < 0.05$). However, no significant differences were found in s-RPE between the 7MW and 7MW+BFR groups. During the last 3-wk, the number of repetitions of push-up, step-up onto chair, squat, triceps dip on chair, and push-up and rotation at the second set were significantly lower in 7MW+BFR than in 7MW ($p < 0.05$). Maximum oxygen uptake increased significantly after 7MW (from 50.5 ± 6.1 to 53.6 ± 5.8 ml/kg/min; +6.4%) and 7MW+BFR (from 49.3 ± 5.5 to 51.7 ± 5.4 ml/kg/min; +5.2%) interventions. The peak (+12.0%) and mean (+11.3%) force during IMTP enhanced significantly in 7MW+BFR, but no significant changes were found in 7MW (+4.5%; +5.3%) and CON (-6.1%; -6.7%). Changes in peak and mean force during IMTP were significantly higher in 7MW+BFR than in CON ($p < 0.05$). There were no significant interaction effects for CMJ height, maximal rate of force development during IMTP, sum of skinfold thickness, TC, and blood lactate levels. However, abdominal skinfold thickness increased significantly in CON.

CONCLUSION: Both 7MW and 7MW+BFR might improve the aerobic capacity in active males but might not affect power and body composition. Integrating the vascular occlusion into a 6-wk 7MW program might further increase muscular strength. Supported by grants from Ministry of Science and Technology, Taiwan (MOST 111-2410-H-003-139-MY2). References: [1] Klika, B. & Jordan, C. (2013) [2] Riegler, M., et al. (2017) [3] Silva, J., et al. (2019). Contact: andescheng@ntnu.edu.tw

RELATIONSHIP BETWEEN PERFORMANCE AND ABILITY IN UNILATERAL WEIGHT TRAINING OF COLLEGIATE TRACK AND FIELD ATHLETES

TERADA, K., YAMAMOTO, I.

TENRI UNIVERSITY

INTRODUCTION: This study aimed to determine the extent to which an athlete's ability to perform unilateral weight training (WT) is related to their performance level (PL) in athletics and performance indicators (PIs) related to athletics. Additionally, we examined whether this relationship was stronger than that with the conventional ability to perform bilateral WT.

METHODS: We enrolled 18 male collegiate track and field athletes, 4 of whom performed short-distance sprints and 14 performed jumping exercises. The ability to perform unilateral WT was evaluated using the unilateral deadlift (Dl), unilateral squat (Sq), and unilateral power clean (Pc) parameters developed by the author. The indices used were the lifting speed of the barbell, measured using a linear position transducer, and the exerted power calculated from the lifting speed of the barbell. The test was performed separately for the right and left sides at four different load weights according to the body weight ratio in each unilateral WT exercise. The index of the ability to perform each bilateral WT exercise was calculated by dividing the season's highest weight during the study period, which was the 1 repetition maximum of the bilateral Dl, bilateral Sq, and bilateral Pc, by the body weight. The PL of the subjects was assessed by scoring their highest season record during the study period according to the International Association of Athletics Federation scoring tables of athletics, 2017 edition. PIs, including the rebound jump index, drop jump index, vertical jump, leg extension power, and center of pressure trajectory measurements, were obtained for both unilateral and bilateral exercises. Additionally, a questionnaire was used to investigate the season's best records during the study period for running times of 30-, 60-, and 100-m sprints, the standing long jump, and the five-step jump.

RESULTS: The relationship between the ability to perform unilateral and bilateral WT and each variable of PL and PI was examined by calculating the Pearson product–moment correlation coefficient. In particular, a moderate-to-strong correlation was found between the power exerted in unilateral Dl and unilateral Sq and PL when lifting heavy weights, and a

moderate correlation was also found with PIs. No correlation was found between PL or PIs and the ability to perform unilateral Pc or bilateral WT. When the power exerted during unilateral WT was compared by dividing the PL into two groups, i.e., the group with a lower PL (low-ranking group, n = 9) and the group with a higher PL (high-ranking group, n = 9), the higher-ranking group showed significantly higher values in unilateral DJ and unilateral Sq for most load weights.

CONCLUSION: These results suggested that the ability to perform unilateral WT, particularly unilateral DJ and unilateral Sq, may better reflect PL and PIs in short-distance jumping track and field events than the conventional ability to perform bilateral WT.

THE APPLICATION OF BIOFEEDBACK TRAINING IN SPORTS. A NARRATIVE REVIEW

NIU, Y.
BEIJING SPORT UNIVERSITY

INTRODUCTION: The aim of this study is to summarize and summarize the application of biofeedback in the field of sports, and give some suggestions on its future research trends. Biofeedback is developed by combining multi-disciplinary research. At the end of 1970s, biofeedback technology was widely used in the sports field. Up to now, the research of biofeedback training in the field of sports focuses on the field of sports psychology and sports rehabilitation, it is widely used because of its non-invasive and convenient operation.

METHODS: It was a narrative review study. We used the following keywords to search the Web of Science、EBSCO Academic search Complete database: 'sports' and 'biofeedback' to qualify articles to analysis.We searched for reports published between 2000 and 2023. Two independent researchers completed the procedure between July 2023 and November 2023.?In the first step, we obtained 39 studies .The studies had to meet the following requirements: (a) published scien-tific articles; (b) experimental or quasi-experimental reports; (c) use of biofeedback as the main treatment.A total of 14 articles were included in the study, and the following criteria were analyzed: sports events, biofeedback methods, evaluation indicators, application effects.

RESULTS: The results of 92% (N = 13) showed that biofeedback training had a positive effect on the improvement of athletes ability. It can not only reduce athletes pre-competition anxiety, regulate the level of arousal, improve the athletes ability of emotion regulation and self-control, but also improve the learning efficiency of sports skills, also can enhance the human body muscle strength and balance function, prevent sports injury, improve sports performance. Only 8% (N = 1) of the results were negative, which may be related to the sports program and sociological factors.

CONCLUSION: The results show that most of the biofeedback training plays a positive role in improving sports ability, which proves that the biofeedback training is practical and scientific, and is an effective way to improve the training effect of sports ability. However, The ecological validity of biofeedback training is a problem worth paying attention to, that is, whether the biofeedback training effect can be transferred from the laboratory to the real sports training and competition situation. Although some studies have tried to carry on the training in the sports field, but this aspect of the research is limited and needs to be further strengthened.

Athletes of different sports may also benefit from different biofeedback information during training, for example, Judo require strength and a high level of muscle movement, therefore, electromyography and skin current may be better training methods, while shooting and archery require good psychological preparation and high concentration, so choose EEG feedback training is more appropriate. Therefore, the correlation between different biofeedback methods and sports events needs further study.

THE EFFECTS OF ROWING ERGOMETER INTERVAL TRAINING ON 2.4KM RUNNING PERFORMANCE AMONG MALES AND FEMALES

BALASEKARAN, G., LOONG, C.H., YUE, W., NG, Y.C.
NANYANG TECHNOLOGICAL UNIVERSITY

INTRODUCTION: A high level of cardiovascular fitness (CVF) is often associated with longevity and health. Interval training is used to boost CVF levels, however, the effect of different exercise modalities interval training on running outcomes are unknown. 2.4 km run is a common valid field test used to assess an individual's CVF. This study investigated the effect of rowing ergometer interval training on 2.4km running performance among male and female participants.

METHODS: A total of 19 healthy male and female participants (height: 167.94 ± 6.97 cm; weight: 67.21 ± 12.57 kg; fat: 15471.68 ± 5778.59 g; fat free mass (FFM): 51757.84 ± 12429.33 g)) volunteered for this study. Their anthropometric measurements were recorded, and pre- and post-body composition measured via dual-energy X-ray absorptiometry (DEXA) machine. Participants underwent a pre- and post-2.4km run test on the track. They also participated in 10 sessions of 45-60 minutes rowing on an ergometer per session over 5 weeks and 8 interval training sessions. Participants wore a heart rate (HR) monitor each and completed a standardized warm up protocol that consisted of 3 minutes rowing on the ergometer at their own pace, followed by stretching of their lower back, hamstrings, quadriceps using 3 dynamic stretches. Rowing interval training (RIT) followed a decreasing Work (W):Rest (R) ratio starting with short bouts of exercise in week 1 with longer rest before progressing to longer bouts of exercise with lesser repetitions. HR and rate of perceived exertion (RPE) were recorded during each session.

RESULTS: Significant differences were found between pre- and post-2.4km run test (pre-2.4km: 806.21 ± 160.02 s vs. post-2.4km: 758.95 ± 160.49 s, p = 0.000); pre- and post-fat (pre-fat: 15471.68 ± 5778.59 g vs. post-fat: 15125.58 ± 5829.33 g, p

= 0.022); males pre- and post-FFM (males pre-FFM: 61961.80 ± 6464.90 g vs. males post-FFM: 62894.50 ± 6326.74 g, p = 0.002). pre-2.4km timings between genders (males: 685.00 ± 82.91 s vs. females: 940.89 ± 105.39 s, p = 0.000); post-2.4km timings between genders (males: 627.90 ± 48.58 s vs. females: 904.56 ± 99.90 s, p = 0.000). There were also significant positive correlation between pre-fat and pre-2.4km run test (pre-fat: 1547.68 ± 5778.59 g vs. pre-2.4km: 806.21 ± 160.02 s, p = 0.020, r = 0.530); post-fat and post-2.4km run test (post-fat: 15125.58 ± 5829.33 g vs. post-2.4km: 758.95 ± 160.49 s, p = 0.028, r = 0.503); significant negative correlation between pre-FFM and pre-2.4km run test (pre-FFM: 51757.84 ± 12429.33 g vs. pre-2.4km: 806.21 ± 160.02 s, p = 0.000, r = -0.762).

CONCLUSION: Results indicated that 8 sessions of rowing ergometer interval training are significantly effective in improving 2.4km running performance and reducing body fat for the total cohort. Males FFM increased significantly. Sports enthusiasts, athletes, physical education teachers and coaches may consider cross-training methods, such as rowing ergometer, to improve CVF. Varied training may help exercise adherence.

THE EXPLOSIVE POWER GENERATION CAPACITY IN JAPANESE INTERNATIONALLY COMPETITIVE SPRINT AND ALL-ROUND SPEED SKATERS

KUMAGAWA, D., AKIYAMA, K., IMAWAKA, T., ARIMITSU, T.

KOKUSHIKAN UNIVERSITY

INTRODUCTION: Explosive power is considered an important factor in speed skating short distance events. Because the force and power generation capacities of the lower limb muscles are improved by speed skating training in speed skaters (Nemoto et al. 1990, de Koning et al. 1991). On the other hand, there is little knowledge about the difference between senior athletes and junior skaters regarding explosive power generation capacity among top skaters. This study therefore evaluated the maximal power generation capacity of senior and junior Japanese internationally competitive speed skaters.

METHODS: Participants were Japanese male and female senior and junior speed skaters. They were divided into two groups according to age category: senior skaters (SS; 19 years old and over) and junior skaters (JS; 18 years old or younger). In addition, these participants were divided according to their skating event into two groups of sprinters (SP) and all-round skaters (AR) for both males and females. Their jumping ability was tested in squat jump, countermovement jump with arm swing and without arm swing. Subsequently, participants performed a 30-second all-out Wingate cycling test to measure peak and average power.

RESULTS: Regarding the three types of jump heights, SP skaters of both JS, SS, and male and female showed significantly higher values than AL skaters. Peak power in the Wingate cycling test was significantly higher for SP skaters than for AL skaters in both JS and SS. SP skaters showed higher average power than AL skaters in JS and SS for males and SS for females. In addition, peak and average power for both SP and AL skaters, SS showed significantly higher values than JS. Additionally, there was a significant difference in relative power per body weight between JS and SS.

CONCLUSION: These results indicate that the ability to produce explosive power may be further improved not only in sprint skaters but also in all-around skaters from the junior stage onwards.

EFFECT OF FLYWHEEL INERTIAL TRAINING ON LANDING PERFORMANCE DURING TUCK JUMP AND DYNAMIC STABILITY: A PILOT STUDY

JIANG, L., HE, J., HONG, Y., BAO, D.

BEIJING SPORT UNIVERSITY

INTRODUCTION: Extensive research has shown that reducing ground reaction forces (GRF) during landing can reduce the risk of injury. Quadriceps function is thought to potentially reduce GRF. Flywheel Inertial Training (FIT) may be an effective method for enhancing quadriceps capacity, which improves landing phase performance.

METHODS: Thirty-two healthy, adult males, mean (±SD) age of 21.5(±1.4) years and mean (±SD) training of 5.5(±1.2) years, were randomized to either FIT Group(FG) or Control Group(CG). Upon completion of 3 training sessions and fulfillment of experimental conditions, receiving 6 weeks of flywheel inertial training (Use the inertial weights that are closest to the average speed of 80%1RM per person for each barbell, calculated using Gym Aware ; N=16) or barbell training (80% one-maximum repetition; N=16). Both groups underwent 4 sets × 8 reps per session of squat separated by 3-min rest. The outcomes were tuck jump performance, peak vertical ground reaction forces ([P-vGRF] assessed by 10-second Tuck Jump Assessment [TJA]) and dynamic balance assessment including Composite Score (CS), three directions of anterior (ANT), posteromedial (PM) and posterolateral (PL) (assessed by Y-Balance Test [YBT]).

RESULTS: The primary two-way repeated measures ANOVA showed significant time effects on TJA scores ($p < 0.001$), with post-hoc analyses indicating lower post-intervention scores for both FG ($p < 0.001$) and CG ($p < 0.001$), and FG scores significantly lower than CG ($p < 0.001$). P-vGRF during landing showed significant time effects ($p < 0.005$), with a notable reduction in FIT group post-intervention ($p < 0.011$), but no significant effects in asymmetric P-vGRF or during other phases ($p > 0.075$).

Dynamic balance saw significant time-group interactions and main time effects on YBT-CS (Left: $p < 0.002$; Right: $p < 0.010$; Left: $p < 0.031$; Right: $p < 0.002$), with FG showing improved scores post-intervention ($p < 0.000$) and against CG (Left: $p < 0.044$; Right: $p < 0.038$). ANT and PM directions exhibited main time effects (ANT: Left: $p < 0.001$; Right: $p < 0.003$; PM: $p < 0.000$), and PL direction showed significant time-group interactions (Left: $p < 0.003$; Right: $p < 0.008$) and a main effect for the right limb ($p < 0.016$). Post-hoc analyses highlighted improvements in ANT and PM directions for CG and both

groups respectively, and in PL direction, FG showed significant gains compared to pre-intervention (Left: $p < 0.002$; Right: $p < 0.001$) and against CG (Left: $p < 0.007$; Right: $p < 0.001$).

CONCLUSION: Although further validation of this hypothesis and exploration of its applicability and efficacy across different sports and populations are warranted in this study. But these findings suggest that Flywheel Inertial Training could further reducing ground reaction forces and increasing the dynamic postural control than traditional training. The insights gained from this study may be of assistance to injury prevention and might provide trainers a more efficient training alternative.

LINEAR SPEED, JUMP PERFORMANCE AND CHANGE OF DIRECTION IN DIFFERENT DIMENSION CONSTRAINTS

SMIRNIOTOU, A., GIOLDASIS, A., PANTELI, F., THEODOROU, A.
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: In team sports, game elements coexist with remarkable variations under different conditions, such as the size of the playing field, the number of players, the duration of the game, and the frequency of substitutions, which significantly affect the speed and strength performance of athletes [1]. Intermittent high-intensity efforts, rapid acceleration and deceleration, changes of direction and the rapid covering of different distances are all required actions. Dynamic movements such as sprinting, jumping, and changing direction in different FIELD dimensions affect speed and power performance [2]. This study aims to compare the effects of field size restrictions in two team sports on sprinting, jumping, and change of direction performance.

METHODS: This study investigated the sprinting, change of direction, and jumping performance of amateur Soccer (SP; n=25; age=22.78±5.20yrs; experience=14.51±3.24yrs) and Futsal Players (FP; n=25; age=24.85±4.37yrs; experience=16.12±4.86yrs). Participants tested for linear sprint (SL) over 10 and 30m, change of direction (505 test), and jumping performance (CMJ and SJ). Sprint and COD times were recorded using a Brower electronic timing system. Jumping performance was measured using the Optojump system. Descriptive statistics, t-tests, and Pearson's correlations, with a significance level $p<0.05$, were used.

RESULTS: Mean SL10m and SL30m were 1.82±0.13 and 4.21±0.24sec for SP and 2.17±0.23 and 5.12±0.63sec for FP, respectively. Significant differences were found on SL30m ($F=6.44$; $p=0.023$). Mean CMJ and SJ were 38.53±5.30 and 36.28±5.00cm for SP and 29.70±4.41 and 29.35±6.54cm for FP, respectively. Significant differences were found in CMJ ($F=5.20$; $p=0.041$) and SJ ($F=4.98$; $p=0.016$). Mean COD right and left turn were 2.51±0.17 and 2.48±0.14sec for SP and 2.85±0.21 and 2.89±0.24sec for FP, respectively. Significant differences were found for both COD right ($F=9.02$; $p=0.010$) and COD left turn ($F=11.528$; $p=0.005$). In addition, significant correlations were found between the abilities of both SP and FP.

CONCLUSION: Despite the common gameplay elements, the study revealed significant performance differences between SP and FP. SP showed superior performance in the 30m sprint, which may be influenced by the nature of soccer gameplay, which often requires longer sprints due to the larger playing field. In terms of jumping ability, SP was superior in both CMJ and SJ. In addition, SP showed faster COD times, possibly due to the larger field size requiring rapid and efficient changes of direction after prolonged and faster sprints. Comprehension of these differences provides coaches with valuable insights for designing sport-specific training plans, to optimise performance in soccer or futsal. It is recommended that future research focuses on investigating the cognitive differences between athletes.

REFERENCES:

1) Bekris et al., Baltic Journal of Sport and Health Sciences, 2023

2) Smirniotou et al., The Journal of Sports Medicine and Physical Fitness, 2009

CHANGES IN PEAK FORCE DURING THREE SETS TO FAILURE IN THE BENCH PRESS EXERCISE WITH DIFFERENT RANGES OF MOTION

TSOUKOS, A., BOGDANIS, G.C.
UNIVERSITY OF ATHENS

INTRODUCTION: The range of motion has been defined as the degree of movement that occurs at a given skeletal joint during exercise [1], and its influence on force and power generation has been examined by comparing: (a) the full ROM (fROM), that is to move the barbell or the external resistance as far as anatomically possible with(b) partial ROM (pROM), that is a predetermined part of ROM within the fROM spectrum [2]. Research has shown different kinetic responses when performing resistance exercises at different ranges of motion [3]. However, no study has examined changes in peak force during repetitive sets to failure with different ranges of motion. Therefore, the aim of the present study was to examine the peak force responses during three sets to failure in the bench press exercise with different ranges of motion.

METHODS: Ten men performed three sets to failure with maximum intended velocity in the bench press exercise on a Smith machine against a relative load of 65% of maximum with three different ROMs (a) Full ROM (FULL); elbow ROM from 78.4 ± 12.1o to full extension), (b) Bottom ROM in which the barbell was moving at the bottom half of the bench press (BOTTOM, elbow angle from 77.3±8.8o to 127.5± 8.7o) and (c) Top ROM (TOP) in which the barbell was moving at the top half of the bench press (TOP; elbow angle from 114.3±4.2o to full extension). Peak force [4] was recorded at the initial and final repetitions of each set using two dual-axis force platforms at a sampling frequency of 1000 Hz. Peak force efficiency (PFE) was calculated using the following equation: PFE = Peak Force x Barbells weight-1. The closer to 1 the better the efficiency. Significance was set at $P<0.05$.

RESULTS: The relative lifting load was greater during TOP compared to FULL and BOTTOM ($p<0.01$). The three-way ANOVA [ROM (FULL, TOP, BOTTOM) x SET (1,2,3) x PART (INITIAL, LAST)] showed a significant interaction for peak force ($p<0.01$; $\eta 2=0.33$). Tukey's post hoc tests indicated that peak force was significantly higher in TOP compared to FULL (from 13.4% to 21.8%) and BOTTOM (from 29.4% to 39.5%). Also, peak force was higher in FULL ROM compared to BOTTOM (from 8.0% to 18.9%) in all sets and parts ($p<0.001$). Peak force decreased from the initial to the final repetitions in all sets during the FULL ($p<0.01$), in the 1st and 3rd set during the TOP ($p<0.01$) and in the 1st set only during the BOTTOM ($p=0.05$). PFE was significantly different between all conditions (FULL=1.10, TOP=1.06, BOTTOM=1.00).

CONCLUSION: Peak force was greater during TOP compared to FULL and BOTTOM. Also, changes in peak force during FULL were greater compared to BOTTOM. These results might be due to better peak force efficiency (PFE) that the participants showed during the BOTTOM.

REFERENCES:

1. Schoenfeld BJ, Grgic J. (2020).

2. Newmire DE, Willoughby DS. (2010).

3. Clark, R. A., Bryant, A. L., & Humphries, B. (2008).

4. Lander, J. E., Bates, B. T., Sawhill, J. A., & Hamill, J. (1985).

THE CORRELATION BETWEEN TECHNICAL ADVANCEMENT AND GAZE PATTERNS IN VOLLEYBALL UNDERHAND PASS

KATO, T., FUJIWARA, K., INOUE, S., NAKAMURA, Y., TAKAMI, K., YAMAMOTO, H., SUGAJIMA, Y.

ASAHI UNIVERSITY

INTRODUCTION: In sports activities, "vision" plays an important role in situational judgment. The incorporation of gaze-focused instruction could potentially result in improved players performance and reduce the time needed for beginners to acquire technical skills. Therefore, this study aimed to analyze the improvement in skills, and clarify the relationship with eye movement dynamics. If improvements in underhand passing skills by volleyball team members are observed through peer coaching, identifying significant changes in eye movement dynamics during this process may suggest the potential for incorporating eye movements into technical instruction.

METHODS: Sixteen participants, comprising 8 adult male university students and 8 members of the university volleyball team, participated in the study. The study utilized the Tobii Pro Glasses 3, a wearable eye-tracking device, for eye movement analysis. A peer of the participants individually performed 10 underhand passes with a member of the volleyball team, wearing the Tobii Pro Glasses 3. The eye movement phases were categorized as (A) from the participants hand to the top of ball trajectory, (B) around the top, and (C) from the top to the opponent receiving the ball. The number of steps taken by the volleyball team member in the lateral and forward/backward directions was recorded. After the first set of passes, individual coaching was provided for approximately 10 minutes, followed by a second set of passes. A paired t-test (IBM SPSS) was employed to compare pre- and post-coaching measurements of step count, gaze fixation positions, and dwell time ratios in five defined areas: (1) opponent, (2) near opponent, (3) ball, (4) near ball, and (5) other.

RESULTS: The male university student group showed improved step counts in lateral and forward/backward directions after receiving underhand passing coaching, with an average decrease from 1.53±0.53 steps before coaching to 1.17±0.36 steps after coaching. Regarding eye movement dynamics changes after individual coaching by volleyball team members, a significant increase in gaze fixation on the "ball" was observed ($p=0.025$). Specifically, the gaze fixation ratio on the ball increased from 11% before coaching to 41% after coaching around the top of the passing trajectory. Although the volleyball team members did not provide specific eye movement guidance, individualized technical coaching resulted in alignment of eye movement dynamics with those of the volleyball team.

CONCLUSION: Individualized technical coaching led to improved step counts in 7 out of 8 university students. Notably, participants started to focus on the ball around the top of the passing trajectory, similar to the volleyball team members. This suggests that incorporating eye movement guidance may have additional benefits in coaching effectiveness, as confirmed by the potential improvement in underhand passing skills.

EFFECTS OF HIGH-PULL TRAINING WITH OPTIMAL LOAD ON POWER GENERATION CAPACITY

HATASHIMA, K., TANABE, G., HANAKI, Y., KUMAGAWA, D., TANAKA, S.

KOKUSHIKAN UNIVERSITY

INTRODUCTION: Muscular power is considered that one of the main determinants for athletic performance of require the explosive production of force. Weightlifting and its derivatives are considered highly effective training methods for power development because they produce among the greatest power during maximal extension occurs at the hip, knee, and ankle, relative to other traditional resistance exercises (1). However, there are not many reports intervention study of the effect of training using weightlifting and its derivatives. Therefore, the purpose of this study was to investigate that the effects of power development by High-Pull (HP) as a pulling derivative training.

METHODS: Thirty-one healthy male college students recruited for this study (19.1±1.0years, 172.4±6.4cm, 68.0±7.1kg). The subject performed HP exercise at intensities of resistance that maximal power output during 2days per week in 8 weeks. The peak velocity during three different external loads in HP was calculated in Pre, 4 weeks after (Mid) and 8 weeks after (Post). The peak velocity during three different external loads in HP was calculated in all subjects. After, relationship between the load and velocity was expressed by a linear regression line. The maximal theoretical velocity (V0) and load (L0)

were indicated as the interception of the regression line with the vertical and horizontal axis, respectively. In addition, the slope (Slv) of the linear load-velocity relationship were calculated in all subjects. The power during three different external loads in HP was calculated. Relationship between the power and load was expressed by a second-degree polynomial model. The maximal theoretical power (Peak Power: PP) was estimated as the top of the parabola (2). In addition, load at PP was calculated in all subjects. All subjects were divided two groups into velocity-superiority (VG) and force-superiority (FG) based on all subjects Slv in Pre.

RESULTS: Analysis of variance revealed a significant interaction in V0 between the groups and period ($p<0.05$). V0 in Pre was significant difference between SG and FG ($p<0.05$). In addition, there was not observed significant difference between Mid and Post. On the other hand, there was no significant differences of L0 for groups and periods. Although there was a significant difference of period main effect on PP ($p<0.05$), significant interaction was not observed.

CONCLUSION: HP exercises was effective for improving the maximal theoretical velocity of the L-V relationship for FG. These findings were supported that the "principle of velocity specificity" as a specific stimulus to promote velocity-specific neural training adaptations (3). From these results, it was suggested that High-Pull training with maximal power output load effective for athletes with inferior high-velocity strength.

REFERENCES:

1) Takei et al., J. strength cond. res, 2021

2) Piceron et al., Eur. J. Appl. Physiol, 2016

3) Cormie et al., Med. Sci. Sports Exerc, 2007

THE EFFECT OF SPRINT INTERVAL AND HIGH INTENSITY INTERVAL TRAINING ON THE RATE OF CARBOHYDRATE METABOLISM AT 75%VO2MAX IN TRAINED RUNNERS

ZACHAROGIANNIS, E., PARADISIS, G., DALLAS, G., TSOPANIDOU, A., ZACHAROGIANNI, A.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Sprint interval (SIT, intensities 140-170%VO2max with short work bouts <30s and long recovery periods 4min) and high intensity interval (HIIT, intensities 90-100%VO2max with work bouts 30s-5min and recovery periods 30s-5min) training have been proposed to improve cardiorespiratory endurance performance in untrained as well as elite distance runners. However prolonged (>90min) running endurance performance directly depends on the rate of carbohydrate (rCHO) metabolism due to limited CHO storage. Purpose: The purpose of the present research was to study the effect of SIT and HIIT training methods on rCHO use at a submaximal (mean marathon pace) running velocity corresponding with 75%VO2max.

METHODS: Twenty-two trained endurance runners (15 males and 7 females, mean ± sd age 33.6±12.1 years, body mass 74.5±10.7 kg, stature 176.5±6.7 cm, % body fat 12.9±3.2 and VO2max 54.33±5.1 ml.kg-1.min-1) assigned randomly to participate either in SITG (n=11) or HIITG (n=11) group. Each experimental group added for 8 weeks (2 days/week) either SIT or HIIT training sessions together with the rest of their training routine. Pre and post training subjects performed incremental test to determine VO2max and one 6 min continuous submaximal run at a speed corresponding with 75%VO2max 48 hours after VO2max trial. Submaximal run speed was the same during post measurement. Oxygen consumption and respiratory exchange ratio (RER) were monitored in 60 s intervals during maximal and submaximal exercise trials. CHO oxidation was calculated using stoichiometric equations (Frayn, 1983) with the assumption that urinary nitrogen was negligible.

RESULTS: Anova analysis showed that 8 weeks application of HIIT lowered 20% mean ± sd (pre 2.92±0.8 V post 1.9±0.47 g.min-1) rCHO at the same mean±sd (11.7±1.24 km.h-1) running speed ($p<0.05$) for the HIITG. The SITG (pre 3.56±1.01 V post 3.52±0.89 g.min-1) lowered only 1% rCHO ($p>0.05$) at the same pre and post mean±sd (12.2±1.3 km.h-1) running speed.

CONCLUSION: Although SIT may be recommended as a time saving mode of interval training to improve running endurance performance, for prolonged though endurance running maximal effort its effectiveness regarding CHO sparing adaptations is limited. The results of the present study support the use of HIIT instead of SIT during marathon and ultramarathon training.

RESEARCH ON THE KEY TECHNIQUE OF MENS 100M WHOLE PROCESS BASED ON VIDEO PANORAMA ANALYSIS AND SCENE SPLICING TECHNOLOGY

HU, B., YUAN, T., GUO, Q., GAO, D., LU, Q.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The purpose of this paper is to use video panorama processing technology to analyze the mens 100m final of the 2023 National Athletics Championships, World Championships, and Asian Games Trials, with the champion Zhenye Xie as the object of study. The game is filmed on-site to obtain first-hand video data, and then the action is decomposed using the Dartfish software to derive a segmented panoramic image and a panoramic video.

METHODS: The research methods mainly include literature review, surveys,data analysis, experimental methods, and software development. The entire 100m course was divided into five sections, with five camera positions focusing on shooting images within the distance range , and finally five videos were shot, which were used to extract the panoramic image.Then, using "Timing""measure" function to get the key kinematic indexes and make a further analysis.

RESULTS: In this race, the champion Zhenye Xie ran a total of 46.5 steps in 10.09s. Measurement of the panorama of each segment yielded that his average step length was 2.13m, the minimum step length was the 1st step, 1.31m, and the maximum step length was the 35th step, 2.38m; his average step time was calculated to be 0.21s, the maximum step time was the 1st step, 0.48s, and the minimum step time was the 38th and 39th steps, 0.17s. 0.17s; his average step speed was calculated to be 10.53m/s, the minimum step speed was 1.31m/s for step 1, and the maximum step speed was 13.59m/s for step 38.the average speeds of the section were as follows:section 1, 0-20m,6.80m/s; section 2, 20-40m,10.99m/s, section 3,40-60m, 11.56m/s; section 4,60-80m, 11.49m/s, section 5, 80-100m, 11.30m/s.

CONCLUSION: Video panorama technology and panorama splicing technology can be used as a powerful analytical tool for speed projects, which can amplify the athletic performance of the players in the process of rapid sports, and provide a means for researchers to grasp the technical characteristics of the athletes more accurately, in which the process of pre-collection of data needs to be strictly controlled by the collection tools to improve the quality of video processing and improve the accuracy of the measurement data. The following is a summary of the data collected during the first stage of the game.Video collection, frame analysis and panorama extraction were carried out in this game to visualise the sports performance; Zhenye Xies performance was broken down into frames to obtain key kinematic parameter indexes: stride length, stride time, stride speed, segment timing, segment speed and so on. In the perspective of video panorama analysis, due to the differences existing in the shooting of different camera positions, there is a certain human error in the acquisition of kinematic indexes, and the use of finer units of measurement reference values and the interception of a larger range of front and side images are conducive to the reduction of errors and the enhancement of the accuracy of the analysis.

IMPACT OF MUSCLE LENGTH ON INTER- AND INTRA-SET DECREASE IN POWER OUTPUT DURING REPEATED SETS OF BENCH PRESS EXERCISE

BOGDANIS, G., TSOUKOS, A.

NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Previous studies have shown that exercise at long muscle length may have a significant effect on force and power output and may also induce a greater degree of fatigue [1]. Also, it has been suggested that training at long muscle lengths using a relatively long time under tension (TUT) may maximize muscle hypertrophy [2]. However, little is known regarding the reduction in muscle performance during repeated sets of resistance exercise at different muscle lengths. Therefore, the aim of this study was to examine the impact of muscle length on inter- and intra-set decrease in power output during repeated sets of bench press exercise.

METHODS: Following familiarization and maximum strength testing (1RM), ten resistance trained men performed three sets to failure with two min of recovery at two different ranges of motion (ROM) in the bench press exercise on a Smith machine: (a) one condition in which the barbell was moved at the upper half of the full ROM (SHORT) and (b) another condition in which the barbell was moved at the lower half of the full ROM (LONG). Repetitions were executed as fast as possible, against a load of 65% of the ROM-specific 1RM. Force was measured using two force plates on which the bench was placed, and barbell velocity was monitored by a linear transducer.

RESULTS: Barbell vertical displacement was similar in SHORT and LONG (25.1 ± 27.0 vs. 26.4 ± 28.0 cm, respectively, $p>0.5$). 1RM was higher in SHORT than LONG (120 ± 14 vs. 94 ± 17 kg, $p<0.001$). Mean power output at the start of each set was higher at SHORT compared with LONG (set 1: 511 ± 27 vs. 426 ± 63 W, $p<0.001$), but it dropped to similar values at the end of each set, irrespective condition . The percent drop of mean power within each set was similar across both sets conditions (SHORT: 45 ± 17, LONG: 43 ± 13%), as was the drop of mean power at the initial repetitions (6 ± 16% vs. 2 ± 12% from set 1 to set 2, respectively, $p>0.5$ and 12 ± 10% vs. 15 ± 8% from set 2 to set 3, respectively, $p>0.5$). TUT was 25 % higher (57.1 ± 9.6 vs. 46.0± 10.1 s, $p=0.012$) and total impulse was 60% higher in SHORT than long (49.0 ± 10.2 vs. 30.6 ± 9.1 kN.s, $p<0.001$).

CONCLUSION: Exercising at the upper part of the full ROM in the bench press exercise results in considerably higher applied forces over a longer period of time (TUT), compared with exercise at the lower part of ROM. These differences may be due to the different muscle length and the mechanical advantage at the upper part of ROM and the findings may have implications for training.

PHYSICAL STRENGTH FACTORS COULD PREDICT THE COMPETITIVE LEVEL FOR JAPANESE MALE TENNIS PLAYERS

KOYA, N., KITAMURA, T.

DAIDO UNIVERSITY

INTRODUCTION: Technical skills are the predominant factors in tennis [1]. Therefore, players spend a lot of time in technical training with a racket on court. Devoting the same time to physical training without a racket is challenging. However, as the level of competition increases, many players realise the importance of physical strength and fitness [1, 2, 3].

When designing training programs for tennis players, it is important to consider physical strength required, as this varies depending on the competition level. Clarifying the difference in physical strength between domestic and global levels can be a useful and developmental training indicator. Although research on this topic is still in the early stages, quantifying these factors is necessary for designing training programs that can help players compete at a world-class level. This study aimed to determine physical strength factors that can serve as a guideline for Japanese male tennis players and to examine the physical strength indicators.

METHODS: 53 male tennis players performed five physical strength tests (5m sprint, T-test, 505 agility test, VJ, and medicine ball throw (MBT)). The Japan Tennis Association ranking points per one tournament (JTA/1T) were used as an indicator of tennis competition level. Pearson's product-moment correlation coefficient was used to assess the association between ranking and physical fitness. Principal component analysis was performed on the physical strength variables, and PCA1 was conducted as a comprehensive index of physical strength. Multiple regression analysis with JTA/1T as the dependent variable and each physical strength test item as the independent variable was performed to determine the physical strength items that affected ranking. Based on these results, a regression formula was derived to predict the rankings. Statistical significance was set at $P<0.05$.

RESULTS: Multiple regression analysis was performed on 53 male tennis players, and a significant regression equation was found using MBT and T-test as independent variables, which could predict rankings (Y=10886.60+719.99x1-5298.06x2 (x1: MBT,x2: T-test), $F=27.95$, $p<0.001$). The contribution rate of this equation was 41.8% ($r=0.647$); in other words, 41.8% of the rankings could be explained by the MBT and T-test.

CONCLUSION: The key discovery of this research was that enhancing physical strength factors related to MBT and T-test could help Japanese male tennis players closer to world-class status. Additionally, these indicators could be used to recognize talented junior players in the future.

1.Smekal et al. (2001) 2. Fernandez-Fernandez et al.(2009) 3. Reid and Schneiker (2008)

RELATIONSHIPS BETWEEN INTERSET REST INTERVAL AND THE REPETITIONS DURING BENCH PRESS

WE, H., PARK, J.H., YUN, S., SEO, Y., LEE, Y., LEE, S.H., SON, S., LEE, D.T.
KOOKMIN UNIVERSITY

INTRODUCTION: The purpose this study was to analyze the relationships between the rest interval between sets and the repetitions during bench press.

METHODS: Fifteen healthy young men (23.6±2.2 yrs, 174.8±3.4 cm, 76.2±10.2 kg, 24.9±3.2 kg/m2, 1 repetition maximum (1RM) 75.9±19.3 kg) participated in 3 separate bench press testing sessions. In each session, they performed 3 sets at 70% weight of their 1 RM and were asked to rest 2 (2-RI), 5 (5-RI), or 10 min (10-RI) between sets. They were also asked to repeat at their best for each set, and the repetitions were counted. Differences between rest intervals and between sets were compared using one-way ANOVA and paired t-test, respectively. Correlations in repetition between rest intervals were examined using Pearson correlation.

RESULTS: The repetitions were 17.9±5.1, 7.7±3.0, and 5.1±2.7 in 2-RI, 17.3±3.9, 11.9±3.8, and 9.1±3.5 in 5-RI, and 17.3±3.8, 15.1±4.3, and 12.4±3.6 reps in 10-RI during the 1st, 2nd, and 3rd sets, respectively. The decrements of repetition from the 1st to the 2nd sets were significantly greater in the order of 2-RI (11.7±3.6, $p<0.001$), 5-RI (7.5±3.1, $p<0.001$), and 10-RI (4.3±2.2 reps, $p<0.05$). Accordingly, the percentile decrements of repetition from the 1st to the 2nd sets were greater in the order of 2-RI (60±13, $p<0.001$), 5-RI (39±15, $p<0.001$), and 10-RI (23±11%, $p<0.005$). No differences in repetition between the 2nd and the 3rd sets were noticed in all rest intervals. But the percentile decrements of repetition from the 2nd to the 3rd sets were greater in 2-RI (36±18) than 10-RI (17±15%) ($p=0.005$). When the magnitude of decrements from the 1st to the 2nd sets were compared, 2-RI and 5-RI were highly correlated ($r=0.788$, $p<0.001$). But no relationships were found between 2-RI and 10-RI ($r=0.238$) or 5-RI and 10-RI ($r=0.426$).

CONCLUSION: The repetitions of bench press during the 2nd set at 70% of 1 RM was affected by the rest interval between sets, but those during the 3rd set was not so. Nonetheless, the percentile decrements were affected by the rest interval. The rest interval may influence the repetitions of the following set, but it appeared to be not the case at the 10 minutes interval. It is of interest that these observations are consistent in other weights and other types of resistance exercise.

INFLUENCE OF OMEGA-3 FATTY ACID INTAKE ON LACTATE PRODUCTION AFTER A BASKETBALL MATCH

APOSTOLIDIS, A., BOGDANIS, G., APOSTOLIDIS, N., PAPAPANAGIOTOU, A.
UNIVERSITY OF ATHENS

INTRODUCTION: Basketball is a team sport characterized by repeated fast actions, involving short sprints, jumps and changes of direction (McInnes et al., 1995). During a match exercise intensity is high, as indicated by the average heart rate which is around 80 to 90% of the maximum, while the metabolic demands for anaerobic and aerobic energy are also augmented [1,2]. The physiologically demanding nature of a basketball match is evident by marked elevations of blood lactate and non-esterified fatty acids, while metabolic perturbations and muscle microtrauma due to the intense eccentric muscle activity, induce oxidative stress and inflammatory responses which may last for several days [3]. There is evidence that omega 3 supplementation may modify the metabolic responses to heavy eccentric exercise [4]. The aim of the present study was to investigate the effect omega-3 polyunsaturated fatty acids supplementation, on blood lactate responses to a basketball match.

METHODS: The experimental group consisted of 10 basketball players who received an omega-3 supplement consisting of 2 g of eicosapentaenoic acid-EPA and 1 g of docosahexaenoic acid-DHA, daily for five weeks. The control group consisted of 10 basketball players who received a placebo for the corresponding period of time. Each group was divided in two teams, and they played two matches of 40 minutes pure time (5 vs. 5 without substitutions). Capillary samples to measure blood lactate concentration were taken before, at halftime and immediately after the games. Statistical analysis

was performed using a two-way mixed model ANOVA with repeated measures (2 groups X 3 sampling points), followed by Tukey's post-hoc tests.

RESULTS: The ANOVA did not show any significant differences between the experimental and the control group at baseline lactate measurement (0.9 ± 0.39 vs. 1.1 ± 0.65 mmol/L, p=0.406, respectively). On the contrary, differences between groups were found at the halftime (2.1 ± 0.64 vs. 3.9 ± 1.59 mmol/L, p=0.006, respectively), and at the end of the game (1.6 ± 0.56 vs. 2.7 ± 1.36 mmol/L, p=0.050).

CONCLUSION: The findings of the present study show that five weeks of omega-3 supplementation result in a decrease in blood lactate responses to a basketball match, as previously seen for heavy eccentric exercise [4].

EFFECTS OF DIFFERENT TYPES OF EXERCISE (CONCENTRIC AND ECCENTRIC) ON CONTRACTILE PROPERTIES OF ELBOW FLEXOR USING TENSIOMYOGRAPHY.

HIRATSUKA, K., IKEDA, N.2, YOKOZAWA, S.3, HATASHIMA, K.4, KUMAGAWA, D.4, TANAKA, S.4

1: HACHINOHE GAKUIN UNIVERSITY, 2: RITSUMEIKAN UNIVERSITY, 3: HEISEI INTERNATIONAL UNIVERSITY,4: KOKUSHIKAN UNIVERSITY

INTRODUCTION: Fatigue influences athletic performance and can also increase the risk of injury in sports, and most of the methods to evaluate it require an additional voluntary effort. Recently, tensiomyography (TMG) has received attention as a non-invasive assessment of muscle contractile properties. TMG is independent of motivation or volitional effort. For this reason, TMG has been investigated as a means to assess muscle contractile properties after fatigue. However, no previous study has compared muscle contractile function changes over days after eccentric versus concentric exercise. Thus, the aim of the present study was to investigate muscle contractile properties occurring in the early and recovery phases after concentric and eccentric exercise using TMG.

METHODS: Eleven healthy males (mean ± standard deviation [SD] age: 21.4± 0.5 years; height: 172.2± 4.3 cm; weight: 68.8± 7.7 kg) participated in this study. Subjects performed eccentric contraction exercise (ECC) of elbow flexor with one arm, and concentric contraction exercise (CON) of elbow flexor with the other arm with the same total work (ECC: 3455.5± 927.9 J, CON: 3455.7± 929.0 J). Maximal voluntary isometric contraction (MVC) torque, range of motion (ROM), upper arm circumference (CIR), muscle soreness (SOR) and muscle contractile properties (TMG parameters: maximum displacement [Dm], contraction time [Tc] and velocity of deformation [Vd]) were assessed before, 1 hour and 1–5 days after exercise.

RESULTS: There was no significant difference in total work during exercise between the two exercise types. Significantly larger changes in MVC, ROM, and CIR were evident following ECC compared to CON, and only ECC resulted in significant increases in SOR. Significant differences existed between ECC and CON for changes in muscle contractile properties. Dm and Vd in ECC were significantly lower than CON 1 hour after exercise and remained low for up to 5 days after exercise. Tc showed a significant increase following ECC compared with CON, and no significant changes in Tc from the pre-exercise values were evident for CON.

CONCLUSION: In conclusion, despite the total work being the same, TMG parameters varied depending on the type of muscle contraction. These results are particularly important to understand how TMG parameters are modified with the type of contraction, and indicate that TMG can be highly sensitive in detecting fatigue-induced changes and its recovery.

THE PERFORMANCE AND PERCEPTUAL RESPONSE TO A RESISTANCE EXERCISE OVERTRAINING PROTOCOL (SQOT): A PILOT STUDY

BELL, L., RUDDOCK, A., MADEN-WILKINSON, T., ROGERSON, D.

SHEFFIELD HALLAM UNIVERSITY

INTRODUCTION: A short-term period of overtraining (OT) can lead to either enhanced performance capabilities (functional overreaching (FOR)), or performance stagnation (non-functional overreaching (NFOR)). To date, little is known about the transitory threshold where highly demanding resistance exercise training results in either FOR or NFOR. This pilot study aimed to characterise the perceptual and strength performance effects of a barbell back squat training microcycle designed to induce overtraining (OT), and therefore, enhance current understanding of the response to short-term OT.

METHODS: Following informed consent, 8 male trained participants (mean ± SD; age = 24.6 ± 2.8 years; relative to body mass back squat one repetition maximum (1-RM) = 1.9 ± 0.4; training experience = 7.0 ± 3.2 years) participated in a resistance exercise training programme consisting of four phases: 1) baseline testing (PRE), 2) a 2-week foundation training (BASE), 3) a 5-day back squat OT microcycle (SqOT), and 4) a 2-week taper comprised of two full body resistance training sessions each week (TAPER). SqOT consisted of 5 sets of barbell back squats performed each day using 80% of daily adjusted 1-RM performed until a 40% velocity loss was achieved. Performance (isometric mid-thigh pull (IMTP) peak force (PF); countermovement jump (CMJ) PF and height) and perceptual (perceived recovery scale (PRS); Hooper Index (HI)) were recorded at PRE, before each day of SqOT and at select intervals during TAPER (POST 1 d, 2 d, 7 d and 14 d). Follow-up back squat 1-RM testing was conducted at POST7 and POST14.

RESULTS: There was a mean percentage increase of 4.8% for 1-RM at POST7 and 5.2% at POST14, relative to PRE values. IMTP PF improved at POST7 (10.3%), relative to PRE, with improvements maintained at POST14 (10.3%). CMJ PF decreased each day of SqOT (4.2% at Day 1, 9.1% at Day 2, 10.9% at Day 3, 9.2% at Day 4 and 7.2% at Day 5) relative to PRE but had returned to PRE values by POST7. There were no changes in CMJ height either during SqOT or TAPER. There was no difference in PRS or HI scores between PRE and Day 1 of SqOT. However, there was a decrease in PRS of 27.7% at Day 2, 41.5% at Day 3, 23.1% at Day 4, 20.0% at Day 5, 18.5% at POST1, 8.6% at POST2, and 10.8% at POST7 relative to PRE. PRS did not

return to PRE values until POST14. Global HI score increased by 17.4% at Day 2, 35.9% at Day 3, 15.2% at Day 4, 15.2% at Day 5 and 21.7% at POST1 relative to PRE values but had returned to baseline by POST2. HI decreased by 9.8% at POST7 and 14.1% at POST14.

CONCLUSION: Findings from this pilot research demonstrate that a short-term period of OT may be an effective strategy to increase back squat 1-RM and IMTP PF following an acute reduction in CMJ PF and perceived recovery and wellness both during, and in the days following SqOT. Additional findings note that the duration of the post-OT taper appears to influence the magnitude of FOR and the point at which peak strength performance occurs.

YOU DON'T RUN LYING DOWN – MUSCLE ACTIVITY OF A NOVEL STANDING TEST ASSESSING ISOMETRIC HIP-EXTENSION STRENGTH

HUGHES, J.1, HOLZHAUER, L.2, JULIAN, R.2,3

1CARDIFF METROPOLITAN UNIVERSITY, 2UNIVERSITY OF MÜNSTER, 3UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Team sports often require high volumes of acceleration, deceleration, and changes in direction that lead to fatigue through intense force generation and braking, increasing the risk of hamstring injuries1, 2. The hips ability to generate substantial force is crucial for hamstring support during the stance phase of running, particularly at higher speeds and during sprinting3. The gluteus maximus, identified as a compensatory hip extensor, can protect the hamstrings from excessive strain under fatigue4. Therefore, evaluating the gluteus maximus capacity is vital to mitigate non-contact injuries linked to fatigue. This paper presents a novel unilateral isometric hip-extension strength test for assessing posterior-chain muscle activity.

METHODS: Muscle activity of biceps femoris, gluteus maximus, semitendinosus, and gastrocnemius were assessed in eight participants (age: 21.9 ± 2.4y) using normalized sEMG during maximal voluntary contraction for the stance and pull leg. The study used a 2 x 4 x 2 (task condition x muscle group x leg dominance) repeated measures factorial ANOVA design.

RESULTS: A significant main effect of the task condition ($p < .001$, $eta2 = .55$), showed the pull leg had higher muscle activation than the stance leg. Muscle activation varied significantly across muscle groups when combined with the task condition ($p < .001$, $eta2 = .49$), especially in the hamstrings of the pull leg. Leg dominance did not significantly affect muscle activation patterns ($p < .758$, $eta2 < .01$).

CONCLUSION: The test effectively assessed hamstring activation, particularly in the pull leg, and demonstrated its utility in independently monitoring each leg. It could reveal asymmetries in leg strength, potentially valuable in sports like football, where such differences are relevant. The influence of leg dominance on muscle activation was minimal, suggesting the test's potential to highlight between-leg strength disparities.

REFERENCES

1. Thorborg, et al. (2013), 2. Hägglund, et al. (2013), 3. Schache, et al. (2014), Edouard, et al. (2018)

COMPARISON OF 2 JUMP TESTS USED TO ASSESS ANAEROBIC POWER AND CAPACITY IN ELITE ALPINE SKI RACERS

PATTERSON, C., RASCHNER, C.

UNIVERSITY OF INNSBRUCK

INTRODUCTION: Jump tests are popular to assess anaerobic power and capacity in alpine ski racers. Our lab has shown that training can improve the loaded repeated jump test (LRJT) results (1) which may lead to improved performance. We have also shown that LRJT results are only minimally related to ski racing performance (2). Male racers perform the LRJT with 40% body weight on a barbell. Many racers have spine and knee problems and cannot perform the test. We have developed a new squat test (60ST) for anaerobic power and capacity in ski racers. It has only 6 body weight jumps and 60 squats. The aim of this study is to compare the results of the 2 tests in male ski racers.

METHODS: 9 male ski racers (Austrian national team juniors and European Cup) were tested with the 60ST in 2018. The 60ST required 3 reference body weight jumps, then 60 squats with 70% body weight on a barbell (90° knee angle, 2 minutes duration) immediately followed by 3 jumps again. The single best relative power of the 3 post-squat jumps was then expressed as a percentage of the best reference jump power. Data from the last LRJT in 2017 was used. The LRJT consisted of 60 jumps (2.5 minutes) on force platforms with a loaded barbell (40% body weight). The mean relative power of the last 12 jumps (30 seconds) was expressed as a percentage of the reference jump power performed 5 minutes before the test. The percentage results of the two tests were then compared with a student's t-test and a Pearson's correlation.

RESULTS: The mean reference relative power of the 60ST was 43.5 W/kg, and post mean relative power was 39.0 W/kg, or 89.6% (range 83.6 – 98.6%) of the reference. The mean reference relative power of the LRJT was 41.5 W/kg, and the mean relative power of the last 12 jumps was 34.0 W/kg, or 82.0% (range 62.8 – 90.0%) of the reference. The students t-test showed that the 2 tests were significantly different ($p = 0.04$), and there was no correlation between the tests ($r = 0.02$).

CONCLUSION: The difference in reference jumps was probably due to load difference. The 60ST reference was done with body weight and the LRJT reference was with 40% body weight. The drop off in power in the LRJT was greater, again due to the heavier load. The 60ST also produced fatigue, but markedly less than the 60ST. The 60ST involves less stress on the spine and knees, with only 6 body weight jumps. However, the athlete must have healthy knees and good core stability to

perform 60 squats with an additional load of 70% body weight. 2 Athletes had 60ST post jump values of 98% of their reference, perhaps indicating that the test is too "easy". Some ski racers have commented that the LRJT is a good reflection of the fatigue experienced in a giant slalom race. Skiing will never will adequately simulated in a lab setting, but work is being conducted to develop a test that is taxing and simulates the demands of ski racing.

1. Patterson et al. (2014), 2. Patterson et al. (2019)

COMPARING IMU OUTPUTS BETWEEN 1ST TEAM AND U18 FEMALE SOCCER PLAYERS THROUGHOUT PRESEASON

SMITH, A., DONNELLY, J., WHITE, A., SCOBIE, N.
UNIVERSITY OF GLASGOW

INTRODUCTION: With the growth in professionalism, popularity and revenue in women's soccer, greater investment is being made throughout academy environments to ensure young players can reach the physical, physiological, and mental demands of the sport. However, limited research at the youth level creates ambiguity when determining differences in physical loading between academy and senior players. Thus, this study aimed to compare physical IMU outputs between female U18 academy players and professional soccer players throughout pre-season.

METHODS: Participants were recruited from the same Scottish women's soccer team U18 squad (n = 19, mean age 16.5 ± 0.6 years) and 1st Team (n= 23, mean age = 25.1 ± 5.6 years) during the 2023/24 season. Top speed (m/s), Distance covered (m), Sprint count (n), Sprint Distance covered (m), and count of Acceleration and Deceleration actions (n) from IMU output were analysed (Playermaker). Descriptive statistics summarised key findings, with inferential methods utilised to determine variances between squads. Multivariate tests reported statistical significance at $P<0.05$ between squads for physical metrics.

RESULTS: Mean weekly distance was significantly higher for U18 players in comparison to 1st team (5566.8 ± 1585.8km vs 4598.9 ± 2046.4km, $P < 0.01$). Mean weekly top speed (m/s) was significantly higher in 1st team in comparison to U18 squad (6.2 ± 0.7 m/s vs 5.9 ± 0.6 m/s, $P < 0.01$). Mean weekly sprint distance covered was significantly higher in 1st team versus U18 (72.9 ± 104.7m vs 40.8 ± 61.5 m, $P<0.01$). No significant differences were highlighted for mean weekly sprint count and count of acceleration and deceleration actions between squads ($P > 0.05$).

CONCLUSION: These findings show that although U18s are exposed to a greater volume, this is performed at lower intensities within the pre-season window, and therefore potentially not replicating the high intensity intermittent nature of the game. These findings suggest the introduction of individualised speed thresholds appropriate for developmental state. Furthermore, formatting future training to incorporate more anaerobic physiological adaptations to help prepare academy players for the physical demands of professional soccer.

EXPLORING GENDER AND FATIGUE EFFECTS ON HAMSTRINGS TO QUADRICEPS RATIO IN TRIATHLETES: A COMPARATIVE ANALYSIS OF JOINT TORQUE AND MUSCLE ACTIVATION MEASURES

LI, T.E., HSU, W.1, LIN, Y.2, WEI, H.1
NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: The Hamstrings to Quadriceps (H:Q) ratio is a crucial index utilized in sports science, rehabilitation, and athletic performance enhancement programs. It serves as a indicator of assessing muscle strength and functional muscle balance around the knee joint [1]. This study aimed to explore gender and fatigue effects on the H:Q ratio calculated by using both joint torque and muscle activation variables obtained from maximal isometric contractions and to investigate the correlation between the H:Q ratio calculated from the two different measuring instruments.

METHODS: Twelve males and ten females triathletes who underwent pre- and post- isometric test before and after a incremental cycling test as fatigue protocol. The tests included three sets of maximal isometric contractions of knee extension and flexion at 90 degrees to the ground on their dominant side. Recordings of electromyography (EMG) signals from the vastus lateralis and semitendinosus muscles were conducted simultaneously. Peak torque and EMG signals were normalized to body weight and maximal voluntary contraction respectively before processed to calculate the H:Q ratios. Two-way ANOVA was employed to analyze fatigue and gender effects on peak torque at the knee joint and normalized integrated EMG as well as H:Q ratio obtained from these two measurement, namely the H:Q torque ratio and the H:Q EMG muscle activation ratio. Spearman correlation test was utilized to assess the correlation between H:Q torque ratio and H:Q EMG muscle activation ratio.

RESULTS: Before and after fatigue protocol, a decreasing trend in peak torque values during knee joint extension and flexion was observed with significant differences noted. This led to no significant difference in the H:Q torque ratio (Male: PRE: 39.77±8.30, POST: 43.85±9.50%, Female: PRE: 43.42±10.38, POST: 43.79±11.61%; p=0.39) . Consequently, the H:Q EMG muscle activation ratio (Male: PRE: 45.48±18.84, POST: 41.16±17.52%, Female: PRE: 49.21±13.73, POST: 38.90±9.21%; p=0.02*) showed significant differences before and after fatigue. Additionally, no significant differences were found between genders, and there was no significant correlation between H:Q torque ratio and H:Q EMG muscle activation ratio, which is consistent with previous studies [2, 3].

CONCLUSION: In our triathletes, both H:Q torque ratio and H:Q EMG muscle activation ratio fall around 40-50%. This wide range of H:Q torque ratio was possibly due to diverse in muscle demands due to age and level of triathlon. Different measuring instruments, where torque assesses muscle strength while EMG reveals muscle activation levels, affected H:Q ratio, adding another evidence in the literature that interpretation of the H:Q should be made with caution.

REFERENCES:

1.Ruas, C.V., et al., Sports medicine-open, 2019

2.Kong, P.W. and S.F. Burns, Phys Ther Sport, 2010

3.Oliveira, A.d.S.C., et al., J Electromyogr Kinesiol, 2009

Acknowledgments

Funding: Thanks to the support from the National Science and Technology Council (Guarding the infinite blooming power and beauty (2/4), Project No. 113-2425-H-011-001)

EFFECT OF MOTOR IMAGERY TRAINING ON MUSCULAR PERFORMANCE AND HYPERTROPHY

STAVROU, N.2, KREKOUKIA, M.1, PSYCHOUNTAKI, M.2, SPILIOPOULOU, P.1, ZARAS, N.3,4, BOGDANIS, G.1, TERZIS, G.1

1SPORTS PERFORMANCE LABORATORY, SCHOOL OF PHYSICAL EDUCATION AND SPORT SCIENCE, NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, GREECE; 2SPORTS PSYCHOLOGY & MOTOR BEHAVIOR LABORATORY, SCHOOL OF PHYSIC

INTRODUCTION: Motor imagery represents one of the most widely used cognitive-behavioral interventions to enhance sports performance [1]. Training volume in a resistance program consists major variable for the development of muscular strength and especially muscle hypertrophy [2]. However, the long-term effect of motor imagery on both muscular performance and muscle mass remains unclear as it is unknown if the application of this specific cognitive-behavioral technique can influence the daily training volume an exerciser can perform. Aim of the study was to investigate the long-term effect of motor imagery, combined or not to resistance training, on muscular performance and morphology.

METHODS: Fifty-eight healthy moderately resistance-trained participants (29 men and 29 women) with no mental preparation experience were randomly assigned to one of four experimental groups: a resistance-training group (RT) (n=15), a resistance training and motor imagery group (RT+MI) (n=15), a motor imagery group (MI) (n=20), or a control group (CTRL) (n=8). Resistance training consisted of two weekly sessions performed on nonconsecutive days for 8 weeks. Resistance training sessions (altogether 16) included of four sets X six repetitions (85% of 1RM) in leg press and Smith machine semi-squat exercises. Motor imagery protocol consisted of two supervised sessions/week (~20min/session) and 5 times/week self-guided sessions (~10min/session). Body composition (Dual Energy X-ray Absorptiometry, DEXA), maximal leg isometric force (MLIF), maximum strength (1-RM), counter movement jump height (CMJh), and quadriceps cross sectional area (CSA) using B-mode ultrasonography were evaluated.

RESULTS: Lower extremity lean body mass, total quadriceps, and vastus lateralis C.S.A. were significantly and similarly increased in RT+MI and RT groups. MLIF, 1-RM and CMJh were also increased significantly with no differences between RT+MI and RT groups. Significantly and similarly was increased leg press and squats training volume (sets X repetitions X load) per week in RT+MI and RT groups.

CONCLUSION: In conclusion, adding motor imagery to a resistance training program leads to increases in maximal strength, power, and muscle mass. The combination of resistance training with motor imagery doesn't seem to outperform the effect of physical practice on muscular performance and hypertrophy.

1. Guillot, A., and Collet, C. (2008)

2. Mcleod et al. (2023)

ISOMETRIC NECK MUSCLE STRENGTH AND RELIABILITY OF A FLIGHT HELMET-ATTACHED FORCE GAUGE AMONG FAST JET PILOTS

HONKANEN, T., VAARA, J.P., MATTIILA, V., JANHUNEN, M., SOVELIUS, R., KYRÖLÄINEN, H.

CENTRE FOR MILITARY MEDICINE, FINLAND

INTRODUCTION: Fast jet pilots are repetitively exposed to high Gz-forces and abrupt head maneuvering which can cause neck pain, loss of flight years and possible disability. Strong neck muscles may decrease the risk of injury and disability. However, there is no reports in the literature about standard neck muscle testing regimen in any air forces. The purpose of this study was to examine the intra- and inter-tester reliability of a commercial force gauge attached to a pilot's helmet for measuring isometric neck muscle strength.

METHODS: A total of 41 volunteer Air Force Academy cadets were recruited for this study. All subjects performed two measurements sessions for intra-tester reliability, whereas 31 subjects participated for the third session for inter-tester reliability. Peak force values were measured in all four directions (flexion, extension, lateral flexions). Best of three attempts in each direction was chosen. Three measurements were performed in three different days. Self-reported delayed muscle soreness (DOMS) and neck pain was assessed with Visual Analogic Scale (VAS) before and after each measurement session. ICC values were calculated to assess both intra- and inter-tester reliability.

RESULTS: The overall inter-tester reliability was good (ICC = 0.79 – 0.90), whereas the intra-tester reliability varied from moderate to good (ICC = 0.58 – 0.84). In both intra- and inter-tester reliability, the flexion test had good (ICC 0.84 – 0.89) and the lateral flexion tests results moderate to good (ICC 0.73 - 0.90) reliability. Whereas the extension test had lowest reliability in both intra- (ICC 0.58) and inter-rater (ICC 0.79) tests. The average VAS -score (in 1 to 100 scale) prior the second measurement session was 16/100 in DOMS and 0/100 in pain.

CONCLUSION: The present study observed good reliability in isometric neck muscle strength test in the flexion and lateral flexions. In addition, DOMS and pain questionnaires indicate that isometric neck strength could be measured safely and

without interrupting other duties, i.e. flying. In conclusion, the helmet-attached force gauge is reliable and clinically applicable valid method to evaluate isometric neck strength. However, further development of testing procedure and equipment have to be done to increase the reliability of test in the extension direction.

RESPONSE OF SALIVARY ALPHA AMYLASE IN UNIVERSITY ATHLETES AT HIGH ALTITUDE AND SEA LEVEL

IMAI, T.
AICHI INSTITUTE OF TECHNOLOGY

INTRODUCTION: Exercise training in a low-pressure hypoxic environment at high altitude stimulates erythropoietin and can be expected to increase oxygen uptake through increased red blood cell counts and other effects [1] . On the other hand, training in a special environment at high altitude increases the physiological stress on the body more than in sea-level training. Therefore, there is a higher risk of condition breakdown. Hence, it is necessary to monitor the condition of athletes daily through subjective assessment and physiological indices.

Salivary alpha-amylase (sAA) is produced by the sympathetic nervous-adrenal medullary system (SAM) axis and is a known indicator of sympathetic nervous activity [2] . Therefore, it is also used as an indicator of mental and physical stress in exercise training. sAA can be quickly and inexpensively measured and has the potential to objectively assess the physical and mental state under the special conditions of high-altitude training. The purpose of this study was to compare the response of sAA to training at sea level and high altitude.

METHODS: In this study, nine university athletes were majoring in medium and long distance. sAA was collected for concoctive four days on sea level and high-altitude training. High altitude training was performed in Hida ontake kokgen highland training area (Elevation 1,800～2000m). The subjective condition of university athletes was assessed on a scale of one to ten, with one indicating the worst condition. sAA is assessed using a simple measurement device (salivary amylase monitor, Nipro Corp, Japan) with a specialized kit. The data was analyzed with Two-way ANOVA).

RESULTS: Age and physical characteristics of university athletes were (20.7±0.7 yr, 171.9±5.9 cm, and 57.3±5.3 kg). sAA of sea level was first to forth day（8.8±1.4, 7.3±1.2, 8.3±1.1,and 9.3±1.3 kU/l; mean ±SE ）. aAA of high altitude was (51±9.6, 30.3±6.3, 27.7±6.5 ,and 30.1±8.5 kU/l; mean ±SE）. There was no interaction between sAA values on the sea level and the high altitude, but the first day at the high altitude was significantly higher than the second, third, and fourth days, respectively（first day vs. $p<0.05$）. Subjective assessment was not significantly different in sea level and high altitude (sea level:4.3±0.6,4.6±0.3,5.8±0.4, and 4.4±0.3; mean ±SE) vs. (high altitude: 4.9±0.3, 4.6±0.4, 5.1±0.4, and 5.2±0.4; mean ±SE)

CONCLUSION: The sAA on high altitude was highest on the first day. It was suggested that this may reflect a mental and physiological stress response that subjective sensation cannot assess.

[1] B Berglund. High-altitude training. Aspects of haematological adaptation. Sports Med. 1992;14(5):289-303.

[2] Yamaguchi M, Kanemori T, Kanemaru M, et al. Performance evaluation of salivary amylase activity monitor.

Biosens Bioelectron. 2004 ;15;20(3):491-497.

THE EFFECTS OF TWO TRAINING PROTOCOLS ON BODY COMPOSITION IN HOME-SCHOOLED YOUTH DISTANCE RUNNERS

FIAUD, V., SHIM, A., SPECK, T.
WEST TEXAS A&M UNIVERSITY, COLLEGE OF SAINT MARY

INTRODUCTION: Home-schooling is the fastest growing form of education in the past 5 years [1]. In Texas, homeschoolers' competition access is regulated by the school districts who decide who participates. With limited access to athletic competitions and training facilities, homeschooled athletes rely on parents and volunteers to provide training. Long distance running season is split into 2 periods, the cross-country Fall season and the track Spring season. Body fat percentage is commonly known to affect athletes abilities to perform and directly relates to endurance runners [2]. Keating et al. (2017) stated that no significant body fat changes were recorded between the two training types with a relatively short intervention. The purpose of this study was to explore the effects of 2 different 8-week training protocols on youth long distance runners' body fat percentage during the winter break.

METHODS: Twenty-four youth homeschooled athletes (m= 12, f=12, range: 9-18 years old) were recruited. All participants were healthy with no injuries within the last 3 months. Two 8-week training protocols were developed: 1 running and 1 blended running/strength, all age & level appropriate. A control group with no training was included for reference. All subjects were randomly assigned to one of the three groups (Running, Blend, Control). Their body composition was tested at t1 (Nov.), t2 (Jan.) and t3 (May) using the BodPod. A 3x3 factorial repeated measures ANOVA explored the differences in groups over time. Significance was set at $P<0.05$.

RESULTS: The results showed no statistically significant interaction Group x Time (Wilks 'Lambda = .848, $F(4,44) =.946$, $p=.446$). A main effect for Time showed statistical differences. Overall, the body fat percentage of the participants increased significantly (Wilks 'Lambda = .667, $F(2,22)=5.494$,$p=.012$) from the t1, at the end of the cross-country season (M=17.058%), to t2, at the completion of the 8-week training program (M=20.069%). The observed power was .797. No statistically significant differences were observed between the data collected at t1 season and t3 ($p=.055$), or between the data collected at t2 and t3 ($p\approx1.000$).

CONCLUSION: This study investigated the effects of 2 training programs on body composition in homeschooled youth long distance runner. The findings of this study tend to support that training in-between the competitive seasons is not necessary to maintain body fat percentage at a specific level. It is interesting to also note that the break occurs during the winter, possibly affecting the body fat percentage. In addition, developing youth athletes' bodies may respond differently than adults to training. From a practical standpoint, it would mean that the methods of exercise do not influence the results and thus, the coaching staff should consider the athlete's preferences as well as access to facilities. As a conclusion, it appears that the program that would generate the best adherence should be preferred.

1. Jamison-2023 2.Dellagrana-2015

EFFECTS OF FRAGRANCE INHALATION OF LEMONGRASS ESSENTIAL OIL AND HIGH-CONCENTRATION ARTIFICIAL CARBONATED SPRING LOWER LEG BATH MUSCLE FATIGUE

YAMAMOTO, N.1, KASHIWAGI, Y.2, HIRANO, T.5, TAKENOYA, F.3, SHINTAKU, Y.4, WADA, T.5

1 JAPANESE RED CROSS HOKKAIDO COLLEGE OF NURSING, 2 SENSHU UNIV., 3 HOSHI UNIV., 4 WAKAYAMA PROFESSIONAL UNIV. OF REHABILITATION, 5 KOKUSHIKAN UNIV.

INTRODUCTION: It was reported that high-concentration artificial carbon dioxide baths (CO2-water, CO2≥1000ppm) suppress autonomic nerve activity and promote recovery from fatigue (Yamamoto, N. et. al., 2017). In addition, the odor stimulation of aromatherapy has been shown to have stimulating and sedative effects (Takenoya, F. et. al., 2018). These combined effects may enable prompt recovery from physical and mental fatigue. Therefore, the purpose of this study was to examine the effects of a highly concentrated (>1000 ppm) artificial carbonated spring (CO2-water) and fragrance inhalation of lemongrass essential oil on fatigue and muscle function.

METHODS: The healthy male college students (n=6) participated in this study. The subjects were randomly divided into the aroma group and the control group, and a crossover test was conducted. The aroma group was given three sprays of lemongrass essential oil (Cymbopogon flexosus, geraniol 39.66%, neral 31.83%, geraniol 6.93%) diluted to 1% on the inside of a non-woven mask, which they wore during the experiment. The subjects performed to 150 times calf raises. The Borg CR10 scale, which indicates subjective exercise intensity, was recorded every 2 minutes during the calf raises. After the calf raises, the subjects immersed their lower legs up to below the knee into CO2-water at 35 °C for 10 minutes. Subjective thermal sensation (TS) during the lower leg bath were recorded by every two minutes. Before exercise, after exercise, and after the lower leg bath, we measured general fatigue by Visual Analogue Scale (VAS) and maximal isometric plantar flexion and dorsiflexion torques. In addition, muscle soreness was recorded using the Talag scale for 7 days after the experiment. We compared the variables after the aroma group and after the control group using a paired Students t-test. The significance level was set at $p < 0.05$.

RESULTS: CR10 tended to be lower in the aroma group than in the control group during the latter half of calf raises. After calf raises, VAS tended to be lower in the aroma group than in the control group. The VAS after the CO2-water lower leg bath was lower than that immediately after the exercise, and a rapid recovery was observed. Also, ankle joint torque tended to be lower in the control group after exercise and after the lower leg bath. Changes in muscle soreness were lower in the aroma group than in the control group on all days during the first week after exercise.

CONCLUSION: In this study, subjective exercise intensity was modified by fragrance inhalation of lemongrass essential oil. In addition, muscle soreness tended to be suppressed in the aroma group. Thus, the combination of CO2-water lower leg bath and aromatic effects may improve work efficiency. These results suggest that the combination of CO2-water baths and aromatherapy can be applied not only to sports training and medical care, but also to a wide variety of work situations.

EFFECT OF INTER-SET INTERVAL ON OXYGEN UPTAKE AND HEART RATE DURING BENCH PRESS

PARK, J.H., WE, H., LEE, S., SEO, Y., YUN, S., LEE, D.T.

KOOKMIN UNIVERSITY

INTRODUCTION: The inter-set interval is crucial in resistance training for the development of hypertrophy and muscular strength. However, the effect of inter-set interval in resistance training for energy expenditure has not been extensively studied. This study aimed to investigate the inter-set interval during bench press on oxygen uptake and heart rate.

METHODS: 16 healthy men (23.6±1.9 years, 174.9±3.4 cm, 76.0±10.0 kg) underwent three tests. During each testing, they performed three sets of bench press at their 70% (53.3±14.3 kg) of one-repetition maximum (1RM) with three different inter-set intervals; 2 (2M), 5 (5M), and 10 min (10M). Each testing was separated at least 2 days, and the order was balanced. Prior to the first testing, their height, weight, and 1RM were measured directly. During testing, oxygen uptake (VO2) and heart rate (HR) were continuously monitored, and repetitions at each set were counted.

RESULTS: Testing at 2M, 5M, and 10M lasted 465±33, 1015±30, and 1923±29 sec, respectively. The repetitions at 2M, 5M, and 10M were 18±5, 17±4, and 17±4 (at 1st set), 8±3, 12±4, and 15±4 (at 2nd set), and 5±3, 9±3, and 12±3 (at 3rd set), respectively. The average VO2 during testing at 2M, 5M, and 10M was 11.2±1.3, 9.7±1.5, and 9.1±1.1 ml/kg/min, respectively ($p<0.001$). The average VO2 of 3 inter-set intervals at 2M (12.7±1.9 ml/kg/min) was higher than 5M (9.1±1.4) and 10M (7.5±1.0) ($p<0.001$). However, no differences were found in average VO2 of bench press exercise between 2M (9.7±1.6), 5M (10.4±2.0), and 10M (10.6±1.5 ml/kg/min). There were no significantly differences in average HR during testing between 2M (102±14), 5M (101±12), and 10M (97±13 beats/min).

CONCLUSION: The results revealed that the shorter inter-set rest interval during bench press exercise showed a higher oxygen uptake without changing heart rate. It implies that, if there is no specific training purpose, a shorter inter-set rest intervals during resistance exercise would lead to an increased energy expenditure per unit time.

REGIONAL DIFFERENCES IN ELECTROMYOGRAPHIC ACTIVITY DURING ISOMETRIC RESISTANCE EXERCISE INVOLVING THE SHOULDER GIRDLE MUSCLES: A STUDY BASED ON LIFTING LOAD, JOINT ANGLE, AND EXERCISE TYPE

TAKUYA, O.

JAPAN WOMENS COLLEGE OF PHYSICAL EDUCATION

INTRODUCTION: The side raise exercise (SR) is one of the shoulder-strengthening exercises, primarily targeting the lateral deltoid muscles. The front and rear raise exercises (FR and RR, respectively) are also commonly employed to strengthen the shoulder girdle muscles. Despite the similarities in movement, the specific effects of these exercises on the shoulder girdle muscles remain unclear. Furthermore, given the presumed differences in maximal load capacity for each exercise, it is conceivable that muscle activities may be influenced by both the type of exercise and joint angles. This study aimed to elucidate the effects of exercise types (i.e., SR, FR, and RR), lifting loads, and joint angles on electromyographic (EMG) activities of the shoulder girdle muscles

METHODS: Seven physically active, non-athletic females participated in this study. Following a warm-up exercise, participants performed maximal isometric shoulder lateral raise exercises, with the shoulder abduction angle set at 60 degrees, while seated, bilaterally, for 3 s. Subsequently, participants undertook six types of incremental isometric exercise tests: three exercise types (SR, FR, and RR) at two shoulder angles (60 and 90 degrees). The load for each test began at 1 kg, increased by 1 kg following a one-minute interval, and continued until reaching the load that could be sustained steadily for 5 s. EMG activity was recorded from four muscles on the right side (anterior and posterior deltoid, trapezius, and infraspinatus). These data were filtered, and root mean square values were calculated, then standardized as percentages relative to the values during maximal isometric side lateral raise exercise.

RESULTS: The maximal load significantly varied depending on the interaction between exercise types and shoulder angles, with higher loads observed during the 60-degree exercises compared to the same exercise types. EMG activity in the anterior deltoid muscle during maximal load exercises differed between exercise types but remained consistent across shoulder angles. When comparing shoulder angles, maximal load differed among the three types of exercises, but EMG activity did not show significant differences. During incremental exercise, EMG activity in both the anterior and posterior deltoid muscles was similar across the three types of exercises, with higher maximal EMG values observed during RR exercises compared to the other exercises. Furthermore, EMG activity in the infraspinatus muscle remained unchanged across the three types of exercises, in contrast to the other three EMG activities.

CONCLUSION: While the SR, FR, and RR exercises share similar movements and are intended to strengthen the shoulder girdle muscles, their effects on the EMG activity differ. This studys findings indicate that the effects of these exercises on the shoulder girdle muscles are influenced by exercise type, shoulder angle, and load. Additionally, the relationship between maximal load and EMG activity varies across different muscles.

VALIDITY OF THE UKK WALK TEST IN PREDICTING THE MAXIMAL OXYGEN UPTAKE IN JAPANESE

ADACHI, T., FUJITA, K., YOKOYAMA, T., MARUTANI, Y.

OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: The UKK Walk Test was developed in Finland and has not been validated for Japanese individuals. Users have indicated an underestimation in predicted VO2 max. This study aimed to examine the validity of the UKK Walk Test (UKKWT) in Japanese individuals.

METHODS: The participants were 40 healthy adult men and 42 women between the ages of 20 and 65. The physical profile of the subjects was male, height 170.3 ± 7.3 cm, weight 66.9 ± 11.4 kg, and BMI 23.0 ± 3.1 kg/m2. In females, height was 156.9 ± 5.5 cm, weight was 53.1 ± 8.3 kg, and BMI was 21.5 ± 3.0 kg/m2.

VO2 max was determined during uphill walking on a treadmill. The test protocol followed the method of Laukkanen et al. Respiratory gases were analyzed using the Aero Monitor AE-310S (Minato Medical Science Co., Ltd., Japan). Heart rate was recorded with a Polar H10 (Polar Electro, Finland) on the chest and a Polar M430 (Polar Electro, Finland) on the arm. The UKKWT was conducted according to the UKK Walk Test Testers Guide. UKKWT walked at 80% HRR. Predicted VO2 max was calculated from the formula of Oja et al.

All data are presented as means and standard deviations. The validity of predicted and measured VO2 max values was compared using Bland-Altman analysis.

RESULTS: The measured VO2 max was 43.3 ± 6.7 ml/kg/min for men and 33.5 ± 5.8 ml/kg/min for women. The performance time in walking during UKKWT was 16.3 ± 1.0 min for men and 18.2 ± 1.3 min for women. The heart rate at the end of UKKWT was 156 ± 13 beats/min for men and 155 ± 10 beats/min for women. Predicted VO2 max was 40.4 ± 7.8 ml/kg/min for men and 30.3 ± 5.0 ml/kg/min for women. The mean difference between predicted and measured VO2 max by Bland-Altman analysis was -2.9 ml/kg/min for men and -3.2 ml/kg/min for women. The 95% limits of agreement were within the range of -4.3 to -1.5 ml/kg/min for males and -4.6 to -1.9 ml/kg/min for females, excluding zero. Bland-Altman analysis showed significant differences ($p<0.001$) only for fixed errors for both sexes.

CONCLUSION: Bland-Altman analysis showed a bias in the negative direction for both men and women, suggesting that the VO2 max predicted by the UKKWT was lower than the measured value, indicating the presence of a fixed error. The Japanese are shorter in stature than the Finns, which may have resulted in a shorter stride length during walking, which may have affected the performance time in walking on the UKKWT. The standard BMI of the Japanese is 22 kg/m2, which tends to be lower than that of the Finnish. Thus, racial differences in body size may have influenced the predicted VO2 max. These results suggest that the VO2 max prediction formula developed in Finland by UKKWT is probably underestimating VO2 max for the Japanese.

References :

Oja P et al. (1991). Int J Sports Med, 12(4), 356-362.

Laukkanen RMT et al. (1999). Int J Sports Med, 20, 113-116.

EFFECTS OF WHOLE-BODY AND LOWER-BODY COLD WATER IMMERSION ON EXERCISE-INDUCED MAXIMAL VOLUNTARY ISOMETRIC CONTRACTION, MUSCLE DAMAGE INDEX AND MECHANICAL PROPERTIES

LEE, J., MOON, J., KIM, N.

DAEGU NATIONAL UNIVERSITY OF EDUCATION

INTRODUCTION: Cold water immersion (CWI) is drawing attention as a method for maintaining muscle damage and conditioning in athletes. Previous studies have shown that whole-body CWI and lower-body CWI are effective in improving muscle damage and fatigue, respectively. However, there is an insufficient scientific evidence on which to investigate the effect of whole-body and lower-body CWI treatment on MVIC, muscle damage index and muscle mechanical properties. Thus, the purpose of this study was to investigate the effect of whole-body and lower-body cold water immersion (CWI) on eccentric exercise-induced maximal voluntary isometric contraction (MVIC), muscle damage index and mechanical properties.

METHODS: Twenty seven adult male participants were divided into three treatment groups; whole-body CWI (n=9), lower-body CWI (n=9), and active recovery (n=9). All participants participated in each treatment after eccentric exercise. The participants measured average skin temperature, pain score, MVIC, Tensiomyography (TMG), and blood samples were taken for analysis of creatine kinase (CK), lactate dehydrogenase (LDH), lactate concentration.

In this study all data were presented as mean and standard deviation (mean ± SD) and SPSS version 23.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis with a significance level of $p<.05$. A two-way repeated measure ANOVA used for effect of treatment on skin temperature, pain scale, MVIC, muscle damage index, muscle mechanical properties and lactate concentration. Bonferroni's method was used for post-hoc test and the statistical effect siza was verified with Cohen's. The effect size was interpreted as lower than 0.2, median 0.4~0.5, higher than 0.8.

RESULTS: In the case of MVIC, significant differences were observed at all time points for whole-body and lower-body CWI treatment, as well as active recovery treatment. The pain score after 30 minutes and 48 hours after exercise was significantly lower in the whole-body CWI treatment and the lower-body CWI treatment than in the active recovery treatment, respectively. Compared with active recovery, whole-body and lower-body CWI treatment significantly decreased blood LDH concentration 48 hours post-exercise, respectively. Whole-body and lower-body CWI and active recovery treatments removed significant differences in lactate concentration across all time points. Regarding Dm, both CWI and active recovery treatment exhibited significant decreased at 30 minutes post-exercise compared to rest. Moreover, in the case of CWI treatment, Dm was significantly reduced at 30 minutes after exercise compared than at 48 hours after exercise. As for Tc, significant differences at all time points in both CWI treatment and active recovery treatments.

CONCLUSION: CWI treatment alone can be effective regardless of water depth for recovering from muscle damage, muscle function, and achieving faster lactate concentration reduction.

STUDY OF BIOMECHANICAL AND MUSCLE ACTIVITY PATTERNS DURING A 30MIN DOWNHILL RUNNING TEST AND SUBSEQUENT MUSCLE DAMAGE IN MALE TRAILERS.

HODY, S., SCHWARTZ, C., ABRAN, G., BURY, T.

UNIVERSITY OF LIEGE

INTRODUCTION: Downhill running (DR) sections, a common component in off-road races, can lead to exercise-induced muscle damage (EIMD) due to the greater eccentric work of some lower limb muscles. Running biomechanics and muscle activation may change during prolonged DR but these adjustments have not been clearly identified in trailers yet. Therefore, this study aimed to characterize the running pattern over a 30min downhill running test and to investigate the DR-induced muscle damage.

METHODS: Recreational male trailers (n=12; 27.9 ± 8.9 yrs) underwent a maximal VO2max test on a treadmill to determine their maximal aerobic speed (MAS). Then, they were submitted to a 30min DR protocol at 90% MAS (-15% gradient). Physiological and biomechanical parameters (using a 3D motion system) were measured during DR (at the start, middle, and end), coupled with surface electromyography (EMG) recordings. Plasma creatine kinase (CK), maximal isometric force (MIF) of the knee extensors and muscle soreness were assessed pre, 24h and 48h after DR.

RESULTS: The subjects (VO2max: 56.94 ± 7.15 mlO2.min-1.kg-1) completed 30min DR at 90% MAS (14.11 ± 1.58 km/h). While significant differences between level running and DR were found, the spatiotemporal parameters (step frequency, swing and stance times) and kinematics data did not change over the DR test. Concurrent EMG analysis revealed significant

differences from the start to the end of the DR for vastus lateralis (VL) and biceps femoris (BF) muscles. VL muscle activity increased during the swing phase ($p<0.05$) while BF muscle displayed a decreased activation during the stance phase ($p<0.05$) over the DR. No significant change was found for any other studied muscles (rectus femoris, vastus medialis, gastrocmemius lateralis and medialis muscles). Plasma CK activity significantly increased from pre (190 ± 88.48 UI/l) to 24h (615.75 ± 260.96 UI/l) and 48h (362 ± 145.13 UI/l) post-exercise ($p<0.01$). A significant decrease in MIF was observed at 24h (-5.49 ± 6.47%) and 48h (-4.51 ± 6.22%) post-DR compared to pre ($p<0.05$). Significant muscle soreness was also observed with the highest values found for the quadriceps (3.58 ± 2.49 a.u) and the gluteal (4.04 ± 2.51 a.u) muscles at 48h post-exercise ($p<0.01$).

CONCLUSION: Our data highlighted significant changes in muscle activity for vastus lateralis and biceps femoris muscles over a 30min downhill running test while no biomechanical adjustment was found. The DR induced muscle damage as reflected by significant changes in EIMD indirect markers. Further correlation studies between muscle activity during DR and subsequent EIMD may help to better understand performance in trail disciplines.

DIFFERENTIAL EFFECTS OF ISCHEMIC PRECONDITIONING ON EXERCISE PERFORMANCE ACROSS ENERGY SYSTEMS: A SYSTEMATIC REVIEW AND META-ANALYSIS

CHEN, Z., YANG, Y., WU, W.Q.
BEIJING SPORT UNIVERSITY

Introduction

The practical impact of ischemic preconditioning on exercise performance remains controversial, with numerous empirical studies yielding contradictory data and outcomes [1-4]. This study aims to systematically evaluate and conduct a meta-analysis on the effects of ischemic preconditioning on the completion time of various exercises, in order to further clarify its influence on exercise performance.

Methods

As of September 6, 2023, a systematic search was conducted across eight databases, including CNKI , VIP, CMB , Wan-Fang, Cochrane Library, Web of Science, PubMed, and Embase. This search identified 300 articles. Stringent inclusion and exclusion criteria were established, and after initial screening, abstract review, and full-text assessment, nine articles were included for analysis [5-13]. Subsequent statistical analysis was performed using Review Manager software.

Results

Ischemic preconditioning did not significantly improve the completion time of all exercises (MD = -0.03, 95% CI: -0.07 to 0.02, Z = 1.06, P = 0.29 > 0.05). for a more profound investigation, the exercises were categorized into three subgroups based on the characteristics of the three energy system [14]. The meta-analysis results indicated that ischemic preconditioning did not significantly affect the completion time for exercises dominated by the high-energy phosphate system (MD = -0.02, 95% CI: -0.07 to 0.03; Z = 0.75; P = 0.45 > 0.05). However, it significantly reduced the completion time for exercises dominated by the anaerobic glycolytic system (MD = -0.5, 95% CI: -0.88 to 0.11; Z = 2.54; P = 0.01 < 0.05). There was no significant impact on the completion time for exercises dominated by the aerobic oxidative system (MD = -8.81, 95% CI: -49.91 to 32.29; Z = 0.42; P = 0.67 > 0.05).

Conclusion

In summary, the energy supply system is a critical factor influencing the relationship between ischemic preconditioning and exercise performance. Ischemic preconditioning elicits a cascade of physiological and biochemical adaptations that enhance lactate tolerance and oxygen deficiency tolerance [15-20], thereby significantly improving the performance of exercises dominated by the anaerobic glycolytic system, without exerting a significant effect on the performance of exercises dominated by the high-energy phosphate system or the aerobic oxidative system.

1. Cheng, C. F.et al.(2021)2. Cruz, R.S. D.O.et al.(2016)3. Sabino-Carvalho, J.L.et al.(2017)4. Paixao, R. c. et al. (2014)5. Gibson, N. et al.(2013)6. Griffin, P. J. et al.(2018)7. Richard, P. et al.(2018)8. Thompson K M A et al. (2018)9. Ferreira, T.N.et al.(2016)10.Jean-St-Michel, E.et al.(2011)11. Bailey, T. G.et al. (2012)12. Seeger, J. P. et al. (2017)13. Tocco, F.et al.(2014)14.Wells, G. D.et al.(2009)15.Zhao, Z.Z. et al.(2023)16. Jeffries, O. et al. (2018)17. Saeki, l.et al.(2011)18.Carini, R.et al.(2000)19. Paull, E. J. et al.(2019)20.Peng, Y. et al.(2008)

DEVELOPMENT OF THE JAPANESE VERSION OF THE UKK WALK TEST

FUJITA, K., ADACHI, T., YOKOYAMA, T., MARUTANI, Y.
THE UNIVERSITY OF OSAKA

INTRODUCTION: The UKK Walk Test (UKKWT) is a cardiorespiratory endurance test developed in Finland in the 1990s that can accurately predict maximal oxygen uptake (VO2max) by walking 2 km at full effort and even pace. However, the predictive ability of VO2max by the UKKWT has not been fully examined in Japanese subjects. This study aimed to improve the prediction equation of VO2max by the UKKWT for Japanese subjects (UKKWT_J) and to compare its predictive ability with the original version of Oja et al. (UKKWT_O).

METHODS: The subjects were 40 healthy Japanese men and 42 women aged 20–65 years. The VO2max was measured during uphill walking on a treadmill. The test protocol followed the method of Laukkanen et al. Respiratory gases were analyzed using the Aero Monitor AE-310S (Minato Medical Science Co., Ltd., Japan). The UKKWT was conducted according to the UKK Walk Test Testers Guide. In the UKKWT, VO2max was predicted from the time taken to walk 2 km at 80% HRR,

the heart rate at the end of the walk, BMI, and age. To develop a prediction equation for VO2max in Japanese individuals, multiple regression analysis was conducted using the above four parameters of the UKKWT as independent variables, with measured VO2max as the dependent variable. A paired-t test was used to compare the measured and predicted VO2max and the predictive ability of VO2max by the UKKWT_O vs UKKWT_J were compared using the root mean square error (RMSE) and the coefficient of variation (C.V.).

RESULTS: The measured VO2max was 43.3 ± 6.7 ml/kg/min in men and 33.5 ± 5.8 ml/kg/min in women. The VO2max predicted by the UKKWT_O was 40.3 ± 7.7 ml/kg/min in men and 30.3 ± 5.0 ml/kg/min in women. A significant difference was observed between the measured VO2max and predicted VO2max by the UKKWT_O ($p<0.001$). In contrast, the VO2max predicted by the UKKWT_J was 43.4 ± 5.4 ml/kg/min in men and 33.3 ± 4.1 ml/kg/min in women, showing no difference from the measured VO2max. The RMSE and C.V. of the VO2max predicted by the UKKWT_O were 5.2 ml/kg/min and 12.0% in men and 5.4 ml/kg/min and 16.0% in women, respectively. In contrast, they were 3.8 ml/kg/min and 8.8% in men and 4.0 ml/kg/min and 12.1% in women, respectively, in the UKKWT_J. The predictive ability of VO2max was better in the UKKWT_J than in the UKKWT_O.

CONCLUSION: In the present study, the VO2max prediction equation by the UKKWT was improved for Japanese subjects. As a result, we were able to construct a model that could predict VO2max more accurately than the original test, in both men and women. However, there was still a problem of an error of approximately 10% for the average of the measured VO2max. Further improvement of the prediction accuracy of VO2max is needed for the social implementation of the UKKWT_J in the future.

References:

Oja P et al. (1991). Int J Sports Med, 12(4), 356-362.

Laukkanen RMT, et al. (1999). Int J Sports Med, 20, 113-116.

EFFECTS OF TISSUE FLOSSING ON CONTRACTILE CHARACTERISTICS AND FUNCTIONAL PERFORMANCE OF THE QUADRICEPS FEMORIS IN MALE RECREATIONAL ATHLETES: A RANDOMIZED CROSSOVER STUDY

FELIX TEO, J.J., MUKHERJEE, S.

NANYANG TECHNOLOGICAL UNIVERSITY

INTRODUCTION: Tissue Flossing (TF) involves wrapping a thick rubber band around a joint or muscle for partial occlusion of blood flow, while performing range-of-motion exercises [1]. It has gained popularity in recent years for improving range-of-motion and functional performance, speeding up recovery, and decreasing pain caused by diseases or injuries [2]. However, the underlying physiological mechanisms remain largely speculative. Specifically, the effects of TF on muscle contractile characteristics are yet to be defined. This study investigated the effects of an acute bout of TF on the muscle contractile characteristics and functional performance of the uninjured quadriceps femoris muscle.

METHODS: A randomized crossover design was adopted. Muscle contractile characteristics of the rectus femoris, vastus medialis, and vastus lateralis were measured using the TMG-100 tensiomyography system (TMG). The parameters recorded were delay time, contraction time, sustain time, relaxation time, and maximal radial displacement. Functional performance was assessed using a single-leg triple-hop distance test (HOP). Participants were screened for leg dominance, then randomized to the dominant or non-dominant leg group. In each session, TMG and HOP were first conducted to obtain baseline measures. After TF of the quadriceps femoris for a maximum of 3 minutes, measurements were repeated. After at least 24 hours, participants returned for testing of the contralateral leg using the same methodology.

RESULTS: Eighteen male recreational athletes (mean age: 23.9years) participating in sports with a major involvement of the quadriceps femoris muscle were recruited. After an acute bout of TF, there was a significant improvement in HOP for the non-dominant leg, from 540.11cm to 563.39cm ($p = .001$). The HOP for the dominant leg also increased from 544.22cm to 553.83cm, but it was not significant ($p = .207$). Additionally, no significant changes in quadriceps femoris contractile characteristics were observed.

CONCLUSION: The results from this study suggest that TF can be a useful intervention to improve functional athletic performance. However, our findings could not be attributed to the specific neuromuscular measures examined in this study through TMG parameters. Similarly, other studies reported improvements in maximum voluntary contraction but could not elucidate them using changes in mechanical or neuromuscular properties [3]. Thus, it is likely that TF elicits improvements in functional performance through other mechanisms such as increased growth hormone and norepinephrine levels following compression release [4]. Future studies should investigate these other possible mechanisms, such as hormonal changes, fascial shearing and decongestion of joint effusions.

1. Starrett & Cordoza (2015) 2. Konrad et al. (2021) 3. Konrad et al. (2020) 4. Driller et al. (2017)

WARM–UP PROTOCOL WITH IMPLEMENTED PLYOMETRIC CONDITIONING IN PRE-PUBESCENT SOCCER PLAYERS: EFFECT OF RECOVERY TIME AND LEG STIFFNESS ON JUMPING PERFORMANCE.

BASSA, E.1, KAKOULIDIS, D.1, XENOFONTOS, A.2, PETRAKIS, D.1, PATIKAS, D.1

1 ARISTOTLE UNIVERSITY OF THESSALONIKI, GREECE 2 FREDERICK UNIVERSITY, CYPRUS

INTRODUCTION: Post Activation Performance Enhancement (PAPE) is a physiological phenomenon wherein an acute augmentation in muscle performance, in terms of strength or power, is observed subsequent to a conditioning activity (CA), conducted at maximal or submaximal intensity levels [1]. The primary objective of this study was to investigate the

PAPE of jumping performance in pre-pubescent soccer players, after a CA consisted of a warm-up including plyometric exercises. Additionally, this study aimed to assess the impact of this CA on the leg stiffness and its relationship with PAPE in jumping performance.

METHODS: Twenty-five pre-pubescent male recreational soccer athletes (age: 11,62±1,11 y, maturity offset: -2,41±0,77y before peak height velocity) participated in this study. Using Optojump system (Microgate, Bolzano, Italy), counter-movement jump (CMJ) performance or leg stiffness while performing 7 submaximal jumps at 120 bpm [2], were evaluated before and after the CA, which consisted of a warm-up with 9 ankle hopping jumps, 6 CMJs and 3 tuck jumps. Six sessions with one test (CMJ height or stiffness) and one post-CA interval (4, 8 or 12 minutes) were conducted in randomized order.

RESULTS: The results revealed a statistically significant effect of recovery time on jump height ($p < 0.01$), with higher jump heights observed at 4- and 8-min post-CA compared with pre-CA values. Furthermore, a significant effect of recovery time on leg stiffness was observed ($p < 0.01$), with increased stiffness at 4-, 8-, and 12-min post-CA compared with pre-CA values. Notably, jump height PAPE and leg stiffness revealed a moderate positive correlation at 4 and 8 min ($r = 0.42$, $p < 0.05$ and $r = 0.46$, $p < 0.05$, respectively), whereas low positive correlation was observed at 12 min ($r = 0.25$, $p < 0.05$) after CA.

CONCLUSION: Vertical jump performance and leg stiffness are acutely enhanced following a dynamic warm-up protocol with implemented plyometric conditioning activity, in pre-pubescent soccer athletes. Additionally, the moderate correlation between stiffness and improvement in jumping performance suggests that leg stiffness might be an underlying mechanism underpinning PAPE in vertical jumping.

REFERENCES:

1. Blazevich AJ, Babault N. Front Physiol., 2019

2. Dalleau et al. Int J Sports Med., 2004

SYSTEMATIC REVIEW AND META-ANALYSES OF AEROBIC CAPACITY IN CROSS-COUNTRY SKIING, USING RETROSPECTIVE PARTICIPANT CLASSIFICATION FRAMEWORK ASSESSMENT

MORTON, S., MACPHERSON, T., FORREST, L., EASTON, C.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Maximal oxygen uptake (VO2MAX) is important for endurance sports [1] like cross-country skiing (XCS). Studies correlate VO2MAX with XCS performance [2], but meta-analyses are challenging, perhaps due to variation in study methods and performance level definitions [3]. The aim of this review was to compare VO2MAX across performance tiers from a Participant Classification Framework (PCF) [3] and identify potential research gaps.

METHODS: A systematic search of databases up to November 2023 was conducted to assess physiological outcomes and XCS performance, focusing on the predictive value of VO2MAX. Blind study screening and PCF scoring were performed by two investigators. Random-effects meta-analyses were utilized to calculate pooled PCF group means and 95% confidence intervals. Subsequent multiple meta-regressions were conducted to assess variances, with tau and R2 reported to explain variance in VO2MAX due to PCF. Heterogeneity was assessed using tau2.

RESULTS: 70 studies were reviewed, separated by VO2MAX protocol and sex. A meta regression was conducted for running protocols (Males: 41 studies; n= 623; Females: 22 studies; n= 289). PCF explained 49% of the variance in VO2MAX in males (tau= 6.14, R2= 0.49). Group means increased with PCF (PCF: 1= 53.7ml.kg-1.min-1 CI: 46.8-60.9; 2= 66.0ml.kg-1.min-1 CI: 57.7-74.1; 3= 71.1ml.kg-1.min-1 CI: 69.0-73.3; 4= 76.0ml.kg-1.min-1 CI: 74.1-78.0; 5= 82.5ml.kg-1.min-1 CI 79.7-85.2; tau2= 37.7). In females, PCF explained 56% of variance in VO2MAX (tau= 4.80, R2= 0.56). VO2MAX group means also increased with PCF (PCF: 1= 44.6ml.kg-1.min-1 CI: 42.2-47.0; 2= 57.2ml.kg-1.min-1 CI: 54.2-60.3; 3= 61.4ml.kg-1.min-1 CI: 59.3-63.5; 4= 65.4ml.kg-1.min-1 CI: 63.4-67.4; 5= 70.4ml.kg-1.min-1 CI 69.1-71.7; tau2= 23.0). Further meta-analyses were conducted in males, with limited PCF tiers, for VO2MAX methods using Double Poling (DP) Ski Ergometer (SkiErg): 'Whole Body' (PCF range 2-4), Diagonal Stride (DS) (PCF range 2-5) and V2 (PCF range 3-5). For DP SkiErg Whole Body, VO2MAX increased across the PCF range analysed. In DS, VO2MAX also increased with PCF, with the exception of an elevated tier 2, calculated from just 1 study (67.2ml.kg-1.min-1 CI: 65.7-68.7). In V2, VO2MAX increased between tier 3 and 4, but no further increase was observed between tier 4 and 5 (4= 71.0ml.kg-1.min-1 CI: 67.1-74.9; 5= 70.9ml.kg-1.min-1 CI: 69.7-71.2). Data were lacking for further detailed analyses in females.

CONCLUSION: VO2MAX increased across PCF tiers in methods analysed, except in the DS and V2 technique. The exception in DS may be explained by the low number of tier 2 studies included. VO2MAX, as measured in running, also increased with PCF tier in females. Where low study numbers were present, PCF tiers may be underrepresented; these findings should be interpreted with caution. Further research including females, ski specific techniques, and application of PCF assessment in XCS is required.

[1] Joyner and Coyle, 2008

[2] Carlsson et al. 2016

[3] McKay et al. 2022

THE RISK AND PERFORMANCE CIRCUMPLEX MODEL: OPTIMIZING PERFORMANCE AND REDUCING THE RISK IN HIGH LEVEL FUTSAL ATHLETES

TUBAGI POLITO, L.F., SOLER, P., GONÇALVES, P., PIGNATA JUNIOR, W., SAKANO, R., CARNEIRO, Y., MONTENEGRO, C., SESMA, E., BRANDÃO, M.

SPORT CLUB CORINTHIANS PAULISTA

INTRODUCTION: The load control and monitoring are strategies applied for optimizing performance and reducing the risk of injuries and any other medical complications resulting from excessive training. This way, there were a lot of instruments scientifically validated which proposed to provide important information to physical coaches about the readiness, fatigue, sleep, recovery, stress, and pain of the athletes. Nonetheless, despite the large amount of available parameters for athletes' analysis, its integration in the training and match routine is a hard task. Thus, the purpose of the current research is to provide preliminary validation evidence of Risk and Performance Circumplex Model (RPCM).

METHODS: Sixteen highly trained futsal athletes (age: 17 + 0.65 years; total body mass: 73 + 8,49kg; height: 1,74 + 0,06m; workout weekly minimal volume: 720min) were evaluated during one week of a Futsal National League. The evaluations involved: (1) Hooper Index; Total Quality of Recovery; Muscles and Joints Pain; (2) Heart Rate Variability (HRV); (4) Countermovement Jump (CMJ). The RPCM was calculated through the integrated values of Hooper Index and Total Quality of Recovery. The statistical analysis was done using the GraphPad Prism Software (version 8.0). After data exclusion of those who did not complete all the data collect (less than 25% of the entire sample), and the identification of the outliers, using the Rout Test, the normality of data was tested using the Shapiro-Wilk Test. Thus, besides the descriptive statistical analysis, to analyze the relation among RPCM and the other objective variables (HRV, TBM and CMJ), it was used the Spearman's Correlation ($p < 0.05$).

RESULTS: For sleep, stress, fatigue, pain, total quality of recovery, risk index and performance index, the following data were found, respectively: 4.09 + 0.73; 4.08 + 0.80; 4.06 + 0.89; 3.75 + 1.01; 16.45 + 2.24; -5.14 + 3.13; 5.04 + 3.29. For the objective variables, the following data were found, respectively: 34.87 + 4.84 (CMJ); 89.45 + 42.87 (HRV - RMSSD); 1.12 + 0.64 (HRV - LF/HF); 79.89 + 29.95 (HRV - SDNN).

CONCLUSION: Although no significant correlations between the risk and performance indices (calculated through the RPCM), and the objective variables (CMJ and HRV) were found, some characteristics of RPCM provide preliminary scientific evidence of its validation, including: (1) the integration of the subjective and objective variables on just one instrument provided a practical instrument to be analyzed faster during the training routine, enabling more accurate decision-making; (2) the performance and risk index (both calculated by the RPCM) were enough to minimize the risk of injuries, and therefore, in order to improve the active and healthy participation of the athletes in the tournament, In which the team were the champion without a single injured athlete.

CAN STRAIN GAUGE REPLACE FORCE PLATE TO MEASURE GYMNAST RELATIVE STRENGTH ON STILL RINGS?

LECOCQ, T., MOCHIZUKI, L., TORDI, N.

UNIVERSITÉ DE FRANCHE COMTÉ

INTRODUCTION: Still rings routine has evolved during the last century toward more and more strength. The gymnast's relative strength is paramount to overcome the effect of gravity with his own upper limbs' features. Authors measured upper limb relative strength with force plates placed under the gymnast (Bango, 2013, 2017) or under his hands' palm (Dunlavy, 2007) in various positions. Despite being the gold standard, force plates are big, heavy, and expensive pieces of material for a gymnastic association interested in the relative strength measurement. The aim is to quantify how accurately a pair of strain gauges placed in the cables can measure the vertical force produced by gymnasts.

METHODS: 14 gymnasts (32 ± 11 years, 74,5 ± 7,1 kg, 172,6 ± 6,4 cm) performed 19 maximal isometric contractions in the iron cross position. After measuring the gymnast's arm span with shoulder at 90° and hands in the rings, the following instruction were given "Try to lift your body for 5 seconds by pushing your hands down while maintaining straight arm". Gymnasts stood on two force plates (K-Deltas, Kinvent, Montpellier) to measure the vertical ground reaction force (vGRF) at rest and during the maximal contraction task. The cable load (Tension) was measured by a pair of one-dimension strain gauges (K-Pull, Kinvent, Montpellier) attached to the rings cable, rigged on a high bar, 50 cm apart. vGRF and Tension were synchronously recorded on a tablet with the manufacturer software at a frequency of 1 kHz. Signals were smoothed with a 100ms window moving average. The angle between the vertical and the cable was calculated using : Angle=sin-1(((Armspan-50)/2)/(Cable length)) and the vertical component of the cable force was corrected with : vForce = (cos(Angle))×Tension. Right and left vForce were summed (total vForce) and a mean value over 2-seconds in the middle of the contraction was compared with vGRF. The linear correlation between both methods' mean value (total vForce and vGRF) were calculated using Pearson´s r. Bland-Altman plot was utilized to check the agreement and paired-sample Student T-Test to quantify the differences between total vForce and vGRF.

RESULTS: Total vForce and vGRF are correlated (R=0.99). The strain gauge method presents a systematic error of -0.42 kg ($P < 0.001$) and a 95% confidence interval of 1.15 kg compared to the force plate.

CONCLUSION: The systematic under-estimation might be explained by the discrepancy between the arm span measurement position and the maximal contraction position. By removing 5 cm to all athletes' arm span, the systematic error decreases to -0.12 kg ($P = 0.068$), with a 1.02 kg confidence interval. The 2.5 cm reduction on each side could be explained by scapula retraction, slight arms bending and hands position modification. The strain gauges are a valid tool to

measure the upper limb relative strength provided that the arm span doesn't change during the contraction since it affects the angle of the cable and therefore the vertical component of the force.

BLOOD AND SALIVARY LACTATE RESPONSES TO ACTIVE REST FOLLOWING CIRCUIT EXERCISE

KOJIMA, C., MORISHIMA, T.2, ITO, R.3, YASUNAGA, S.3, SHIMOGAKI, T.3, HASHIMOTO, T.3, ISAKA, T.3, IEMITSU, M.3
1: RITSUMEIKAN UNIVERSITY, 2: CHUKYO UNIVERSITY, 3: RITSUMEIKAN UNIVERSITY

INTRODUCTION: Tracking changes in blood lactate concentration over time in response to exercise provides us a lot of information regarding anaerobic and aerobic capacities. As such, noninvasive techniques are required to measure lactate concentrations instead of obtaining a small amount of blood invasively. Recently, some previous studies compared blood and salivary lactate concentrations with various exercises, and they indicated that salivary lactate has the potential to be an alternative method to evaluate blood lactate in response to exercises. However, it remains unclear whether salivary lactate reflects changes in blood lactate during post-exercise recovery with or without active rest. Therefore, we investigated blood and salivary lactate concentrations with or without active rest following intensive exercise.

METHODS: Healthy seven males and four females were recruited (age: 20.6 ± 0.9 years, height: 170.3 ± 8.3 cm, weight: 62.5 ± 7.2 kg). They completed two trials, consisting of control (CON) and active rest (AR) trials. The order of the trials was randomized and the trials were separated with at least a week. In AR trial, participants completed 15 min of light cycling exercise at an individual exercise intensity which was equivalent to 120 bpm of heart rate, whereas in CON trial, participants remained seated for identical period of the AR trial during post-exercise period. In both trial, participants performed 6 sets of 5 min of circuit exercise combined with two resistance exercises for lower extremities and cycling exercise. Blood and salivary concentrations were measured before, immediately after the circuit exercise, immediately after each trial and next morning using a potable devise (Lactate Pro 2, ARKLAY, Inc., Japan). The statistical analysis was performed using a repeated-measured two-way ANOVA. Statistical significance was accepted as a $P < 0.05$.

RESULTS: Blood lactate concentrations were significantly increased immediately after circuit exercise in both trial (AR trial: 11.9 ± 2.9 mmol/L, CON trial: 13.4 ± 3.0 mmol/L, Ps < 0.05 vs. before exercise), and a significant difference was observed between trials immediately after each trial (AR trial: 4.2 ± 1.4 mmol/L, CON trial: 6.9 ± 2.8 mmol/L, $P < 0.05$). Albeit salivary lactate concentrations were also significantly increased immediately after circuit exercise in both trial (AR trial: 4.4 ± 3.0 mmol/L, CON trial: 5.4 ± 3.9 mmol/L, Ps < 0.05 vs. before exercise), the values at completing each trial indicated a significant trend between trials (AR trial: 0.8 ± 0.4 mmol/L, CON trial: 3.1 ± 2.0 mmol/L, $P = 0.05$). In addition, there was a significant correlation between blood and salivary lactate concentration immediately after each trial ($r = 0.856$, $P < 0.001$).

CONCLUSION: Salivary lactate concentrations may reflect relative changes in blood lactate concentrations during post-exercise period with active rest following intensive exercise.

Authors index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

supported by

SPORTOOLS
Data management in sports

ISBN 978-3-9818414-7-3