

## Sport and Exercise Science New Zealand

Annual Conference, 26-27 October 2018, Otago Museum, Dunedin

Hosted by the School of Physical Education, Sport and Exercise Sciences and the Department of Human Nutrition at Otago University

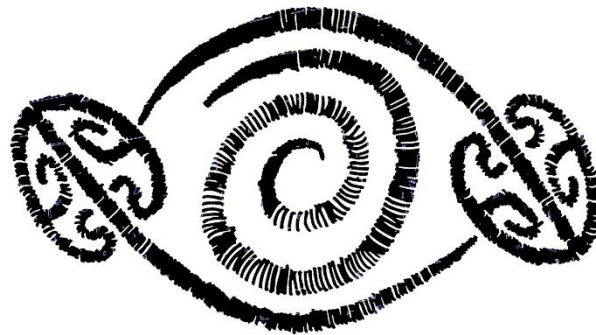
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## Welcome

Welcome to the **2018 Sport and Exercise Science New Zealand Annual Conference** at the University of Otago! Having held the past two conferences at the Avantidrome in Cambridge, we make a welcome return to the South Island this year and we are delighted that the team at the University of Otago agreed to host this year's conference. We very much look forward to catching up with you at the conference over the next two days. Don't forget to join us for a drink at the University of Otago Staff Club this evening (Friday) if you are free, from 6.30pm onwards.

As part of our continued work to develop links with international partners we are very fortunate, and delighted to welcome, **Professor Kathryn Schmitz**, President of the American College of Sports Medicine, **Anita Hobson-Powell**, CEO of Exercise and Sport Science Australia and **Dr Keith Tolfrey**, Chair of the British Association of Sport and Exercise Science as speakers at the conference, but also as highly valued colleagues and friends of Sport and Exercise Science New Zealand. It is with great pleasure that we can confirm that a signing of MOUs between SESNZ and ACSM and SESNZ and BASES will also be part of the formal proceedings at the Conference. In addition, we will use our time with Anita to deepen and strengthen our partnership with ESSA. Thank you Katie, Anita and Keith for taking the time to join us!

We would like to take the opportunity to thank all of you as delegates for attending, whether you are presenting or attending to enjoy some of the excellent presentations that will be made during the two days. It is exciting to see the growth in attendance to the conference being made year on year and this year's growth has meant that we are able to create interest streams due to the increasing popularity of the conference.

Good luck to all the presenters and don't forget, if you are a student, to register for the student prizes – for the best oral presentation and poster presentation, which will be awarded on Saturday afternoon. A big thank you also goes to our sponsors and helpers who include: gbc Biomed, Australian Catholic University, High Performance Sport New Zealand and, our gratitude to Chris Button and the team at the School of Physical Education, Sport and Exercise Sciences at the University of Otago.

As a date for your diary, we are very pleased to confirm that the **2019 SESNZ Conference** will be held at Massey University, Palmerston North on the 18<sup>th</sup> and 19<sup>th</sup> October 2019. Thank you very much to Andy Foskett, Toby Mündell and the team at Massey for agreeing to be our hosts in 2019, and we look forward to gathering again there next year.

It is always a team effort to make a conference run, so thank you to everyone involved at the University of Otago for their work behind the scenes to getting things ready for our annual get together. A warm welcome to all and please do not hesitate to contact any of the Board with feedback suggestions or ideas for the future. If you would like to get involved with the direct work of SESNZ and the Board we would be delighted to hear from you as well.



**Nick Draper**

**Chair, SESNZ Executive Board**

# Programme

Day One: Friday 26 <sup>th</sup> October (Hutton Theatre)		
7:45 – 8:45	Registration and refreshments	
8:45-9:00	Welcome	
9:00-10:00	<b>Keynote Speaker: Professor Kathryn Schmitz</b> , Professor of Epidemiology, Penn State University and President of the ACSM.	
10:00-10:25	<b>Morning Tea</b>	
Parallel Sessions	Hutton (Clinical Exercise Physiology)	Barclay (Training load)
10:30	Effects of high intensity interval vs moderate intensity continuous training on fitness and body composition in active breast cancer survivors. <i>Richard Bell</i>	The effects of heavy-sled sprint training on acceleration capabilities in female rugby sevens athletes: A pilot study. <i>Francesco Sella</i>
10:45	Protein, insulin-like growth factor (igf-1) and exercise: a systematic review. <i>Colleen Gulick</i>	An exploration of the term “training density”, what it means, how it’s measured and how it’s applied to rugby union training. <i>Tiaki Brett Smith</i>
11:00	Heat conditioning for health in arterial disease. <i>Ashley Akerman</i>	The effects of morning preconditioning protocols on testosterone, cortisol and afternoon sprint cycling performance. <i>Kerin McDonald</i>
11:15	Blood pressure responses to different modes of heating. <i>Holly Campbell</i>	Physical characteristics of NZ Army, Navy and Airforce officer trainees pre and post a 6-week joint officer induction course. <i>David Edgar</i>
11:30- 12:30	<b>Lunch</b>	
12:30-13:30	<b>Keynote Speaker: Professor John Hawley</b> , Professor of Exercise Physiology and Nutrition, Australian Catholic University.	
Parallel Sessions	Hutton (Sports Nutrition)	Barclay (Sport Performance)
13.30 – 13.45	Effects of glucose ingestion and exercise on cerebrovascular. Function. <i>Ben Smith</i>	Evaluating the effectiveness of plyometric training plan for improving the serve performance of under 16 male tennis players. <i>M.Komalaraj</i>
13.45 – 14.00	Low energy availability and cardiovascular disease risk in elite female rugby players: an observational study. <i>Sam Christensen</i>	Comparing two landing error scoring system protocols: same but different! <i>Kim Hébert-Losier</i>
14:15 – 14:30	The effect of a 31-day ketogenic diet on submaximal exercise economy and capacity in trained endurance runners. <i>David Shaw</i>	How are deceptive movements portrayed in badminton? <i>So Hyun Park</i>
14:30-15:00	<b>Invited Speaker: Dr Keith Tolfrey</b> , Reader in Paediatric Exercise Physiology, Loughborough University, Chair of the British Association of Sport and Exercise Sciences (BASES)	

<b>Day One: Friday 26<sup>th</sup> October (Hutton Theatre)</b>			
15:00 – 15:30	<b>Afternoon Tea</b>		
<b>Parallel Sessions</b>	<b>Hutton (Sports Nutrition)</b>	<b>Kakapo (Education)</b>	<b>Barclay (Exercise Physiology)</b>
15:30	Nutrition-related barriers, attitudes and influences towards dietary intake and body composition elite male athletes. <i>A Sharples</i>	Thinking out loud: teachers' facilitation on students' learning in outdoor adventure education. <i>Sheryl Seow</i>	Influence of acute and chronic hypoxia on brain blood flow regulation during thermal stress. <i>Travis Gibbons</i>
15:45	Social media as a nutrition resource for athletes: a cross sectional survey. <i>Bridget Bourke</i>	The study on physical literacy knowledge of physical education teachers in Sabaragamuwa province, Sri Lanka. <i>Sellathurai Jeganenthiran</i>	Cerebrovascular reactivity following maximal resistance exercise. <i>Tom de Hamel</i>
16:00	Reducing upper Respiratory illness in New Zealand team athletes. <i>Vaughan Somerville</i>	Perception of autonomy support from the coaches to southern province athletes in Sri Lanka. <i>Sellathurai Jeganenthiran</i>	Delineation of swimming-related effects on cerebral blood flow velocity. <i>Leena Shoemaker</i>
16:15	Perceptual and physiological responses to differing ergogenic mouth swilling solutions. <i>Russ Best</i>	The role of informal, unstructured practice in developing football expertise: the case of Brazilian 'Pelada'. <i>Luiz Uehara</i>	
16:30	Hepcidin and iron status in elite female rugby players. <i>Simone Smith</i>		
16:45-18:00	<b>POSTER PRESENTATIONS</b>		
18:00-18:30	<b>Updates from our international counterparts ESSA, ACSM, BASES.</b>		
18:30-onwards	<b>MOU Signing and Celebration + Social function at University of Otago Staff Club</b>		

Day Two: Saturday 27 <sup>th</sup> October (Hutton Theatre)			
08:00-08:30	Refreshments		
08.30-09:30	<b>Keynote Speaker: Dr Shona Halson</b> , Australian Catholic University		
Parallel Sessions	Hutton (Heat stress)	Tekapo (Sport Med/Biomech)	Barclay (Sport psychology)
9:35	Does the mode of heat acclimation affect the kinetics of adaptation? <i>Lorenz Kissling</i>	History of concussion is associated with higher head acceleration during simulated rugby tackle. <i>Melanie Bussey</i>	Effects of sleep deprivation on perceptual-motor performance under low and high threat. <i>Arne Nieuwenhuys</i>
9:50	The impact of solar radiation exposure on professional team-sport training and recovery. <i>Fergus O'Conner</i>	New Zealand Rugby Community Concussion Strategy: 2018 Pilot Study. <i>Janelle Romanchuk</i>	Life skills acquisition and psychological development in elite cricketers: evaluating the effectiveness of a life development intervention. <i>Adam Miles</i>
10:05	Heat response testing in elite rugby sevens athletes: an eye to Tokyo 2020. <i>Stephen Fenemor</i>	The effects of fatigue on the spine motion of cricket fast bowlers. <i>Corey Perrett</i>	Working memory training in a modified Loughborough soccer passing test impacts skill performance in youth football players. <i>Joseph Hall</i>
10:20	Post-training hot water immersion for team-sport athletes: effects on concurrent training load and treadmill running in the heat. <i>Josh Stewart</i>	Identifying shoulder injuries among New Zealand Cricket fast bowlers: a 12-month retrospective injury surveillance. <i>Sibi Walter</i>	Cognitive, emotional, and behavioural factors associated with tapering. <i>Maxwell Stone</i>
10:40-11:10	<b>Morning Tea</b>		
Parallel Sessions	Hutton (Exercise Physiology)	Tekapo (Physical Activity)	Barclay (Motor learning)
11:15	The relationship between physiological and psychophysical function throughout heat acclimation. <i>Jamie Prout</i>	School bag weight as a barrier to active transport to school among New Zealand adolescents. <i>Sandra Mandic</i>	Motor learning by analogy: effects of visual-verbal preference. <i>Tina van Duijn</i>
11:30	Effects of hypohydration and the menstrual cycle on pain perception. <i>Beverley Tan</i>	Understanding rural adolescents' perceptions of walking versus cycling to school. <i>Jessica Calverley</i>	The effect of unilateral hand contractions on cognitive inhibition. <i>Merel Hoskens</i>
11:45	Female CrossFit members experience irregular menstrual cycle. <i>Katie Schofield</i>	The economic role of the accredited/clinical exercise physiologist within the New Zealand allied health field. <i>Amy Pearce</i>	Motor movement recall: analogies are more memorable than explicit rules. <i>Liis Uiga</i>
12:00-13:30	<b>Lunch (AGM)</b>		
13:30-14.00	<b>Invited Speaker: Professor Glenn McConell</b> , Institute for Health and Sport (IHES), Victoria University, Australia.		

Day Two: Saturday 27 <sup>th</sup> October (Hutton Theatre)	
14:00-14:20	New Strength and Conditioning Accreditation Programme for NZ. <i>Presentation by SESNZ</i>
14:30-15:00	<b>Afternoon Tea</b>
15:00-15:30	<b>Keynote Speaker: Associate Professor Debra Waters</b> , Director of Gerontology Research, University of Otago
15:30-15:45	Chronic cardiovascular effects of whole-body vibration training in the elderly. <i>Sally Lark</i>
15:45-16:00	Promoting safer landing by older adults who fall unexpectedly. <i>Rich Masters</i>
16:00-16:30	Closing



# Exercise and Sport Science

Understanding the science of human movement and performance

"The whole is greater than the sum of its parts."

Aristotle

The list of benefits of exercise and sport participation on health, wellbeing and quality of life is continually growing. Exercise and Sport Science is an internationally-recognised scientific discipline consisting of four core sub-disciplines: biomechanics, motor control/learning development, physiology and psychology. Our curriculum is aligned with accrediting bodies in Exercise and Sport Science providing attractive career opportunities.

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gbcBioMed is proud to have supported SESNZ over many years and to be the Gold Sponsor this year.

Thanks to SESNZ for this opportunity to show its appreciation to our many sports science customers for their support. Gold Sponsorship includes 3 free registrations so gbcBioMed was especially pleased to be able offer these and see all 3 snapped up.

During our involvement with SESNZ, we have witnessed the changes in the organisation and the conferences - from the combined GP/SESNZ to the current stand-alone conferences!

It's very evident from the last few conferences that SESNZ has found new energy and commitment - we hope this will continue and will inspire unity within the sports science community.

gbcBioMed has been in business for around 15 years and like SESNZ we have evolved over this time – however our business philosophy remains the same – to represent world leading manufacturers, producing the best products which are unique and innovative. gbcBioMed adds to this with our commitment to excellent sales and service support.

Such brands as Cortex, Lode, h/p/cosmos, AccunIQ, Cyclus2, BTS, InBody, Zephyr, Vacu-Med, Hans Rudolph, EGZO Tech and Swift Performance can be found in sport science labs all round the world.

Most NZ sports science labs have equipment that gbcBioMed has supplied and supported, along with private clinics, high performance clinics and hospitals.

Martin Little, our Service Engineer and I have had the privilege of visiting, most of the labs in NZ, some in Aussie and other countries.

Kiwi labs are up there with the best in the world,... anything lacking due to funding restraints etc is almost made up for with enthusiasm and smart thinking – actually, more funding would work wonders as well!!!

GbcBioMed, like SESNZ, is changing and we are always looking to improve and broaden our product range while sticking to our philosophy. So, if you encounter a company developing a new or innovative product which you think is good, we would love to hear about it. Equally if you have some ideas that can be developed into a product we would be keen to talk. GbcBioMed has cultivated an extensive world-wide network of contacts so we can usually assist with equipment selection advice, or help with choosing the best option for your next project.

Enjoy the conference; catch up with old friends and make new ones; learn and contribute new ideas.

Ken Marment

gbc BioMed ,

## Sponsors and Exhibitors

We are extremely grateful to our Gold sponsor, Ken Marment at gbc BioMed and his unfailing support of SESNZ over the years. Ken you who have contributed to the Sport and Exercise Science New Zealand conference in various ways and we sincerely thank you for this. Please read what Ken has to say after the Poster abstracts.



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## SESNZ Member Benefit

SESNZ is working with GSI Direct, a New Zealand company that has been operating in the New Zealand commercial insurance industry since 2005.

GSI Direct are a Lloyd's cover holder and an Authorised Agent of certain underwriters at Lloyd's to arrange insurance on behalf of the insurer and coordinate the response when a claim is made.

- SESNZ members can purchase insurance cover directly through the following link <https://quotes.gsidirect.co.nz/quote/policies/2539>.
- Enter your details and purchase your policy online.
- A schedule, invoice and policy documentation will then be automatically emailed to you.
- For 2,000,000 PI cover, \$1 million public liability and \$1 million statutory liability the insurance premium would be **\$230 GST inclusive**.

GSI Direct specialise in providing small businesses, consultants and contractors with affordable liability insurance online in New Zealand. We encourage SESNZ members to investigate whether they can save on their premiums through this offering, or if they currently don't purchase any insurance, investigate whether it's something they should consider.

2018 SESNZ Annual Conference  
**Keynote Speakers**

**Professor John Hawley**

is a world renowned researcher with a primary research focus on the interaction of exercise and diet on the regulation of fat and carbohydrate metabolism, particularly within skeletal muscle, the molecular basis of exercise training adaptation and the cellular bases underlying exercise-induced



improvements in insulin action. John has published over 220 scientific manuscripts, written over 100 articles for technical journals and has authored numerous book chapters for exercise biochemistry and sports medicine texts. He also serves on many editorial boards for top journals in his field.

**Professor Kathryn Schmitz**

is the President of the American College of Sports Medicine (ACSM). Kathryn is also a Professor in Epidemiology at Penn State University. She is the author of more than 180 articles in scientific literature on the topics of cancer, behavioral research, rehabilitation, exercise science, obesity prevention, and other areas of medicine and public health.



**Dr Shona Halson**

is an Associate Professor in the School of Behavioural and Health Sciences at Australian Catholic University. Prior to this she was a Senior Physiologist at the Australian Institute of Sport for 15 years. She has a PhD in Exercise Physiology and has been involved in conducting research into the areas of



recovery, fatigue, sleep and travel. She is an Associate Editor of the International Journal of Sports Physiology and Performance. Shona was selected as the Director of the Australian Olympic Committee Recovery Centre for the 2008 Beijing Olympic Games, the 2012 London Olympic Games and the Rio 2016 Olympic Games. She has published numerous

peer-reviewed articles and has authored several book chapters on sleep, fatigue and recovery.

**Associate Professor Debra Waters**

is the Director of Gerontology Research at Otago University and the Deputy Director of the Ageing Well National Science Challenge. Her area of expertise is in body composition and physical function during ageing and community-based exercise interventions in older individuals.



**Dr Keith Tolfrey**

is the Chair of the British Association of Sport and Exercise Sciences (BASES). Keith's research has focused on the physiological determinants of endurance performance such as maximal lactate steady state, economy, and peak oxygen uptake in young people. His current research interests include fat metabolism, postprandial lipaemia, and estimation of energy expenditure in physical activity in young people.



**Professor Glenn McConnell**

is Professor of Exercise Metabolism & ISEAL Research Group Leader, Institute of Sport, Exercise & Active Living (ISEAL) at Victoria University, Melbourne, Australia. His area of expertise is regulation of skeletal muscle glucose uptake during exercise and the factors regulating the increase in insulin sensitivity following exercise.



Manchester Metropolitan University in 2000 and then worked at Edinburgh University for 3 years before moving to New Zealand. Chris' research interests concern an ecological dynamics approach to motor skill learning. In recent work he is applying these theoretical ideas to the acquisition of swimming survival skills in children. Dr Button has published research on a broad range of topics including individual differences, movement variability, perceptual skill, and interpersonal coordination

## Keynote Presentations

### **Making Exercise Standard Practice in Oncology**

Kathryn Schmitz, PhD<sup>1</sup>

<sup>1</sup>*Professor in Epidemiology at Penn State University, USA*

The American College of Sports Medicine, National Comprehensive Cancer Network, Exercise and Sport Science Australia, and the Clinical Oncology Society of Australia all recommend exercise as standard practice for those diagnosed with cancer, during and after treatment. In this presentation, Dr. Schmitz will review these guidelines, present examples of how exercise programming is carried out across seven countries around the globe and discuss the issues to making exercise standard practice in the setting of oncology.

### **Exercise-Nutrient Interactions: Effects on Metabolism & Performance**

John A. Hawley, PhD<sup>1</sup>

<sup>1</sup>*Exercise & Nutrition Research Program, The Mary MacKillop Institute for Health Research, Australian Catholic University, Melbourne, Victoria, Australia.*

The application of molecular techniques to exercise biology has provided new insight into the complexity and breadth of intracellular signaling networks involved in the response to endurance- and resistance-based training (Hawley et al., 2014; 2018). An emerging area of research interest directly arising from a better understanding of the molecular bases of training adaptation is how nutrient availability modifies the regulation of many contraction-induced events in muscle. Changes in macronutrient intake (predominantly carbohydrate and fat) rapidly alter the concentration of blood-borne substrates and hormones causing marked perturbations in the storage profile of skeletal muscle and modifying patterns of fuel metabolism during exercise. As such, these exercise-nutrient interactions have the capacity to selectively activate or repress gene expression and intracellular signaling proteins (Egan et al., 2016), ultimately driving the phenotype-specific characteristics observed in highly trained athletes (Hawley et al., 2011). Exercise-nutrient practices (i.e., training with low carbohydrate availability) are based on the underlying premise that imposing greater “metabolic loading” and provoking extreme perturbations in cellular homeostasis will, when repeated over weeks or months, augment acute exercise responses and amplify adaptation. Such a “science-up” approach to advance training and nutrition strategies for enhancement of sports performance seems logical and practical. However, several important caveats need to be placed on the validity of such processes. For example, there is often a mismatch between the changes in mechanistic variables (i.e., upregulation of cell signaling pathways) and whole-body functional outcomes (e.g., changes in training capacity or performance). Another caveat involves the possibility that a training strategy that promotes one attribute may endanger or impair another: an impairment in

metabolic flexibility might result from the complex interactions between pathways of substrate utilization whereby an upregulation of one pathway (fat oxidation) may result in a simultaneous and reciprocal downregulation of others (muscle glycogenolysis), resulting in an overall reduction in exercise capacity. Finally, the vast majority of published studies involving training and/or nutrient interventions have typically lasted only a few days or weeks and involved <30 training sessions. Such a time frame and limited number of workouts do not permit the integration and level of sophistication required to implement the combinations and permutations of the various practices described into the long-term periodized training programs of elite endurance athletes. (Hawley et al., 2018). The typical sample sizes used in many investigations along with current laboratory-based measures of “performance” mean that sport scientists are often unable to detect the small but meaningful changes that would alter elite performance outcomes. The ‘new world order’ in exercise biology shows the need to integrate “mechanistic” observations from molecular biology into an “applied” sports context has never been greater (Hawley et al., 2014).

Further reading

Egan B, Hawley JA, Zierath JR. SnapShot: Exercise Metabolism. *Cell Metabolism* 24: 342-342, 2016.

Hawley JA, Burke LM, Phillips SM, Spriet LL. Nutritional modulation of training-induced skeletal muscle adaptations. *Journal of Applied Physiology* 110: 834-845, 2011.

Hawley JA, Hargreaves M, Joyner MJ, Zierath JR. Integrative biology of exercise. *Cell* 159: 738-749, 2014

Hawley JA, Lundby C, Cotter JD, Burke LM. Maximizing Cellular Adaptation to Endurance Exercise in Skeletal Muscle. *Cell Metabolism* 27: 962-976, 2018.

### **Sleep, Performance Behaviour Change and the Elite Athlete**

Shona Halson, PhD<sup>1</sup>

<sup>1</sup>*Associate Professor, School of Health and Behavioural Science, Australian Catholic University.*

Although the function of sleep is not fully understood, it is generally accepted that it serves to recover from previous wakefulness and/or prepare for functioning in the subsequent wake period. Restricting sleep to less than 6 h per night for four or more consecutive nights has been shown to impair cognitive performance and mood, disturb glucose metabolism, appetite regulation and immune function. There is also emerging research on the effects of sleep deprivation on bone health.

Results of recent AIS research examining the importance of sleep and sleep habits in elite athletes have demonstrated poor sleep quality and quantity in some elite athletes. Athletes’ sleep/wake patterns were monitored using wrist activity monitors and sleep diaries. On average, participants across all sports obtained a total sleep time of 6:8 ± 1.1 h. Findings from

this research reveal that elite athletes obtain less than the recommended 8 hours of sleep for the general population.

This presentation will outline what is currently known about sleep in athletes and discuss the role that reduced sleep quality and quantity may have on athletic performance. Importantly, education and behaviour change strategies will be outlined in a bid to provide practitioners with tools to assist in improving athletes sleep.

### **The Obese and Frail: Exercise and Diet Interventions for Older Adults**

Debra Waters, PhD<sup>1</sup>

*1University of Otago, Department of Medicine, School of Physiotherapy, Dunedin, New Zealand*

In New Zealand, as in other developed countries, frailty and obesity in older adults is becoming an increasingly prevalent problem. The idea of an obese patient who is also frail is an enigma for many practitioners, who picture frail patients as those who are thin and weak. Recently the New Zealand Ministry of Health stated that obesity has overtaken tobacco as a greater risk to the loss of health. Part of the loss in health, is

the loss of physical functioning, which is often not measured in clinical settings. In reality, obese older adults may have low skeletal muscle mass, with poor physical function and thus an increased risk of frailty compared to obese older adults with normal levels of skeletal muscle. This combination of low skeletal muscle mass and function, with high fat is called sarcopenic-obesity. The challenge can be in identifying these people in a clinical setting. Typical measures of weight and BMI are not sensitive to age-related changes in skeletal muscle, bone and fat that occur during aging. Thus, weight and BMI may be “normal” when body composition and function is not. Compounding this challenge is the ongoing research on safe and effective interventions to reduce obesity, while not accelerating the age-related loss of skeletal muscle and bone. This presentation will cover some of the current thinking around classification, identification and effective interventions for this specific group of patients who, other than their obesity, are not often identified as “at risk” for frailty and may be given advise to diet to reduce body weight and lower other metabolic risks. The research presented will show that this can have negative consequences for bone and skeletal muscle if not managed carefully with appropriate caloric restriction and exercise.

## Invited Presentations

### Postprandial Metabolism in Young People

Keith Tolfrey, PhD<sup>1</sup>

<sup>1</sup>*School of Sport, Exercise and Health Sciences, Paediatric Exercise Physiology Research Group, Loughborough University, UK*

Exaggerated postprandial metabolic perturbations in triacylglycerol (TAG) and glucose concentrations are implicated in the development and progression of different diseases, and independently predict future cardiac and vascular events in adulthood. Various acute exercise and dietary interventions have been shown to attenuate postprandial metabolic responses in adults. However, processes leading to atherosclerosis and type 2 diabetes begin during childhood and adolescence, which progress over the lifespan; thus, highlighting the need for preventive interventions from a young age. This presentation will include some of the work that our group at Loughborough University have completed examining the effects of exercise and diet manipulations on postprandial metabolism in young people. Studies with healthy boys and girls have shown consistently that a single 30 to 60 min session of moderate-intensity exercise completed 12 to 16 h before a standardised meal reduces postprandial TAG. Manipulations of exercise duration and intensity suggest an exercise energy expenditure dose-dependent response is not supported directly in healthy young people, but a minimum energy expenditure threshold may be evident. Studies investigating alternative modes of exercise have reported lower postprandial [TAG] after intermittent games activity and high-intensity interval running, which may appeal to the spontaneous physical activity habits of young people. More recently, our research has been conducted in local schools to determine the extent to which the laboratory-based exercise effects might transfer to “real-world” settings where young people spend the majority of their time during the week. Initial findings show that our postprandial research model can be applied in supportive schools, with results that mirror those in tightly-controlled laboratory studies. In-school, small-sided football and brief bouts of high-intensity sprint running were as efficacious in reducing postprandial lipaemia as time-matched continuous brisk-walking and were more enjoyable according to the participants. Conversely, the combination of regular breaks in sitting time and brisk-walking had virtually no effect on postprandial metabolism in healthy adolescents. Our research provides much needed empirical evidence of acute physiological responses that, if applied regularly over time, could translate into longer-term health benefits for young people as they move towards adulthood. However, the work needs to be expanded now to include possible physiological pathways that might explain the mechanisms underpinning the effects we have identified repeatedly in young people; the ethical and practical logistics of advances in this direction will be challenging.

### New understanding of how exercise increases insulin sensitivity

Glenn McConell, PhD<sup>1</sup>

<sup>1</sup>*Institute for Health and Sport (IHES), Victoria University, Footscray, Melbourne, Australia.*

Regular exercise increases insulin sensitivity, reduces the risk of diabetes and improves clinical symptoms in those with type 2 diabetes (T2D). The benefits of exercise training largely reflect an accumulation of adaptations/perturbations from a series of acute exercise bouts. There is an insulin-independent increase in skeletal muscle glucose uptake for ~2-3h post-exercise after which the muscle is more sensitive to insulin for 24-48h in both rodents and humans. Indeed, leg glucose uptake during a euglycaemic hyperinsulinaemic clamp is around 50% greater 3-4h after a 60 min bout of single-legged exercise in humans compared to a rested leg. Importantly, acute exercise also increases skeletal muscle insulin sensitivity in people with T2D.

We recently showed that initiation of an insulin clamp four hours after single-legged exercise in humans increased microvascular perfusion (determined by contrast enhanced ultrasound) by 65% in a exercised leg and 25% in a rested leg and leg glucose uptake increased 50% more in the exercised leg than the rested leg. Furthermore, when the increase in microvascular blood flow by insulin was prevented by local infusion of the nitric oxide synthase (NOS) inhibitor L-NMMA, the increased insulin sensitivity in the exercised leg was abrogated (Sjøberg et al. 2017). This was despite no effect of the NOS inhibitor on skeletal muscle insulin signaling (Sjøberg et al. 2017). Therefore, the increase in skeletal muscle insulin sensitivity after acute exercise is at least partly due to increases in microvascular perfusion, and thus enhanced glucose delivery. It is generally assumed that there are three potential limitations to insulin-stimulated glucose uptake into skeletal muscle; glucose delivery, glucose transport and glucose phosphorylation and metabolism. The balance of these factors will affect the skeletal muscle interstitial concentration of glucose.

We recently examined, after single leg exercise, insulin sensitivity across the leg and interstitial muscle glucose concentration during a euglycaemic hyperinsulinaemic clamp with infusion of the vasoconstrictor L-NMMA and the vasodilator ATP into the femoral artery. We found that the apparent muscle sarcolemmal permeability to glucose can be estimated in vivo and is increased twice as much by insulin in exercised compared with rested muscle. We further found that the capillary wall can be a significant barrier for glucose leading to low interstitial glucose concentrations. The increase in glucose delivery (blood flow) with insulin under these circumstances prevents skeletal muscle interstitial glucose concentration decreasing to critically low levels that would nullify the insulin sensitising effect of exercise. Our results

provide new understanding of the limiting factors for muscle glucose uptake during insulin stimulation and how exercise enhances insulin sensitivity in the post-exercise recovery period.

Reference

Sjøberg Kim A., Christian Frøsig, Rasmus Kjøbsted, Lykke Sylow, Maximilian Kleinert, Andrew C. Betik, Christopher S.

Shaw, Bente Kiens, Jørgen F. P. Wojtaszewski, Stephen Rattigan, Erik A. Richter, Glenn K. McConnell. Exercise increases human skeletal muscle insulin sensitivity via coordinated increases in microvascular perfusion and molecular signaling. *Diabetes*. 66: 1501-1510, 2017.

# Oral Presentations

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## Clinical Exercise Physiology

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### 1. Effects of high intensity interval vs moderate intensity continuous training on fitness and body composition in active breast cancer survivors

Bell, R.<sup>1,2</sup>, Baldi, J.C.<sup>2</sup>, Jones, L.M.<sup>1</sup>

<sup>1</sup>*School of Physical Education, Sport & Exercise Sciences, University of Otago*

<sup>2</sup>*Department of Medicine*

Breast cancer and its treatment can decrease cardiorespiratory fitness and alter body composition in breast cancer survivors, thereby increasing risk of overall, cardiovascular and cancer-specific mortality. Exercise in cancer populations may offset these deleterious effects, with a suggestion that HIIT may be more effective than MICT for improving cardiorespiratory fitness. This purpose of this study was to compare the two modalities in recreationally active breast cancer survivors. Twenty recreationally active breast cancer survivors who had been treated with chemotherapy and/or radiotherapy completed 2-3 sessions per week of HIIT or MICT for a total of 24 sessions over 9-12 weeks. A  $VO_{2peak}$  test and a dual X-ray absorptiometry (DXA) scan for body composition was undertaken and repeated at the end of the intervention. Nineteen participants completed the intervention with no study-related adverse events. Both groups improved  $VO_{2peak}$  ( $p=0.007$ ) and reduced waist circumference ( $p=0.006$ ) over the intervention, but no statistically significant differences were found between groups. A significant ( $p<0.05$ ) interaction effect was found between group and time for minute ventilation. This pilot study has shown that a 9- to 12-week intervention of either HIIT or MICT can improve cardiorespiratory fitness and decrease waist circumference in physically active breast cancer survivors.

### 2. Protein, Insulin-like Growth Factor (IGF-1) and Exercise: A Systematic Review

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Insulin-like growth factor-I is associated with multiple physiologic outcomes including: increased muscle growth and repair as well as increased cancer risk. Nutritional status (e.g. protein intake) has been observed to influence circulating IGF-1. However, effects of dietary protein intake on IGF-1 are inconsistent. The aim of this study was to conduct a systematic review and meta-analysis to determine the relationship between IGF-1 and dietary protein intake. Searches of Scopus, PubMed,

Sport Discus, Web of Science, and Academic Search Complete databases up to September 2017 retrieved 6,271 publications, which were subsequently screened to determine if they met inclusion criteria. Papers were screened independently in duplicate and data are currently being extracted from relevant studies. If the systematic review reveals groups of studies that are homogenous then meta-analyses may be performed using STATA. We will evaluate statistical heterogeneity using the Chi-square ( $X^2$ ) statistic. Publication bias will be explored using funnel plots. Based upon the review of the literature we anticipate conducting subgroup analyses to investigate if aspects of study design such as: sampling timing (relative to feeding), source of protein (animal versus vegetable), and quantity of protein ingested effect the association between protein intake and IGF-1 concentrations.

### 3. Cardiovascular responses to heat stress in health and disease

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Understanding what drives adaptations to exercise is key to developing meaningful conditioning programs in health, disease, and performance. Heat stress is a principal stressor within exercise, and alone it can improve all components of the cardiovascular system. Given the similar cardiovascular outcomes to both stressors, heat stress could have a fundamental role in adaptation. Cardio-protective benefits of exercise are driven by multiple independent mechanisms, one of which is changes in blood flow (and ensuing shear stress). Heat stress elicits similar shear-mediated cardiovascular adaptations, and other concurrent benefits (e.g., cellular protection, improved metabolic profile, enhanced muscle contractility). Recent research from our lab has highlighted the role of heat, acutely and chronically, independent of exercise, and as a supplemental stressor. We have shown that in cardiovascular disease, heat and exercise appear to produce a similar adaptive stimulus; when the two stressors are combined in healthy populations, this is also the case. Heat may therefore provide a viable alternative, or supplementary stressor to regular exercise, at least for cardiovascular-related and -mediated outcomes. This presentation will highlight key projects and speculate about the future of heat for conditioning in health, disease, and performance.



#### 4. Blood pressure responses to different modes of heating

Campbell, H<sup>1</sup>, Kissling, L<sup>1</sup>, Akerman, A<sup>1,2</sup>, Prout, J<sup>1</sup>, Thomas, K<sup>1,2</sup>, Gibbons, T<sup>1</sup>, Cotter, J<sup>1</sup>

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Heat is a common stressor, and whether caused by exercise or the environment it can drive adaptations to enhance cardiovascular function. Exercise in hot conditions, spa bathing and sauna are three common and practical modes of heating. They may exert different effects, but this remains unknown. To compare these modes of heat stress in regard to their thermal (core temperature and perceptions) and cardiovascular function (blood volume and arterial pressure) during heating and for up to 1 d afterward. Ten, healthy, active participants (3 women), completed four 60-min exposures in randomised order: Spa (40 °C), Sauna (55 °C, 55 % rh), Exercise in humid heat (40 °C, 50% rh), and a Thermoneutral control bath (36°C), with recovery measures 0, 0.75, 2 and 24 h afterward. Exercise in the heat was most effective in eliciting hypotension during recovery at 0.75 h (-11 mm Hg for systolic pressure) and rebound plasma volume expansion by 24 h (+5.2%). No significant effects were elicited following Spa or Sauna. Heat discomfort was comparable between conditions. The superior cardiovascular effects from Exercise may reflect a combination of its additional thermal, metabolic and cardiovascular strain during exposure.

#### 5. The effects of heavy-sled sprint training on acceleration capabilities in female rugby sevens athletes: A pilot study

Sella, F.S<sup>1</sup>, Beaven C.M<sup>1</sup>, McMaster D.T<sup>1</sup>, Hébert-Losier K<sup>1</sup>, Gill, N.D<sup>1</sup>.

<sup>1</sup>*University of Waikato (Faculty of Health, Sport and Human Performance)*

Well-developed acceleration abilities are critical for performance in rugby sevens. In this pilot study, we investigated the effects of heavy-sled sprint training on acceleration profiles in female rugby sevens athletes. Eleven junior female rugby sevens athletes completed 3-weeks of resisted sprint training (5-30m) with heavy sleds (30-85% of body mass). Acceleration performance and biomechanical outputs were computed pre- and post-intervention using the methods described by Samozino et al. Training-induced changes were calculated using effect size (ES) and magnitude-based inferences. Correlations (r) between changes in sprint performance and biomechanical outputs were calculated. Small improvements in 5m and 10m times, and changes in mechanical effectiveness of force application (RFmax), force-velocity slope (SFV), and maximum power output (Pmax) were observed (ES = 0.36-0.40). Almost perfect correlations were found between changes in 5m and 10m times with  $\Delta P_{max}$ , theoretical maximum force ( $\Delta F_0$ ), and  $\Delta SFV$  ( $r \geq 0.92$ ). Heavy-sled sprint training was likely to improve 5m and 10m times, maximum power, and sprint biomechanics. Specifically, changes in Pmax, F0, and SFV explained over 85% of the

variance associated with improvements in 5m and 10m times. Heavy-sled sprint training is likely to increase acceleration capabilities in female rugby sevens athletes.

#### 6. An exploration of the term “training density”, what it means, how it’s measured and how it’s applied to rugby union training.

Smith, T.B<sup>1</sup>, Tarrant, O. P,<sup>2</sup> Bradey, C,<sup>1</sup> Olsen, C,<sup>1</sup> Bright, W,<sup>1</sup>

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<sup>2</sup>*Munster Rugby Club, Limerick, Ireland*

Ideally for specific training periods the training workloads should mirror the position specific workload requirements of a match. The advent of sports specific global positioning systems (GPS) has enabled the identification of rugby specific locomotion metrics. To help quantify the training workload that equals match workload, the notion of “training density” has been coined. Training density (density) is essentially work rate per minute, measured as a specific metric value per minute. The aim of this presentation is to discuss the process of determining rugby union specific relevant metrics, measuring position specific match densities and applying these to training. Various GPS metrics were analysed for their suitability for measuring locomotion density in rugby union players. GPS match data (Statsports Technology Ltd, Courtney Hill, NI) for a super rugby team was explored so that only the data collected while the player was playing on the field was examined. **Results:** The most relevant metrics included high metabolic load, sprint metabolic load, high-speed distance and specific acceleration zone counts. An accurate live GPS system provides the ability to monitor match specific training drills to ensure the requisite match specific densities occur for the team, the various positions and individual players.

#### 7. The Effects of Morning Preconditioning Protocols on Testosterone, Cortisol and Afternoon Sprint Cycling Performance.

McDonald, K<sup>1</sup>, Maulder P.<sup>1</sup>

<sup>1</sup>*Wintec*

Opportunity exists for athletes to undertake morning exercise protocols in an attempt to potentiate afternoon performance. Four track sprint cyclists involved with Cycling NZ’s development programme completed either a morning cycling (Cyc) or weights (W) based protocol (P) prior to an afternoon 500m cycling time trial. Heart rate, testosterone (T) and cortisol levels were measured along with peak power (PP) in the morning and afternoon. The WP produced significantly ( $P = 0.018$ ) faster times between 250-500m in comparison to CycP. The anticipated circadian decline of T was observed after the CycP but was however mitigated following the WP. While slight decreases in 500m times were experienced during the WP, they are considered within the normal variations experienced between performances by elite athletes. Differences in morning T levels between protocols may be due to athlete’s motivation to complete each protocol. The effect of the WP on the circadian rhythm of T could be linked to a greater

recruitment of muscle fibres. The use of a heavy resistance morning exercise protocol is recommended for positively effecting testosterone levels in the afternoon. Possible gender and individual responses from conducting a W over Cyc protocol may exist but requires further investigation.

### 8. Physical characteristics of New Zealand Army, Navy and Airforce officer trainees' pre and post a 6-week joint officer induction course (JOIC).

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<sup>2</sup>New Zealand Defence Force, Wellington, New Zealand

Fitness levels of officers entering militaries worldwide has become a major focus. A plethora of research exists from other countries, but fitness data on the New Zealand Defence Force (NZDF) is lacking. This study intended to characterise NZDF

officer trainees' pre and post a 6-week JOIC. 116 participants (Army; n=75, Navy; n=25, Airforce; n=16) were tested pre and post a 6-week JOIC, consisting of; a 2.4km-run, upper-body strength-endurance (press-ups and curl-ups) and Y-balance musculoskeletal-screening. At baseline, Army performed better in the 2.4km-run and press-ups compared to the other services ( $p<0.05$ ), Navy performed better in curls-ups. Across all services, there were significant pre to post improvements in 2.4km run time ( $676 \pm 83s$  to  $625 \pm 82s$ ,  $p=0.02$ ), press-ups ( $25 \pm 11$  to  $32 \pm 11$ ,  $p=0.04$ ) and curl-ups ( $41 \pm 21$  to  $56 \pm 38$ ,  $p=0.01$ ). Army officers possessed superior baseline fitness compared to Navy and Airforce. Across all services, following a 6-week JOIC, significant improvements were found for aerobic-fitness, upper-body and core strength/endurance. Appropriate training program design is critical to ensure significant improvements across all measures of fitness following a 6-week JOIC.

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## Sports Nutrition

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### 9. Effects of glucose ingestion and exercise on cerebrovascular function

Smith, B. J.<sup>1</sup> Cotter, J. D.<sup>1</sup> Wilson, L.<sup>2</sup> Shoemaker, L. N.<sup>1</sup> Rehrer, N. J.<sup>1</sup>

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Acute hyperglycaemia impairs peripheral endothelial function. However, evidence regarding glucose and cerebrovascular function in response to exercise is limited. **Aim:** Investigate effects of glucose on cerebral blood flow regulation, and if exercise ameliorates any glucose induced reduction in cerebrovascular reactivity (CVR). Ten physically-active healthy adults ( $21 \pm 1$  y; 5 males/5 females) participated in two trials in a crossover design. Both trials involved a 75g Oral Glucose Tolerance Test with blood glucose (BG), middle cerebral artery velocity (MCAv) and CVR measured at baseline and 30-minute intervals. Control trial at rest, the other after ten 1-minute 90% Wmax cycling intervals with 1-minute rests. BG didn't differ between trials ( $p=0.126$ ). In both trials MCAv was greater than baseline at 30-minutes ( $p<0.0001$ ) and 60-minutes ( $p<0.01$ ). CVR (cm/s/mmHg) for both trials were lower than baseline at 30 minutes ( $p<0.01$ ), 60 minutes ( $p<0.05$ ), and 90-minutes ( $p<0.01$ ). Cerebrovascular conductance (CVC) had no significant difference between trials, however, CVC was greater at 30-minutes ( $p<0.01$ ) and 60-minutes ( $p<0.05$ ) for control and exercise. Mean arterial pressure had no significant differences between trials or over time ( $p>0.05$ ). Hyperglycaemia impaired CVR while increasing MCAv. HIIE didn't influence any cerebrovascular outcomes, indicating negligible cerebroprotective effects.

### 10. Low Energy Availability and Cardiovascular Disease Risk in Elite Female Rugby Players: An Observational Study.

Christensen, S.<sup>1</sup>, Black, K.<sup>1</sup>, Baker, D.<sup>2</sup>, Sims, S.<sup>3</sup>, Smith, B.<sup>3</sup>, Kumar, J.<sup>1</sup>, Groom, J.<sup>1</sup>

<sup>1</sup>University of Otago, <sup>2</sup>Chiefs Super Rugby Franchise, <sup>3</sup>University of Waikato

Extensive research exists regarding LEA and both bone health and reproductive function; however, research is limited regarding the cardiovascular effects. Research to date, mostly in individual endurance sports, has investigated blood lipids, flow mediated dilation, and questionnaire data, which provide some evidence that LEA is associated with unfavourable lipid profiles and endothelial dysfunction. The aim of this study was to describe the lipid and arterial stiffness profiles of elite New Zealand female rugby players with and without LEA. Twenty-one elite female rugby Sevens players participated in the study. LEA status was assessed using the LEAF-Q questionnaire. Cardiovascular health was assessed through blood lipid profiles and pulse wave velocity to assess arterial stiffness. Results indicated trends towards lower HDL,  $-0.26$  mmol/L (0.06,  $-0.57$ ) and higher triglycerides,  $0.22$  mmol/L (0.48,  $-0.03$ ) in those at risk for LEA compared to those not at risk. A trend towards higher pulse wave velocity was also seen in those at risk compared to those not at risk,  $0.86$  ms<sup>-1</sup> (2.40,  $-0.68$ ). These results suggest that elite female rugby Sevens athletes in New Zealand at risk for LEA show trends towards poorer cardiovascular health.

### **11. The effect of a 31-day ketogenic diet on submaximal exercise economy and capacity in trained endurance runners.**

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<sup>3</sup>*University of Auckland, Faculty of Medical and Health Sciences*

This study investigated the effect of a 31-day ketogenic diet on submaximal exercise economy and capacity. A randomised, counterbalanced, crossover study was conducted with 8 trained marathon and/or ultramarathon runners. Participants undertook a testing block prior to and after 31 days of ingesting a ketogenic diet or their habitual moderate-to-high carbohydrate diet. Dietary adherence was confirmed by daily communication with a registered dietitian, daily urine ketone measurements, weekly blood ketone measurements, frequent image-assisted weighed dietary diaries and increased maximal fat oxidation rates. The testing block included an incremental running test to exhaustion (day 1), rest (day 2), and a run to exhaustion at 70% maximal oxygen utilisation in a fed state according to the dietary allocation (day 3). A ketogenic diet appeared to unfavourably effect exercise economy as determined by elevated oxygen utilisation and energy expenditure, however, this did not impair running time to exhaustion. These data suggest a ketogenic diet does not impair submaximal exercise capacity and may support athletes undertaking ultra-endurance events when access to dietary carbohydrate is limited.

### **12. Nutrition-Related Barriers, Attitudes and Influences towards Dietary Intake and Body Composition Elite Male Athletes**

Sharpley, A<sup>1</sup>, Galloway, S<sup>1</sup>, Black, K<sup>2</sup>, Baker, D<sup>3</sup>, Smith, B<sup>4</sup>

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<sup>3</sup>*High Performance Sport New Zealand*

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The heavy physiological demands of rugby union require adequate nutritional intake to promote overall health as well as for optimal training and performance. However, research suggests that the dietary intakes of rugby union players are far from optimal. It is unclear if rugby union player's nutrition knowledge, beliefs and attitudes about nutrition have an association with their overall dietary intake. Understanding these relationships is required in order to provide efficient dietary advice to individual players. There is currently limited research investigating the reasons elite rugby players ingest the foods they do. This study aimed to investigate the nutrition barriers and attitudes that influence rugby union player's dietary intake and if there was any association with maintaining optimal body composition. The study design was an observational cross-sectional design. Thirty-three professional

rugby players were asked to complete an online questionnaire and one face-to-face interview. Interviews were recorded, transcribed, and then underwent thematic analysis. Nine participants had unfavorable body-composition. Seven of these participants ate a lot between dinner and bed. Eight participants used outside sources to get nutrition information. All of these eight participants were not contracted to a Super Rugby Franchise. This research suggests that rugby player's dietary behaviour does influence their body composition.

### **13. Social Media as a Nutrition Resource for Athletes: A Cross Sectional Survey**

Bourke, B<sup>1</sup>, Baker, D<sup>2</sup>, Braakhuis, A<sup>3</sup>

<sup>1</sup>*University of Auckland*

<sup>2</sup>*High Performance Sport NZ*

Social media contains a wealth of nutrition information and proposes a cost-effective, highly engaging platform to deliver nutrition information to athletes. This study used an online questionnaire to determine whether New Zealand athletes are using social media as a source of nutrition information, and to understand perceptions of social media as a nutrition resource. Both Recreational and Elite athletes were surveyed. From the 306 athletes who completed the questionnaire, 65% reported social media use for nutrition purposes in the last 12 months. Social media use was predicted by both athlete status and gender. Athletes commonly used social media for practical nutrition purposes, including recipes and information about restaurants/cafes. Perceived advantages of social media as a nutrition resource included: ease of access, well presented information, personal connectedness and information richness. Athletes' primary concern for obtaining nutrition information from social media was information unreliability. This study has identified strategies to deliver nutrition support to athletes through social media. For nutrition and dietetic practitioners, it is about balancing the delivery of formal credible nutrition information, but also exploiting the informal and appealing nature of social media.

### **14. Reducing Upper Respiratory Illness in New Zealand Team Athletes**

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<sup>5</sup>*Department of Nutrition and Dietetics, University of Auckland, Auckland, New Zealand*

Upper respiratory illness (URI) is a common illness complaint by athletes. The aim of this study was two-fold; firstly, identify at what level of New Zealand sport URIs are most prevalent and secondly use a nutritional supplement to determine if URI rates can be reduced in this cohort. The researchers initially recruited players (n = 90) from different levels of rugby (school boy

(three tiers), amateur and professional) and asked participants to complete a URI questionnaire twice a week for the duration of their season. The outcome of this study was that 1st XV schoolboy players had the highest URI incidence and duration. Consequently, researchers recruited top-level players ( $n = 32$ ) across different codes at one school and conducted a two-month parallel double-blind RCT with participants allocated to either olive leaf extract (OLE) or placebo. The main outcome was that there was no significant difference in the URI incidence (0.59 vs. 0.58; Odds Ratio = 1.02 (95% CI 0.21-4.44)) or sick days (0.16 vs. 0.20) between those on OLE and placebo. Overall this project shows that top-level school players have an increased URI incidence and duration, and although OLE supplementation does not attenuate this, further supplements should be investigated.

### 15. Perceptual and Physiological Responses to Differing Ergogenic Mouth Swilling Solutions

Best, R<sup>1,2</sup>, Maulder, P<sup>1</sup>, Berger, N.<sup>1,2</sup>

<sup>1</sup>Teesside University

<sup>2</sup>Waikato Institute of Technology

Carbohydrate and menthol mouth-swilling have been used to enhance exercise performance in the heat. However, these strategies differ in mechanism and subjective experience. Participants ( $n=12$ ) sat for 60 min in an environmental chamber (35°C; 15±2%). Following a 15-minute control period participants undertook three 15-minute testing blocks. A different randomised swill (Carbohydrate; Menthol; Water) was administered per testing block (one swill every three minutes per block). Heart rate, tympanic temperature, thermal comfort, thermal sensation and thirst were recorded for each swill. Small elevations in heart rate were observed after carbohydrate (ES:  $0.22 \pm 90\%$  CI: -0.09 to 0.52) and water (0.26; -0.04 to 0.54). Tympanic temperature was moderately different between control and all testing blocks. Menthol showed small improvements in thermal comfort relative to carbohydrate (-0.33; -0.63 to 0.03) and water (-0.40; -0.70 to -

0.10), and induced moderate reductions in thermal sensation (-0.71; -1.01 to -0.40 and -0.66; -0.97 to -0.35, respectively). Menthol also reduced thirst by a small to moderate extent. To conclude, carbohydrate and water may elevate heart rate, whereas menthol elicits small improvements in thermal comfort, moderately improves thermal sensation and may mitigate thirst. This suggests a hedonic response of value in hot conditions for a short-moderate duration.

### 16. Hcpidin and Iron Status in Elite Female Rugby Players

Smith, S<sup>1</sup>, Black, K.<sup>1</sup>

<sup>1</sup>University of Otago

Hcpidin was identified as a negative regulator of iron levels in the early 2000s. Since then, the exercise-induced hepcidin response has been proposed as a mechanism of iron deficiency (ID) in athletes. By assessing and tracking haematological and inflammatory parameters in elite female rugby players, the aim of the current study is to describe the relationship between hepcidin and iron levels amongst elite female rugby players. Venepuncture blood samples were analysed from 17 elite female rugby players in February and July and analysed for iron, ferritin, soluble transferrin receptor, high sensitivity C-reactive Protein (CRP) and hepcidin. Dietary intakes, physical activity demands and DXA scans were also measured. Mean iron concentration in February was 21.3 µmol/L and increased to 21.9 µmol/L in July. Mean ferritin and sTfR values in February were 77.1 µg/L and 2.62 mg/L respectively, and 75.1 µg/L and 2.50 mg/L in July. Average CRP concentrations increased from 0.95 mg/L to 1.66 mg/L and mean hepcidin concentrations decreased from 34.2 ng/mL to 33.1 ng/mL. All mean variables were within the expected reference ranges, however some individual values fell outside this range. The exercise-induced hepcidin response may contribute to ID in elite female athletes, although more research is needed.

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## Sport Performance

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### 17. Comparing two Landing Error Scoring System protocols: Same but different!

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<sup>1</sup>University of Waikato

The Landing Error Scoring System (LESS) screens for risk of non-contact lower-extremity injuries. The original LESS requires individuals to jump down from a 30-cm box to 50% of body height. However, clinicians and scientists often do not dictate landing distance during LESS assessment. This study examines whether landing distance influences LESS score and

risk categorisation. Seventy volunteers (34 males, 36 females) performed 3 x 30-cm drop-jumps under two landing conditions: (1) 50% of body height, (2) no set distance. The average LESS score and proportion of individuals categorised at high (LESS  $\geq 5$ ) and low (LESS  $< 5$ ) risk were compared. LESS scores (difference:  $-0.01 \pm 1.49$ , paired t-test  $p = 0.947$ ) and proportion of individuals at high and low risk (odds ratio: 1.09, McNear test  $p = 1.00$ ) were similar between conditions. However, risk categorisation was inconsistent for 23 participants (33%). At a group-level, LESS score and risk categorisation was similar between the two landing distances examined. However, at an individual-level, landing distance influenced risk categorisation

in one-third of the sample. When tracking changes in movement patterns linked with injury risk, using a consistent LESS protocol is recommended.

### 18. How are deceptive movements portrayed in badminton?

Park, S. H.<sup>1</sup>, Ryu, D.<sup>2</sup>, Uiga, L.<sup>1</sup>, Masters, R. S. W.<sup>1</sup>, Mann, D. L.<sup>3</sup>, Abernethy, B.<sup>4</sup>

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<sup>3</sup>*Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam*

<sup>4</sup>*Faculty of Health and Behavioural Sciences, The University of Queensland*

Studies have shown that the pick-up of essential kinematic information leads to correct movement anticipation. However, little is known about the mechanisms underlying the anticipation of deceptive movements in sport. This study, therefore, investigated the role of kinematic and non-kinematic

visual information in the anticipation of deceptive and non-deceptive badminton shots. Skilled (n = 12) and less-skilled (n = 12) badminton players were asked to predict where the shuttle would land after watching videos of deceptive and non-deceptive badminton shots. Kinematic and non-kinematic information was delineated by isolating the high and low spatial frequencies inherent in the video image – low-spatial frequencies (low-SF) mainly presented kinematic information, whereas high-spatial frequencies (high-SF) emphasised non-kinematic information. Results revealed that skilled players were worse at anticipating deceptive shots that were presented in high-SF (emphasising non-kinematic information) footage than when anticipating shots presented in low-SF footage (kinematic information only) or normal footage. These results suggest that deceptive intent is portrayed via non-kinematic visual information. Future studies should develop training protocols for players to become more resilient to deception by ignoring non-kinematic information.

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## Exercise Physiology

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### 19. Influence of acute and chronic hypoxia on brain blood flow regulation during thermal stress.

Gibbons, T.<sup>1</sup>, Dawkins, T.<sup>4</sup>, Caldwell, H.<sup>2</sup>, Howe, C.<sup>2</sup>, Tymko, M.<sup>2</sup>, Hoiland, R.<sup>2</sup>, Coombs, G.<sup>2</sup>, Patrician, A.<sup>2</sup>, Stembridge, M.<sup>4</sup>, Wilson, L.<sup>1</sup>, Thomas, K.<sup>1</sup>, Ainslie, P.<sup>2</sup>, Cotter, J.<sup>1</sup>

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<sup>4</sup>*Cardiff Metropolitan University*

Environmental stressors are most often studied in isolation, yet natural environments commonly entail multiple stressors. For example, hypobaric hypoxia and cold are concurrent features of high altitude. Moreover, many clinical conditions – e.g. acute trauma, cardiac arrest, and stroke – often result in thermal instability and focal or systemic hypoxia. How the brain tolerates these stressors strongly indicates how well the individual as a whole will tolerate such stressors, as the brain integrates both physiological and behavioural adaptation. We therefore investigated how acute and chronic hypoxia influences brain blood flow regulation, cognition, and thermal perceptions under hot and cold stress. At sea level (344 m) and high altitude (4330 m), 13 male participants were exposed to passive heating (oesophageal temperature +1.5°C ± 0.1°C) and cooling (-0.9 ± 0.5°C). Brain blood flow, direct arterial blood pressure, ventilation, respiratory gases, and cardiac output were measured in resting thermoneutral conditions and at both

thermal extremes with and without the superimposition of acute hypoxia at sea level, and under chronic hypoxia at high altitude. Results are being analysed and will be presented.

### 20. Cerebrovascular Reactivity Following Maximal Resistance Exercise.

de Hamel, T.<sup>1</sup>, Wilson, L.<sup>2</sup>, Perry, B.<sup>3</sup>, Thomas, K.<sup>4</sup>, Tirez Macdonald, T.<sup>1</sup>, Cotter, J.<sup>1</sup>

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Maximal resistance exercise (RE) acutely impairs peripheral arterial function during recovery, but effects on cerebral arteries remain unknown. Vascular dysfunction is associated with increased atherosclerotic development and risk of stroke. **Aim:** To examine the effect of RE on cerebrovascular reactivity (CVR) during recovery. We hypothesised that CVR would decrease, as occurs in the periphery. Ten physically-active adults (30 ± 25 y) undertook two trials in crossover fashion, at least one day apart. One trial involved five 20-s, bilateral MVC knee extensions within 10 min, with cerebrovascular function measured before exercise and during 50 min afterward. The other trial was a time control. RE did not reliably alter middle cerebral artery velocity (MCAv; interaction: p=0.89) or its

reactivity to CO<sub>2</sub> (interaction:  $p=0.15$ ) during recovery, despite the mean reactivity immediately after exercise being higher by 50%. The two major systemic factors controlling MCAV, i.e., mean arterial pressure and end-tidal CO<sub>2</sub> pressure (PETCO<sub>2</sub>), were unchanged, except for a small and transient exercise-related reduction in PETCO<sub>2</sub>. Sustained, maximal resistance exercise with severe Valsalva maneuvers had no measurable effect on our index of cerebral blood flow or its major regulatory mechanism. Thus, we did not find evidence for such exercise causing cerebrovascular dysfunction (acutely).

## 21. Delineation of swimming-related effects on cerebral blood flow velocity

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Exercise aids vascular and cognitive health. Aquatic exercise has been suggested as favourable for cerebrovascular adaptations. However, because cerebrovascular and cognitive effects of swimming and its component factors remain unknown, we examined these in swimmers and terrestrial athletes. Ten land-based athletes (22±5 years) and eight swimmers (19±1 years) completed 3 cognitive tasks and manipulation of 8 swimming-related factors (i.e., posture, immersion, end-tidal CO<sub>2</sub> pressure (PETCO<sub>2</sub>) and motor involvement), with measurement of middle cerebral artery blood velocity (MCAV<sub>mean</sub>), heart rate, PETCO<sub>2</sub> and mean arterial blood pressure. Swimmers had ~17% slower MCAV<sub>mean</sub> during all rest conditions ( $p\leq 0.04$ ). Prone posture and the consequent rise in PETCO<sub>2</sub> each increased MCAV<sub>mean</sub> (~13%;  $p<0.00$ ). Water immersion independently increased MCAV<sub>mean</sub> when upright (~13%;  $p<0.00$ ) but not prone ( $p=0.13$ ), without altering cognition (executive function;  $p\geq 0.15$ ). The motor involvement of swimming tended to decrease MCAV<sub>mean</sub> ( $p=0.06$ ) but improved reaction time by 4% ( $p=0.03$ ), regardless of athlete group ( $p=0.12$ ). In conclusion, swimming increased MCAV<sub>mean</sub> because postural and PETCO<sub>2</sub> effects outweighed the exercise effect. Chronic swim training appeared to lower resting MCAV<sub>mean</sub> but swimming improved executive functioning acutely, regardless of athlete group. Future research should explore the chronic effects of swimming on cerebrovascular function, particularly flow and vessel diameter.

## 22. The Relationship between Physiological and Psychophysical Function throughout Heat Acclimation

Prout, J.<sup>1</sup> Cotter, J.<sup>1</sup>, Lamberts, R.<sup>2</sup>, Corbett, J.<sup>3</sup>, Sims, S.<sup>4</sup>, Kissling, L.<sup>1</sup>, Campbell, H.<sup>1</sup>, Gibbons, T.<sup>1</sup>, and Akerman, A.<sup>1</sup>.

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Humans adapt powerfully to heat. Repeated bouts of clamped- or controlled-hyperthermia are deemed the ‘gold-standard’ approach to heat acclimation (HA), and are used in research, but athletes typically self-regulate their exposures, i.e., based on their perceived thermal and total strain. The purpose of this study was to determine the relationship between psychophysical and physiological thermoregulatory function throughout heat acclimation.

Thirteen endurance-trained participants ( $x \pm x y$ ;  $x$  female) completed 9 days of cycling-based HA (60 min·d<sup>-1</sup>) in a heated laboratory (40 ± x°C; 50 ± x% RH). Athletes’ core temperature increased  $x \pm x$ °C, through either a self-regulated or controlled regimen. On days 1, 5, and 9, athletes cycled at 1.75 W·kg<sup>-1</sup> for the first 30 min of their HA session. Present results here (relationships between core temperature/skin temperature, and thermal sensation, thermal discomfort, and affect). These data indicate that psychological and physiological adaptations occur at same/different rates, and those with greatest psychological adaption did/did not experience the greatest physiological adaptation.

## 23. Effects of hypohydration and the menstrual cycle on pain perception

Tan, W.L.B.<sup>1</sup>, Philipp M.<sup>1</sup>, Mundel T.<sup>1</sup>

<sup>1</sup>*Massey University*

Chronic pain (pain persisting ≥ 3 months) is a global health problem and is associated with tremendous social and economic cost. Yet, current pain treatments are often ineffective, as pain is complex and influenced by numerous factors. Hypohydration has recently been shown to contribute to pain perception in men<sup>1,2,3</sup>, but its effects in women is unknown. In women, changes in sex hormone levels during the menstrual cycle and with the use of oral contraceptive pills can alter pain perception, as well as the regulation of body water. This narrative review examined the current literature regarding the effects of hypohydration and the menstrual cycle on pain perception, to explore a potential interaction between these factors in modulating pain. The available data indicates a pro-nociceptive effect of hypohydration, although research in this area is limited ( $n=3$ ). More evidence supports menstrual cycle effects on pain perception ( $n=27/42$  or 64%), but no definitive conclusions can be drawn due to methodological limitations and inconsistencies across studies. Thus, further research investigating the links between hypohydration and the menstrual cycle on pain perception is needed, as findings could have important implications for the treatment of pain and the design of future studies on pain perception in women.

## 24. Female CrossFit members experience irregular menstrual cycles

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<sup>1</sup>University of Waikato

CrossFit is one of the fastest growing exercise trends. The current CrossFit literature is prolific with articles of the proposed risks associated with this modality of exercise. Limited data has been collected on the menstrual cycle status in NZ CrossFit female members and the risk of low energy availability (LEA). An online self-administered questionnaire was distributed to members of NZ CrossFit gym social media groups and the NZ CrossFit Nationals email database. The questionnaire included demographic information, training history, and menstrual cycle information. Preliminary analysis of the data shows female CrossFit members (n=40; age

29.5±5.3 y, height 165.9±6.5 cm, weight 70.4±13.2 kg) trained 5.7±2.3 h.wk<sup>-1</sup>. Forty-two percent of women reported issues with their menstrual cycles: 25% do not observe menses due to OCP/hormonal implants, 15% report irregular periods, and 2% do not track their cycle. Fourteen women reported their periods have stopped for three or more consecutive months. In this general exercising population the issue of disturbed menstrual cycle is of concern. Further analysis of the data will determine associations with injury and illness rate, disordered eating behaviours, diet trends, and risk of LEA. Female CrossFit members experience self-reported irregular menstrual cycles.

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## Education

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### 25. Thinking Out Loud: Teachers' Facilitation on Students' Learning in Outdoor Adventure Education

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Outdoor adventure education has been identified as one of the main foci for programming and learning in New Zealand high schools. Student learning in adventure education is often based on experiential learning where facilitation is integral in the process. Outdoor education teachers usually carry out facilitation during or after an activity to help students gain new knowledge of themselves or of others. Facilitation refers to the process of assisting students to derive meaning from an experience by getting them to reflect upon it. Facilitation can take the form of group debriefs, metaphors, story-telling, or informal conversations. Often being considered as part of the hidden curriculum of outdoor education, facilitation is essential, yet indirect and subtle. This research will examine and delve deeper into a facilitated session within a 2D1N residential camp to understand how facilitation techniques used by teachers can assist students' learning. Qualitative results from the study will be presented and discussed. These findings will contribute to empirical research for facilitation literature and potentially bridge the gap between the role of facilitators and learning for youth in outdoor education.

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### 26. The Study on Physical Literacy Knowledge of Physical Education Teachers in Sabaragamuwa Province, Sri Lanka

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<sup>1</sup>Sabaragamuwa University of Sri Lanka

Physical Literacy (PL) is the ultimate goal of the Physical Education (PE) which highly effects to the sports performances, overall health and wellness. A child should be guided by PE teachers to achieve a healthy, well-being active lifestyle through a systematic PE. The prime aim of this study was to identify the level of PL Knowledge of PE teachers in Sabaragamuwa Province which consists of two administrative districts in Sri Lanka. Descriptive Cross-Sectional Sampling Survey method was applied to do the study and 103 subjects were selected as the sample using Stratified Random Sampling method. Self-administrative Questionnaire was used to collect the data which assesses the PL Knowledge and Demographic factors of PE teachers. Results indicated that the average level of PE teacher's knowledge about overall PL was 64.90%. There was no significant difference between the average Score of overall PL Knowledge and demographic factors except teaching experience (P- value = 0.033). Within the findings of this study revealed can be concluded that PE teachers in Sabaragamuwa province have insufficient level of knowledge on PL which would have negative impacts on children's sports performances & healthy well-being lifestyle. **Key words** – Physical Literacy, Physical Education, PE Teacher, health & well-being.

## 27. Perception of Autonomy Support from the Coaches to Southern Province Athletes in Sri Lanka

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Autonomy support can be defined as interpersonal sentiment and behavior teachers provide to their students during instruction to identify nature and develop students' inner motivational resources. This study was focusing on the matter that was recognized from the national athletes mostly faced during their sport career as well as their responses when they lose up the event even their performances are best. Since one of the major influencing factors on an athlete's performance is "coach", this particular study focused to identify the perception of autonomy support from the coaches to southern province athletes in Sri Lanka. 60 athletes were selected from 3 districts (20 from each district- 10 male and 10 female). The study was done by using simple random sampling method. Required data were gathered by direct interviewing with a standard questionnaire containing necessary variables to get the athletes' responses. The sport climate questionnaire (SCQ) contained 15 qualitative questions seeking required responses on the athlete's perception on his/her coach. Tally individual method and descriptive static method were used to analyze the data collected. According to the gathered information during survey overall acceptability for perception was neutral. But there was a considerable difference between perception result obtained for men and women athletes. Analysis conducted using descriptive statistics clearly showed men athletes had strong

response towards, question number 2, 3, 4, 5, 6, 8, 11, 12, 13, and 15 when compared to women athletes. In addition women athletes had strong response towards, question number 1, 10, and 14 with respect to men. In contrast for question 7 and 9 both men and women athletes had neutral response. As an overall conclusion, both men and women athletes in southern province in Sri Lanka had neutral response towards the perception of autonomy support from the coaches. **Key words:** Autonomy support, athletes, coach, perception.

## 28. The Role of Informal, Unstructured Practice in Developing Football Expertise: The case of Brazilian 'Pelada'

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The aim of this presentation is to provide explanation and discussion on how unconventional socio-cultural constraints influence the development of skill and expertise of Brazilian football players. Built on the framework "contextualised skill acquisition research" (CSAR), this presentation is guided by Bronfenbrenner's bioecological model of human development with data generated via contextual analysis, interviews and participant observations. At the micro-level of Brazilian society "pelada" emerges as one of the socio-cultural constraints that shapes the talent of Brazilian football players by influencing the development of their perceptual-motor expertise.

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## Heat Stress

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## 29. Does the mode of heat acclimation affect the kinetics of adaptation?

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<sup>2</sup>*The Department of Surgical Sciences, Dunedin School of Medicine, University of Otago, NZ.*

Heat acclimation is a strategy used to improve exercise performance in the heat, but the most effective method is unknown. The aim of this study was to investigate adaptive responses to exercise in the heat, hot water immersion (HWI), and sauna, versus a thermoneutral water control. We hypothesised that exercise in the heat would be most effective. A repeated measures design, 13 physically-active participants (5 female) undertook four, 5-d heat exposures (60 min/d) in randomised order, wherein rectal temperature (Tre) was clamped at neutrality (36°C water) or raised by 1.5°C in HWI

(40°C), sauna (55°C; 55% RH), or exercise in the heat (40°C; 50% RH). Exercise in the heat expanded plasma volume (PV) (7.2 ± 4.7%) by 2.6% more than HWI (95%CL: [-0.18, 5.38], n=13) and 4.7% more than sauna ([0.96, 8.52], n=13), while HWI was 2.1% more than sauna ([-1.21, 5.49], n = 13). HWI reduced Tre by 0.30°C (± 0.25°C, n=12) and was 0.18°C more than exercise in the heat ([0.01, 0.34], n=12), and 0.11°C than sauna ([-0.31, 0.09], n=12). Preliminary results indicate that PV expansion is greatest with exercise in the heat whereas reduction in Tre was greatest with HWI.

## 30. The impact of solar radiation exposure on professional team-sport training and recovery

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<sup>1</sup>*Bond University*

<sup>2</sup>*Gold Coast Suns FC*

<sup>3</sup>*Victoria University*



This study determined the effect of varying levels of solar radiation exposure on the quality of training and rate of recovery during physical preparation for professional team-sport competition. Forty-five male, team-sport athletes completed seven-weeks of pre-season training ( $17 \pm 2$  sessions) where environmental conditions (ambient temperature, humidity and solar radiation) were monitored. Outdoor session external and internal load was quantified for each athlete and waking heart rate variability (HRV) was recorded as a marker of recovery. Data was analysed using linear mixed models (R statistical computing package). Mean environmental conditions were  $31 \pm 2$  °C,  $62 \pm 6$  % humidity and  $718 \pm 231$  W/m<sup>2</sup> solar radiation. Mean session distance per minute (m.min<sup>-1</sup>), percent high-speed running (HSR%) and percent time >85% HR<sub>max</sub> was  $104 \pm 22$  m.min<sup>-1</sup>,  $25 \pm 10$  % and  $16 \pm 15$  %, respectively. m.min<sup>-1</sup>, HSR%, percent time >85% HR<sub>max</sub> (all  $P < 0.001$ ) and HRV ( $P = 0.019$ ) were reduced as solar radiation exposure increased. There is an inverse relationship between increasing solar radiation exposure and athlete performance that reduces athlete work capacity and impairs recovery from team-sport training. Specific training and/or recovery strategies may be required to mitigate physiological stress for athletes routinely training under high solar radiation exposure.

### 31. Heat Response Testing in Elite Rugby Sevens Athletes; An Eye To Tokyo 2020

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<sup>2</sup> High Performance Sport New Zealand

<sup>3</sup> New Zealand Rugby Union.

Hot environmental conditions at the 2020 Tokyo Olympics are likely to impact performance. Little is known about the responses and recovery of elite rugby sevens athletes to the heat stress expected in Tokyo. Elite male rugby sevens athletes completed a 15-min warm up, simulated sevens game and 1.2 km time trial (TT) on a treadmill in ambient (AMB; 20 °C, 50% rH) and Tokyo (HOT; 35 °C, 80% rH) conditions. Gastro-intestinal temperature, heart rate, sweat electrolytes, sweat rate, rate of perceived exertion, thermal sensation, thermal comfort

and level of thirst were measured at various intervals pre, during and post the HRT. Data collection still in progress. Will be completed and analysed by the conference date. This investigation will inform the development of heat-management strategies for team sport athletes preparing for the Tokyo 2020 Olympics.

### 32. Post-Training Hot Water Immersion for Team-Sport Athletes: Effects on Concurrent Training Load and Treadmill Running in the Heat

Stewart, J.<sup>1</sup>, Mündel, T.<sup>1</sup>, Foskett, A.<sup>1</sup>

<sup>1</sup>Massey University

This study investigated the effects of hot water immersion (HWI) as a practical, short-term heat acclimation strategy for team sport athletes during a simulated training camp. Eleven, non-acclimatised, males performed an intermittent running protocol (mLIST) in temperate outdoor conditions (18°C, 67% RH) for six consecutive days followed by a post-training cool-down (CON; n=6) or an additional 40 min of HWI in 38°C (n=5). Three days before and two days following the mLIST, participants completed a maximal incremental treadmill run in the heat (33°C, 23% RH). The HWI group displayed a reduced mean heart rate ( $P = 0.03$ ) during immersion from Day 1 to Day 6 (by  $16 \pm 10$  beats·min<sup>-1</sup>) and improved feelings (by  $0.9 \pm 0.5$  a.u.;  $P = 0.09$ ). Daily HWI had no detrimental effects on concurrent training as no significant differences (all  $P > 0.05$ ) were found between groups for total distance run, session RPE and composite measure of training load (duration x RPE). Treadmill VO<sub>2peak</sub> improved from pre-post for the HWI group (by  $2$  ml·kg<sup>-1</sup>·min<sup>-1</sup> or 4%;  $P = 0.02$ ) but not the CON group ( $0$  ml·kg<sup>-1</sup>·min<sup>-1</sup> or 0%;  $P = 0.94$ ). These data indicate that short-term post-training HWI improves running VO<sub>2peak</sub> in the heat without detrimental effects on the ability to concurrently maintain training load.

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## Sports Medicine/Biomechanics

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### 33. History of concussion is associated with higher head acceleration during simulated rugby tackle.

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<sup>2</sup>The Australian Institute of Sport, <sup>3</sup>New Zealand Rugby

The incidence of sports related concussion in rugby union is one of the highest across all full contact sports<sup>1,2</sup>. One of the most significant risk factors for sports related concussion is a previous history of concussion<sup>3-5</sup>. Yet, little is understood regarding the mechanism for this risk. The aim of this study was to explore the association between concussion history and head acceleration during simulated rugby tackles in recreational club level male and female players. An observational cross-sectional study design. 25 players were recruited, 10 (7♀) with no history

of a medically diagnosed concussion, 8 (3♀) within 12-months of concussion and 7 (3♀) with 24+months since last concussion. Each participant was fitted with a CSx® triaxial accelerometer positioned over the right mastoid process and performed 7 front-on dominant shoulder tackles on a swinging relatively-weighted (~50% body-mass) bag. The mixed model analysis showed that players who had sustained a concussion 12-months ago had the highest head acceleration values (♀=48.6g & 8265.9 rad/s<sup>2</sup>, ♂=59.3g,  $p<0.05$ ) and males 24+months had higher linear acceleration compared with males no history of concussions (mean difference 17g,  $p=0.01$ ). These findings suggest probable disruption to neuromuscular control of the head in athletes with concussion history as a potential mechanism for recurrent concussion incidence.

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### 34. New Zealand Rugby Community Concussion Strategy: 2018 Pilot Study

Salmon, D<sup>1</sup>, Murphy, I<sup>1</sup>, Harwira, J<sup>1</sup>, Romanchuk, J<sup>1,2</sup>, Sullivan, J<sup>3</sup>, Clacy, A<sup>4</sup>, Cassidy, T<sup>2</sup>, Hodge, K<sup>2</sup>, Walters, S<sup>5</sup>, Whatman, C<sup>5</sup>

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<sup>5</sup>Auckland University of Technology, Sport and Exercise Science

Concussions are one of the most prominent concerns in contact/collision sports due to increased susceptibility of concussed players to future injuries and potential for long-term health problems<sup>1-3</sup>. Concussions in rugby have overall incidence rate of 2.43-6.8 concussions/1000 player match-hours at the community level<sup>4,5</sup>. In NZ, ACC data indicates that the highest rates of concussion are sustained in the 13-18 year-old demographic, with 25% of concussions in school sports related to rugby. To help address these concussion

related concerns, NZR has developed an education and concussion management pathway (CMP) with the fundamental goal of improving player safety. The CMP includes an electronic clinical decision support tool, designed to streamline the process, from identification of a suspected concussion through to diagnosis and treatment. The purpose of the pilot study was to assess the CMP and the concussion knowledge and attitudes of key stakeholders in the community rugby system. 28 teams (n=769) across five regions in NZ participated in the pilot study. A 15-minute concussion education session was delivered pre-season to each team. A mixed methods approach included the Rosenbaum Concussion Knowledge and Attitudes Survey (RoCKAS) – completed pre-education and mid-season – and post-season focus groups. The focus groups consisted of concussion knowledge, attitude and CMP questions. Results are currently in progress.

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### 35. The Effects of Fatigue on the Spine Motion of Cricket Fast Bowlers

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Lower-back injuries in cricketers are relatively common, particularly among fast bowlers. Previous studies have identified many risk factors for lower-back injuries, including workload and bowling technique. A problem with many of these studies is that each bowler is recognised as having one technique – the intra-individual variability that is likely to occur due to factors such as fatigue has largely been ignored. Furthermore, these studies tend to group participants into large cohorts such as injured/non-injured groups. This study used 3D kinematics of the spine and pelvis primarily to investigate

individual bowling actions and how they changed over a six-over spell before and after a bout of high acute-workload. Additionally, this study also examined the inter-individual variability in spine kinematics for the presence of common strategies to deal with fatigue. Results showed that fatigue affected the spinal motion of fast bowlers – particularly the magnitude of lateral bending. However, due to the amount of inter-individual variability among fast bowlers, generalisations from group data are unlikely to be relevant to all individuals. Future research which contained more testing sessions and tracked workload prospectively prior to these sessions would give a better indication of the relationship between fatigue and spinal kinematics among fast bowlers.

### **36. Identifying shoulder injuries among New Zealand Cricket fast bowlers: A 12-month retrospective injury surveillance**

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To quantify the shoulder injury prevalence among New Zealand Cricket's (NZC) domestic first-class fast bowlers. A 12-month retrospective self-reporting injury surveillance was conducted with 62 male contracted NZC bowlers. The survey consisted of two parts; firstly, questions were asked about player position, training and match history. Then, questions covered the acute and overuse injuries experienced. The survey response rate was 56 % (35/62). The players had a mean age of 27 years, and 83% were right handed medium fast bowlers. A total of 47 injuries were reported. Acute injuries were (68%, 32) compared to overuse injuries (32%, 15). The most injury prone body areas were the lower back (19%, 9), ankle (15%, 7), thigh (15%, 7) and shoulder (13%, 6). Notably half of all acute injuries happened during bowling. Of the 6 shoulder injuries 4 were acute and 2 were classified as overuse. We found that shoulder injuries had the fourth highest prevalence rate, but the number of days missed due to shoulder injuries were low. The high prevalence of shoulder injuries necessitates a need for rigid long-term injury surveillance and an effective shoulder injury prevention programme to decrease shoulder injury prevalence.

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## *Sport Psychology*

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### **37. Effects of sleep deprivation on perceptual-motor performance under low and high threat**

Nieuwenhuys, A.<sup>1</sup>

<sup>1</sup>*University of Auckland*

This study investigated whether partial sleep deprivation modulates effects of anxiety on perceptual-motor performance under low and high threat. 62 participants underwent a 3-day sleep deprivation protocol (5hrs per night [n = 32] vs. 8hrs per night [n = 30]) and subsequently performed a perceptual-motor task that required them to move small coloured blocks from one instrumented pegboard to another – matching a target layout presented on a computer screen. During the task, threat was manipulated by means of performance-contingent loud (100dB; high threat) or quiet (50dB; low threat) noise blasts. Dependent variables included performance effectiveness (performance time, placement errors) and efficiency (effort invested, visual search behaviour). Experimental manipulations of sleep deprivation and threat reliably induced sleepiness ( $p < .001$ ) and anxiety ( $p < .001$ ), respectively. Under high-threat, participants generally reported higher effort investment ( $p = .01$ ) and effectively speeded-up their performance ( $p < .01$ ) without increasing errors. No significant changes were observed in visual search behaviour. No significant main or interaction effects were observed for sleep deprivation. Despite increasing sleepiness, partial sleep deprivation (3 nights of 5hrs vs. 8hrs sleep) may not significantly affect perceptual-motor performance under high threat.

Performance in motivated environments is relatively robust against effects of sleep deprivation.

### **38. Life Skills Acquisition and Psychological Development in Elite Cricketers: Evaluating the Effectiveness of a Life Development Intervention**

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Researchers have acknowledged the need for elite athletes to pursue both performance excellence and personal excellence during their careers in elite sport; a process underpinned by life skills development (Stambulova & Wylleman, 2014). To date, few researchers have evaluated the effectiveness of interventions designed to promote life skills in elite athletes. The purpose of this study was to evaluate the effectiveness of an intervention for promoting both performance and personal excellence in elite athletes. The performance and personal excellence programme (PPEP) was delivered to six male elite cricketers (Mage = 22.00yrs; Melite experience = 2.14yrs). These cricketers participated in six workshops and completed nine online take-home tasks over a 12-week period. We used a series of ABA single-case designs to evaluate the PPEP effects on life skills acquisition and basic need satisfaction. SMDall effect sizes demonstrated that the programme had a positive effect on life skills acquisition for five of the six participants. Data from social validation interviews revealed that the PPEP was a valuable experience, with the taught life skills being

utilized in both sport and non-sport contexts. These findings highlight the value of life skills programmes that promote experiential learning via psychological need support and psychological need satisfaction.

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### **39. Working Memory Training in a modified Loughborough Soccer Passing Test impacts skill performance in youth football players**

Hall, J.<sup>1</sup>

<sup>1</sup>*School of Health Sciences and Sport, University of Canterbury*

This presentation details the study which took place, within the context of a wider project. Working Memory Training (WMT) provides an opportunity to affect skill performance in football by systematically overloading working memory, a system supporting decision making in skilled performance. This study measured the effect of a WMT intervention on performance of a modified Loughborough Soccer Passing Test (LSPT) -Stroop test, designed to incorporate selective and/or controlled attention into the LSPT, simulating the use of working memory during match performance. The test also featured a novel method for adjusting the difficulty of WMT based on action accuracy. This Passive and Active Controlled study utilised a pre/post-test and time-series design with measurements of speed, accuracy, overall performance and working memory performance analysed using paired samples, effects sizes, and time-series. The results of the research suggest that using WMT as a dual task could be a method to develop skill performance and working memory performance simultaneously. Research with a larger sample size and a comparative study between the LSPT and LSPT-Stroop to assess match validity, plus refinements to the LSPT-Stroop test are recommended. The

results of this study suggest the possibility of developing both working memory and skill concurrently, which could affect coaching methods.

### **40. Cognitive, emotional, and behavioural factors associated with tapering**

Stone, M. J.<sup>1</sup>, Knight, C. J.<sup>2</sup>, Shearer, C.<sup>3</sup>, Shearer, D. A.<sup>1</sup>

<sup>1</sup>*University of South Wales*

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<sup>3</sup>*Sport Wales*

Before major competitions swimmers taper to remove fatigue and aid performance. Despite considerable research examining taper, little is known around coaches and swimmers psychological experience of taper. Fifteen current or former high-performance swimmers (N =9) and swim coaches (N =6) were interviewed about their thoughts, feelings, and behaviours before, during, and after taper. Data were thematically analysed. Results reveal coaches are striving for performance excellence in taper by developing and evaluating competition readiness. Competition readiness is a state whereby the swimmer is performing optimally. Competition readiness is developed by creating the right taper environment and 'fine-tuning' training to each swimmer. Comparatively, swimmers attempt to maintain positive performance expectations by analysing their swim times, 'feel', and reflecting on previous tapers and training. Swimmers self-assessment during taper can reassure them of their capabilities or causes performance doubts which they remedy through various coping mechanisms. Finally, a coach-swimmer symbiosis is present in taper, where swimmers and coaches analyse one another's behaviour. Concluding, coaches create an optimal performance environment in taper which promotes, technical, physiological and psychological excellence. Swimmers may be at greater risk of developing anxiety due performance analysis and coaches are experiencing unique stressors during taper, which may affect training delivery.

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## *Physical Activity*

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### **41. School Bag Weight as a Barrier to Active Transport to School among New Zealand Adolescents**

Mandic, S.<sup>1</sup>, Keller, R.<sup>1</sup>, García Bengochea, E.<sup>2</sup>, Moore, A.<sup>1</sup>, Coppel, K.J.<sup>1</sup>

<sup>1</sup>*University of Otago*

<sup>2</sup>*University of Limerick, Limerick, Ireland*

Excessive school bag weight is a barrier for active transport to school (ATS). This study examined parental and adolescents' perceptions of and actual school bag weights in adolescents. Parents (n=331; 76.7% women) completed a survey.

Adolescents (n=682; age 15.1±1.4 years; 57.3% boys) completed a survey, anthropometry and school bag measurements. Overall, 68.3% of parents perceived that adolescents' school bags were too heavy to carry to school. This parental perception differed by adolescents' mode of transport to school (active/motorized/combined: 35.1%/78.4%/68.8%, p<0.001). Adolescents perceived that their school bags were too heavy to carry to walk (57.8%) or cycle (65.8%) to school. Adolescents perceptions differed by mode of transport to school (for walking [active/motorized/combined]: 30.9%/69.2%/55.9% agree, p<0.001; for cycling: 47.9%/72.8%/67.7% agree; p<0.001). Actual school bag

weight was  $5.6 \pm 2.1$  kg. Relative school bag weights (% of body weight) was higher in boys and underweight adolescents compared to their counterparts. Neither absolute nor relative school bag weight differed by mode of transport to school. School bag weight was perceived a barrier for ATS and was a greater perceived barrier among motorized versus active transport users. Perceptions of school bag weights should be considered in future ATS interventions.

#### 42. Understanding Rural Adolescents' Perceptions of Walking versus Cycling to School

Calverley, J<sup>1</sup>, Mandic, S.<sup>1</sup>

<sup>1</sup>*School of Physical Education, Sport and Exercise Sciences, University of Otago, NZ.*

Although active transport to school has been extensively studied in urban settings, active transport perceptions among rural adolescents remain unknown. This study compared perceptions of walking versus cycling to school among rural adolescents in New Zealand. Adolescents ( $n=440$ ; age: 13-18 years; 10 schools) from rural Otago living  $\leq 4.8$  km from school completed a questionnaire about school travel and perceptions of walking and cycling to school. Data were analysed using t-test and Chi-square tests. Overall, 45% of adolescents walked and 17% cycled to school regularly. Most adolescents believed that both modes were great ways to get exercise. Compared to cycling, adolescents perceived walking to school as safer (92.6% vs 81.6%) and more pleasant (60.8% vs 47.5%), had less logistic-related barriers, offered better opportunity to socialise (57.1% vs 26.4%), received greater peer/parental/school support and had better infrastructure (85.1% vs 42.7%) (all  $p < 0.001$ ). In contrast, adolescents perceived trip duration, distance, feeling tired and cold/wet weather as greater barriers for walking versus cycling to school (all  $p < 0.001$ ). Rural adolescents perceived that walking to school was safer, with greater social and infrastructure support compared to cycling. Therefore, different approaches are required to promote walking versus cycling to school in rural settings.

#### 43. The Economic Role of the Accredited/Clinical Exercise Physiologist within the New Zealand Allied Health Field

Pearce, A<sup>1</sup>, Longhurst, G.<sup>1</sup>

<sup>1</sup>*Centre for Sport Science and Human Performance, Waikato Institute of Technology*

Mortality rate of NCD in NZ is 89% of all deaths. Healthcare cost per person in NZ is \$4018 per person in 2014 with a gross national income average of \$30750. This is 11% of the GDP. In 2012 that was only \$3721 pp per year. In 2012 NZ had the 2<sup>nd</sup> highest proportion of obesity in the world at 26.5% with the US being number one at 33.8%. NZ has the second lowest rate of knee replacements at 102/100000 and hip replacements at 149/100000 with Germany topping the list at 213/100000 and 296/100000 respectively, this could be due to the positive effect physios have had or that in general the DHB's try to avoid the surgeries? According to the WHO New Zealanders mortality rate for raised blood pressure is 21.6% and obesity 28.3%. In 2006, New Zealanders sustained health losses totalling almost one million years of healthy life (955,000 DALYs). Just over half (51%) of this total health loss resulted from fatal outcomes, with non-fatal outcomes accounting for 49%. Adjusting for age and population size, health loss in Māori was almost 1.8 times higher than in non-Māori, with more than half of Māori health loss occurring before middle age. If Māori had experienced similar rates of health loss to non-Māori at all ages, health loss among Māori would have been 42% less and that of the whole population 7% less. Total DALYs lost are projected to increase from 955,000 in 2006 to 1.085 million in 2016, a rise of 13.4%. This assumes a continuation of recent demographic trends (population growth and ageing) and epidemiological trends (disease and injury incidence and mortality). Projected increases in population size and ageing explain 80% of this trend, with epidemiological changes explaining the remaining 20%.

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### Motor Learning

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#### 44. Motor learning by analogy: Effects of visual-verbal preference

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<sup>1</sup>*Te Huataki Waiora Faculty of Health Sport and Human Performance, University of Waikato*

<sup>2</sup>*School of Public Health, Li Ka Shing Faculty of Medicine, University of Hong Kong*

Analogy instructions have been shown to be a useful tool in motor skill learning. They convey knowledge about how to move by reference to a similar, well-known concept. This

allows reduced reliance on verbal information processes during movement, reflected by reduced EEG high-alpha power in verbal regions of the brain. As analogies are primarily visual forms of instruction, the preference for using verbal or visual instructions is likely to influence the efficacy of analogy instruction. This study investigated visual-verbal preference, change in performance and neural activity (EEG high-alpha power) during performance (preparatory phase) of an adapted basketball task after instruction by analogy. People with a high preference for verbal instructions showed a decrease in activation of verbal regions when they used the analogy. People with low verbal preference did not show a significant decrease

in activation of verbal regions, and their performance deteriorated significantly after introduction of the analogy instruction, whereas people with high verbal preference remained stable. Results generally support our hypothesis that analogy reduces verbal processing demands. It is likely that both cognitive and performance changes after analogy instruction depend on personal aspects of information processing, such as verbal preference.

#### 45. The effect of unilateral hand contractions on cognitive inhibition

Hoskens, M.C.J.<sup>1</sup>, Park, SH<sup>1</sup>, Uiga, L<sup>1</sup>, Cooke, A.M<sup>2</sup>, Masters, R.S.W.<sup>1</sup>

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<sup>2</sup>*School of Sport, Health and Exercise Sciences, Bangor University, UK*

Studies suggest that pre-performance hand contractions cause changes in hemispheric activity, resulting in suppression of conscious processes associated with motor skill execution. The inhibition function of working memory, processed in the right frontal lobe, is required to suppress disruptive cognitive processing of task-irrelevant thoughts, so we aimed to investigate the direct effect of hand contractions on inhibition function. Eighty-one young adults performed an inhibition task, prior to and following contractions of the left or right hand. The control group rested their hands on their lap. Accuracy and reaction time were assessed. The ex-Gaussian metrics of intra-individual variability in reaction time (IIVRT) were determined using tau and sigma. Tau reflects attentional lapses, whereas sigma reflects difficulties in motor response preparation. The results revealed no differences in accuracy, reaction time or sigma between groups. However, a higher tau IIVRT component was revealed following right-hand contractions.

Right-hand contractions may affect activity in the right frontal lobe, leading to increased attentional lapses and unstable inhibition processes. These results were not apparent for left-hand contractions or the control group. Pre-performance right-hand contractions may lead to inefficient right frontal lobe activity, resulting in disrupted attention during tasks that require inhibition.

#### 46. Motor movement recall: Analogies are more memorable than explicit rules

Uiga, L.<sup>1</sup>, van Duijn, T<sup>1</sup>, Holt, G<sup>1</sup>, Masters, R.S.W.<sup>1</sup>

<sup>1</sup>*University of Waikato*

Motor analogies convey rules for execution of movement via a biomechanical metaphor. We investigated whether motor analogies are easier to recall than explicit rules. Thirty young adults performed a table-tennis task under different task conditions. Participants were instructed to aim at a target area on the other side of the table and strike balls presented by a ball machine with under-spin if they were white balls (80%) and top-spin if they were orange balls (20%). Half of the participants were provided with an analogy instruction for hitting top-spin, whereas the other half were provided with explicit rules (n=5) for hitting the top-spin. No instructions were given for hitting the white balls. Performance accuracy and percentage use/recall of the right technique for orange balls were measured. Participants in the analogy group recalled the right technique (i.e., top-spin) for orange balls significantly more often than participants in the explicit rules group ( $p < .05$ ). There were no differences in performance accuracy between the groups. The results suggest that motor analogies are easier to recall than explicit rules. Analogies should be favoured over explicit rules in situations that require a person to utilise a seldom-used motor pattern. Acknowledgement: This work was funded by donation from Freemasons New Zealand.

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### Elderly

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#### 47. Chronic Cardiovascular Effects of Whole Body Vibration Training in the Elderly

Lark, S.<sup>1</sup>, Wadsworth, D<sup>2</sup>, Stoner, L<sup>3</sup>, Abdolhosseini, P<sup>4</sup>, Merrit, J<sup>1</sup>

<sup>1</sup>*Massey University*

<sup>2</sup>*University of the Sunshine Coast*

<sup>3</sup>*University of North Carolina;* <sup>4</sup>*Swedish Medical Center, Seattle*

Concerns of blood pooling in lower extremities leading to orthostatic intolerance in elderly did not eventuate in an acute bout of whole body vibration (WBV), indicating safe use. However, chronic training cardiovascular (CV) effects are unknown. 117 elderly ( $82.5 \pm 7.9$  years) were randomised to either WBV, Control (CON) no vibration or contact, or simulation group (SIM) no vibration but same stand:rest ratio.

WBV training (10x1min bouts; 6Hz; 2mm amplitude; knee flexion  $\sim 20^\circ$ ; interspersed with 10x1min rest) for 3x week for 16 weeks, and follow-up at 3, 6 and 12 months. Pulsewave analysis to measure central systolic and diastolic BP (cSBP and cDBP), Augmentation Index (AIx), and resting HR (rHR), with mean arterial pressure (MAP) calculated from SBP and DBP. WBV training significantly decreased AIx after 8 weeks WBV training ( $p = 0.02$ ) compared to CON or SIM groups. Moderate or large effect sizes for differences in cSBP, cDBP, MAP and, but not rHR. The CV differences were no longer visible at 3 months. Apparent beneficial CV effects with WBV that are lost within 3 months post-training. However, effects may be larger and/or prolonged at higher training loads as 6Hz is relatively low. Possible CV benefits from WBV.

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#### **48. Promoting safer landing by older adults who fall unexpectedly**

Masters, R.S.W.<sup>1,4</sup>, Barbour, K<sup>1</sup>, Hébert-Losier, K<sup>1</sup>, Parsons, J<sup>2,3</sup>, Parsons, M<sup>2,3</sup>, Uiga, L.<sup>1</sup>

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Most research into falling by older people focuses on prevention, rather than safe landing. Our goal is to develop a rule-of-thumb that de-risks landing in the event of an

unexpected fall. In the first stage of the research, focus group interviews were conducted with people experienced in falls or fall prevention (e.g., older adult fallers, physiotherapists). Interviews were recorded, transcribed and processed independently by two reviewers. The interviews revealed that: (1) formal recommendations do not exist for the best way to fall; (2) a safe-landing rule-of-thumb has considerable appeal as a clinical tool; (3) there are many circumstances in which older people fall, so one rule-of-thumb may not fit all occasions. There was good 'in principle' support for the concept of a rule-of-thumb for safe landing by older adults, but research needs to establish the safest way to land. There may be no single biomechanical technique that is effective in all fall circumstances (e.g., slip v. trip) or environments (e.g., bathroom v. footpath), so a rule-of-thumb that encourages an older person to fall in a manner that is slow, soft and silent (for example) may facilitate context-specific self-organisation by the motor system.

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## Poster Presentations

### 49. Food Choice Motives in Student Athletes in the North East of England

Best, R.<sup>1,2</sup>, Campbell, J<sup>3</sup>, Berger, N<sup>2</sup>, Harrison, C.<sup>2</sup>

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<sup>2</sup>*Teesside University*

<sup>3</sup>*Jasmine Campbell Performance Nutrition*

Athletes' food choices play an important part in fuelling and recovering from sport, and support health. Athletes' environments, social influences, personal beliefs, preferences and skills all contribute to food choices. These issues are not isolated to a particular sport or gender and are driven by sport specific demands. Given this complexity, and to underpin nutritional support afforded to athletes we sought to understand food choice motives of 30 student athletes (22 male, 8 female), from team (n 20) and individual (n 10) sports. Athletes completed the Food Choice Questionnaire (FCQ). The FCQ assigns food choice motives into 9 sub-categories. Ratings for each sub-category were calculated and analysed using a customised spreadsheet; with gender and sport played (individual or team) analysed as covariates. Differences were reported using standardised mean differences (ES) with 90% Confidence Intervals and accompanying descriptors. Sport played demonstrated a greater influence on food choice motives (ES: Small to Large), than athletes' gender (ES: Trivial to Small). This suggests food choice occurs largely independent of gender, across team and individual sports. Large confidence intervals confirm that food choice is an individual and complex exercise.

### 50. Adolescents' Perceptions of the School Neighbourhood Environment in Small-to-Medium Urban Areas versus Rural Settlements

White, B.<sup>1</sup>, Mandic, S.<sup>1</sup>

<sup>1</sup>*University of Otago*

Perceptions of the school neighbourhood environment can influence adolescents' active transport to school (ATS) behaviours. This cross-sectional study compared adolescents' perceptions of the school neighbourhood environment in small-to-medium urban areas (SMU) versus rural settlements (RS) in Otago, New Zealand. Adolescents from 10 secondary schools (5 located in SMU and 5 in RS), living  $\leq 4.8$  km from school, reported perceptions of the school neighbourhood environment. Adolescents completed a survey (n=459; 54.2% female; age 15.2 $\pm$ 1.3 years) and a subgroup of adolescents completed Neighbourhood Environment Walkability Scale for Youth questionnaire (NEWS-Y) (n=166; 50.6% female; age 15.2 $\pm$ 1.4 years). Compared to RS, SMU adolescents expressed greater concerns about unsafe road crossings (SMU vs RS: 43.5% vs 29.9%; p=0.027), high traffic volume (37.4% vs 19.5%; p=0.003), and vehicles stopping/parking around school (41.1%

vs 23.4%; p=0.003). SMU adolescents reported higher residential density (64.60 $\pm$ 21.56 vs 57.64 $\pm$ 14.29; p= 0.018) and lower access to recreation facilities (3.28 $\pm$ 0.78 vs 3.72 $\pm$ 0.55; p=0.001), street connectivity (2.79 $\pm$ 0.54 vs 2.97 $\pm$ 0.60; p=0.044) and overall walkability of their school neighbourhoods (-0.30 $\pm$ 2.40 vs 0.43 $\pm$ 2.17; p=0.044). Compared to RS schools, SMU schools had higher traffic volume and lower walkability of school neighbourhoods. School neighbourhood environment should be considered when designing future ATS initiatives among adolescents.

### 51. Effect of footwear on Y-Balance Test performance & risk categorisation

Beaven, C.M.<sup>1</sup>, O'Donnell, S.<sup>1</sup>, Hébert-Losier, K.<sup>1</sup>

<sup>1</sup>*University of Waikato*

The Y-Balance Test (YBT) assesses dynamic balance and screens for injury risk. However, there are inconsistent recommendations regarding footwear use during testing. Forty-two volunteers (26 females, 16 males) performed the YBT with their habitual athletic footwear and barefoot on both legs. In a single-legged stance, participants reached with the contralateral limb in the anterior, posteromedial, and posterolateral directions three times. Leg-length normalised composite scores (%) and anterior-reach differences (cm) were extracted and used to identify high-risk participants (i.e., anterior-reach difference  $\geq 4$  cm or composite score  $\leq 94\%$ ). Anterior, posteromedial, and anterior-reach difference measures were similar between conditions (P>0.05). Posterolateral (2.8 $\pm$ 7.6 cm, P=0.001) and composite scores (93.4 vs 94.8%, P=0.018) were greater barefoot. The proportion of individuals at high-risk based on anterior-reach difference (odds ratio: 1.6, McNear test P =0.58) and composite scores (odds ratio: 2.2, P=0.21) was similar between conditions, although risk categorisation was inconsistent in 31 and 19% of cases, respectively. Footwear altered the composite score such that the group average exceeded the high-risk threshold. While testing in athletic footwear may be more valid, researchers should be aware that risk categorisation is affected. Care should be taken when comparing studies with different protocols.

### 52. Heat stress effects on substrate oxidation rates during incremental cycling

Maunder, E.<sup>1</sup>, Plews, D.J.<sup>1</sup>, Kilding, A.E.<sup>1</sup>

<sup>1</sup>*Sports Performance Research Institute New Zealand, Auckland University of Technology, Auckland, New Zealand*

Heat stress augments carbohydrate metabolism during prolonged exercise. We sought to determine if this effect is regulated by exercise intensity. In randomised, counterbalanced order, nine endurance-trained male cyclists performed



incremental exercise tests (IET) in 18 and 35°C. Physiological variables were compared between-IETs at the absolute workloads eliciting the first ventilatory threshold in 35°C (VT1<sub>heat</sub>, 184 ± 18 W), first ventilatory threshold in 18°C (VT1<sub>temp</sub>, 219 ± 40 W), and second ventilatory threshold in 18°C (VT2<sub>temp</sub>, 266 ± 37 W). Carbohydrate oxidation rate was not significantly different at VT1<sub>heat</sub>, tended to be elevated by heat stress at VT1<sub>temp</sub> (2.38 ± 0.80 vs. 2.17 ± 0.70 g.min<sup>-1</sup>, ES = 0.27 ± 0.31, P = 0.14), and was significantly elevated by heat stress at VT2<sub>temp</sub> (3.89 ± 1.05 vs. 3.33 ± 0.71 g.min<sup>-1</sup>, ES = 0.72 ± 0.41, P = 0.02). Heat stress elevated plasma lactate concentration at VT1<sub>temp</sub> and VT2<sub>temp</sub>, and significantly elevated rectal and estimated muscle temperatures. The present investigation suggests exercise intensity regulates the heat stress-induced stimulation of carbohydrate oxidation during incremental cycling, with greater effects at higher intensities. These preliminary results have implications for determining the competitions and pacing strategies in which heat stress impacts carbohydrate metabolism.

### 53. GPS analysis of a team competing at a national Under 18 field hockey tournament

van der Merwe, F.H<sup>1</sup>, Haggie, M.B.P<sup>1</sup>

<sup>1</sup>Waikato Institute of Technology

The purpose of this study was to utilise global-positioning system (GPS) technology to quantify the running demands of national Under 18 field hockey players competing in a regional field hockey tournament. Ten male players (mean ± SD; age 17.2 ± 0.4 years; stature 178.1 ± 5.2 cm; body mass 78.8 ± 8.8 kg) wore GPS units while competing in six matches over seven days at the 2018 New Zealand national under 18 field hockey tournament. GPS enabled the measurement of total distance (TD), low-speed activity (LSA; 0-14.9 km/hr), and high-speed running (HSR; ≥ 15 km/hr) distances. Differences in running demands (TD, LSA, HSR) between positions were assessed using effect size and percent difference ± 90% confidence intervals. Midfielders covered the most TD and LSA per game and strikers the most HSR during the 6 matches. There were “very large” differences between strikers and midfielders for TD and LSA, strikers and defenders for LSA and HSR, and defenders and midfielders for LSA. These results suggest that these playing positions are sufficiently different to warrant specialised position-specific conditioning training leading into a field hockey tournament.

### 54. Psycho-Behavioural Momentum: Golf Match-Play Player's Perspectives

McCarthy, C.J.<sup>1</sup>, Parker, J.K.<sup>2</sup>, Jones, M.I.<sup>3</sup>, Lovell, G.P.<sup>1</sup>

<sup>1</sup>University of the Sunshine Coast

<sup>2</sup>University of Gloucestershire

<sup>3</sup>Exeter University

Psycho-behavioural momentum (PBM) has been defined as the positive or negative change in cognition, affect, physiology, and behaviour caused by an event or series of events that affects competitors' perceptions of, the quality of performance, and the outcome of the competition. The aim was to capture, in real

time, cognitions, emotions, and behaviours that match-play golfers perceived as important determinants of PBM. A qualitative in-match recording technique logged players' (N = 10; Mage = 26.5 years; MGA handicap = -.9) self-reported cognitions, emotions, and behaviours associated with PBM. To complement the match-play data, semi-structured focus group interviews were conducted to corroborate and extend findings from the match-play data. Thematic analysis identified three themes key to the experiences of PBM: (1) in-game unexpected events; (2) perceived control of PBM; and (3) temporality of PBM. Our findings provide further support for existing conceptual psycho-behavioural models that assist in explaining how individuals experience PBM in competitive skill based sports such as golf. These findings can be used to facilitate the design of efficacious interventions that seek to enhance performance through building athlete awareness of and managing of potential in-game PBM fluctuations.

### 55. How does heat stress affect the exercise response in females?

Zheng, H<sup>1</sup>, Mundel, T<sup>1</sup>, Lei, T, Badenhurst, C.E.<sup>1</sup>

<sup>1</sup>Massey University

This study investigated the additive effect of heat stress on the physiological and performance responses to exercise in women. Six unacclimated, moderately trained and eumenorrhoeic females (age: 39 ± 11 y;  $\dot{V}O_{2max}$ : 50 ± 8 ml·min<sup>-1</sup>·kg<sup>-1</sup>) have been recruited for this study thus far. Each completed an experimental trial in 21 ± 1 °C (MOD) and 32 ± 0 °C (HOT) consisting of 20 min fixed-intensity cycling followed by a 30 min self-paced time-trial. The increase in rectal temperature was 0.21 ± 0.15°C greater in HOT (P = 0.04), accompanied by higher heart rate (by 5 ± 2 beats·min<sup>-1</sup>; P < 0.01) and perceived exertion (by 0.6 ± 0.2 a.u.; P < 0.01). However, mean power output (143 ± 27 W, P = 0.22) and, therefore, work completed were similar during the time-trial in both conditions. Venous blood samples were collected before, immediately after and at 3 hours post-exercise, will be analysed for serum ferritin, hepcidin and IL-6 and these iron regulation results presented at SESNZ. From these preliminary results, we conclude that in moderately trained females heat stress confers greater physiological strain, although exercise performance is maintained.

### 56. Low Energy Availability - a study on the Black Ferns 7's rugby team

Kumar, J.<sup>1</sup>, Black, K.<sup>1</sup>, Baker, D.<sup>2</sup>, Christensen, S.<sup>1</sup>, Sharples, A.<sup>1</sup>, Groom, J.<sup>1</sup>, Sims, S.<sup>3</sup>

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<sup>2</sup>High Performance Sport New Zealand

<sup>3</sup>University of Waikato

Low energy availability (LEA) has been described in various athletic populations however the prevalence amongst elite New Zealand female athletes is unknown. Informed voluntary consent was obtained from 23 contracted elite female rugby players who completed 5-day electronic diet records with the use of a smartphone application (MealLogger ©), and also

completed the LEAF and a knowledge questionnaire. Of the 23 participants (52.2%) of participants were classified as at risk of LEA. Those at risk had a lower median energy intake (28.7 kcal.kg<sup>-1</sup>.bw.d<sup>-1</sup>) compared to those not at risk (31.2 kcal.kg<sup>-1</sup>.bw.d<sup>-1</sup>). The mean knowledge score for those not at risk and those at risk was 5.5 and 4.9 respectively out of a potential score of 10. Further, 45.5% of those not at risk and 8.3% of those at risk, agreed that skipping periods make your bones weak. The current study suggests that knowledge of LEA is low amongst elite athletes and that those who are at risk of LEA have poorer knowledge than those not at risk. This area requires further investigation as it is possible that educating athletes about LEA and its effects may reduce the number of athletes putting their health at risk.

### **57. Training Load and its progression from an amateur to semi-professional environment in Rugby Union**

Al-Attar, J<sup>1</sup>, Blair, M<sup>1</sup>, Croft, H<sup>1</sup>

<sup>1</sup>*Otago Polytechnic, Dunedin, New Zealand*

Differences between training load (TL) at amateur (club) and semi-professional (provincial) rugby union are expected to be significantly different. We investigated the differences in TL as club rugby union players transitioned into the Otago Rugby Football Union (ORFU) training environment in preparation for the 2018 New Zealand provincial premierships (Mitre 10 Cup). Sixteen male rugby union players in the Dunedin Metro Premier club rugby competition, identified by the ORFU selectors, were monitored over three phases ([1], [2], [3]) for a total of 11 weeks. In each training session, session rate of perceived exertion (sRPE) was used to measure players' internal TL. Global positioning system (GPS) units were used to measure external TL, specifically mean heart rate (HR), total distance travelled (m), relative distance (m.min<sup>-1</sup>), distance run at high speed (>16 km.h<sup>-1</sup>), number of high-speed acceleration and deceleration efforts. Weekly TL measurements were conducted to calculate the acute:chronic workload ratio (ACWR) calculated as the workload for most current week divided by average workload of previous 4 weeks. Large spikes in sRPE were experienced as players entered phase 2. The findings from this investigation can contribute to the planning of TL as players progress between amateur and professional RU environments.

### **58. Exercise Management For People With Mcardle Disease: A Pilot Case Study**

Kaur, P<sup>1</sup>, Longhurst, G<sup>1</sup>

<sup>1</sup>*Waikato Institute of Technology*

This is a case study of a 61 year old male who has been diagnosed with McArdle disease 5 years ago. The cardinal signs and symptoms are inclusive of activity intolerance, early fatigue and second wind phenomenon. The Purpose of this study is to implement an intervention strategy for clients with McArdle's disease. A six weeks protocol included an initial baseline functional assessment for the client prior to exercise session. The exercise session was inclusive of a 7-10 minutes of warm up, 20-30 minutes of cardiovascular and resistance training

followed by a 10 minutes of cool down phase. There were two supervised sessions per week. After 10 sessions of exercise protocol functional assessment was repeated and results noted. The client was allowed proper rest periods during the exercise session. Post intervention the functional assessment was repeated. There was significant improvement in agility, muscular strength, muscular endurance, balance, flexibility of upper body and aerobic capacity of the client. Client also reduced weight and waist girth. Overall improvement resulted in gaining confidence for the client. The exercise induced response is due to the main energy substrate that has no dependence on muscle glycogen deposits. We put forward an exercise regime to increase physical activity and quality of life in people suffering from this condition. Low muscle mass and strength levels lead to comprised cardiometabolic phenotype. Hence, exercise-induced hypertrophy is an attainable goal in McArdle's patients.

### **59. Effect Of Intramuscular Injection Of Epinephrine On Oxygen Consumption Kinetics During Heavy Intensity Cycling Bout**

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<sup>1</sup>*New Zealand Institute of Sport*

<sup>2</sup>*University of Lausanne*

Prior heavy exercise bout on cycle ergometer changes the  $\dot{V}O_2$  kinetics of a subsequent heavy exercise bout. These changes are an increase in  $\dot{V}O_2$  fundamental component and a reduction in  $\dot{V}O_2$  slow component. Seven healthy physically active male participants performed 8 min bout of heavy exercise on a cycle ergometer preceded by 1) 8 min heavy exercise bout with a 6 min rest period in between (prior and second heavy bouts); 2) 0.10 mg epinephrine intra muscular infusion on deltoid immediately followed by 5 minutes rest to reach the onset of action of epinephrine. One-hour rest period separated the 2 exercise sets. Ten blood samples were taken during the session. ANOVA was used to define significant differences in  $\dot{V}O_2$  kinetics parameters over all bouts as well as differences over the 10-blood samples taken. Epinephrine bout was significantly higher than the prior cycling bout.  $\dot{V}O_2$  slow component was significantly lower in the second bout compared to the prior bout and to epinephrine bout. The results of the present study demonstrate that Epinephrine injection increased the magnitude of amplitude and  $\dot{V}O_{2end}$  compared to prior heavy bout. Repeated heavy exercise bouts resulted in a smaller  $\dot{V}O_{2sc}$  with unaltered  $\dot{V}O_{2end}$  and amplitude.

### **60. Polo: An Introduction for Sports Scientists**

Best, R<sup>1,2</sup>, Standing, R.<sup>1</sup>

<sup>1</sup>*Waikato Institute of Technology*

<sup>2</sup>*Teesside University*

Polo is an equestrian team sport, played by two teams of four athletes. There is a paucity of literature concerning Polo, focussing predominantly on injury rates, with minimal performance literature. This poster details key characteristics of Polo that are comparable to other areas of applied research, this

therefore lends Polo to being further investigated by Sport Science practitioners. Contested upon the largest pitch in professional sport, both male and female polo players have the opportunity to play around the globe. Despite a rich history, international competition and approximately 24,000 players worldwide, there is an obvious lack of sports science currently implemented within Polo; hence, opportunities in the areas of biomechanics, physiology, performance analysis and athlete wellbeing that are well established in other team sports exist. There are however idiosyncrasies unique to Polo, which may challenge conventional sport science strategies, such as the handicapping system and Polo performance being the manifestation of human and equine attributes.

### 61. Is cognition related to arterial CO<sub>2</sub> and cerebral blood flow reactivity to exercise?

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Cognition, as well as cerebral blood flow (CBF) and its major regulator (i.e., arterial CO<sub>2</sub>), increase with submaximal exercise and decline with maximal exercise. However, these responses may depend on fitness. We therefore investigated whether increased CBF contributes to the exercise-related cognitive benefit, and if it is affected by fitness. Ten active (26±3 years) and ten inactive (24±6 years) participants completed submaximal and maximal exercise whilst arterial CO<sub>2</sub> (PETCO<sub>2</sub>) was clamped at two levels of hypercapnia (i.e., increased PETCO<sub>2</sub>), and CBF velocity (CBFv) was measured continuously. Cognition (i.e., choice reaction time; RT) was measured before, during, and after exercise. Participants completed a separate resting time-control condition wherein PETCO<sub>2</sub> was matched to that during exercise, and cognition was measured accordingly. Mixed-model ANOVA analysis revealed that regardless of fitness, exercise increased CBFv beyond changes in PETCO<sub>2</sub> (p<0.00). More severe hypercapnia increased CBFv at rest (~25%) and during submaximal exercise (~23%, p<0.00), but impaired RT (p≤0.02). Exercise did not significantly improve cognition when compared to a PETCO<sub>2</sub>-matched time-control (p≥0.30). In conclusion, the cognitive effects of exercise were eliminated when PETCO<sub>2</sub> was matched during a resting time-control. Furthermore, fitness predicts RT at rest. However, this effect disassociates during exercise and with changes in PETCO<sub>2</sub>.

### 62. The effects of odor on high intensity exercise

Nakanishi Y.<sup>1</sup>, Nakahara H.<sup>2</sup>, Inoue Y.<sup>3</sup>, Kinoshita H.<sup>1</sup>

<sup>1</sup>*Osaka Aoyama University*

<sup>2</sup>*Morinomiya University of Medical Sciences*

It is possible that certain odor can affect motor performance due to smell-induced neural activity in the limbic system. The purpose of the present study was to examine influences of odor on exercise. Two aroma (peppermint, and eucalyptus), and no-aroma conditions were tested using 8 young healthy males (20.6 ± 5.7yr). They peddled a bicycle ergometer at 80% maximum workload until exhaustion in the room filled with/without the testing aroma. One-way repeated measures ANOVA was performed to test the significance (p<0.05). The mean duration to exhaustion with eucalyptus was 208.5 ± 49.2 sec, which was significantly (about 20%) longer (p<0.01) than the control and peppermint. No odor difference was found in heart rate, blood lactate, and salivary amylase. We assume that one of the reasons for increased exercise duration with eucalyptus was due to tracheal smooth muscle relaxation, which could cause vascular dilation and/or blood pressure decrease. Increase of hemoglobin dissociation or activation of mitochondria may be other reasons. Eucalyptus odor may be used as an ergogenic aid for high intensity exercise. This work was supported by the Japanese Ministry of Education, Culture, Sports, Science and Technology (Number 18K06454).

### 63. Does mental stress impair cerebrovascular function acutely?

Tiree Macdonald<sup>1</sup>, Luke Wilson<sup>2</sup>, Leena Shoemaker<sup>1,2</sup>, Tom De Hamel<sup>1</sup>, Jim Cotter<sup>1</sup>

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Prolonged mental stress can impair systemic processes, including brain function. Stress impairs peripheral vascular function, however, its effects on cerebrovascular function are not well understood. We assessed haemodynamic and cerebrovascular responses to an acute bout of mental stress. Eight healthy participants (age 28 ± 11 y) completed a time-control and stress-intervention condition in crossover manner. Blood pressure, HR, middle cerebral artery velocity (MCAv), cerebrovascular reactivity, and end-tidal respiratory pressures (PETCO<sub>2</sub>) were measured at baseline, then immediately, 20-min, and 40-min after a 10-min bout of stress (Stroop and arithmetic tests). Perceived stress was 6±1 on a 1-10 scale, and HR increased by 8% during the stress protocol. MCAv was unaffected by Stress (interaction; p=0.132) but increased over time (main effect: p<0.001). Cerebrovascular reactivity to CO<sub>2</sub> (%Δ cm/s /Δ mm Hg) decreased during the time control trial, but not during the stress trial (interaction: p=0.025). An acute bout of mental stress did not measurably alter our index of brain perfusion or impair its most important regulatory mechanism (reactivity to CO<sub>2</sub>).

### 64. Does external workload accurately predict lower-back injuries in cricket fast bowlers? A systematic review.

Perrett, C.<sup>1</sup>, Lamb, P.<sup>1</sup>, Bussey, M. D.<sup>1</sup>

<sup>1</sup>*School of Physical Education, Sports & Exercise Sciences, University of Otago, Dunedin*

Approximately one in five fast bowlers sustain injuries every year that cause missed playing time. Lower-back injuries, in particular, result in the greatest loss of playing time for fast bowlers. Although the literature has identified many risk factors, workload may be the most easily modified. In this review, six online databases were searched using four sets of keywords (relating to cricket, bowler, lumbar, workload) to examine a potential relationship between external workload and lower-back injuries in cricket fast bowlers. In total, seven articles were found to fit the inclusion/exclusion criteria, and these were analysed by two reviewers. The analysis included an assessment of potential risk of bias, from the Cochrane Back and Neck (CBN) group guidelines, and the quality of evidence, using the NIH quality assessment tool. We found that, because of a large potential for bias, and an overall low quality of evidence, that the association between external workload and lower-back injuries has minimal strength. Technological advancements that allow total workload to be measured accurately would potentially allow the association between workload and lower-back injury to be examined more precisely, possibly leading to decreased injury rates in fast bowlers.

#### **65. The Effects of Morning Preconditioning Protocols on Testosterone, Cortisol and Afternoon Sprint Cycling Performance.**

McDonald, K.<sup>1</sup>, Maulder P.<sup>1</sup>

<sup>1</sup>*Wintec*

Opportunities exist for athletes to undertake morning exercise protocols in an attempt to potentiate afternoon performance. Four sub elite track sprint cyclists completed a morning cycling (Cyc) or weights-based protocol (WP) prior to an afternoon cycling time trial (500m) in a repeated measures, counterbalance crossover design. Measured variables included heart rate, blood lactate, cycling peak power, salivary testosterone (T) and cortisol levels along with time trial performance. Standardised differences in means via magnitude-based inferences were calculated using paired samples T-tests in SPSS version 24 with statistical significance set at  $p < 0.05$ . The WP produced significantly faster times in the final 250m in comparison to CycP. The anticipated circadian decline of T was observed after the CycP but was however mitigated following the WP. While slight decreases in 500m times were experienced during the WP, they were not significant and were considered within the normal variations experienced between performances by elite athletes. The effect of the WP on the circadian rhythm of T could be linked to a greater recruitment of muscle fibres. Results suggest a morning resistance protocol can positively affect testosterone levels for afternoon performance. Possible gender and individual responses from conducting a W over Cyc protocol were observed and require further investigation.

#### **66. Cardiovascular Fitness and Body Composition Changes within Exercising Female Breast Cancer Survivors.**

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Exercise in breast cancer survivors has been shown to increase cardiovascular fitness (CVF) and attenuate adverse changes in body composition. Baseline and follow-up measures (24-26 weeks apart) of body composition and CVF data was available for 116 female members of the EXPINKT™ programme. Older ( $n=38$ ;  $65\pm 3y$ ) and younger ( $n=78$ ;  $50\pm 5y$ ) groups were created, and a mixed between-within repeated measures ANOVA was undertaken to assess the effect of the exercise programme in the Younger versus Older groups over time. Recorded measures for end heart rate ( $p<0.001$ ), 6-minute walk test ( $p<0.001$ ), and estimated  $VO_{2max}$  ( $p<0.001$ ) showed a significant improvement within both groups as a main effect of time. A between group effect was seen for end heart rate ( $p=0.002$ ). A small effect size decrease in skeletal muscle mass (SMM) ( $p=0.04$ ) and fat free mass (FFM) ( $p=0.04$ ), as a main effect of time, was found within both groups. Notable cardiovascular related exercise benefits are shown in both older and younger breast cancer survivors. The loss of FFM and SMM, despite exercise participation is a concern. Exercise in female breast cancer survivors improves CVF and may help attenuate losses in FFM and SMM; however, in future the intensity of resistance training should be considered.

#### **67. Landing Error Scoring System**

Hanzlíková, I<sup>1</sup>, Hébert-Losier, K<sup>1</sup>

<sup>1</sup>*University of Waikato*

The Landing Error Scoring System (LESS) is a 17-item clinical tool which identifies athletes at high risk of non-contact lower-extremity injuries. This work systematically reviews the literature using the LESS as main outcome to address the psychometric properties and influencing factors of LESS scores. Three electronic databases were searched in March 2018 using "Landing Error Scoring System". All peer-reviewed English language articles using the LESS as main outcome were included ( $n = 38$ ). Overall LESS scores demonstrate good-to-excellent reliability, but concurrent validity of individual items against 3D motion capture is item dependent. The association between LESS scores and other screening tools is poor. The value of the LESS for predicting anterior cruciate ligament (ACL) injury incidence is unclear. Sex, previous ACL injury, and training program influence LESS scores. Literature supports that the LESS is a reliable and generally valid screening tool for assessing movement patterns linked with injury risk with low financial, spatial, and temporal costs. However, further work is needed to improve its concurrent and predictive validity for non-contact lower-extremity injuries. The LESS can be recommended to medical staff and coaches for monitoring movement abilities of athletes.

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Late Breaking

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**68. [Poster] Brain blood flow regulation in high-altitude native Andeans compared to native lowlanders at low and high altitudes**

Gibbons, T<sup>1</sup>, Patrician, A<sup>2</sup>, Tymko, M<sup>2</sup>, Wilson, L<sup>1</sup>, Thomas, K<sup>1</sup>, Cotter, J<sup>1</sup>, Ainslie, P<sup>2</sup>

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Recent findings in Sherpa children and most likely Sherpa adults indicate that resting brain and extracranial blood flow at high-altitude is regulated differently than in age-matched native lowlanders at sea level. Sherpa appear to have decreased flow to the brain and increased flow to the face and scalp, which may lead to the commonly observed condition 'plateau red face' seen in high altitude natives of the Tibetan plateau. Whether this finding is unique to high altitude natives of the Tibetan plateau has yet to be investigated. It is unknown also whether this differential regulation still exists when lowlanders are studied at similar high altitudes. Therefore, we measured internal carotid, external carotid and vertebral artery blood flow in 17 (1F) high-altitude Andean natives (HA) and 13 (1F) age-matched lowlanders (LL) at both low and high altitudes (age: ~HA: 27 ± 7 years, vs. ~LL: 27 ± 7 years). Height, weight, heart rate, blood pressure, oxygen saturation and haemoglobin concentration were assessed in both populations. Results are being analysed and will be presented.

**69. [Poster] Can neck muscle strength, activation or concussion history predict head acceleration during perturbation?**

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Sports related concussion (SRC) is the most common injury in professional rugby union, accounting for 25% of all injuries <sup>1</sup>. The neck musculature may be influential in SRC due to its role in positioning and stabilising the head. It is currently unknown whether neck muscle strength, muscle activation amplitude or onset enhances head stabilisation. One of the known risk factors for SRC is a history of concussion <sup>2</sup>. It is proposed that a loss of neuromuscular control of the head could persist after a concussion and could be associated with future injury risk <sup>2</sup>. The aim of this study was to investigate whether isometric neck strength, neck muscle activation or concussion history can predict head acceleration during a perturbation in premier level rugby players. An observational cohort study was implemented. Fifty male club rugby players were recruited. A custom apparatus perturbed the participant's torso and impulsively loaded the head in five anticipated and five unanticipated trials. A CSx® triaxial accelerometer was adhered to each participant at the right mastoid process. Surface electromyography of the sternocleidomastoid, splenius capitis and the upper trapezius was recorded bilaterally. Isometric neck strength and diagnosed concussion history were also taken. We are currently conducting a linear regression analysis and findings will be available in a month.

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