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SPORT & EXERCISE SCIENCE

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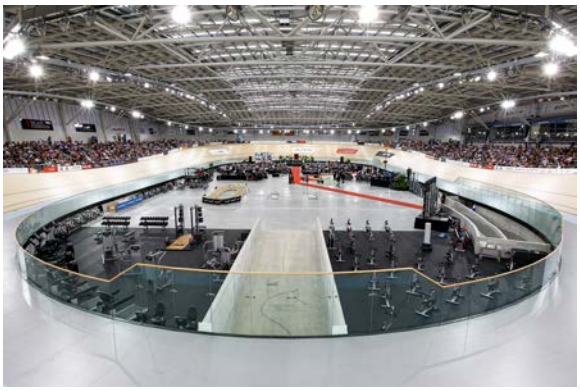
Changing Perspectives on Active Health and Human Performance

Sport and Exercise Science New Zealand Annual Conference, 28-29 October 2016 Avantidrome, Cambridge



Introduction

On behalf of Sport and Exercise Science New Zealand we are delighted to welcome you to our annual conference, which is to be held at the Home of Cycling in Cambridge for the first time. Sport and Exercise Science New Zealand has had an exciting year as an organisation, during which new members have been appointed to the Board, the image has been re-branded and our online presence has been enhanced. We are delighted to see an increase in conference registrations in 2016, after a few years of poor attendance, and hope that we can build on this in the coming years. We would like to see the SESNZ annual conference become re-established on the calendar for anyone working in the sport, exercise and health industry. We have been overwhelmed by the number of abstracts received for the conference and would like to acknowledge the support from the New Zealand Journal of Sports Medicine, which has agreed to include a selection of the abstracts in a special edition of the Journal.

We are most grateful to our Gold Sponsors, the Wilf Malcolm Institute for Educational Research, and COSMED, as well as to our Silver Sponsor, the University of Waikato. We would also like to acknowledge our other exhibitors and supporters, Obex and GBC Biomed, VX Sport, Artinis and the University of Otago.

Thanks also to our world-renowned keynote speakers, Professor Alan St Clair Gibson and Professor Damian Farrow, as well as to all of our presenters for their contributions to what promises to be an interesting range of topics on the theme of Changing Perspectives on Active Health and Human Performance.

We trust you will enjoy the stimulating presentations, top-class research and networking opportunities at the conference and hope that you join us at the informal social gathering on Friday night in Hamilton (venue TBC). If you are interested in being involved with SESNZ, or have any questions or suggestions, please contact our national manager, Kathy Maling, at the registration desk during the conference.

Professor Rich Masters and Dr Matt Driller
Conference Convenors

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We are grateful to our sponsors, supporters and exhibitors who have contributed to the Sport and Exercise Science New Zealand conference in various ways.

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Keynote Speakers

Professor Alan St Clair Gibson (Zig) *(MBChB; PhD; MD)*

Professor Alan St Clair Gibson, was recently appointed Dean of the University of Waikato's new faculty of Health, Sport and Human Performance, St Clair Gibson is famous for his work in the 90's and early 2000's on the Central Governor Theory. The Theory claims that your brain paces your muscles to keep them from reaching exhaustion. When the brain decides enough is enough, it creates sensations that you interpret as muscle fatigue, which causes you to slow down to protect yourself.

St Clair Gibson is well known for his other work too, and has published more than 150 research articles in the areas of basic brain function, control system mechanisms, exercise regulation, psychophysiology and complex system integration.

Professor Damian Farrow *(B.Ed; M.AppSc; PhD)*

Damian Farrow is in VU's Institute of Sport, Exercise and Active Living where he holds a joint appointment with the Australian Institute of Sport as a Professor of Skill Acquisition. Damian has worked with a wide range of Australian sporting organisations and National teams to develop the skills of their athletes. These include; Australian tennis, netball, cricket, rugby, numerous AFL clubs and is currently the National Lead in Skill Acquisition for Swimming Australia. Damian's research centres on understanding the factors critical to developing skill and sport expertise, with a particular interest in the role of decision making and practice methodology. He is a co-editor of the texts "Applied Sport Expertise" and the Routledge Handbook of Sport Expertise and has co-authored a number of general interest sports science books including the popular "Run Like You Stole Something".

Higher Cerebral Blood Flow Responses to Swimming Than to Land-Based Arm or Leg Exercise

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Background: Effective regulation of cerebral blood flow (CBF) is important momentarily and across life. Regulation of CBF involves several local and systemic factors, all of which are altered during exercise. CBF thus depends on exercise intensity and mode. Mild, upright exercise in water increases CBF (velocity) by more than exercise on land. Swimming may provide a uniquely high CBF profile due to demand factors (widespread neuronal activation) and multiple supply factors (e.g., posture and compression), but has not been examined.
Aim: To profile CBF during swimming, and compare against arm and leg exercise on land.
Method: Eight trained adults (Mean±SD: age 29±14 y; $\dot{V}O_{2max}$ 46±8 mL/min/kg; 5 females) completed swimming (overarm or breaststroke in flume), cycling and arm-cranking on different days (randomised order). Exercise comprised five incremental, 3-min stepped intensities based on perceived exertion, from "fairly light" to "extremely hard". CBF was indexed continuously from middle cerebral artery velocity (MCAv; transcranial Doppler).
Results: $MCAv_{mean}$, pooled across intensities, was 9% (±4; P=0.0002) and 14% (±2; P <0.0001) higher in swimming than cycling and arm-cranking (89±14, 81±17, 77±13 $cm \cdot s^{-1}$; P=0.029 and 0.026). $MCAv_{mean}$ peaked (102±15 $cm \cdot s^{-1}$) at 60±25% HR reserve ($HRR_{@peak}$) during swimming, 69±24% during cycling (87±12 $cm \cdot s^{-1}$; P=0.0675) and 47±21% during arm-cranking (82±15 $cm \cdot s^{-1}$; P=0.0137 vs. swimming, P=0.682 vs. cycling); differences in $HRR_{@peak}$ were not evident for swimming versus land-based modalities (P>0.175), but $HRR_{@peak}$ was higher in cycling than arm-cranking (P=0.014). $PETCO_2$, the major factor governing $MCAv_{mean}$, was higher in cycling (37±3 mm Hg) than swimming (35±4; P=0.072) and arm-cranking (33±2; P=0.004), and in swimming than arm-cranking (P=0.042).
Conclusions: Swimming elicits higher $MCAv_{mean}$ (~CBF) than does cycling or arm-cranking across a range of intensities, despite higher $PETCO_2$ during cycling. $MCAv_{mean}$ peaked at typical training intensities, but our findings indicate that flow-mediated cerebrovascular adaptation may be greater with swimming than cycling or arm cranking.

Keywords: Brain Blood Flow; Hypercapnia; Front Crawl; Immersion

Assessing the Potential for Clinical Exercise Physiology in the Waikato Region of New Zealand: A Pilot Study

Tanja Allen, Glynis Longhurst

Centre for Sport Science and Human Performance, Wintec

Background: There is a clear link between physical inactivity rates and the prevalence of non-communicable diseases (NCDs) in the Waikato region of New Zealand, as well as globally. These rising numbers indicate that there is clearly a lack of facilities and practitioners with the appropriate skills and knowledge to cater for people in the moderate to high risk categories for NCD's in the Waikato.
Aim: To ascertain primary healthcare providers' current attitudes and practice towards counselling on physical activity (PA). This included determining what, if any, barriers exist in preventing them counsel patients on PA, and what level of qualifications for exercise professionals they deem essential to be confident in referring. To determine the current situation for people in the Waikato region of New Zealand with NCDs. How, if at all, are their needs were being addressed. Is there a need for CEPs in the Waikato region of New Zealand?
Method: A survey was adapted from a previous survey developed by Exercise is Medicine®. Five medical centres in Hamilton and Te Awamutu, and nurses at a conference were asked to complete the survey. 61 hard copies were delivered with a total of 44 responses received. Analysis of the New Zealand Health Survey 2014/15 and the Green Prescription Patient Survey 2015 was conducted to determine the health status, and services currently provided for people with NCDs, in the Waikato region.
Results & Conclusions: Currently under analysis, due end of September 2016.

Keywords: Non-Communicable Diseases; Physical Activity; Primary Healthcare; Exercise is Medicine®.

The Effects of Yoga as an Adjunct to Home-Based Exercises on Chronic Non-Specific Neck Pain and Disability

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Aim: To determine the degree to which yoga classes are efficacious for treating chronic non-specific neck pain (CNSNP) as an addition to prescribed home-based exercises, and the role of psychosocial factors in recovery.
Methods: The yoga+exercises group (n=13) attended twice-weekly, 60-minute yoga classes and completed home-based neck and shoulder exercises for 10 minutes daily for 8 weeks, whilst the exercises-only (control) group (n=11) completed home-based exercises only. Outcomes, measured at baseline and weeks 4, 9, and 12, included neck pain intensity via Visual Analogue Scale (VAS); disability via Northwick Park Neck Pain Questionnaire (NPNPQ); and quality of life (QoL) scores via The Medical Outcomes Study Short Form 36 item (SF36) questionnaire. Credibility and Expectancy Questionnaire (CEQ), and Yellow Flag questionnaire scores were analysed as correlates of change in outcomes.
Results: Pain intensity and disability decreased in both the yoga+exercises (baseline VAS: 5.4±1.4 (mean±SD), week 9: 3.6±1.2; baseline NPNPQ: 36.1±9.4, week 9: 17.7±8.8), and exercises-only (baseline VAS: 5.1±1.9, week 9: 3.1±2.0; baseline NPNPQ: 32.3±12.9, week 9: 18.5±9.7) groups. No additional change in pain intensity or disability was found in the yoga+exercises group compared to the exercises-only group. After 9 weeks, the yoga group demonstrated a more positive improvement in the SF36 physical functioning health dimension (median 25 points) compared to the exercises only group (median 10-point; P=0.04). A significant correlation between baseline CEQ credibility and 9-week change in SF36 general health dimension was demonstrated in both groups combined (ρ=0.72; P=0.001), and in the yoga group alone (ρ=0.82; P=0.007).
Conclusion: This RCT shows that yoga plus home-based exercises, and home-based exercises only, over an 8-week time period, are both appropriate interventions to decrease pain and disability caused by CNSNP. Yoga plus home-based exercises may improve physical functioning QoL outcomes more than home-based exercises alone.

Keywords: Physical Rehabilitation; Exercise Therapy; Chronic Pain

Standing Workstations: Experience, Acceptability, and Effects on Occupational Sedentary Behaviour and Metabolic Health of Office Workers

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Background: Metabolic Syndrome (MetS) is a collection of clinical signs that represent unfavourable metabolic changes in the body, associated with increasing risk of cardiovascular disease (CVD), Type 2 diabetes mellitis, stroke, and all-cause mortality. In recent years, sedentary behaviour has been linked to markers of MetS, CVD and all-cause mortality. The negative effects of sedentary behaviour may be separate from the benefits of physical activity and steps should be taken replace sedentary behaviour with regular light intensity physical activity.
Aims: To examine the physical effects and lived experience of six office workers following the introduction of sit-stand workstations.
Methods: In this single-case design study, the effects on physical activity and metabolic markers during baseline, 'phase-in' and intervention periods were measured. A concurrent qualitative study aimed to understand the experience of participants. Three semi-structured interviews were conducted and the data were analysed to generate themes and subthemes.
Results: Changes occurred for daily sitting and standing time for 5 participants. Standing time increased between 111 min/day and 341 min/day following the introduction of the standing workstation. Decreased daily sitting time ranged from 107 min/day to 311 min/day. Changes to daily sitting and standing times remained stable and the acceptability was mirrored in qualitative data. Participants reported physical changes, including improved tolerance to standing and a perception of improved posture, as well as emotional changes including increased productivity, cognitive function and tolerance to stress. Three participants showed decreases in waist circumference between 2.5 and 6.7 cm.
Conclusion: The use of sit-stand or standing workstations reduced daily occupational sitting and increased daily occupational standing in all participants where inclinometry data were available. Changes were stable across the entire intervention period suggesting high acceptability of the standing workstation. The failure to detect changes to metabolic markers may be suggestive of study limitations or the complexity of metabolic syndrome.

Keywords: Standing Desk; Occupational Health; Physical Inactivity

Funding Sources: Dan Archer was supported by a Todd Foundation Award for Excellence.

Does Osteopathic Manual Therapy with Breathing Retraining Alter Exercise Economy, Symptoms of Dysfunctional Breathing, or Heart-Rate Variability?

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[2]*Community Development (Sport), Unitec Institute of Technology*
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[4]*High Performance Sport New Zealand*

Background: Dysfunctional breathing (DB) is an alteration in the normal patterns of breathing which can result in intermittent or chronic respiratory and non-respiratory symptoms. DB is often brought about by stress and anxiety, and may have other physiological effects, such as reduced exercise ability.
Aim: To determine whether osteopathic manual therapy with breathing retraining can improve exercise economy, breathing-related symptoms, cardiac autonomic markers or exercise economy.
Methods: Development of the osteopathic intervention entailed several iterations of trials and evaluation, and involved over a dozen experienced practitioners. Active participants (n=19), who perceived that breathing might be limiting their exercise performance were randomised to receive 4 – 6 weeks of intervention either immediately (n=10) or after a 4-week delay (n=9), and were assessed for changes in exercise economy, symptoms suggestive of dysfunctional breathing and heart rate variability.
Results: Improvements in heart-rate variability were noted in those who received treatment compared to those yet to receive it: effect sizes (ES) were 0.7 – 1.2 and 0.39 – 0.40 respectively ($p < 0.05$). Changes in heart-rate variability from before to after treatment were also noted (ES = 1.2 – 1.3; $p = 0.001$). Pre- to post-intervention reductions in breathing symptom questionnaire scores and exercise economy were also noted, but differences were not statistically significant compared to control.
Conclusions: Whilst the mechanisms are unclear, osteopathic treatment with breathing retraining appears to have a beneficial effect on heart-rate variability. This may suggest that breathing exercises aimed at improving breathing habits can be useful for mitigating undesirable autonomic regulation such as stress responses.

Keywords: Abnormal Breathing; Breathing Pattern Disorders; Exercise Performance; Autonomic Response

Real World Effects of Non-Image Forming Light

C Martyn Beaven[1]

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Background: We have all seen futuristic shows where miraculous devices are used to heal injuries and illnesses; but, that is just science fiction, right? Yes, and no. The knowledge that light can impact human physiology should not come as a surprise. Sun exposure is an obvious example of the ability of invisible light wavelengths (UVB rays) to penetrate the human body and cause direct DNA damage and inflammation (sunburn), initiate a prophylactic protective response in the form of an increase in melanin (suntan), and regulate positive endocrine effects (vitamin D production). The usage of appropriate light wavelengths and dosages for health and performance benefit, however, is still relatively under-utilised.
Aim: To present the potential human health and performance benefits of both short (450-495 nm) and long (620-904 nm) wavelength light.
Methods: A brief and targeted review of relevant literature.
Results: Benefits include: enhanced weight management, combating the negative effects of micro-gravity on bone and muscle, improved agility, pain relief, greater muscle recovery, elevated testosterone, heightened reaction times, improved cognitive function post traumatic brain injury, improved muscle endurance, higher IQ, and superior strength gains.
Light application can also manipulate circadian rhythms for athletic performance and off-set the negative impact of cross-time zone travel. Correcting circadian disruptions may also have significant implications for global human health as the International Agency for Research on Cancer has recently stated that circadian disruption is "probably carcinogenic to humans".
Conclusion: Appropriate light application has the potential to impact a range of physiological functions with the capacity to enhance human performance, health, and well-being.

Keywords: Photobiomodulation; Light Therapy; Blue Light; Infra-Red

Mental Rehearsal Impacts Hormones and Subsequent Sport-Specific Performance

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Background: Mental rehearsal is method used to deal with stressful situations, with positive visualization proposed to enhance complex skill performance. The use of a video stimulus has been associated with enhanced kinesthetic sensations and rapid hormone fluctuations that may contribute to enhancing the conscious and unconscious emotional state for skill execution.
Aim: Assess the presentation of negative and positive video on skill execution and hormones.
Methods: 10 professional athletes volunteered for a randomized cross-over study whereby they completed three preparatory phases (either positive or negative video guided mental rehearsal, or self-directed mental rehearsal alone) prior to an exercise stressor and sport-specific motor skill task. Salivary testosterone and cortisol were monitored to assess stress responses.
Results: The presentation of positive video imagery prior to an exercise stressor elicited a positive hormonal outcome and was associated with a significantly enhanced physiological stress resilience ($r = 0.39$). Performance during a sport-specific task was also improved following the positive video condition compared to the negative video and self-directed mental rehearsal, with a significant correlation observed between performance and salivary testosterone ($r = 0.47$).
Conclusion: Mental rehearsal is enhanced by appropriate, context-specific video presentation and propose that the interaction between sex steroids, the adrenal axis, and subsequent conscious and unconscious behaviors may be relevant to competitive sporting environs. Specifically, we suggest that relatively elevated free testosterone imparts a degree of stress resilience and improves self-efficacy, which may lead to enhanced expression of competitive behaviors and provide a more optimal emotional state for skill execution.

Keywords: Visualisation; Motivation; Mental Toughness

Salivary Hormones and Sport Science Applications

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Background: As the primary anabolic hormone, testosterone has received a great deal of research attention, especially in regards to resistance training. While some recent studies have questioned the relevance of transient acute hormonal response following resistance exercise, the abundance of literature would suggest that testosterone plays a major role in muscle adaptation with evidence supporting this notion being described as "incontrovertible". It should also be noted that testosterone plays a number of further roles including visuospatial ability, risk aversion, dominance, and attenuation of the integrated central stress responses.
Aim: To present the potential benefits of assessing and monitoring salivary testosterone in athletic populations.
Methods: A brief and targeted review of relevant literature.
Results: Data from a range of sources demonstrate an important role for endogenous testosterone in actualising functional gains in both male and female athletes. Prescription of specific exercise variables to elicit maximal acute hormonal elevations, at an individual level, is related to increased upper- and lower-body strength. Strength gains associated with blood flow restricted training were also associated with exercise-induced increases in testosterone. Psychological and behavioural aspects of testosterone have the potential to enhance training adaptation by complementing the known anabolic and permissive properties of testosterone. Previously unpublished data regarding a relationship between sport-specific skill tasks and testosterone, as well as data that suggests that caffeine responders display a distinctive hormonal profile, is presented.
Conclusion: Assessment of dynamic changes in salivary testosterone can assist in exercise prescription and assessing athlete status. Manipulation of endogenous hormones can have positive performance and training outcomes.

Keywords: Elite; Strength; Readiness; Over-Reaching; Motivation

Quantifying the Mean Change in Repeated Stiffness Jump Performance over the Season in Professional Soccer Players

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Background: Hyundai A-League players endure one of the longest preparation phases in world football. It is important to monitor player responses to load throughout the preparation and competition phase of the season. Repeated Stiffness (RS) jumps have been linked with neuromuscular fatigue and may prove a useful monitoring tool.
Aim: The aim was to quantify the monthly mean change in RS jumps over a four month "transition period" from preparation to competitive phase.
Methods: A portable vertical jump system (Optojump®, Microgate, Italy) was used to record contact and flight times and to calculate maximal power. Thirteen male professional soccer players (age 26±5 yrs, height 1.80±0.06 m, weight 78±7 kg) were monitored over four months (two months of preparation (August, September) and the initial two months of competition (October, November) of the 2012 – 13 Hyundai A- League season. RS jump testing consisted of 10 RS jumps with the aim to jump as high as possible, with limited bending of knees and minimal contact time. Of the 10 RS jumps, peak power was recorded each week and a monthly mean calculated for each player.
Results: Repeated measures ANOVA determined a statistically significant difference in jump power over the four months (w/kg) (0.017; $p < 0.05$). Post hoc testing showed a significant increase from August to September and October, but no difference between August and November (see Table 1).
Conclusions: The current study showed an increase in jump power in the preparation phase, which was maintained in the first month of the competitive phase. In the second month of competition, however, it appears that the improvements gained in the preseason were no longer maintained. It appears RS jump testing could be used to monitor player responses to training and competition load and as a useful tool to evaluate periodization.

Keywords: Jump Testing; OptoJump; Periodization; Training Load

Table 1. Repeated stiffness jumps maximal power (w/kg) [mean (SD)] over four months (in the preparation and initial competition phases)

	August	**September**	**October**	**November**
Mean RS jump (SD)	42.55 (7.39)	45.48* (7.91)	46.60* (8.15)	44.36 (8.67)
Annual Planning	Preparation	Preparation	Competition	Competition

* Significantly different from August

Back to Fundamentals: What Motor Skills Underpin Physical Literacy?

Chris Button, Jonathan L Ng, Neil Anderson

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Background: A physically literate person can produce and transfer movement patterns to function effectively in different performance environments such as at school, in the workplace, competitive sport, etc. Physical literacy is a complex multi-faceted concept, including a motoric component composed of so-called *fundamental movement skills* (FMS). FMS are presumed to be the 'building blocks' for more sophisticated, context-specific motor skills. It has been suggested that if children do not acquire FMS within a critical developmental period then they will struggle to adapt and transfer these skills, and may consequently have limited opportunities for physical activity, later in life.

Johnson (1962) suggested that motor skills routinely practiced in sport and physical education classes were appropriate for the assessment of FMS (e.g., running, jumping, throwing, striking, kicking, etc.) While FMS assessment has evolved considerably since then, a 'sport-centric' focus has doggedly persisted. Indeed, several of the motor skills tested by Johnson (1962) in his pioneering study remain in the dozen or so movement assessment batteries commonly employed today. Despite reported limitations in sensitivity, reliability and validity (Cools et al., 2009) many such movement assessment batteries are still being used to assess competency in the general population.

Aim: Our general aim is to reconceive the concept of FMS informed by evidence from the motor control and learning literature to construct a more robust, general taxonomy of movement coordination. We are currently pilot testing in primary schools a new active video gaming platform to assess fundamental movement skills based on our taxonomy.

References:

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2009) Movement skill assessment of typically developing preschool children: a review of seven movement skill assessment tools. *Journal of Sports Science and Medicine, 8*(2), 154(115).

Johnson, R. D. (1962) Measurements of achievement in fundamental skills of elementary school children. *Research Quarterly. American Association for Health, Physical Education and Recreation, 33*(1), 94-103.

Keywords: Movement Screening; Paediatrics; Skill Acquisition

The Role of Affective Responses to Exercise in Making an Affective Forecast

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Background: The basic pleasant/unpleasant feelings an individual experiences during exercise are termed the affective response (Ekkekakis, 2003). Positive affective response has been shown to predict future exercise behaviour positively (Williams, 2008). This link could be explained by Decision Affect Theory (DAT; Mellars & McGraw, 2002), which proposes that the experienced affective responses and the affective memory of an event influence one's affective forecast for a future event. Specifically, they will base behavioural decisions for future event(s) around whether these affective forecasts are pleasant or unpleasant. But DAT has not been tested in the exercise context.
Aim: To explore the relation between affective responses experienced during exercise and the affective forecasts for future exercise.
Methods: Twenty inactive female participants (39 ± 11 y) completed three 30-min moderate-intensity exercise sessions one week apart. Before exercise, participants were asked to predict how they thought they would feel overall during exercise; from -10 (very unpleasant) to +10 (very pleasant). Affective responses were recorded using the Feeling Scale (Hardy & Rejeski, 1989), before, every 2 min during, and at 5, 10, and 15 min after exercise.
Results: Linear regression analysis showed that the mean affective response during exercise, positively and significantly predicted the affective forecast for the second (b = .72 p= .002) and third (b = .63 p= .003) exercise sessions.
Conclusions: These relations show that how an inactive person feels during exercise predicts how they think they will feel the next time they exercise. If, as DAT predicts, these experienced affective responses and affective forecasts will influence the decision to participate in future exercise, then it is important that individuals have a positive affective experience to their exercise sessions, at least initially.

Keywords: Physical Activity; Psychology; Predictions

Fundamental Movement Skills of Children with Down Syndrome: The Role of Balance and Working Memory

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Background and Aim: Fundamental movement skills (FMS) proficiency is important in children because it is associated with greater physical activity engagement. We previously showed that children with Down Syndrome (DS) have delayed FMS development, potentially as a consequence of balance deficits. This study, therefore, examined the relationship of FMS proficiency with balance ability. We also examined the relationship of FMS proficiency with working memory to support evidence-based intervention programming.
Methods: Participants included children with DS (n=21), and age-matched typically developing (TD) children (n=20). FMS subskills (locomotor, object control) were measured using the Test of Gross Motor Development-2. Balance ability (centre of pressure [COP] parameters) was measured using a force measurement plate. Short-term memory was measured using the forward digit recall test (verbal), and the forward Corsi block tapping test (visuospatial).
Results: COP parameters were associated with both locomotor and object control scores. Stepwise linear regression revealed that specific COP parameters explained the variance of object control to a greater extent than locomotor scores; more so amongst children with DS than TD children. Locomotor and object control scores were significantly associated with verbal and visuospatial short-term memory in children with DS; but only with visuospatial short-term memory in TD children.
Discussion: Children who displayed greater stance stability also had better FMS proficiency. Such an association was stronger in children with DS than in TD children. As FMS proficiency of children with DS appears to be related to balance ability, it is suggested that physical training of children with DS should consider incorporating balance components. Both verbal and visuospatial short-term memory influence FMS proficiency, implying that training programmes should be tailored to accommodate cognitive deficits. Further research is recommended to explore the findings in a training context.

Keywords: Down Syndrome; Children; Fundamental Movement Skills; Balance; Short-Term Memory

Funding sources: The study was funded in part by the Health and Medical Research Fund of Hong Kong. The first author is funded by the University of Waikato Strategic Investment Funding for Home of Cycling Research Project.

Accounts from Rio: Optimising Performance Support in a Challenging Environment

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At the recent Olympic Games in Rio de Janeiro, High Performance Sport New Zealand operated a performance centre within the Olympic Village to aid the preparation and recovery of Kiwi athletes. The aim of the centre was to provide a performance edge by replicating services and spaces that the athletes access at training centres in New Zealand, thereby enabling them to continue with their normal training and competition routines amidst the high pressure Olympic environment. The centre included a preparation and recovery space, a resistance training area and a specialised kitchen for delivering sports nutrition in a safe and hygienic environment. This presentation will recount the details of what was delivered to the New Zealand athletes, the challenges that were faced and overcome, and practical recommendations moving forward for optimising performance support at pinnacle events.

Keywords: High Performance; Preparation; Recovery; Olympics

Funding Sources: High Performance Sport New Zealand and the New Zealand Olympic Committee.

Combined Stressor Training and Cross Tolerance for Health and Performance

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Humans adapt to chronic/repeated stress, such as exercise or warm environments, to become more tolerant of subsequent exposure. Certain types of cellular and systemic adaptations enhance one's tolerance when exposed to novel stressors, i.e., provide cross tolerance. The parameters of stress – e.g., form(s), magnitude and pattern of energy imposed – used in conditioning influence the nature and extent of adaptations, as do factors that govern individuals' sensitivity and capacity to adapt (e.g., sex, age, disease state, fitness). Exercise training/conditioning is a complex and inadequately-understood stressor that drives the immense array of adaptations that constitute fitness. Fitness therefore enhances cross tolerance to some stressors (e.g., heat, cold, dehydration), but not others (e.g., orthostasis). Conditioning with isolated stressors is increasingly being examined with or without exercise training for its ergogenic or health-related potential; these typically being hypoxia, heat, ischaemia or restricted carbohydrate. Such stressors used in conjunction with or in place of exercise training are readily shown to be effective physiologically in untrained or moderately trained participants, but appear to show little transfer to highly endurance-trained participants or may not confer measurable ergogenic benefit. Research into combined-stressor conditioning is almost nonexistent despite clear physiological rationale and potential applications. Combined heat & hypoxia conditioning is appealing but also highlights problems of interference in adaptation. This presentation will provide an update on the immensely promising field of isolated and combined stressor conditioning. Potential applications are numerous and include performance, primary prevention, prehabilitation, rehabilitation and cross tolerance.

Keywords: Adaptation; Training; Stress Conditioning; Acclimation; Heat; Hypoxia; Exercise

The Direct Immunoassay of Blood-Free Testosterone: Is it Valid in Sport?

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Introduction: In sport, the direct immunoassay of blood-free testosterone (FT) is increasing in popularity, as it circumvents more costly, difficult and time-consuming methods. However, some technical considerations (e.g. sensitivity, specificity) can influence the accuracy and precision of this method, but not yet evaluated within a sporting context. Therefore, this study assessed the validity of direct FT measures, referenced against total testosterone (TT), during athletic competition.
Methods: Capillary blood samples from 49 male and 28 female athletes (age 16-20 years) were taken before and after a simulated Olympic weightlifting competition. The blood concentrations of TT and FT were measured using a solid-phase enzyme-linked immunoassay (DRG, Germany). The hormonal changes and predictive associations were examined using non-parametric statistics.
Results: The male and female athletes both experienced a significant rise in TT (9±19%, 11±20%) and FT concentrations (15±22%, 52±64%), respectively. The individual variances in TT and FTwere strongly related in males (r 2 =0.911) and females (r 2 =0.757), with the FT values representing 0.2-0.3% of blood TT.
Discussion & Conclusions: The athletic competition promoted a corresponding rise in the blood TT and FT concentrations of young athletes. The TT and FT measures were also strongly related in both sexes; however, the actual FT values were well below expected percentages (i.e. 1-3% of TT). This bias limits the use of direct immunoassays when comparing study or laboratory results, as well as establishing accurate reference ranges for similar-aged populations.

Keywords: Hormones; Stress; Androgen; Assay Specification

Diabetes Hacking: A Prospective Study of Diabetes' Patients DIY Technology Modifications and Innovations

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Background: Although commercial diabetes technologies are studied in controlled trials, the hacking (i.e., modification and subsequent use) of these technologies has received little attention. Notably, diabetes hackers' developed an artificial pancreas many years prior to the release of an FDA-approved commercial equivalent.
Aim: To investigate the potential within the digital era for patients, in New Zealand and globally, to be active not only in managing their chronic illness, but in developing new treatments.
Methods: This study will use naturalistic methods to study the global diabetes hacking community, including examination of the hacking community's digital forums and interviews with key hackers. Hackers' existing medical records will be requested in order to evaluate possible improved health outcomes from use of an artificial pancreas.
Results: Results are expected to highlight the role of digital media in the development of a hacking community, the decision-making processes through which hackers decided to make their hacks available for others to utilize and adapt, changes in perceived quality of life for diabetics and their families as a result of hacking, and, if possible, analysis of medical records to evaluate the success of artificial pancreas use improving health outcomes.
Conclusions: The implications of this global community's innovations will be linked to the New Zealand health context.

Keywords: Artificial Pancreas; Diabetes Online Community; Digital Health

The Method of Dehydration is Relevant When Considering the Effects of Dehydration

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Background: Passive dehydration has a relatively high reliance on sourcing extracellular fluid, whereas exercise-induced dehydration releases and also produces endogenous water from glycogen stores. Thus physiological and behavioural effects are likely to differ between exercise- vs heat- or fluid-restriction-induced dehydration.
Aim: To investigate physiological and behaviour-mediating effects of heat versus exercise-induced dehydration.
Design: Controlled-trial, fully repeated measures design; laboratory setting.
Methods: Twelve participants completed four trials; they dehydrated to mild extent (3% ΔBM) or rehydrated to prevent ΔBM under passive heat stress (~40˚C, 60% RH) or exercise heat stress (cycling intervals at ~90% $\dot{V}O_{2max}$ in 29˚C, 50% RH). Plasma osmolality (P_{osm}), change in plasma volume (ΔPV), and thirst were measured at baseline and 3% gross ΔBM. Respired gas was also measured at 3% gross ΔBM.
Results: PV decreased 2.3% more per % ΔBM in passive than exercising dehydration, and was 7.7% lower at 3% ΔBM (13.2 vs 4.4%; p=0.003). But, after subtracting ΔPV across the corresponding rehydration trials, PV reductions were not clearly different between passive and exercise dehydration (1.2 vs 0.4% per % ΔBM; p=0.550). P_{osm} rose by 6 ±5 vs 3 ±7 mOsmol/L during passive vs exercise dehydration (p=0.087). Again, subtracting the corresponding value in the rehydration trial produced unclear differences (4 vs 5 mOsmol/L per % ΔBM; p=0.880). However, 'full rehydration' decreased P_{osm} to 8 ±5 and 11 ±5 mOsmol/L below baseline in passive and active trials, respectively (main effect: p<0.001). Thirst averaged an unclear 1.1 (/9) points higher in active than passive dehydration at 3% ΔBM (p=0.084).
Conclusions: PV and perhaps P_{osm} are impacted more by mild (3%) body mass deficit incurred by heat than by exercise. But, such effects may be due primarily to the stressors per se (heat or exercise) than to the mass deficit. Full replacement causes substantial hypotonicity, and thus seems inappropriate.

Keywords: Hypohydration; Heat Stress; Thirst; Plasma Volume; Exercise

The Determinants of Fast Stretch-Shortening Cycle Function During a Drop Jump in Elite NZ Track and Field Athletes

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Background: Fast stretch-shortening cycle (SSC) function is an important determinant of sprint and jump performance; understanding the relative importance of the constituent factors may have implications for the testing and training of athletes.
Aim: To investigate which performance and mechanical variables determined fast SSC function during drop jumps (DJs) from various heights in elite NZ track and field (T&F) athletes and recreationally active participants.
Methods: In a cross-sectional design, 12 elite NZ T&F athletes and 12 recreationally active participants completed one familiarization session and one testing session. Participants performed DJs from 0.25m, 0.50m and 0.75m onto a force plate. Contact time (CT), flight time (FT), reactive strength index (RSI; FT/CT) and leg stiffness were determined. Eccentric and concentric phase force, power and impulse were also assessed.
Results: Very large differences in RSI were found between elite T&F and recreationally active participants across all drop heights (3.02 vs 2.02 $s \cdot s^{-1}$; ES [±90% CL]: 2.02 ±0.56; p <0.01). This difference was accounted for primarily by briefer CTs (0.16 vs 0.22s; ES: -1.49 ±0.53; p <0.01) and leg stiffness (0.45 vs 0.28 $kN \cdot m \cdot kg^{-1}$; ES: 1.67 ±0.62; p <0.01), with smaller differences observed for FT (0.50 vs 0.46 s; ES: 0.71 ±0.78; p >0.05). Eccentric, and concentric, force and power was higher in elite T&F athletes. However, the largest differences were observed in mean eccentric power (-85 vs -62 $W \cdot kg^{-1}$; ES: 1.83 ±0.56; p <0.01) which exhibited a very large correlation with CT (r ±90% CL: 0.89 ±0.11; p <0.01).
Conclusion: Elite T&F athletes exhibited superior fast SSC function compared with recreationally active participants. This was primarily due to the ability to strike the ground with a stiffer leg spring, an enhanced expression of eccentric power, and subsequently, a briefer ground contact time for a given flight time.

Keywords: Reactive Strength, Eccentric, Concentric, Leg Spring

Predictors of Cardiovascular Health Improvements in Patients at Risk of Cardiovascular Disease: A Cross-Sectional Analysis of Green Prescription

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Aim: To determine the factors predicting cardiovascular health improvements among patients reporting cardiovascular disease (CVD) risk.
Methods: The study was based on New Zealand's exercise prescription programme, Green Prescription (GRx). Using the 2016 GRx Patient Satisfaction Survey, cross sectional data were collected from patients who were referred to GRx in 2015 (n = 2843).
Results: Included in analysis were 71% of total respondents who reported one or more CVD risks, namely weight problems (n = 1463), high blood pressure/risk of stroke (n = 681), high cholesterol (n = 496), Type 2 diabetes (n = 463), pre-diabetes (n = 350), heart problems (n = 310) and/or smoker (n = 128). There were 50.5% reporting no CVD-related health improvements and 49.5% reporting 1-5 improvements. A linear regression indicated 11 of 30 variables predicted cardiovascular health improvements (adj R^2 = .214, p <.001). Pearson's correlations indicated cardiovascular health improvements were positively related to reporting more CVD risk factors (r=.28), changing one's diet (r=.25), spending more time being active (r=.19), receiving a GRx extension in past year (r=.17), gardening (r=.14), cycling (r=.13), exercising with adult family members (r=.12), being male (r=.12), receiving one's first GRx over 6 months ago (r=.11), exercising in a sports club (r=.10) and exercising with friends (r=.09) (all p <.001).
Conclusions: Patients reporting more CVD risk factors showed the highest correlation with cardiovascular health improvements. Patients who changed their food and drink intake as a result of GRx revealed the second strongest correlation with cardiovascular health improvements. Other results suggest that lifestyle physical activity such as gardening and cycling combined with social components of exercising with family, friends and in a sports club are the most promising factors for improving the cardiovascular health of patients at risk of CVD.

Keywords: Exercise; Cardiometabolic Health; Clinical-Based Intervention; Disease Prevention; Physical Activity Counselling.

Funding Sources: Data provided by New Zealand Ministry of Health.

Frequency of Exercise and Metabolic Responses During Sitting, Exercise, and Post-Exercise Periods

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Background: Breaking sedentary time imparts metabolic benefits in terms of postprandial glycaemia and insulinaemia, however, the effect of exercise frequency on metabolism during sitting, exercise and post-exercise periods has not been investigated.
Aim: To compare energy expenditure (EE) and substrate oxidation between different profiles of breaking up prolonged sitting.
Methods: Thirty-six (male=11) sedentary individuals, (age 26±4 y, BMI 24.1±4.6, $\dot{V}O_{2max}$ 36±8 $mL \cdot kg^{-1} \cdot min^{-1}$, mean±SD) performed four, two-day trials, in a randomised-controlled, crossover design: (1) prolonged sitting (SE), (2) sitting with regular activity breaks every 30 min for 2 min (RAB), (3) prolonged sitting with 30-min of continuous exercise at the end of day 1 (PA), (4) RAB and PA combined (RAB+PA). All treadmill exercise was undertaken at a speed/incline corresponding to 60% $\dot{V}O_{2max}$. Participants consumed standardised meals during interventions and an ad libitum meal at the conclusion of day 2. Indirect calorimetry was used to estimate EE, carbohydrate, and fat oxidation during sitting, exercise, and post-exercise periods.
Results: Total EE on day one (7-h) in SE (2401±92kJ, mean±SE) was less than PA (3110±92kJ), RAB (3267±92kJ), and RAB+PA (4150±92kJ); all $p < 0.001$. There was no difference in total EE on day one between PA and RAB ($p = 0.516$). Post-exercise EE in PA (64±4kJ), on day one was less than RAB (697±31kJ) and RAB+PA (615±26kJ); both $p < 0.001$. Total carbohydrate oxidation on day one in RAB (90±6g) was less than PA (144±6g) and RAB + PA (129±6g); both $p < 0.001$. Total fat oxidation in SE (7.4±1.2g) on day one was less than RAB+PA (12.9±1.5g); $p = 0.027$.
Conclusions: Increasing not only duration but frequency of activity alters EE as a result of exercise. More frequent bouts, vs. one continuous bout, result in increased post-exercise EE. This elevation in EE punctuated throughout the day may be responsible for altered postprandial metabolic responses.

Keywords: Sedentary; Metabolism; Excess Post-Exercise Oxygen Consumption (EPOC); Activity Break; Energy Expenditure

Funding Sources: University of Otago, National Heart Foundation

The Effect of Milk-Protein Supplementation and Exercise on Chronic Disease Rehabilitation

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Milk-protein and amino acid supplementation has been shown to upregulate a variety of exercise-induced physiological adaptations in healthy and athletic populations. Some of these adaptations are clinically relevant to diseased populations if the pathology includes vascular irregularities, metabolic dysfunction, or muscle wasting. This presentation provides an overview of the growing body of literature describing this phenomenon and the preliminary findings of a whey-protein plus HIT training study that examined the effect of dual therapies on metabolic function in type-2 diabetics.

Keywords: Supplements; Dairy Products; Cardiovascular Disease; Diabetes Mellitis

Improving Jump and Reach Height with Osteopathic Manual Therapy Techniques in Female Recreational Overhead Athletes

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Background: Lower body training to improve jump height for sport performance has been extensively researched. However, no research has investigated improving shoulder range of motion through osteopathic techniques in order to achieve optimal overhead jump reach.
Aim: To investigate the effects of an osteopathic intervention for shoulder and thoracic range of motion in female athletes on overhead reach during vertical jumping.
Methods: Participants were 17 healthy, active women (aged 18–37) who were involved in basketball (n = 9), netball (n = 7) or volleyball (n = 1). In a crossover design, they received an upper and lower body osteopathic intervention, in randomised order, 1 week apart. Jump reach and maximum ground reaction force with and without arm swings were recorded prior to and immediately following each intervention using a Swift Yardstick™ Vertical Jump Tester and ground reaction force plate.
Results: There was no meaningful difference between interventions in the change in jump height following each intervention (P = 0.96). However, there was a significant change in standing reach height following the upper body intervention (P=0.04), from 211 ± 6.53 cm to 214 ± 6.4 cm (mean ± SD). An arm swing increased ground reaction force during jumping from 1473 N [95% confidence interval 1328 to 1619 N] to 1660 N [1466 to 1854 N].
Conclusion: Overhead jump reach did not improve with osteopathic techniques for shoulder mobility in young, active women. Despite this, a significant increase in standing reach height was observed, suggesting that osteopathic techniques may be beneficial when used to improve joint ROM.

Keywords: Shoulder; Range of Motion; Jumping; Athletic Performance; Osteopathy; Muscle Energy Technique; Soft Tissue Massage; High Velocity Low Amplitude Thrust

Improving Jump and Reach Height with Osteopathic Manual Therapy Techniques in Elite Male Basketball Players

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Aim: To determine the acute effects of upper body manual therapy on vertical jump and reach performance in male basketball players, and to quantify the contribution of arm swing to ground reaction force during a counter-movement jump.
Methods: Thirteen semi-professional to professional basketball players received two 15-minute standardised osteopathic manual therapy protocols 1 week apart, one implemented to the upper extremities and thoracic spine and a control implemented to the lower extremities, in a balanced, randomized cross-over design. Vertical jump and reach height and peak ground reaction forces with and without arm swinging were measured before and immediately following both protocols.
Results: Vertical jump and reach height (mean ± SD) was improved in the group receiving upper body manual therapy (59.3 ± 10.3 cm to 62.1 ± 9.8 cm) compared to the control group (59.3 ± 9.7 cm to 58.3 ± 9.7 cm; $p < 0.001$ for Time x Protocol interaction). The between-protocol differences were retained when adjusting for changes in peak ground reaction forces. Arm swing increased peak ground reaction force from 2187 ± 357 N without arms to 2330 ± 337 N ($p = 0.005$ for effect of arm swing).
Conclusions: It appears that applying a brief upper body manual therapy treatment improved overhead jump and reach height in high level basketball players. The application of these osteopathic techniques could be beneficial for immediate in-game enhancements of vertical jump performance.

Keywords: Range of Motion, Articular; Musculoskeletal Manipulations; High Velocity Low Amplitude Thrust; Muscle Energy Technique; Shoulder; Athletic Performance

Effect of Repeated Sprint Training under Hypoxia on Normoxic Repeated Sprint Performance

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Aim: This study aimed to investigate the effect of repetitive sprint training under hypoxia on subsequent normoxic repetitive sprint ability.
Methods: Well-trained male rugby players underwent 3 weeks of repetitive sprint training (six sessions of four sets of 5 x 5-s sprints with 25 s of active recovery) in either normobaric hypoxia (Hypoxic; n = 9; F_IO_2 = 14.5%) or normobaric normoxia (Normoxic; n = 10; F_IO_2 = 20.9%). Pre and post-training performance was evaluated with repetitive sprint (8 x 20 m timed to go every 20 s), and Yo-Yo Intermittent Recovery Level 1 (YYIR1) tests. After each training set, heart rate, oxygen saturation and rating of perceived exertion were recorded.
Results: Compared to baseline, both the hypoxic and normoxic groups improved fatigue over the 8 sprints one week after the intervention (Week 1, -1.8 ± 1.6%, -1.5 ± 1.4%, mean ± 90% CI in Hypoxic and Normoxic groups respectively). However, from Week 2 onwards, only the hypoxic group maintained the performance improvement compared to baseline (Week 2 -2.1 ± 1.8%, Week 3 -2.3 ± 1.7%, Week 4 -1.9 ± 1.8%, and Week 5 -1.2 ± 1.7%). YYIR1 performances improved throughout the recovery period in both groups with unclear differences found between groups. Relative to the normoxic group, the hypoxic group's SpO_2 was substantially lower, and heart rate substantially higher during training bouts.
Conclusions: Repeated sprint training in hypoxia for 6 sessions increases repeated-sprint ability but not YYIR1 performance in well-trained rugby players.

Keywords: Normobaric Hypoxia, Yo-Yo Intermittent Recovery Test, Team Sports, Repeated Sprint Ability, Intermittent Hypoxic Training.

Rapid Interventions Required! Implementation of a User-Friendly Injury Screen in National-Level Netball Players

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Background: Sports injuries are a considerable public health concern, with a growing body of scientific literature focusing on screening for risk of injury. Although a priority in high-performance sports, limited resources are often ascribed to screening initiatives and effectiveness of practical interventions is vital, particularly in a team-sport setting.
Aim: To employ a rapid user-friendly injury screen in national-level netball players and provide rapid feedback to coaching and medical staff.
Methods: The anterior reach distance of the Y-Balance Test and the Landing Error Scoring System (LESS) score from 28-cm drop jumps were assessed to determine injury risk in 11 players from the National Netball Team of Malaysia. Players with anterior-reach distance differences > 4 cm and/or LESS scores ≥ 5 were categorized as being at '*high risk*' of injury compared to their '*low risk*' teammates. Medical reports were acquired for three months post-screening.
Results: Of the eight *high-risk* players, five of them suffered a lower-extremity injury in the ensuing 3 months (63% positive predictive value). The three *low-risk* players all remained injury-free during the follow-up period. The screening battery took less than 5 minutes per player and feedback was provided to coaching and medical staff within 24 hours. All players who suffered an injury were correctly identified as being at *high risk* (100% sensitivity), with all players categorized at *low risk* staying injury-free (100% negative predictive value).
Conclusions: The screening battery employed was quick, sensitive, and able to predict injury occurrence with relatively high accuracy. The early implementation of injury screening and prevention initiatives in netball players is advised given the current high injury rates associated with this sport and the ability to objectively quantify injury-risk factors.

Keywords: Athlete Testing; Dynamic Balance; Female Athlete; Functional Movement.

The Acute Response and Recovery Time-Course of Autonomic and Performance Parameters Following Various Training Intensities in Highly-Trained Rowers

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Aim: To determine the acute effects of different interval training (IT) sessions on the post-exercise recovery response and time-course.
Methods: Thirteen highly trained rowers (♂= 10, ♀= 3; VO_2peak 4.9 ±0.7 L·min^{-1}) completed three IT sessions on the rowing ergometer, separated by seven days. The sessions consisted of; 5 x 3.5 min, 4 min rest periods (VO_2); 10 x 30 s, 5 min rest periods (Glycolytic); and 5 x 10 min, 4 min rest periods (Threshold). Participants were instructed to perform intervals at the highest maintainable pace. Blood lactate and salivary cortisol were measured pre and post-exercise. Resting heart rate (HR) variability (HRV), post-submaximal exercise HRV (HRV_{ex}), submaximal exercise HR (HR_{ex}), HR recovery (HRR), and modified Wingate peak and mean power were measured pre and 1, 10, 24, 34, 48, 58, and 72 h post-exercise. Participants resumed training throughout the 72 h measurement period.
Results: Differences in acute responses (1 h post-IT) across IT sessions were either *trivial* or *unclear* for all recovery variables. HRV_{ex} demonstrated the longest time-course to return to baseline (HRV_{ex} time (h) to return baseline (mean ± CL); Threshold = 37.8 ±14.2, Glycolytic = 20.2 ±11.0, and VO_2 = 20.6 ±15.2). *Very large* (r = 0.80 ±0.09; mean ± SD) relationships existed between all acute response and recovery time-course data for HRV, HR_{ex}, HRR, peak and mean power following Threshold and Glycolytic IT.
Conclusions: Acute responses were similar following Threshold, Glycolytic, and VO_2 IT in highly-trained male and female rowers. However, the recovery time-course was greatest following Threshold compared to Glycolytic and VO_2 focused training. This suggests a durational influence on recovery time-course exists at HR intensities above the second ventilatory threshold (≥80% HR_{max}), which should be considered in the programming of high-intensity interval training.

Keywords: Non-Passive Recovery; Programming; Heart Rate Variability; High-Intensity Exercise

Novice Raters Demonstrate Acceptable Inter-Rater and Intra-Rater Reliability of the Triple Joint Flexion Test ('TJFT') Scores in Adolescent Field and Court Athletes

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Background: The Triple Joint Flexion Test (TJFT) is a new movement screening test battery derived from work in youth athlete development. The TJFT is intended for use in evaluating movement competencies involving the ankle, knee, hip, and lumbar spine in athletes. To date, there has been no previous investigation of rater reliability for the TJFT.
Aim: Investigate inter- and intra-rater reliability of TJFT scores in screening adolescent male court and field athletes by novice raters.
Methods: Using a repeated measures design, 7 trained novice raters rated TJFT sub-tests on two occasions using real time video. The TJFT was performed by 17 adolescent court and field athletes and separate 182 ratings were made on each occasion. Estimates of reliability were calculated using Gwet's AC1 and AC2 statistics.
Results: Inter-rater weighted agreement of the six TJFT sub tests by 7 raters on Day 1 and 6 raters on Day 2 demonstrated 'moderate' (AC2 > 0.41) to 'substantial' inter-rater agreement (AC2 > 0.61). Intra-rater weighted agreement of the six TJFT sub-tests by 6 raters was mostly 'moderate' (AC2 > 0.41) and ranged from 'fair' (AC2 > 0.21) to 'near perfect' (AC2 > 0.81).
Conclusion: Inter- and intra-rater reliability was sufficiently reliable for clinical use. Further investigation of other TJFT measurement properties including exploration of factor structure, internal consistency, longitudinal validity, and responsiveness should be undertaken in a wide range of sporting codes. The relationship between TJFT findings and subsequent prescription of therapeutic exercise needs explication.

Keywords: Movement Screening; Reliability; Injury, Lower Extremity; Triple Joint Flexion Test

A Self-Paced VO_2max Test: A Review of Published and Unpublished Literature

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The VO_2max test is arguably the most common measure used in exercise physiology[1]. However a ramp test which has no known endpoint and in which, once the participant has started, they have no ability to vary their performance, is unlike any other exercise environment we ask individuals to engage in. Numerous studies have addressed and re-addressed the concept of eliciting the highest possible VO_2 measurement from an individual whether that be labelled Max, Peak, Plateau, or Verified. In contrast, comparatively few studies have addressed the idea of a test to measure VO_2 which has synergies with sporting performance, and in which, athletes can vary their performance in accordance with transient perceptions of fatigue[2-4].

This presentation will review the literature of other authors who have had varied success in gaining support for a reliable repeatable self-paced test which challenges the way in which we conduct one of the most common measures in exercise physiology. The presentation will conclude with findings from some of my own unpublished work on a self-paced perceptually regulated protocol to assess peak oxygen uptake.

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Keywords: Exercise Testing; Ratings of Perceived Exertion (RPE); Complex Metabolic Control

Time Lag Between Perceived Decreased Confidence and Actual Physical Function Following 16 Weeks Vibration Training in Frail Elderly

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Background: Vibration exercise has shown to elicit gains in lower-limb strength in frail elderly, who cannot exercise conventionally. These gains can manifest as improved physical function, confidence and quality of life (QoL). However, it is unknown how long effects last after vibration exercise training ceases.
Aim: Investigate the time line of detraining from whole body vibration (WBV) exercise in frail elderly.
Methods: An RCT 16-week intervention with 1-year follow-up tracking the detraining profile. Rest-home residents (70+ years) were assigned to a WBV-exercise group (WBV), a simulated-WBV-exercise group (SIM), or a control group (CON). WBV- and SIM-participants exercised thrice-weekly (20-min, 1:1 exercise:rest ratio), whilst CON-participants received only normal care. WBV-exercise started with 5∗1-minute at 6 Hz/2mm amplitude, progressing to 10∗1-minute when Hz/amplitude were increased ad libitum. Approximately 20° knee flexion was maintained during exercise for WBV (dampening effect) and SIM participants. Variables were measured at baseline, 8-weeks and 16-weeks of intervention, and 3-, 6- and 12-months post-intervention. Functionality and balance were assessed using the Timed Up-and-Go and Parallel Walk tests, complemented by the Barthel Index Questionnaire. Lower-limb strength was inferred using the 10-metre timed walk. The Activities-specific Balance Confidence scale measured falls-related confidence, and the EuroQol EQ-5D-3L health questionnaire assessed participant's QoL.
Results: Preliminary results reveal WBV increased physical function, lower-limb strength and balance during and at least 3-months post-intervention, while falls-related confidence and QoL increased during and at least 6-months post-intervention. The control group declined in all measures, as did the simulated-WBV group except for QoL, which may be indicative of the psychological impact of study participation.
Conclusions: Upon completing the 16-week training, all benefits were lost after 6 months. However, the psychological benefits of WBV exercise appeared to last longer than physical ones, leading to a mismatch between confidence and physical ability. This could potentially increase falls risk if not managed correctly.

Keywords: Frailty; Functional Tests; Sarcopenia

Funding Sources: NZ Accident Compensation Corporation (ACC)

Time-Trial Performance in Dry and Humid Heat Environment: Effect of Menstrual Phase and Contraceptive Use

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Aim: This study determined women's endurance cycling performance within dry (DRY) versus humid (HUM) heat, in relation to menstrual phase and the eumenorrheic natural (EUM) versus the oral contraceptive pill (OCP) controlled menstrual cycle.
Methods: Environments were matched for WBGT (27 °C) and tested in crossover fashion and in both menstrual phases (n=16), whereas EUM (n=8) versus OCP (n=8) was tested between participants matched for $\dot{V}O_2max$ (59 ± 6 vs. 58 ± 8 $mL \cdot kg^{-1} \cdot min^{-1}$), peak aerobic power (267 ± 30 vs. 281 ± 26 W), body surface area (1.68 ± 0.06 vs. 1.75 ± 0.14 m^2) and body fat (24 ± 5 vs. 24 ± 5%). DRY was 34 ± 0.3 °C and 42 ± 3% RH and HUM was 29 ± 0.5 °C, 82 ± 3% RH. The EUM tests were in early-follicular (EF) and mid-luteal (ML) phases, while OCP were time-matched.
Results: Mean power output during a pre-loaded, 30-min time-trial was not different across the menstrual cycle (p=0.8) or between groups (EUM: 147 ± 18 vs. 148 ± 21 W, OCP: 152 ± 22 vs. 151 ± 17 W, p=0.6), but was 5 ± 6% higher in DRY than HUM (p=0.01). The rectal temperature rise was not different between menstrual phases, environments or groups (EUM: 0.9 ± 0.2 °C, OCP: 0.8 ± 0.2 °C, all p>0.32).
Conclusions: We conclude that in females the type of heat exposure affects performance, but no effects of menstrual phase or control of the cycle were evident.

Keywords: Exercise Performance; Menstrual Cycle; Oral Contraceptive Pill; Dry and Humid Heat

Examining Embodied Cognition in Golf Putting

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Background: Embodiment theories propose that cognition is strongly related to our sensory and motor brain systems. In particular the facial feedback hypothesis proposes that our facial expressions can affect our emotions and behaviour, challenging the traditional belief that our emotions bring about our expressions. A study by Strack et al. (1988) revealed that holding a pen between the teeth (triggering muscles used in smiling) led to higher funniness ratings of cartoons than holding a pen between the lips (smile muscle activity inhibited). The aim was to investigate whether the positive emotions brought about by holding a pen between the teeth would improve golf-putting performance by evoking a positive affective state.
Methods: Participants (n = 58) completed a putting task in which they were required to putt to a target. After a practice phase participants were asked to either hold a pen between the lips, teeth or behind the ear. Before each block participants put the pen in the assigned area and estimated the target size, completed a self-efficacy scale and rated 2 cartoons on their funniness. Size estimations of the target were collected to examine whether participants' positive affective state would influence their perception of target size. Participants then completed 5 golf putts each in 3 conditions. Distance from the target was the primary outcome measure.
Results: There were no significant differences in funniness ratings of cartoons and no significant differences in putting performance between the three pen conditions. The lack of significant findings could be attributed to a learning effect observed over the three learning blocks. In the pen in lips and pen behind ear condition higher self-efficacy scores were associated with better putting performance.
Conclusions: The findings of this study do not appear to support the facial feedback hypothesis. Further work can be carried out on experts using a more effective paradigm to evoke positive emotions.

Keywords: Embodied Cognition; Golf; Sport Performance; Facial Feedback Hypothesis

The Effectiveness of Water Immersion Techniques Post-Exercise on Recovery from Exercise Induced Fatigue: A Meta-Analysis.

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Aim: This meta-analysis investigated the effectiveness of various water immersion techniques post-exercise on the recovery process and provide a "gold standard" protocol for water immersion as a tool for stimulating accelerated recovery processes.
Methods: The search process was performed on the EBSCO Host Database on the UCOL intranet using keywords within the title, keywords & abstract. All articles found during search were analyzed through a coding process before being included in the meta-analysis. Statistical analysis consisted of calculating estimated effect sizes (ES) using Cohen's "d".. ES of 0.2-0.5, 0.5-0.8 & >0.8 were considered significantly small, moderate and large, respectively.
Results: We analyzed 14 studies for a total of 14 ES. The mean ES for all 14 articles was 0.51, demonstrating a moderately significant effect of water immersion techniques on the recovery process post-exercise
Conclusion: The evidence reviewed in this meta-analysis confirms the existence of a positive and moderate effect of water immersion techniques on the recovery process. CWI demonstrated the most significant effect on post-exercise recovery specifically in reducing the subjective perception of DOMS. Therefore, the use of water immersion techniques, specifically CWI, as a post-exercise intervention to stimulate accelerated recovery may be beneficial to coaches & athletes in aiding enhancements in sporting performance capabilities.

Keywords: Water Immersion; Cold-Water Immersion; Recovery; Fatigue; Contrast-Water Therapy; Muscle Damage

A Comparison of Unimodal and Bimodal Countermovement Jump Force-Time Curves

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Background: The countermovement jump (CMJ) is one of the most utilised movements to assess and monitor ballistic performance in athletes. The majority of research has reported jump height, force or power as the primary outcome measure, often misinterpreting the athlete's ability to apply force to the ground during the various phases of the CMJ.
Aim: To determine if unimodal and bimodal CMJ force-time curves influence the primary outcome measures.
Methods: 21 professional rugby union players volunteered as participants for the study and performed 6 acyclic CMJ's standing on two dual-axis portable force plates sampled at a frequency of 200 Hz. The athletes were divided into the following three groups for statistical analysis: unimodal (n = 6), bimodal high-low peaks (n = 8) and bimodal similar peaks (n = 7). Mean percentage differences and effect sizes were calculated to determine the magnitude of difference between groups for a given dependent variable.
Results: The unimodal peak group produced *moderately* larger relative mean concentric force (ES = 1.14 and 1.08), slightly larger eccentric rate of force development (ES = 0.08 and 0.33) and much shorter contraction times (ES = 1.38 and 1.50) in comparison to both bimodal peak groups. Whereas, the bimodal peak groups produced *moderately* (ES = 1.05 and 1.15) larger net impulses and slightly larger jump heights (ES = 0.19 and 0.32) in comparison to the unimodal peak group.
Conclusions: Rugby athletes possessing unimodal force-time curves appear to develop greater eccentric rates of force, produce larger mean concentric forces and have shorter contraction times in comparison to their bimodal counterparts; in contrast, athletes with bimodal force-time curves produce greater net impulses and in turn jump higher than unimodal peak athletes.

Keywords: Impulse; Rate of Force Development; Jump Height, Contraction Duration, Rugby

Relationship between Ballistic and Isometric Force Production in Elite Rugby Players

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Background: The squat jump (SJ) and isometric midthigh pull (IMTP) are often implemented to assess an athlete's ability to produce maximum ballistic and isometric force, respectively. More recently, practitioners have calculated a dynamic strength index (DSI) in an attempt to better inform and individualise strength and ballistic training.
Aim: To determine the relationship between SJ performance and maximum IMTP force production; as well as evaluate the usefulness of the DSI to guide strength and ballistic training.
Methods: Twenty professional rugby union players volunteered as participants for the study and performed 3 acyclic static SJ's and three 5 sec maximum IMTPs using two portable dual-axis force plates sampled at a frequency of 200 Hz. Pearson product moment correlations (*r)* were used to determine the relationship between SJ and IMTP absolute (N) and relative (N/kg) peak force. The DSI (PF_{SJ}/PF_{IMTP}) was also calculated to better categorise individual ballistic and isometric force qualities.
Results: Mean group peak force outputs of 4034 ± 345 N (38.5 ± 4.1 N/kg) and 2635 ± 285 N (25.1 ± 2.5 N/kg) were produced during the IMTP and SJ, respectively. A DSI of 0.65 ± 0.06 U was also calculated as the ratio between SJ and IMTP peak force. *Large* correlations were observed between SJ and IMTP absolute ($r = 0.57$) and relative ($r = 0.64$) peak force, respectively.
Conclusions: The findings suggest that peak force production of elite rugby union players during ballistic and maximum isometric strength tasks are *largely* related. The DSI results also indicate that rugby union players produce much larger peak forces during the IMTP in comparison to the SJ; possibly suggesting a need to focus on improving ballistic force qualities in these athletes.

Keywords: Squat Jump; Isometric Midthigh Pull; Dynamic Strength Index; Rugby

A Comparison of Two Nitrate Dosing Strategies on High Intensity Cycling Performance in Highly-Trained Cyclists

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Background (optional): In recent times dietary nitrate (NO_3^-) supplementation has been championed as an ergogenic aid to reduce blood pressure, increase time to exhaustion, and enhance time-trial performance in moderate- to well-trained athletic populations. Initial reports suggested that athletes of moderate fitness levels improved time-trial performance in events of 6 to 30 mins by 1.3 to 2.8%. Subsequently, further research employing highly-trained populations over similar time-frames have shown more neutral outcomes.
Purpose: To compare the effects of two different dosing durations of dietary nitrate (NO_3^-) supplementation on 1- and 4-km cycling time-trial cycling performance in highly-trained cyclists.
Methods: In a double-blind crossover-design, on a daily basis nine highly-trained cyclists ingested 140ml of NO_3^--rich beetroot juice containing ~8.0mmol [NO_3^-], or placebo, for seven days. Participants completed a range of laboratory-based trials to quantify physiological and perceptual responses and cycling performance: time-trial on days 3 and 6 (4-km) and on days 4 and 7 (1-km) of the supplementation period.
Results: Relative to placebo, effects following 3- and 4-days of NO_3^- supplementation were unclear for 4-km (-0.8;95%CL, ±2.8%, P=0.64) and likely harmful for 1-km (-1.9;±2.6%CL, P=0.17) time-trial mean power. Effects following 6- and 7-days of NO_3^- supplementation resulted in unclear effects for 4- (0.1;±2.2%CL, P=0.93) and 1-km (-0.9;±2.6%CL, P=0.51) time-trial mean power. There were possibly beneficial enhancements in economy, relative to placebo, at 50 (0.14;±0.24%CL, P=0.42) and 60% (0.13;±0.29%CL, P=0.87) peak power output after 3-days NO_3^- supplementation. Effects were trivial or unclear for remaining measures.
Conclusions: Dietary NO_3^- supplementation appears to be detrimental to 1-km time-trial performance in highly-trained cyclists after 4-days. Whilst, extending NO_3^- dosing to ≥6-days reduced the magnitude of harm in both distances, overall performance in short duration cycling time-trials did not improve relative to placebo.

Keywords: Beetroot Juice; Time-Trial; Exercise Economy

Go Faster Stripes Really Can Make You Go Faster

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Background: High performance rowing is underpinned by the need to cyclically apply force according to perceptually specified temporal constraints. Of importance is the "catch" where performers must match boat motion with oar placement at the start of each stroke.
Aim: This study examined whether rowers could exploit contrasting textures between the water and striped markings on the top hull surface of the boat in order to improve performance.
Methods: A single-subject ABACA design was adopted involving a female sculler of national standard. Rower-boat velocity matching was examined via changes in speed and a coupling value based on boat speed and oar angle. Treatment effects were examined both visually and via effect size.
Results: Set against Cohen's (1992) criteria, sagittal lines had a large negative effect on speed (-1.2) and a trivial effect on coupling values. Transverse lines showed a large beneficial effect on speed (0.82) and mixed results for coupling.
Conclusions: Both treatments showed evidence of perturbed behaviour; but only transverse lines appeared to aid the perception of approach velocity, as supported by changes in boat speed and coupling values. Results tentatively support the use of contrast textures to enhance the perception for critical movement couplings.

Keywords: Rowing; Coupling; Contrast; Perception; Ecological Dynamics

Can a Pre-Participation Test of Movement Quality Predict Injury in Sport and Exercise? Systematic Reviews of Reliability and Validity of the 'Functional Movement Screen'

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Background: Sport and exercise is critical for healthy communities, but participation is inevitably associated with exposure to risk of musculoskeletal injury. Loss of participation due to injury not only threatens the health benefit of physical activity, but also impedes competitive success. Injuries are also associated with substantial economic cost and personal suffering. Poor movement quality is a factor theorised to increase risk of injury. The 'Functional Movement Screen' (FMS) is widely used by applied practitioners as a pre-participation screening tool to identify poor movement quality.
Aim: To critically appraise and synthesise studies investigating the reliability and predictive validity of the FMS.
Study Design: Two systematic literature reviews were undertaken, the first focused on rater reliability, and the second on validity of injury prediction.
Methods: Systematic literature search of bibliographic databases. Reliability studies were assessed for risk of bias using the QAREL appraisal tool, and validity studies assessed using the Q-Coh tool. Meta-analysis and a best evidence synthesis were undertaken.
Results: 12 reliability and 24 injury prediction studies were appraised. Overall, there was 'moderate' evidence in favor of 'acceptable' inter- and intra-rater reliability. However, the strength of association between FMS composite scores and injury was not sufficient to support the use of FMS as an injury prediction tool in a wide range of sporting codes.
Conclusions: Although practitioners can achieve acceptable reliability, the validity of FMS as a tool for injury prediction is poor. We discuss the practical implications of these findings for practitioners and indicate directions for further applied research.

Keywords: Pre-Participation Examination; Sport; Injury Prevention

Pilates Exercise Improves Chronic Low Back Pain and Patient-Specific Disability

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Background: Chronic low back pain (LBP) accounts for a substantial proportion of healthcare expenditure for back pain. Although Pilates exercise has been reported to improve pain, flexibility, proprioception, and perceptions of health in people with chronic LBP, there have been few studies investigating Pilates delivered in small group classes utilising both equipment-based and mat-based exercises.
Aim: To evaluate changes in pain, and functional disability in adults with chronic LBP following a 6-week Pilates intervention including both mat and equipment based exercise.
Methods: A repeated measures pre-test – post-test single group design was undertaken. The intervention was scheduled so that each participant attended one mat class and one reformer class each week, for 6 weeks. Outcome measures (low back and leg pain intensity, Troublesomeness, Patient Specific Functional Scale, Oswestry Disability Index) were repeated at baseline and one week following conclusion of the intervention.
Results: Data from 47 participants (n=31 females, n=16 males), between 25 – 65 years of age (mean age 41.3 years) were analysed. Participants attended a total of 12 sessions over a 6-week period. Post-intervention there was a significantly lower level of functional disability as measured using Patient Specific Functional Scale (mean difference = 2.81, $p \leq 0.001$, d=0.81), and Oswestry Disability Index (mean difference = 5.58, $p \leq 0.001$, d=0.53); and a decrease in average pain intensity (z=3.85; $p \leq 0.001$; d=0.55). Improvements in LBP Troublesomeness were also observed (mean difference = 0.96; 95% CI: 0.64 to 1.23, $p \leq 0.001$).
Conclusions: These findings suggest that Pilates is an effective treatment for improving functional disability and decreasing pain and Troublesomeness in adults with chronic non-specific LBP.

Keywords: Lumbar Spine; Lumbosacral Region; Chronic Pain; Movement Control Exercise Techniques; Exercise Rehabilitation; Functional Tests; Exercise Therapy

Exploring the Challenges of Obtaining Objectively Measured Physical Activity Data from Pre-Menopausal Women

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Background: Physical activity-based health improvement initiatives required good quality, objectively measured physical activity data, however various challenges undermine the acquisition of such data.
Aim: To examine the efficacy and challenges of a standard hip-worn accelerometry protocol conducted in pre-menopausal New Zealand women. Specific objectives included determining rates of compliance, and understanding the barriers, burdens and acceptability associated with wearing accelerometers.
Methods: Healthy New Zealand women (n=406) of three ethnicities (Māori, Pacific, European) aged 16-45 y (30.9 ±8.7 y) wore hip-mounted Actigraph wGT3X+ accelerometers for seven consecutive days, removing only during water activities. Post-hoc, a sub-sample (n=45; age: 29.4 ±9.0 y) was interviewed to investigate the comfort/convenience and burdens of wearing accelerometers.
Results: Wear compliance (≥10 hr/day, ≥4 days) was 86%. European women returned more valid data (92.7%, $p<0.04$) than Pacific (73.0%) or Māori (82.1%) women. Data were completely missing for 22 participants (5.4%). Burden from accelerometer wear was greatest during sleeping (66.7%) due to discomfort. High burden in social settings (45.2%) resulted from visibility of accelerometers through clothing and restricted clothing choices.
Conclusions: Discomfort during sleeping, restricted clothing choices and embarrassment in social settings, and ethnicity are key factors affecting the efficacy of collecting physical activity data from New Zealand women using hip-worn accelerometers. Refining accelerometer design to improve comfort and acceptability, and increasing participant engagement by ensuring appropriate understanding of study relevance should improve wear-compliance and data quality, and reduce attrition in hip-worn accelerometry protocols.

Keywords: Wear Time; Adherence; Activity Monitor; Movement Sensing Device

Funding Sources: Nutricia Research Foundation (number 2013-24).

The Validity and Reliability of the Gymaware Linear Position Transducer for Measuring Counter-Movement Jump Performance in Elite Female Athletes

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Background: Lower-body neuromuscular power is commonly measured and monitored through various vertical jump assessments, which have previously been validated and studied for their reliability in male participants.
Aim: The purpose of the current study was to assess the validity of the Gymaware linear position transducer (LPT) device to measure jump height when compared to the 'gold standard' force plate (FP) in female athletes. A secondary aim of the study was to determine the test-retest reliability of the LPT in elite female athletes when tested three separate times over a one-week period.
Methods: The study involved a total of 38 female participants. Twenty-seven (age = 19.4 ± 2.2 yrs; body mass = 67.7 ± 10.2 kg) recreational athletes performed 3 counter-movement jumps on the FP, with the LPT attached to the athlete via a waist belt to compare jump height measurements simultaneously, to evaluate the validity of the LPT. To assess test-retest reliability of the counter-movement jump with the LPT, 11 elite netball athletes (age = 23 ± 6 yrs; body mass = 79.8 ± 8.9 kg) completed 3 counter-movement jumps on 3 separate days, separated by 48 hours.
Results: Pearson correlation coefficients between the FP and LPT for jump height was $r = 0.90$. The mean difference between the FP and LPT for jump height was 7.8 ± 2 cm. The test-retest reliability of the jumps measured by the LPT resulted in an intra-class correlation coefficient of 0.70 for jump height, 0.90 for peak velocity and 0.91 for mean velocity. The coefficient of variation for jump height, peak velocity and mean velocity were 6.2%, 4.7% and 6.7%, respectively.
Conclusions: The results from the current study would suggest that the Gymaware LPT device is a valid and reliable tool for measuring neuromuscular power in elite female athletes, as identified through high ICC's and low CV's for jump height, peak and mean velocity.

Keywords: Neuromuscular Performance; Technology

Sleep and Stress Hormone Responses in Training and Competition in Elite Female Athletes

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Background: Stress hormone levels in a competition vs training setting are yet to be evaluated in elite female athletes. The effect that these levels of stress have on subsequent sleep quality and quantity is also yet to be investigated.
Aim: The aim of the current study was to evaluate different psychophysiological stress markers in competition and training environments and the subsequent effect on sleep indices in an elite female athlete population.
Methods: The study involved 11 elite female netball athletes (mean ± SD; age = 23 ± 6 yrs) providing multiple salivary hormone measures and having their sleep monitored on two occasions; a match day, and a training day. The training and match were performed at the same time of day and were matched for intensity and duration. Saliva samples were collected immediately pre (5:00pm) and post session (7:15pm), and at 10:00pm and were analysed for cortisol concentrations. Sleep monitoring was performed using wrist actigraphy to assess total sleep time (TST), sleep efficiency (SE%) and sleep latency (SL).
Results: Cortisol levels were significantly higher ($p<0.01$) immediately post the match vs post training (mean ± SD; 0.925 ± 0.341 µg/dL and 0.239 ± 0.284 µg/dL, respectively) and at 10:00pm (0.143 ± 0.085 µg/dL and 0.072 ± 0.064 µg/dL, respectively, $p<0.01$). The difference between trials was associated with a *very large* effect (ES : 2.23) immediately post (7:15pm) and a *large* effect (ES : 1.02) at 10:00pm. There was a significant reduction in TST (mean ± SD; -117.9 ± 111.9 minutes, $p<0.01$, ES : -1.89) and SE% (-7.7 ± 8.5%, $p<0.02$, ES : -0.79) on the night following the netball match compared to the training session. Although not significant ($p>0.05$), there was an increase in SL following the netball match v the training session (67.0 ± 51.9 minutes and 38.5 ± 29.3 minutes, respectively), which was associated with a *moderate* effect (ES : 0.80).
Conclusions: The current study reports that cortisol levels are significantly higher and subsequent sleep quantity and quality is significantly reduced in elite female athletes following a match compared to a training session.

Keywords: Netball; Cortisol; Recovery

Predicting Clinical Outcome Following Pilates Exercise Rehabilitation in People with Chronic Low Back Pain

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Background: Identifying characteristics of patients with low back pain (LBP) who respond best to exercise therapy may allow their management to be better tailored according to subgroup classification.
Aim: To determine predictors of change in disability in people with chronic LBP following a Pilates-based exercise program.
Study Design/Setting: Community-based single cohort, before-after trial.
Methods: Healthy adults (n = 55) with non-specific chronic LBP completed a graded 6-week programme involving two 1-hour Pilates sessions per week (1 mat and 1 equipment-based) led in small groups by a trained Pilates instructor. Predictors of change in disability, as measured by the Patient-Specific Functional Scale, were identified through regression analysis and used to develop a clinical prediction rule.
Results: Clinically important improvement in disability was predicted by four variables that explained 48% of the variance in outcome (P<0.001): gradual rather than sudden onset of LBP, patient-specific functional score <3.7 points, absence of aberrant motions on forward bending, and body mass index >24.5 kg/m^2. Failure to show clinically meaningful improvement was predicted by three variables that explained 40% of the variance in outcome (P<0.001): sudden onset of LBP, patient-specific functional score ≥3.7, and difference between left and right active straight leg raise >7°.
Conclusions: A combination of five, easily measured variables were able to predict disability outcome following a graded program of movement control exercises in people with chronic LBP.

Keywords: Activities of Daily Living; Functional Tests; Chronic Pain; Lumbosacral Region; Lumbar Spine; Movement Control Exercise Techniques; Exercise Therapy; Clinical Prediction Rule

The Impact of Sequential Intermittent Pneumatic Compression on Exercise Recovery and Subsequent Performance in Trained Cyclists

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Aim: To examine the efficacy of Sequential Intermittent Pneumatic Compression (SIPC) on exercise recovery and subsequent performance, when implemented between a 20-min cycling bout (simulated scratch race) and a 4-min cycling test (simulated individual pursuit), as experienced during an Omnium track cycling competition.
Methods: Sixteen trained cyclists (male = 10, female = 6, mean ± SD; age: 37 ± 15 and 28 ± 12 years, respectively; VO_{2max}: 50 ± 11 $ml \cdot kg^{-1} \cdot min^{-1}$ and 46 ± 5 $ml \cdot kg^{-1} \cdot min^{-1}$, respectively) completed a familiarisation trial followed by two experimental trials in a counterbalanced, crossover design. Participants performed a fixed-intensity, 20-min cycling bout on a Wattbike cycle ergometer, followed by a 30-min recovery period where either SIPC recovery boots or passive recovery (CON) were implemented. At the conclusion of the recovery period, subjects performed a 4-min maximal cycling bout (4-minTT). Average power (Watts) for the 4-minTT, blood lactate concentration during the recovery period (BLa) and perceived total quality recovery (TQR) were used to examine the influence of SIPC on recovery and subsequent performance.
Results: While not statistically significant (p = 0.06), SIPC resulted in a 2.9 ± 5.7% improvement in 4-minTT performance (74% likely positive; 26% likely trivial; 0% likely negative; ES ±90%CI: 0.10 ±0.09) when compared to CON. There was an *unclear* effect (ES: 0.15 ±0.92) for SIPC vs CON in the clearance of BLa during the recovery period. There was a *small* effect for TQR in favour of the SIPC trial (ES: 0.25 ±0.32).
Conclusion: Although not statistically significant, there was a trend towards improvements for SIPC to enhance perceived recovery and subsequent performance; when used during the recovery period between a simulated scratch race and individual pursuit race, designed to mimic two events in an Omnium track cycling competition.

Keywords: Omnium, Track Cycling, Fatigue, Recovery-Boots, Wattbike

Descriptive Analysis of Linear and Angular Acceleration Forces Experienced at the Head During a Simulated Front-on Rugby Union Tackle

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Background: A concussion is a complex pathophysiological process affecting the brain as a result of a biomechanical force. In rugby the tackle accounts for 50% of all concussions, which highlights the importance of understanding head impact kinematics during these events.
Aim: To explore the linear and angular head acceleration profile of forwards and backs during a simulated front-on rugby tackle.
Trial Design/Setting: Laboratory based descriptive study
Methods: Forty-one club level rugby players performed ten tackles each, five with the preferred and five with the non-preferred shoulder, in a randomized order. Participants preformed a front-on tackle of a 50kg boxing bag traveling at a resultant linear velocity of 4.2m/s. Formalized instructions were provided to standardize the procedure and technique. During each tackle a CSx Head Positioning Unit was worn on the mastoid process behind the ear. The sensor recorded linear (*g*) and angular head acceleration (rad/s^2) at 3200 and 4000Hz respectively, over an 18.75ms period for all impacts exceeding a 10*g* threshold.
Results: Of the tackles performed 370 exceeded the 10*g* threshold and were included in the analysis. Peak linear and rotational acceleration values of 88±51*g* and 2403±604rad/s^2 were observed for the backs. For the forwards peak linear values of 91±48*g* and rotational acceleration of 2560±530rad/s^2 were documented. The reliability of the head acceleration produced during the tackles were poor for both linear (ICC=0.21) and rotational (ICC=0.22) acceleration. No meaningful correlations ($p \geq 0.05$) were observed between the anthropometric variables, concussion history or the acceleration forces recorded at the head.
Conclusion: In the current study the peak linear acceleration experienced at the head was 88*g,* which is somewhat higher than what has been reported in tackle simulations in American football. Further investigation into head acceleration during game play is needed and in particular during the tackle situation.

Keywords: Concussion; Injury Prevention; Biomechanics

Funding Sources: CSx systems Ltd. for providing the Head Positioning Unit.

Chasing the 0.2: Striving for Impact in High Performance Sport

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A recent editorial by Buchheit 2016, titled “Chasing the 0.2”, challenges today’s modern applied sport scientist to ask research questions that make real impact in an elite performance setting. In reference to statistic’s smallest important (standardized) effect, attainment of 0.2 by sport practitioners is not always easy. However, it is the modern day Sport Scientist’s responsibility to strive for this goal, through their daily work with athletes and coaches. Using Buchheit’s editorial as reference, this presentation will outline practical examples of attempts towards a 0.2 effect, with specific reference to my work with Rowing New Zealand and other professional sports.

Keywords: Athletic Performance; Effect Size; Elite Sport

Poor Correlation Between Three Popular Functional Movement Tests in Professional Rugby Players Indicates Each Test Addresses a Different Aspect of Movement Quality

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Background: Poor 'movement quality' is one of many modifiable intrinsic risk factors for overuse injury. Several different tests of movement quality have been described and are popular in pre-participation screening in professional rugby and other team sports.
Aims: 1) To report descriptive data for a sample of professional rugby union players performing the Functional Movement Screen (FMS), Y-Balance Test (YBT) and Landing Error Scoring System (LESS). 2) To investigate concurrent validity represented by the correlation between scores derived from the FMS, YBT and LESS. 3) To investigate differences between scores derived from the FMS, YBT and LESS in forwards versus backs.
Methods: Twenty-four professional rugby union players (13 forwards, 11 backs) underwent a battery of active movement tests (FMS, YBT, LESS) during pre-season screening prior to the competitive season. Composite FMS, composite normalised YBT, and LESS scores were generated using the standardised test scoring protocols and scoring criteria.
Results: The mean±SD composite FMS score for all players was 13.2±2.5, out of 21. Nine out of 13 forwards, and 10 of the 11 backs demonstrated a left-right difference (magnitude of difference ≥1 out of 3) in at least one FMS subtests. Composite mean reach distance on YBT was 95.5±9.4% of leg length (n=21). Overall, the mean number of landing errors on the LESS was 5.8±3.4. Loose forwards demonstrated the lowest (4.7±1.5) and locks the highest (7.3±4.0) number of landing errors. Pearson's correlation between the LESS and composite FMS (r = -0.007) and composite YBT (r = -0.036) were 'trivial'. The correlation between YBT and FMS scores was 'minor' (r=0.274). There were no significant differences between forwards and backs on any of the movement tests.
Conclusions: Each test may be addressing a different aspect of movement quality. We recommend that movement quality is evaluated using a range of movement screening tests.

Keywords: Pre-Participation Screening; Rugby Union; Injury Prevention

Evaluation of the Cyclus Ergometer and the Stages Power Meter Against the SRM Crankset for Measurement of Power Output in Cycling

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Aim: The purpose of the present study was to evaluate two commercially available power meters: the Cyclus ergometer (CYC) and the Stages power meter (STA) in comparison to a highly-validated power meter (SRM).
Methods: Ten trained cyclists (mean ± SD; age 24 ± 8 y, body mass 69.7 ± 7.3 kg) performed an incremental exercise test to exhaustion (GXT), two 10-second sprints and a 1-min all-out performance test on a bicycle attached to a Cyclus (CYC) cycle ergometer. The bicycle was also fitted with the SRM cranks and the STA power meter. Power output (W) for the CYC and STA for each test was compared to the SRM to determine the validity of the devices.
Results: The coefficient of variation (CV) for the STA vs SRM during the GXT was 2.4 ±1.1% (±90% CL) and 2.3 ±0.9% for the CYC vs SRM. For the 1-min all-out performance test, the STA vs SRM had a CV of 3.4 ±1.6% and 3.0% ±1.6% for CYC vs SRM. Comparison between power meters during the 10-second sprint test showed a CV of 18.2 ±1.6% for STA vs SRM and 13.7 ±1.6% for CYC vs SRM.
Conclusions: In summary, both the CYC and STA are practical, easy to use devices and exhibit an acceptable level of agreement during low (< ~500W), but not high (> ~650W) power outputs.

Keywords: Cycling; Performance; Monitoring; Mobile Power Meter

Development of an Automated Athlete Tracking System for Snowboard Slopestyle Athletes

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Aim: As wearable sensor technology advances, comprehensive on-snow monitoring of snowboard slopestyle athletes can be developed [1, 2]. Objective data could be used to track training loads, monitor fatigue and potentially reduce risk of injury. This presentation reports on the progress of a research programme working to develop an athlete tracking system suitable for use by snowboard athletes.
Methods: The programme is comprised of four stages: 1) establish the accuracy and reliability of suitable inertial measuring units (IMU); 2) investigate relationship between body mounted accelerometers and landing impacts; 3) identify aerial manoeuvres using body mounted IMUs; 4) implementation and validation of an on-snow tracking system.
Results and Discussion: In the first stages, three candidate IMUs containing an accelerometer, gyroscope and magnetometer sensors were identified and found to be accurate and valid for measuring acceleration, angular velocity and angular displacement. The OptimEye (Catapult, Australia) and IMeasureU (I Measure U, New Zealand) were chosen for further research characterising landing impacts and identifying aerial manoeuvers. In the second stage, IMU measurements from drop landings were compared to force plate measurements. Both IMUs showed similar correspondence with the gold standard and were both selected for the next stage of the programme. Preliminary findings from the third stage suggest both IMUs will be able to identify aerial manoeuvres by calculating angular displacement around each axis to give a total rotational amount.
Conclusion: Findings from these studies will be used to refine data collection and processing techniques for stage four of the programme; implementation and validation of an on-snow athlete tracking system.

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Keywords: Sensors; Athlete Monitoring; Snowboard Slopestyle; Inertial Measuring Unit (IMU); Training Load

A Baseline Profile of Brain Health in a Semi-Professional Rugby Union Team

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Background: Concussions in collision based sports are a major medical concern. There is emerging evidence regarding increased rates of depression, mild cognitive impairments and deficits in neurocognitive function in individuals with a concussion history. Concussive and sub-concussive impacts are deemed to have a cumulative effect that has been shown to induce neurocognitive changes. Adolescent rugby participation has been shown to have deleterious effects on neurocognitive and scholastic function compared to non-contact sports.
Aim: To observe brain health at pre-season in a semi-professional rugby team.
Methods: 55 semi-professional players provided data during a pre-season screen using the following measures: Pittsburgh Sleep Quality Index (PSQI), Rivermead Post Concussion Symptom Questionnaire (Rpq-3 and Rpq-13) Beck Depression Inventory (BDI-II) and Beck Anxiety Inventory (BAI) and the University of Pennsylvania Smell Identification Test.
Results: A disturbed sleep pattern and sense of smell were noted in 41.8% and 55.8% of players. BDI-II indicated that 72.7% were minimally and 5.5% were mildly depressed. The BAI revealed that 50.9% had minimal, 18.2% mild and 1.8% moderate levels of anxiety. The mean±SD for Rqp-3 and Rpq-13 were 1±1 and 3.4±4. Significant correlations were observed between PSQI and RPQ-13, RPQ-3, BDI-II and BAI (r=.31-.62, p<0.01). Age was found to negatively correlate with Rpq-13 (p<0.01), indicating players with higher post-concussion scores, were younger, more likely to be depressed, anxious and sleep poorly. Additional negative correlations were observed for years of club rugby experience, Rpq-13 (r=-.41, p<0.01) and BAI (r=-.35, p=0.03). Years of semi-professional rugby experience was negatively correlated to Rpq-13 (r=-.33, p=0.01) and BDI-II (r=-.32, p=0.04). Meaning older players with more experience were more likely to have lower post-concussion, anxiety and depression scores.
Conclusions: These findings provide a snapshot of pre-season brain health in semi-professional players. This forms the basis for further investigations and understanding the effect that concussive and sub-concussive impacts have on the brain.

Keywords: Brain; Concussion; Depression; Anxiety; Sleep

Funding Sources: Authors would like to acknowledge the Department of Medicine's Dean's Bequest Fund for financial support for the project.

Defining the Role of the Anaerobic Speed Reserve in Middle Distance Running

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International standards and depth in middle distance (MD) running are becoming increasingly competitive. For example, new world records (mm:ss:ms) in the women's 1500m (3:50.07) and men's 800m (1:40.91) have been set in the last 5 years. How are competing nations from around the world developing speed over these distances? While the answer to that question is likely unattainable, there is nevertheless a need to consider new areas of opportunity for developing speed in these events in order to compete for medals on the international stage. The degree to which the anaerobic speed reserve (ASR) is required, or needed within and between MD events is yet to be investigated in the literature.
Data from 13 World Championship and Olympic Games (Sydney 2000 – Rio 2016) reveal the 'last lap kick' as a key performance determinant in 1500m running. Further, the increasing 'long sprint' nature of the Men's 800m event (2011-2016) suggests anaerobic qualities may be important determinants of medal winning outcomes in MD running (Billat et al., 2009; Mytton et al., 2015). 'Gun to tape' or 'sit and kick' pacing strategies dictate energetic distribution within a race, and are underpinned, amongst other determinants, by an interplay between aerobic and anaerobic energy systems. Therefore, the aim of this presentation is to offer current opinion on the rationale for MD programmes to develop ASR as well as offer perspectives on the physiological and mechanical qualities that underpin ASR with reference to the last lap kick in 1500m and the 'long sprint' 800m event groups.

Keywords: Pacing; Elite Performance; 800m; 1500m

Improvement in Active Weight-Bearing Dorsiflexion and Achilles Tendon Excursion Following Soft-Tissue Percussion: A Case Series

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Background: Restriction of lower limb dorsiflexion has been associated with adverse musculoskeletal outcomes. Impairment to soft tissue sliding of the tendo-Achilles region is one possible cause of decreased dorsiflexion. Anecdotally, a novel percussive soft tissue technique has been used to increase tissue sliding and improve dorsiflexion range.
Aim: To explore the effects of a percussive soft tissue technique applied to the tendo-Achilles region of healthy participants with reduced dorsiflexion.
Methods: A percussive soft tissue technique was administered once on Day 1 and once on Day 4. Pre-post comparisons of active weight-bearing dorsiflexion (ADF) and Achilles tendon (AT) excursion were made before and after treatment on Days 1, 4 and 8 using high-resolution, B-mode, real-time ultrasound imaging. Findings were interpreted compared to minimal detectable change established from pilot work as 1.76° for ADF, and 0.64 mm for AT excursion.
Results: Six healthy participants (M = 3, F = 3, mean ± SD age: 27.2 ± 6.3 years, height: 1.75 ± 1.1 m, median body weight: 75 [range 62 to 98] kg) with reduced ADF participated in the study. All participants improved ADF, with mean change of 6.15° (d=0.81) on Day 1, 3.10° (d=0.37) on Day 4, and overall change (pre-intervention Day 1 to follow up Day 8) was 11.29° (d=1.49). Between pre-intervention Day 1 and follow-up Day 8, 3 participants increased AT excursion, 2 participants decreased AT excursion, and change was unclear (<MDC) for 1 participant.
Conclusions: In this case series, all participants improved ADF following the soft-tissue technique, though improvement in AT was inconsistent. These findings provide evidence to support further research with more power to investigate the influence of the percussive soft tissue technique on AT excursion and ADF.

Keywords: Sliding Surfaces; Manual Therapy; Tendo-Achilles, Ankle Range

Does Self-Regulated Combined High-Intensity and Sprint Interval Training Confer Vasculoprotection?

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Background: Controlled laboratory-based studies have demonstrated that aerobic, high-intensity and sprint interval training (HIT and SIT respectively) independently confer vasculoprotection, thereby reducing cardiovascular risk. However, no study has quantified effect magnitudes when exercise is self-regulated.
Aim: To determine the effects of community-based, self-regulated combined HIT and SIT on arterial health, specifically, tissue biomarkers associated with arteriosclerosis as well as arterial structural and remodelling indices.
Design and Methods: A repeated-measures between-subjects design was adopted during which fifteen healthy, sedentary adult males were randomly assigned to experimental *(EXP)* and control *(CON)* groups. The *CON* group maintained their routine lifestyles for eight weeks. The *EXP* group attended 45 min self-paced group cycling sessions involving HIT and SIT thrice weekly for eight weeks at a local gym. Assessments carried out at baseline (PRE), after four weeks (MID), and post-intervention (POST) included cardio-respiratory fitness (peak oxygen uptake, VO_{2peak}), resting carotid-femoral pulse wave velocity (cfPWV), augmentation index (AIx@75), central pulse pressure (cPP), wall thickness (common carotid and femoral intima-media thickness, cIMT and fIMT respectively), and arterial geometry (common carotid end-diastolic diameter, cEDD, and wall:lumen ratio, cWLR).
Results: The average heart rate during self-regulated sessions was 81±7%HR_{peak}. Improvements in VO_{2peak} and arterial health measures from PRE to POST were observed in *EXP* only *($p<0.05$)*. At POST, there were significant between-group differences in VO_{2peak}, cfPWV, cPP, fIMT, cEDD, and cWLR *($p<0.05$)*.
Conclusions: In healthy, sedentary adults, self-paced HIT and SIT cycling improves VO_{2peak}, reduces arteriosclerotic indices and systemic wall thickness, and increases carotid diameter. In consonance with evidence from laboratory studies, the present results demonstrate the effectiveness of a 'real-world' community-based exercise approach to enhance arterial health and potentially reduce cardiovascular risk.

Keywords: Vascular; Ageing; Atherosclerosis; Arterial; Health; Exercise; Training

Funding Sources: This research was supported in part by Les Mills International Limited, who provided the exercise classes and contributed towards project consumable costs.

Pattern Recognition in Rugby Union

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Background: The ability to recognise patterns of play has been identified as a fundamental discriminator of performance in team sports (Smeeton et al., 2004) and specifically rugby union (Hendricks, 2012).
Aim: To investigate the effect of skill level and level of structure on recall of rugby union patterns.
Method: The current study used Chase and Simon's (1973) classic 5-second recall task to examine differences in memory for patterns of structured and unstructured game-play in rugby union. Experts (N = 48; age =17.3 ± 0.7) and novices (N = 41; age 18.4 ± 3.2) viewed still images of structured (N=10) and unstructured (N=10) rugby patterns for 5 seconds before they were occluded. They were then instructed to recall player positions by marking them on a blank template. The average distances from the correct location of the players were analysed using a one-way ANOVA.
Results: Experts displayed significantly higher accuracy scores than novices for structured images ($p=0.001$); however, there were no differences when recalling unstructured images ($p>0.05$). Bivariate correlation analysis revealed a significant positive correlation between the number of sports played by rugby union novices and their accuracy scores on the unstructured images ($r=0.366$, $p=0.019$).
Conclusions: The experts' superior performance on the structured images is thought to be due to 'chunking' rather than superior memory. Large amounts of information are encoded and retrieved as a single entity or chunk, avoiding the restrictions of short-term memory. The association between number of sports played and accuracy scores supports Abernethy's (2005) claim that pattern recognition skills can transfer between sports.

Keywords: Chunking; Expert-Novice; Structured; Unstructured

Sex Differences in Hydration, Thermoregulation and Performance

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Sex differences exist from birth, yet are often under-reported in exercise and nutrition research. Often women are excluded or grouped with men, without menstrual cycle phase acknowledgement. The aim of this talk is to describe sex differences as they apply to performance parameters of thermoregulation, hydration/hyponatremia, and thirst. The perturbations of sex hormones across the menstrual cycle induce several metabolic, thermoregulatory, and neuroendocrine challenges, which may impact performance. Women, compared to men, have higher body surface area to body mass ratio, higher body fat mass, and higher density and number of sweat glands. Women also use a higher percentage of sweat glands while secreting less sweat. These facts may cause inherent differences in tolerance to heat between the sexes. Women are at greater risk for exercise-induced hyponatremia (low blood sodium concentration) and this risk has been attributed to their lower body weight and size, excess water ingestion, and estrogen-mediated inhibition of potassium transfer. Moreover, the greater levels of estradiol in plasma and tissue also play a role in increasing the risk of hyponatremia in women. The hormonal influences of sex hormones affect fluid dynamics by altering capillary permeability, vasomotor function, and the central set-point control of renal hormones and plasma osmolality. Elevations in plasma progesterone concentrations during the luteal phase inhibit aldosterone-dependent sodium reabsorption at the kidneys due to progesterone competing with aldosterone for the mineralocorticoid receptor. Moreover, progesterone is thermogenic, induce a core body temperature rise by 0.5’C; with concomitant resetting of cutaneous vasodilation and the osmotic set-point for thirst.

Keywords: Female Athletes, Sodium-Potassium Balance, Fluid Dynamics

A Critical Exploration of the Role of the Lifters and Jumpers in the Rugby Union Lineout

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Background: In a typical rugby union lineout, the attacking jumper is lifted upwards by two teammates in an attempt to catch the ball above the opposition jumper who is also competing for the ball. A common strategy promoted in New Zealand rugby is for the two lifters to squeeze the jumper up after the jumper reaches an approximate jump height of 20-30 cm. Despite the lineout being an important facet of play, little has been published on the relative importance of the various factors required to optimise the time taken for the jumper to reach their peak catch height.
Aims: 1) explore the effectiveness of various jump-and-lift strategies used in Super Rugby; and 2) examine the effects of the jumper's body mass and attempted jump height, and the lifters' magnitude and point of force application on the time to reach peak catch height during the squeeze technique, specifically.
Methods: A measurement system was constructed that enabled real-time measurement of catch height and time to reach catch height during lineouts, which was then employed during a lineout training session to explore the effectiveness of various lift-and-jump strategies. From the pilot data, a biomechanical model was developed to explore the impact of change in various factors on time to peak catch height during the squeeze technique. **Results:** The squeeze technique produced the worst results (i.e., slowest time to peak height) during the training session. The model predicted that the magnitude of the lift force influenced time to reach peak height the most, with the other factors examined having a similar effect. **Conclusions:** Employing the squeeze technique increased the time to peak catch height by ~20-30% compared to an optimal jump-and-lift technique. These findings have practical applications that can impact the Rugby Union lineout strategies on game day.

Keywords: Coaching; Performance Enhancement; Technique Analysis

No Clear Benefit of Muscle Heating on Hypertrophy and Strength Gains with Resistance Training

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Background: Heat is a major form of stress caused by exercise, though its value in driving adaptation is not well understood.
Aim: Through a contralateral-limb control study we examined whether supplemental heating of active muscle during resistance training differentially affected physical and functional adaptations compared to those from traditional training without muscle heating.
Methods: Ten healthy young adult volunteers (5 females) completed 12-wk progressive resistance training of the knee extensors, comprising 30 sessions of 32 repetitions (4 sets of 8) of unilateral knee extensions at 70% of leg-specific 1-RM. One randomly allocated thigh was heated during and for 20 min after each training session, using a customised heat pad eliciting muscle temperatures of 38–39.5 °C. Thigh lean mass was measured at baseline and 12 weeks, and concentric knee extensor maximal isokinetic (90°.s^{-1}) torque was measured at baseline and each 4 wk.
Results: Quadriceps' lean mass increased across 12-wk training, by 15 ±7% (761 ±280 g; p=0.00) and 15 ±6% (752 ±304 g; p=0.00) in the heated and control limbs, respectively; the difference being trivial (0 ±3%; p=0.94). Peak torque increased (p=0.02) to more extent, by 33 ±38% and 35 ±37%, respectively; with an unclear difference of 2 ±17% between limbs (p=0.82). Rate of torque development increased by 47 ±44% in the heated limb (p=0.01) and 45 ±39% (p=0.08) in the control limb (difference: 2 ±18%; p=0.90). No sex differences were evident for mass or strength changes.
Conclusions: Heating of the active muscle mass during and after resistance training shows no clear positive (or negative) effect on training-induced hypertrophy or the improvements in concentric isokinetic strength and rate of torque development, compared to those from resistance training without heat.

Keywords: Force; Torque; Females; Isokinetic; Quadriceps

Effect of Training Load on Acute Fatigue and Wellness During an In-Season Non-Competitive Week in Elite Rugby Athletes

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Background: Training adaptations will occur from the balance between training load and recovery. Therefore, it is critical to understand the effects of training load on the levels of fatigue and readiness of athletes.
Aim: The aim of this study was to understand the effect of training load on acute fatigue and wellness during an in-season non-competitive week in elite rugby athletes.
Methods: The training load, perceptual and neuromuscular fatigue of sixteen elite rugby athletes was monitored every morning during a non-competitive week within the in-season period of the Super Rugby competition. Training load was obtained from GPS during the field sessions, and from individual RPE for the extra conditioning and gym sessions. Perceptual fatigue was obtained every morning from a 5-item questionnaire (WQ) and a questionnaire on the muscle soreness (SQ) at 9 different muscle sites. Neuromuscular fatigue was measured using a countermovement jump.
Results: Although training day 3 had a significantly ($p<0.05$) greater load in comparison to training days 1 and 2, there was a greater effect of training load on muscle soreness and neuromuscular performance when two training days were performed consecutively. Moreover, the effect of training load on muscle soreness was only evident in lower body muscles. Data from the present study also suggest that two days off training are adequate for complete recovery from a high-load training week in rugby athletes.
Conclusion: There was a clear effect of training load on fatigue, with greater fatigue occurring when training took place on two consecutive days. Monitoring soreness from different lower body muscle sites was demonstrated to add important information for practitioners.

Keywords: Training Load; Monitoring; Wellness; Elite; Rugby

The Usage and Perceived Effectiveness of Different Recovery Modalities in Amateur and Elite Rugby Athletes

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Background: The use of recovery modalities to help enhance recovery is popular among athletes. However, little is known about the usage of various recovery modalities and the perception of their benefit amongst different levels of athletes.
Aim: The aim of this study was to compare the usage and perceived effectiveness of different recovery modalities in amateur and elite rugby athletes.
Methods: Fifty-eight amateur (n=26) and elite (n=32) rugby union athletes completed a questionnaire designed to determine the usage and the perceived effectiveness of 15 different recovery modalities. A 5-point Likert scale was used to examine the perceived importance of recovery for performance, the effectiveness of each recovery modality, the number of different recovery modalities used and the number of times each recovery modality was performed per week.
Results: No significant differences were found between groups (elite: 5.0 ± 0.2; amateur: 4.9 ± 0.3) for the perceived importance of recovery to enhance performance ($p>0.05$). When comparing the effectiveness of each recovery modality, the elite group perceived active recovery, massage, pool recovery, additional sleep and stretching to be significantly more effective in comparison to the amateur group. There was a significant difference ($p<0.05$) in the number of different recovery modalities (elite: 7.8 ± 1.3; amateur: 3.0 ± 1.8), and also in the total number of times a recovery modality was used per week (elite: 24.3 ± 5.4; amateur: 5.9 ± 4.3).
Conclusion: Although no differences were found for the perceived importance of recovery, elite rugby athletes used significantly more recovery modalities and performed these modalities more often when compared to the amateur group. This is likely to be related to both the limited access to recovery modalities and the lower perceived effectiveness of numerous recovery modalities by amateur athletes.

Keywords: Recovery; Perceived Effectiveness; Elite; Amateur; Rugby

Differences in Strength, Power and Speed Between Age Groups in Elite Soccer Athletes

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Background: Recently, it has been observed a high inflow of athletes with young age in professional football teams. However, it is unknown if athletes of different age groups differ in the strength, power and speed skills.
Aim: This study compared the strength, power and speed skills levels in soccer athletes of different age groups from an elite soccer club.
Methods: 69 elite soccer athletes from three age-groups [above 19 (senior, n=19), under 19 yrs (U-19, n=24) and under 17 yrs (U-17, n=26)] were tested during the pre-season. The knee extensors peak torque was assessed during an isokinetic (60°/s) concentric knee extension test. The jump height was determined in three jump tests: counter-movement jump (CMJ), squat jump (SJ) and the 40cm box drop jump (DJ). Sprint times were obtained at 5m, 15m and 20m.
Results: A greater peak torque was observed in senior (mean, 246.7 Nm) compared to U-17 (214.6 Nm) athletes. A greater jump height was seen in senior (CMJ=44.0cm, SJ=43.3cm, DJ=43.6 cm) in comparison to U-19 (CMJ=37.6cm, SJ=36.1cm, DJ=36.7cm) and U-17 (CMJ = 36.6 cm, SJ=36.1cm, DJ=36.3cm). Sprint times in all distances were also lower in the senior athletes (5m=0.892s, 15m=2.203s, 20m=2.783s) compared to U-19 (5m=0.927s, 15= 2.267s, 20m=2.873s) and U-17 (5m=0.952s, 15m= 2.291s, 20m=2. 2.897s). No differences were found between the U-17 and U-19 groups for any variable.
Conclusion: The present results indicate that soccer athletes under 19yrs do not have the same strength, power and speed skills as professional athletes. Therefore, strength and condition interventions should be specifically designed in young athletes in order to ensure the same physical capacity when ingress in professional football.

Keywords: Elite Soccer; Strength; Power; Age-groups

The Role of Consciousness in Balance Performance

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Background: Traditional centre of pressure (COP) measures do not account for the complex dynamics of postural control. Researchers have suggested that complexity-based COP measures not only describe the dynamic characteristics of sway but also inform about conscious control in balance. However, limited evidence is available for this claim.
Aim: To examine the relationship between traditional and complexity-based COP measures and the propensity for conscious control of movements.
Methods: Three groups, consisting of 53 young adults, 39 older adults with a history of falling, and 39 older adults without a history of falling, were asked to perform single- and dual-task quiet standing balance tasks. Four traditional COP measures were recorded: ellipsoidal area (85.35%), average velocity, standard deviation of medial-lateral and anterior-posterior axis. Additionally, four complexity-based measures were recorded: sample entropy and detrended fluctuation analysis for medial-lateral and anterior-posterior axis. Propensity for conscious control of movements was measured using the Movement Specific Reinvestment Scale.
Results: The results showed that a higher propensity for conscious control of movements was associated with a more constrained (less complex) mode of balancing and more variable sway in the medial-lateral direction in young adults. The association was not apparent under dual-task conditions during which participants' attention was diverted away from the balancing task. Furthermore, no relationship was apparent between postural control and propensity for conscious control of movements in older adult fallers or non-fallers.
Conclusions: It is of clinical importance to understand how consciousness affects postural control. Our findings show that complexity-based COP measures are indicative of conscious involvement in postural control in young adults. The absence of such relationships in the older adults raises questions about the underlying conscious and unconscious mechanisms of balance in older adults.

Keywords: Postural Stability; Reinvestment; Quiet Standing; Older Adults

EEG Coherence and Conscious Motor Processing in Golf Putting Beginners

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Background: EEG coherence (a measure of cortico-cortical communication) between the motor planning and verbal processing regions in the brain has been proposed as a measure of conscious motor processing (Zhu et al, 2011). We used the Conscious Motor Processing (CMP) factor of the Movement Specific Reinvestment Scale (Masters et al, 2005) as a state measure to examine differences in coherence as novices practiced golf putting in different learning conditions.
Methods: Novices (n=13) performed golf putts in three consecutive conditions. In a baseline condition, exploratory learning was induced by providing an insufficient movement instruction. In an implicit condition, a validated golf putting analogy was provided, and in an explicit condition, 6 putting instructions were provided. EEG (at locations Fz, Pz, T3, and T4) was recorded continuously during each condition. Participants completed a state measure of conscious motor processing (CMP) after each condition.
Results: No effects were evident in the baseline condition, but a significant positive correlation was visible between CMP state score and T3-Fz coherence in both the analogy condition ($r = .702$, $p = .007$) and the explicit condition ($r = 0.637$, $p = .019$).
Conclusions: Increased conscious motor processing was expected in the explicit condition but not the analogy condition. Masters and Liao (2003) argued that analogies reduce the cognitive effort required to learn a new movement, so we expected less conscious motor processing to be reflected by lower coherence. It is possible that initially processing analogy instructions is cognitively demanding, as suggested by Lam, Maxwell, and Masters (2009). Regardless, the associations between coherence and CMP scores underline that coherence may be a valid neurophysiological indicator of conscious motor processing.

Keywords: Implicit Motor Learning: Reinvestment; EEG Coherence; Golf Putting; Novice Golfers

Duration of Concurrent Muscular Strength and Endurance Training in Soccer Players and Effect on Performance: A Review

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Introduction: The physical demands of soccer competition require players to have high levels of aerobic endurance and muscular strength. Therefore, concurrent training of both muscular strength and aerobic endurance is often used in soccer. Concurrent training, however, has been proposed to cause an interference effect between aerobic training and resistance training.
Aim: The aim of this study was to review recent research on concurrent training practices in soccer, with a particular focus on the duration of the training program.
Methods: Database SportDiscus was searched for journal articles published within the last 15 years with "concurrent training", and "soccer" or "football" as the search terms. The search yielded 380 articles, which were subsequently reviewed. Inclusion criteria for the review included programs of greater than 5 weeks duration, participants over 16 years of age and comparison of different training methods.
Results: Six articles addressed all of the selection criteria and were included in this review. Performance measures included the Yo-Yo intermittent recovery test level 1 (YYIRT 1), maximal aerobic speed (MAS), 30m-sprint and one-repetition maximum squat (1RM). All six studies showed improvements in performance irrespective of the concurrent training protocol used. Furthermore, concurrent protocols demonstrated greater improvements than soccer only programs. Study duration varied between 6 to 16 weeks. Greater performance improvements were associated with longer training programs (> 8weeks), compared with shorter duration programs.
Discussion: This review showed that concurrent training results in improved strength, aerobic performance and sprint performance in soccer players. It was also shown that when using concurrent training it is important to use programs lasting longer than eight weeks in duration in order to maximise performance gains. Future research should investigate the different training modalities used in concurrent training and the duration of the overall concurrent training program in soccer.

Keywords: Resistance Training; Aerobic Training; Periodization

Exercise Prescription Can Be More Successful with an Adjunct Modality: Holographic Kinetics

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Background: How exercise prescription could be more successful for mental health, especially in suicide prevention.
Waikato health reports of an increase in suicides, especially among young Maori residents. (Taupo Hospital, 29 August 2016). In private practice in Taupo and Turangi I met many young female adults having to cope with angry behaviour of their partners. The combination of holographic kinetics and exercise prescription demonstrated positive results in behaviours. Holographic Kinetics (founded by SteveRichards, Australian aboriginal descendent)deals with the aftereffects of the stolen generation and other interferences. A pilot study to ascertain the consistent positive effect of this combination of modalities could bring peace and harmony to the future generations.
Aim: "To investigate the effect of exercise prescription in combination with holographic kinetics upon behaviour alteration".
Methods: pre – and post intervention: interview, questionnaire re behaviour, anger level and management, depression, cortisol levels. Intervention: exercise prescription, holographic kinetics, behavioural changes.
Results: to be recorded in the future.
Conclusions: The right approach leads to happier families and safety for all.

Keywords: Suicide Prevention; Domestic Violence Reduction; Exercise Prescription; Holographic Kinetics; Lifestyle Alteration; Happy Families

Physical Activity Needs of Prostate Cancer Survivors Compared to Age-Matched Non-Cancer Controls

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Background: In New Zealand, prostate cancer (PCa) is the most commonly diagnosed cancer in men. While better detection, diagnosis, and treatment have led to improved survival rates, many men do not survive well. Physical activity is often used as adjuvant treatment to improve a cancer survivor's quality of life, ameliorate treatment side effects, and/or prevent cancer recurrence. Targeted physical activity in the PCa population may improve health outcomes in this sector of the population.
Aim: To determine body composition, strength and physical activity levels in men with PCa compared with non-cancer age-matched controls.
Methods: Participants recruited for this case-control, cross-sectional study were PCa survivors who had completed treatment (other than hormonal therapy) or were on active surveillance compared with age-matched non-cancer controls. During a single one-hour appointment, body composition and handgrip strength were assessed and physical activity levels obtained by questionnaire.
Results: Ninety-eight men were recruited, 51 PCa survivors and 47 controls. There was no between group difference for body mass index, body fat percentage, or physical activity levels ($p > 0.05$). Skeletal muscle mass, fat free mass, skeletal muscle index and handgrip strength were lower ($p < 0.05$) in the PCa group.
Conclusion: Reductions in handgrip strength and lean tissue mass in PCa survivors compared to age-matched non-cancer controls indicate that resistance training should be a key component of a comprehensive survivorship programme to maintain independence.

Keywords: Exercise Prescription; Survivorship; Physical Function

General

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