



Abstracts

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PARTICIPATION, PREVENTION AND PERFORMANCE”**

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Fremantle, 19 - 22 October 2011

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WEDNESDAY 19 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1700 – 1800	Keynote	Overcoming the Cholera of the 21st Century: Inoculating communities against inactivity	Mark Fenton	Orion & Pleiades Room	1

1

Overcoming the Cholera of the 21st Century: Inoculating communities against inactivity

KEYNOTE

be active wa Physical Activity Taskforce Supported Speaker



M. Fenton^{1*} ▪ ¹Tufts University, Boston MA

Developed countries are struggling with rising chronic disease epidemics that may rival the infectious diseases of the past century for their impacts on population level health. Inactivity related disease is not just an affliction of wealthy nations; even developing countries are experiencing distressing increases in overweight and obesity in their populations. Education and behavior change programs have not stemmed the rising tide of inactivity and poor nutrition driving these epidemics, because the roots of this scourge are systemic. But research is giving an increasingly clear picture of how we can begin to vaccinate communities against the inactivity epidemic afflicting the world. The only question is whether we will have the vision and leadership to implement policies that are needed to create healthier communities by design. This talk will share how these policies are beginning to be applied in communities around the US and world.

THURSDAY 20 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
0800 – 0900	Workshop	Multi-directional instability of the shoulder – one approach to conservative management	Mary Magarey	Orion Room	2
0800 – 0900	Workshop	Objective assessment of physical activity and sedentary behaviour	Jo Salmon, Nicky Ridgers & Anna Timperio	Pleiades Room	3
0800 – 0900		OneSMA	SMA National Board	Carnac Room	4
0800 – 0900	Workshop	Musculoskeletal assessment and principles of management of common symptomatic presentations of the lower limbs in children with hypermobility disorders	Natalie Bennet-Bremner	Garden Room	5
0800 – 0900	Workshop	CPR Certification	Mark Brown	Rottneest Room	6
0930 – 1030	Keynote	Exercise in the heat – can the brain be manipulated?	Romain Meeusen	Orion & Pleiades Room	7
1100 – 1230	Invited	The case of the water polo player's shoulder – Clinical reasoning, assessment and management	Mary Magarey	Orion & Pleiades Room	8
		Clinical assessment of the lumbar spine	Jeni Saunders		9
1100 – 1230	Symposium	Developing evidence-informed exercise guidelines to prevent lower limb injuries among community Australian Football players – the NoGAPS project	Caroline Finch, Alex Donaldson, Nadine Andrew & David Lloyd	Carnac Room	10
		The design of a study to better understand facilitators and barriers towards safety guideline uptake – the NoGAPS project	Caroline Finch		11
		Where should community Australian Football invest in injury prevention? A review of over 30 years of injury reports	Caroline Finch		12
		What is the evidence-base for exercise as a lower limb injury prevention strategy in community Australian Football?	Nadine Andrew		13
		Translating the scientific evidence for preventing lower limb injuries into training guidelines: The role of mechanistic versus clinical versus epidemiological studies	David Lloyd		14
		Gaining expert consensus on lower limb injury prevention exercise guidelines for community Australian Football—the NoGAPS project	Alex Donaldson		15
1100 – 1230	Symposium	Influence of development, exercise and disease on tendon and muscle mechanics	Anthony Blazeovich, Jonas Rubenson, Glen Lichtwark, Neil Cronin & Amitabh Gupta	Garden Room	16
		The development of tendon mechanical properties from childhood to adulthood and their relationship with force production	Anthony Blazeovich		17
		The force-length operating range of the human soleus muscle during walking and running	Jonas Rubenson		18
		Achilles tendon (3D): Do the mechanical properties of tendon change in response to exercise?	Glen Lichtwark		19
		Exercise-induced changes in tendinous tissue compliance: Outer tendon or aponeurosis?	Neil Cronin		20
		Patellar tendon mechanical properties in elite jumping athletes: A prospective study	Amitabh Gupta		21
		Strength training affects Achilles tendon anatomical and mechanical properties, and force production, in pre-pubescent children	Anthony Blazeovich		22

THURSDAY 20 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1100 – 1230	Free papers: Physical activity – older adults			Rottneest Room	
		Exercise for reducing visceral adiposity: Aerobic or resistance training?	Nathan Johnson		23
		High velocity power training with weight-bearing and balance exercises improves bone density and function in high risk older adults: A 12-month RCT	Jenny Gianoudis		24
		The impact of high vs. low intensity resistance exercise on lymphoedema status and severity of symptoms	Robert Newton		25
		Effects of education and motivational interviewing on short and long-term participation in a home-based physical activity program	Kay Cox		26
		Factors affecting participation in physical activity among migrants at risk of cardiovascular disease	Warren Payne		27
		Barriers, motivators and life experiences of physical activity for older home care clients	Elissa Burton		28
		Long-term effects of 6-months of home-based physical activity and counselling on the mental health of older adults The MOVES Study	Kay Cox		29
1330 – 1500	Invited	Exercise is medicine for chronic disease management	Rob Newton	Orion Room	30
1330 – 1500	Free papers: Groin / football			Pleiades Room	
		The relationship between pre-season musculoskeletal screening and injury rates in junior Australian Rules Football players	Hazel Anderson		31
		The epidemiology of injuries and the relationship between injury rates and pre-season training performance in an elite junior Australian Rules Football cohort	Samuel Chalmers		32
		The predictive validity of a single leg bridge test for hamstring injuries in football players	Grant Freckleton		33
		Injuries at Western Australian Football League Club in season 2010 – a review of reporting system and effectiveness injury management processes	Ben Piggott		34
		Is sports safety policy being translated into practice: What do community rugby union coaches know and do about the Mayday procedure?	Alex Donaldson		35
		Spines in Line – A review of the scrum engagement laws	Peter Milburn		36
		Hip flexor muscle strength but not size is reduced in patients with hip labral tears	Dilani Mendis		37
		Is there a difference in adductor muscle length and relative adductor strength in AFL players with and without groin injury?	Diana Hopper		38
1330 – 1500	Symposium	The anti-doping landscape now and beyond – A practical guide to assist athlete support personnel in the prevention of doping	Stephen Watt, Darren Mullaly & Peter Harcourt	Carnac Room	39
1330 – 1500	Free papers: Training effects			Garden Room	
		Does exercise training influence cardiac morphology? A prospective, longitudinal MRI study	Angela Spence		40
		Acute versus chronic exposure to androgen suppression for prostate cancer: Impact on the exercise response	Daniel Galvao		41
		A one-year lifestyle intervention improves myocardial function in patients with chronic kidney disease	Erin Howden		42
		Fitness and body composition: Which factors influence heart morphology?	Christopher Buck		43
		The effects of eccentrically-biased versus conventional resistance training in older adults	Isaac Selva Raj		44
		The effects of combined exercise training on clinical measures in people with type II diabetes and cardiovascular disease	Steve Selig		45

THURSDAY 20 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1330 – 1500	Free papers: Physical activity – interventions, policy and advocacy			Rottnest Room	
		Planning and outcomes framework for increased and improved physical activity opportunities in Western Australia	Jo Del Prete		46
		Encouraging Australians to Draw the Line on gaining weight	Trevor Shilton		47
		Do height adjustable 'hot' desks change sedentary work behaviour in an open plan office?	Nicholas Gilson		48
		Feasibility of and support for breaks in sedentary time and light-intensity physical activity during work hours among employees within desk-based work settings	Jason Bennie		49
		Initial effectiveness and acceptability of a video-tailored physical activity intervention	Corneel Vandelanotte		50
		Impact of changes to the national health strategy on the availability of physical activity and nutrition promotion programs in NZ	Julia McPhee		51
		Effects of Find Thirty every day: Cross sectional findings from a Western Australian population wide mass media campaign 2008–2010	Justine Leavy		52
1530 – 1630	Refshauge Lecture	Asthma, exercise and the athlete – An overview of four decades of researching these topics and their inter-relationships	Ken Fitch	Orion & Pleiades Room	53
1530 – 1630	Symposium	Successful advocacy for physical activity: Moving from evidence to influence	Trevor Shilton, Fiona Bull, Jo Del Prete & Mark Fenton	Rottnest Room	54

2 Multi-directional instability of the shoulder – one approach to conservative management

WORKSHOP

M. Magarey^{1*} ▪ ¹School of Health Science, University of South Australia

In this workshop a brief overview of the basic pathology and presentation of multi-directional instability of the shoulder will be presented, followed by demonstration of one approach to conservative management of the condition including consideration of injury preventative strategies, acknowledging the fact that the shoulder will always be vulnerable to injury in unpredictable situations.

3 Objective assessment of physical activity and sedentary behaviour

WORKSHOP

J. Salmon^{1*} ▪ N. Ridgers^{1*} ▪ A. Timperio^{1*} ▪ ¹Centre for Physical Activity and Nutrition Research, Deakin University

The aim of this workshop is to overview and discuss the practicalities of several new technologies for assessing physical activity and sedentary behaviour, including the most recent Actigraph GT3X+ model, the activPAL inclinometer, and the SenseWear armband. The workshop will provide information on when to use these devices (ie, what sort of research study, who is being assessed), how to use these devices (battery charging, initialising, downloading) and data management issues.

4 OneSMA

SMA National Board^{1*} ▪ ¹SMA National Board

OneSMA is a proposal put forward by the SMA National Board to merge the nine existing organisations that currently make up the federated structure of SMA, into one structure. Consultation has taken place with each of the SMA State Boards and executive officers in a number of instances and forums to date. The Australian Conference of Science and Medicine in Sport in Fremantle provides a unique opportunity to inform and update interested members on the OneSMA proposal and how they can engage in the process in the future. The session will provide members the opportunity to hear first hand of the benefits and challenges associated with the proposal to transform SMA's governance structure.

5 Musculoskeletal assessment and principles of management of common symptomatic presentations of the lower limbs in children with hypermobility disorders

WORKSHOP

N. Bennet-Bremner^{1*} ▪ ¹Kidz Clinic Physiotherapy, Western Australia

Hypermobility disorders are connective tissue disorders resulting in increased tissue or joint extensibility. This can cause ligamentous laxity, a propensity for bruising, poor scarring, coordination issues, joint pain, greater incidence of growing pains, more frequent sprains, strains and/or tendinopathies, subluxations/dislocations and fractures and a greater rate of fatigue. There is a higher incidence of musculoskeletal disorders in hypermobile population. Clinical characteristics and symptomology appears to be different dependent on which of the 3 morphology groups the child falls into (ectomorph, mesomorph, endomorph).

The workshop will aim to cover:

- the different observable signs and symptoms that present with hypermobility disorders in babies, toddlers, school age children and teens
- common subjective reporting of symptoms
- objective assessment of the lower limbs and gait in the hypermobile child and asterisk signs
- multidisciplinary management principles of hypermobility disorders affecting the lower limb and pelvis
- brief overview of the Spiral Thigh Brace and its use in children with femoral anteversion with video footage

6 CPR Certification

WORKSHOP

M. Brown^{1*} ▪ A. Green² ▪ Sports Doctors Australia³ ▪ ¹SMA QLD ▪ ²University of Queensland ▪ ³Sports Doctors Australia

This Workshop is designed to provide a CPR update with a Sports Medicine flavour. It provides an ideal opportunity for Sports Medicine Clinicians to up skill in a credentialed emergency resuscitation hands on session. It is primarily provided for Doctors, Physiotherapists, Podiatrists or any other health professionals who require an annual update for their daily work and to fulfil the requirements for their professional education or registration. The workshop will fulfil the updated 2011 guidelines of the Australian Resuscitation Council and all participants will receive a Statement of Attainment as Nationally Recognised Training.

KEYNOTE

Qualisys Supported Speaker

R. Meeusen^{1*} ■ B. Roelands¹ ■ ¹Department of Human Physiology, Vrije Universiteit Brussel, Belgium

The original central fatigue hypothesis emphasizes that an exercise-induced increase in serotonin is responsible for the development of fatigue. In humans, several pharmacological studies failed to alter exercise capacity through changes in serotonergic (5-HT) neurotransmission, indicating that the role of serotonin is often overrated.[1] Central neurotransmitters have all been implicated in the control of thermoregulation and are thought to mediate thermoregulatory responses, certainly since their neurons innervate areas of the hypothalamus -the human thermoregulatory center-, among which also the PreOptic area/Anterior Hypothalamus (PO/AH). The combination of exercise, and the manipulation of central neurotransmission in the heat might contribute to elucidate the mechanisms of fatigue. Studies from our lab showed that DA significantly enhanced performance, coinciding with the attainment of high core temperatures and heart rates, without any change in thermosensation and in the perception of effort.[2,3] In contrast, increased brain concentration of Noradrenaline (NA) strongly decreased performance in the heat and no effect of 5-HT could be detected.[4,5] Thermal regulation appears to be an important factor that will mainly be influenced by brain DA and NA in the PO/AH, although the exact role of other neurotransmitter systems is not clear so far. [6]

It is very unlikely that one neurotransmitter system is responsible for the appearance of central fatigue. Most probably central fatigue is caused by a complex interplay between the different neurotransmitters systems, with the most important role for the catecholamines DA and NA. Although work to date has given us clear observations on external behavioural changes after pharmacological interventions, the exact role of the different brain areas linked to exercise capacity and thermoregulation have yet to be elucidated.

References:

1. Meeusen R, Watson P, Hasegawa H, et al. Central fatigue. The serotonin hypothesis and beyond. *Sports Med* 2006; 36(10): 881-909.
2. Watson P, Hasegawa H, Roelands B, et al. Acute dopamine/noradrenaline reuptake inhibition enhances human exercise performance in warm, but not temperate conditions. *J Physiol* 2005; 565(Pt 3): 873-83.
3. Roelands B, Hasegawa H, Watson P, et al. Acute DA reuptake inhibition enhances performance in warm but not temperate conditions. *Med Sci Sports Exerc* 2008; 40(5): 879-858.
4. Roelands B, Goekint M, Heyman E, et al. Acute norepinephrine reuptake inhibition decreases in normal and high ambient temperature. *J Appl Physiol* 2008; 105(1): 206-12.
5. Roelands B, Goekint M, Buyse L, et al. Time trial performance in normal and high ambient temperature: is there a role for 5-HT? *Eur J Appl Physiol* 2009; 107(1): 119-26.
6. Hasegawa H, Ishiwata T, Saito T, et al. Inhibition of the preoptic area and anterior hypothalamus by tetrodotoxin alters thermoregulatory functions in exercising rats. *J Appl Physiol* 2005; 98(4): 1458-62.

INVITED

M. Magarey^{1*} ■ ¹School of Health Science, University of South Australia

A national level water polo player presented with a long term painful shoulder that was significantly interfering with her ability to both swim and throw, particularly shooting for goal. She has had extensive physiotherapy management over many years, evaluation by a number of expert water polo physiotherapists and management in the context of training and competition tours. This paper will explore the reasoning associated with the player's presentation and management over a three month period, including medical, imaging and surgical considerations.

J. Saunders^{1*} ■ ¹Sydney University Medical School

The approach to assessing a patient with a lumbar spine problem often is very dependent on the craft group of the assessor. Manual therapists will be interested in things that do or do not move, EP's in strength and gait cycle imbalances, surgeons with nerve compression and physicians with excluding disease (bone, inflammatory, metastatic). I.e. systematic practitioners will tend to follow the model of pain that they know (mechanical, inflammatory, degenerative, psychosocial) General practitioners are therefore often surrounded in confusion. It is important as a member of a team looking after athletes (industrial athletes) or active people that we learn from each other about significant components of physical assessment that maybe relevant to this particular individual.

HISTORY: Mechanism (or lack of) injury can be important as it may well suggest which structure was injured.

"I slipped downstairs and landed on my back." Is this statement adequate? Is there more you would like to know?

Age gender past incidences of low back pain, activities are all important.

THINGS YOU SHOULD NOT MISS! How can you build into your consultation these important clues that this may be a serious disease??

What aspects of history, physical examination and imaging are important here?

THINGS YOU SHOULD KNOW! Should an exercise physiologist know how to identify a stress fracture of the pars interarticularis?

Should a physician be able to recognise lack of intervertebral movement?

Should a surgeon be able to recognise lack of TA/multifidus strength?

SO HOW CAN ALL THIS BE ACHIEVED IN ONE CONSULTATION: The use of a systematic system or sheet may aid to reminding us to carry out simple screening tests in all the facets that we need to know.

I will present a systematic system of history taking and physical examination that encompasses ALL the categories of problems that may occur with the lower back and share this with audience members.

SYMPOSIUM

C. Finch^{1*} ■ P. White¹ ■ N. Andrew^{2*} ■ D. Lloyd^{3*} ■ A. Donaldson^{1*} ■ ¹Australian Centre for Research into Injury in Sport and its Prevention (ACRISP)

²Department of Epidemiology and Preventive Medicine, Monash University, Alfred Hospital ■ ³Musculoskeletal Research Program, Griffith Health Institute, Griffith University

Translating scientific evidence about effective interventions into evidence-based, useful and useable guidelines for community sport is one of the biggest challenges facing the sports injury prevention research community. The aim of this symposium is to shed some light on how to approach this challenge by presenting a series of papers based on Phase 1 of the NHMRC-funded National Guidance for Australian (football) Partnerships and Safety (NoGAPS) partnership project. The symposium will begin with an overview of the project including a description of the study protocol. This will be followed by two papers reporting the results of reviews of the literature—the first of these will describe the epidemiological profile of lower limb injuries in community Australian Football, while the second will outline the evidence-base for exercise as a lower limb injury prevention strategy in community Australian Football. The fourth presentation will focus on the process of translating various forms of scientific evidence into guidelines for use in community sport. The final paper will describe and present the findings of an expert consultation process designed to ensure the developed guidelines are contextually relevant and supported by the opinion leaders in the field. The symposium will conclude with an interactive discussion with the audience.

Paper 1: The design of a study to better understand facilitators and barriers towards safety guideline uptake - the NoGAPS project

Paper 2: Where should community Australian Football invest in injury prevention? A review of over 30 years of injury reports

Paper 3: What is the evidence-base for exercise as a lower limb injury prevention strategy in community Australian Football?

Paper 4: Translating the scientific evidence for preventing lower limb injuries into training guidelines: the role of mechanistic versus clinical versus epidemiological studies

Paper 5: Gaining expert consensus on lower limb injury prevention exercise guidelines for community Australian Football - the NoGAPS project

C. Finch^{1*} ■ B. Gabbe² ■ D. Lloyd³ ■ J. Cook⁴ ■ W. Young⁵ ■ M. Nicholson⁶ ■ H. Seward⁷ ■ A. Donaldson¹ ■ T. Doyle⁸ ■ P. White¹

¹Australian Centre for Research into Injury in Sport and its Prevention (ACRISP) ■ ²Department of Epidemiology and Preventive Medicine, Monash University, Alfred Hospital

³Musculoskeletal Research Program, Griffith Health Institute, Griffith University ■ ⁴Department of Physiotherapy, School of Primary Health Care, Monash University

⁵School of Human Movement and Sport Sciences, University of Ballarat ■ ⁶Centre for Sport and Social Impact, La Trobe University ■ ⁷Australian Football League Medical Officers Association

⁸Human Protection and Performance Division, Defence Science Technology Organisation, Fishermens Bend, Victoria

Background: Limited information exists about how best to conduct intervention implementation studies in community sport settings. It is clear that considerable research effort needs to be directed towards understanding the context within which evidence-based injury prevention interventions are to be implemented, whilst continuing to build the evidence-base for the effectiveness of sports injury interventions.

Methodology: The NoGAPS project is the first large-scale international study to identify factors that influence the translation of evidence-based injury prevention interventions into practice in community sport and to explore their adoption by players, coaches and others. Whilst the project will generate new knowledge relevant across different community sports, the study will be conducted within community-level Australian Football clubs, teams and players over three years. An evidence-informed exercise-based lower limb injury prevention program has been developed and this will be fully evaluated in terms of the implementation context, infrastructure and resources needed for its effective translation into community sport. At all stages of the project, analysis of the community sports safety policy and practice contexts will be undertaken to understand the barriers and facilitators to safety program development and uptake. A randomised group-clustered ecological study will be conducted to compare the reach, effectiveness, adoption, implementation and maintenance (RE-AIM) of the intervention over two seasons.

Results: This study is currently underway and this talk will provide an overview of the entire study design and evaluation plan for forthcoming years. It will set the scene for, and serve as an introduction to, other talks in this symposium.

Discussion: The primary outcome of this project will be evidence-based sports injury prevention guidelines that are fully supported by a comprehensively evaluated dissemination plan. The dissemination plan will detail the support structures and add-ons necessary to ensure sustainability and subsequent national implementation of any safety program aimed at community sport. Research outcomes will include new knowledge about how sports safety policy is set; how consensus is reached among sports safety experts in the community setting; and how evidence-based safety guidelines are best developed, packaged and disseminated to community sport. Using Australian Football as the particular example, this project will also provide specific evidence for the effectiveness of an evidence-based exercise-training program for lower limb injury prevention in community Australian Football.

P. White¹ ■ C. Finch^{1*} ■ A. Donaldson¹ ■ B. Gabbe² ■ J. Cook³ ■ D. Lloyd⁴ ■ H. Seward⁵ ■ ¹Australian Centre for Research into Injury in Sport and its Prevention (ACRISP)

²Department of Epidemiology and Preventive Medicine, Monash University, Alfred Hospital ■ ³School of Primary Health Care, Faculty of Medicine, Nursing and Health Sciences, Monash University

⁴Musculoskeletal Research Program, Griffith Health Institute, Griffith University ■ ⁵AFL Medical Officers Association

Introduction: Comprehensive epidemiological information about injuries is needed to identify and prioritize efforts to develop and implement injury prevention interventions in sport. While previous research has mainly focused on injuries in elite Australian Football, more recent studies have described injuries in community Australian Football players. This talk will present the first compilation of information about the profile of community Australian Football injuries in order to identify the most commonly injured body regions, natures and mechanisms of injury experienced by the largest participation group in this sport.

Methods: A set of complementary systematic search strategies was adopted to identify both peer-review and grey literature sources of detailed information about the injuries that occur among community Australian Football players. Injury reports that contained specific details on both the injury nature and injured body regions were retained and summarised. Information on injury mechanism was also extracted and summarised, when available.

Results and Discussion: The available data on injuries that occur among community Australian Football players are limited. Injuries to the lower limb were the most common community Australian Football injuries. Lower limb injuries consist mainly of sprains/strains and superficial injuries and are most commonly the result of incidents involving player contact with others, being hit by the ball, or by overexertion. Injuries to the upper limb were less common but more severe, consisting of fractures and sprains/strains that required medical attention. Upper limb injuries were largely the result of making contact with another player or falling to ground.

Conclusions: Based on the available data, on both a frequency basis and for their impact on sustained participation in the game, lower limb injuries should be a particular priority for injury prevention efforts in community Australian Football. Interventions aimed at reducing lower limb injuries in community Australian Football players should a) make players' body tissues and joints more resilient to withstanding physical contact with others through improved tissue responses to the transfer of impact forces; b) reduce opportunities for that contact to occur in the first place; and c) reduce the amount and certain types of adverse physical strain that players place on their muscles and tendon through overexertion.

13

What is the evidence-base for exercise as a lower limb injury prevention strategy in community Australian Football?

N. Andrew^{1*} ■ B. Gabbe¹ ■ J. Cook² ■ D. Lloyd³ ■ J. Donnelly⁴ ■ C. Nash² ■ P. White⁵ ■ A. Donaldson⁵ ■ C. Finch⁵

¹Department of Epidemiology and Preventive Medicine, Monash University, Alfred Hospital ■ ²School of Primary Health Care, Faculty of Medicine, Nursing and Health Sciences, Monash University

³Musculoskeletal Research Program, Griffith Health Institute, Griffith University, Gold Coast ■ ⁴School of Sport Science, Exercise and Health, University of Western Australia

⁵Australian Centre for Research into Injury in Sport and its Prevention (ACRISP)

Introduction: Australian Football has a high incidence of lower limb injuries. Injuries such as muscle strains, hip and groin pain, tendinopathies and ligament injuries are particularly prevalent. A systematic review of the literature was performed to establish the evidence-base for using exercise as a strategy for preventing lower limb injuries, and to provide the basis for developing an exercise training injury prevention program for implementation in community-level Australian Football clubs.

Methodology: The literature pertaining to common lower limb injuries in athletic populations was searched. Searches were performed using the Cochrane Central Register of controlled trials, the Cochrane Bone Joint and Muscle Trauma Group Specialised Register, MEDLINE and other databases, from January 1990 to January 2011. Reference lists and grey literature sources were also searched. Randomised, quasi-randomised, cohort, case control and cross-sectional studies conducted with adult sporting populations were extracted. Primary outcomes of interest were injury reduction, and risk factor identification and modification. Secondary outcomes were compliance, injury severity and adverse effects. Data extraction forms based on the Cochrane Collaboration guidelines and the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement were used to assess the methodological quality of studies. Extracted studies were also assessed with respect to cost, uptake and feasibility within a community context.

Results: In total 69 studies were reviewed. Of these 17 related to hamstring injury, 15 related to knee or ankle ligament injury, 13 related to tendons and eight were hip or groin related. Another 16 targeted general lower limb injuries. Most were observational studies emphasising risk factor identification. A small number were randomised controlled trials (RCTs). RCTs performed under controlled conditions and aimed at reducing injury risk factors or mechanisms showed some positive results. A small number of field-based RCTs identified neuromuscular training as being effective in reducing knee and ankle ligament injuries. Most studies however were compromised by poor methodology, inconsistent outcome reporting, a lack of baseline comparisons and non-standardised injury definitions. Many studies were under-powered due to small injury numbers and low compliance.

Conclusion: The evidence-base for exercise as a lower limb injury prevention strategy is predominantly restricted to studies addressing injury aetiology and mechanisms. Developing a program based on current evidence is challenging. The findings of the literature review highlight the need to develop and test interventions in well designed RCTs that encourage uptake and compliance. This step is crucial in developing an effective evidence-base for sports injury prevention.

14

Translating the scientific evidence for preventing lower limb injuries into training guidelines: The role of mechanistic versus clinical versus epidemiological studies

D. Lloyd^{1*} ■ J. Cook² ■ B. Gabbe³ ■ W. Young⁴ ■ P. White⁵ ■ A. Donaldson⁵ ■ C. Finch⁵

¹Musculoskeletal Research Program, Griffith Health Institute, Griffith University ■ ²School of Primary Health Care, Faculty of Medicine, Nursing and Health Sciences, Monash University

³Department of Epidemiology and Preventive Medicine, Monash University, Alfred Hospital ■ ⁴School of Human Movement and Sport Sciences, University of Ballarat

⁵Australian Centre for Research into Injury in Sport and its Prevention (ACRISP)

Introduction: Even though sports injuries are common overall, large participant numbers are required in epidemiological studies to test if interventions can lower injury risk. Many studies that have injury reduction as the outcome measure have not succeeded because a) they have no true randomized placebo control group, b) individual injury diagnoses are rare and so different injuries need to be grouped together, c) the intervention was not well designed and failed to target the mechanism of injury, and d) there was poor intervention uptake and compliance. Because of the lack of good Randomised Control Trial (RCT) evidence, other sources of evidence and experience have to be collated to develop injury prevention guidelines. Our Translating Research into Injury Prevention Practice framework advocates including more attention on understanding the injury mechanisms, couched in these simple terms: "a sporting injury occurs because the tissue loading is inappropriate for its current strength".

Methods: We proposed four levels of evidence or knowledge to develop intervention measures:

1. identify the cause of injury which requires determining crucial factors implicated in tissue loading and/or strength
2. create measures to counter the crucial tissue loading and/or strength factors, based on experimental investigation and/or clinical experience
3. interventions based on Level 2 studies need to be created and tested in highly controlled laboratory investigations to assess if they do counter the tissue loading and/or strength factors
4. large scale interventions that "mimic" the successful Level 3 interventions need to be created and their efficacy in lowering the injury risk in a 'real world' setting tested as RCTs

We used Level 3 and 4 studies to develop the guidelines, which had to be able to be implemented by community level coaches/trainers with limited access to training apparatus. To this end consultation with practicing exercise trainers, physiotherapists and coaches was instituted. Results: The studies selected varied greatly in their description and implementation of training. Level 3 studies provided well defined and controlled training, performed one-on-one by trained instructors, using specialised apparatus. Level 4 studies were usually implemented at the community level and were designed within these constraints. For some injuries the evidence was limited so clinical experience had to be used. Discussion: Within the constraints of available evidence, guidelines were developed that could be implemented in the community setting. The consultation was necessary, although throughout the process referral to the evidence was required to ensure the guidelines reflected the best in injury prevention.

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Gaining expert consensus on lower limb injury prevention exercise guidelines for community Australian Football—the NoGAPS project

A. Donaldson^{1*} ▪ J. Cook³ ▪ P. White¹ ▪ C. Finch¹ ▪ D. Lloyd⁴ ▪ B. Gabbe² ▪ ¹Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), Monash Injury Research Institute, Monash University ▪ ²Department of Epidemiology and Preventive Medicine, Monash University
³Department of Physiotherapy, Monash University ▪ ⁴Musculoskeletal Research Program, Griffith Health Institute, Griffith University

Introduction: The initial phase of the NoGAPS project involved developing evidence-based exercise-training guidelines as a lower limb injury prevention strategy in community Australian Football. To ensure that the content of these guidelines was contextually relevant and supported by the opinion leaders in the field, an expert consensus consultation was conducted.

Methodology: Members of the Australian Football League (AFL) Sports Science Advisory Group; AFL Medical Officers Association; AFL Physiotherapists Association; and a small number of other Australian lower limb injury prevention experts were invited to participate in a three-round online Delphi process to develop consensus on the content of the guidelines. Participating experts were asked to rate their level of agreement on including each exercise in the guidelines and on the progression of these exercises using a five point scale (Strongly agree, Agree, Neutral, Disagree, Strongly disagree). Participants were also given an opportunity to identify and describe any additions or changes to the exercises or the progression of exercises included in the guidelines. Outcomes of the first two rounds of the Delphi process were de-identified, summarised and reported back to participants before they were requested to complete the survey for the subsequent round.

Results and conclusions: This presentation will discuss the level of consensus reached around each of the exercises included in the guidelines and the progression of exercises proposed in the guidelines. It will also present the changes made to the guidelines in response to the outcomes of the expert consultation and discuss the strengths, weaknesses and challenges associated with using the Delphi process to develop consensus among sports injury prevention and sports medicine practitioners.

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Influence of development, exercise and disease on tendon and muscle mechanics

SYMPOSIUM

A. Blazevich^{1*} ▪ G. Lichtwark² ▪ N. Cronin³ ▪ L. Barber³ ▪ ¹Edith Cowan University ▪ ²University of Queensland ▪ ³Griffith University

Recent advances in medical imaging technologies have allowed researchers to more accurately measure the impact of the mechanical and functional properties of human tendons on movement performance. The aim of this symposium is to report on the latest findings regarding the effects of acute and chronic physical activity on human tendon mechanical properties, and their resulting effects on movement performance. The symposium will begin with an overview of studies examining the influence of tendon mechanical properties on muscle force production, focussing on new data documenting the relationship between tendon properties and force production in children and adults. This will be followed by a presentation showing the unique behaviour of the soleus muscle during walking and running, which is afforded by a complex soleus muscle-Achilles tendon interaction. Two papers will then be presented detailing the latest research on the effect of acute bouts of physical activity on the behaviour of both the tendon and aponeurosis (i.e. internal tendon); the influence of running exercise and bouts of varying durations and intensities of muscle work will be specifically examined. This will be followed by an overview of research documenting the variation in (patellar) tendon properties over a ~1 year training period in athletes. Finally, the role of longer-term exercise, and in particular strength training, will be examined. Data recently obtained in pre-adolescent children completing a strength training program will show the remarkable plasticity of human tendons and the impact of changes in mechanical properties on force production in children. A question and answer session will follow the presentations, which will facilitate a discussion of the papers and ideas for future research.

Paper Title 1: The development of tendon mechanical properties from childhood to adulthood and their relationship with force production

Paper Title 2: The force-length operating range of the human soleus muscle during walking and running

Paper Title 3: Achilles tendon (3D): Do the mechanical properties of tendon change in response to exercise?

Paper Title 4: Exercise-induced changes in tendinous tissue compliance: Outer tendon or aponeurosis?

Paper Title 5: Patellar Tendon Mechanical Properties in Elite Jumping Athletes: A prospective study

Paper Title 6: Strength training affects Achilles tendon anatomical and mechanical properties, and force production, in pre-pubescent children

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The development of tendon mechanical properties from childhood to adulthood and their relationship with force production

A. Blazevich^{1*} ▪ T. Korff² ▪ F. Fath² ▪ C. Waugh² ▪ ¹Edith Cowan University ▪ ²Brunel University, United Kingdom

Introduction: Differences in force production between adults and children are commonly attributed to differences in maturity of the neuromotor system. However, tendon stiffness, which adapts to chronic loading and increases with age, influences both electromechanical delay (EMD) and contractile rate of force development (RFD) in adults. We hypothesised that differences in rapid force production between adults and children might be associated with the greater tendon stiffness in adults. We also sought to determine which changes in the anatomical structure of the tendon underpinned the increases in stiffness, and whether increases in tendon stiffness were a correlate of body mass or peak force potential rather than an 'age-related' phenomenon.

Methodology: Achilles tendon stiffness (slope of the tendon elongation-force curve measured during an MVC), tendon length and cross-sectional area (CSA)(measured with ultrasound), Young's modulus (tendon stiffness normalised to resting length and CSA), RFD (slope of force-time relation), EMD (delay between EMG and force onsets) and rate of EMG rise (RER; slope of EMG-time relation) were examined in 52 pre-adolescent children (5-12 years) and 20 adults. Changes in the variables with age and relationships between the changes in variables were examined using correlation-regression methods.

Results: Achilles tendon stiffness increased ~300% from age 5-6 years through to adulthood. Strong relationships existed between body mass and peak force, with both variables together explaining 78% and 61% of the variance in stiffness and Young's modulus, respectively, across all subjects. Age was not as good a predictor. The increase in tendon stiffness was partly explained by a greater increase in CSA (105%) than length (60%), but changes in the intrinsic tendon properties (i.e. Young's modulus, 139%) were a major influencing factor. EMD decreased significantly with age and was negatively correlated with tendon stiffness in children and adults. RFD calculated to 50, 200 and 400 ms was significantly lower in children than adults and was related to tendon stiffness in children and for all subjects combined. RER and tendon stiffness together accounted for 61% of the variability in RFD in children.

Discussion: Tendon stiffness increased dramatically from early childhood to adulthood due to both increases in CSA and changes in the intrinsic properties of the tendon. However, increases in body mass and force production appear stronger influencing factors than age per se. Increases in tendon stiffness were clearly related to changes in RFD and EMD, suggesting a role of tendon properties in fast force production changes with age.

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The force-length operating range of the human soleus muscle during walking and running

J. Rubenson^{1*} ▪ N. Pires¹ ▪ D. Shannon¹ ▪ G. Pinniger¹ ▪ H. Loi¹ ▪ ¹University of Western Australia

Introduction: Knowledge of where skeletal muscles operate on their force-length relationship is important for understanding the mechanics and control of both normal and dysfunctional movement. However, relating the force-length relationship of muscles to human movement, and gait in particular, has been hampered by a lack of reliable experimental data. The purpose of this study was to determine the force-length operating range of the soleus muscle during both walking (preferred speed) and running (3 m/s) based on a) subject-specific muscle force-length data b) direct muscle fascicle imaging, and c) electromyography (emg) data. It was hypothesized that during walking the soleus muscle operates only over the ascending limb of its force-length relationship, reflecting a functional requirement for muscle stability during stretch-shorten cycles, and that during running the muscle operates over the plateau region optimizing force output.

Methods: Eight healthy, recreationally fit male subjects were studied. The active isometric force-length relationship of the soleus muscle was measured using a maximal voluntary contraction (MVC) protocol incorporating net moment measurement (Biodex), emg, ultrasound imaging, subject-specific passive fascicle force-length data and a scaled musculoskeletal model of the lower limb (OpenSim). Estimates of tibialis anterior muscle co-contraction were also included. Gait trials were collected on a motorized treadmill while dynamically imaging the same muscle fascicles on which the force-length relationship was established (Telemed; 70Hz). Ankle joint angles were determined using motion capture (Vicon; 250Hz). Electromyography recordings of the soleus muscle were collected (Noraxon; 1500Hz) in order to assess active vs. passive muscle strain.

Results: Our force-length protocol resulted in a plateau in force producing capacity, thus permitting an estimate of optimal fascicle length (L₀) and the construction of a normalized fascicle force-length relationship. During walking at the preferred speed, the soleus fascicles underwent a characteristic stretch-shorten cycle during stance and primarily lengthening during swing. When the muscle was active in stance, the fascicles operated over the shallow ascending limb of the force-length relationship. A similar strain pattern was observed during running, although the fascicles exhibited less lengthening strain.

Discussion: Our results support the hypothesis that muscles undergoing a stretch-shorten cycle operate over the ascending limb of their force-length relationship, where a positive slope of force vs length facilitates stable force production. Surprisingly, this pattern is seen in both walking and running, the latter requiring high force output. This finding may reflect a general strategy where muscles are optimised for mechanical stability as opposed to force production.

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Achilles tendon (3D): Do the mechanical properties of tendon change in response to exercise?

G. Lichtwark^{1*} ▪ D. Farris² ▪ R. Newsham-West³ ▪ ¹University of Queensland ▪ ²North Carolina State University, USA ▪ ³Griffith University

Introduction: The elastic properties of the Achilles tendon are crucial for efficient generation of power in locomotor tasks. The Achilles tendon is exposed to high, repetitive strains during tasks like running which makes it highly susceptible to injury. Cyclic loading of the Achilles tendon is known to induce tendon creep, which represents a change to material properties of the tendon. Recent experimental measures suggest that the Achilles tendon shows little or no creep after repetitive loading exercise such as hopping and running. These previous measures have not taken into account the complex three-dimensional shape of the Achilles tendon and have largely ignored the potential changes in elasticity of the free Achilles tendon (distal tendon insertion to soleus muscle-tendon junction). We hypothesised that the free Achilles tendon would experience similar strains to the whole tendon under load and that the tendon would increase in slack length and compliance with exercise.

Methodology: Freehand three dimensional (3D) ultrasound was used to examine the structure of tendon when slack and during force production. We examined this both before and after 20 minutes of moderate intensity running in young adults (18-35 years, n=11). By analysing the strain of the tendon during force development, we quantified the slack length and stiffness of the free Achilles tendon and the whole Achilles tendon (distal tendon insertion to the gastrocnemius muscle-tendon junction) as well other structural measures (e.g. tendon cross sectional area).

Results and Discussion: Contrary to our hypothesis, the strain of the free tendon was found to be greater than that of the whole tendon at moderate force levels of 50% maximum voluntary contraction (P<0.05). Our initial results suggest that the mechanical and structural properties of the Achilles tendon are relatively robust in response to the moderate running exercise performed. While we found small increases in slack length of both the free Achilles tendon and the whole Achilles tendon, this was not statistically significant (P = 0.21). This may be due to the variability in the insertion site for length measurement with changes in the strain at the lateral and medial borders of the muscle with contraction. Further work is required to standardise these measurements in 3D.

N. Cronin^{1*} ■ J. Peltonen² ■ J. Avela² ■ T. Finni² ■ ¹Griffith University ■ ²University of Jyväskylä, Finland

Introduction: The advent of non-invasive ultrasonography has enabled the study of muscle-aponeurosis-tendon interaction during a range of human movements. We have used this methodology to examine the possibility of changes in the compliance of tendinous tissues in response to variations in tendon strain rate, as well as after different forms of acute exercise that place different demands on the muscle-tendon system: walking and hopping.

Methodology: Ultrasonography was used at high sampling rates (75-150) to examine length changes of muscle fascicles or the outer Achilles tendon (AT). In the first part of the study, an ankle dynamometer was used to induce different tendon strain rates. For the walking and hopping conditions, surface electromyography data were also collected from the triceps surae and tibialis anterior muscles, and 3D motion analysis and force platforms were used to examine joint kinematics and kinetics, respectively.

Results and conclusions: The results of this study indicate several important findings. Firstly, the compliance of the outer Achilles tendon is not sensitive to strain rate during ankle plantar flexion at slow (0.9% s⁻¹) to fast (11% s⁻¹) strain rates, which is consistent with several previous in vitro studies. Secondly, in response to an acute bout of hopping to exhaustion, we found no evidence of a clear change in outer Achilles tendon compliance, despite a clear reduction in maximal voluntary plantar flexion force. Both of the aforementioned findings suggest that outer Achilles tendon compliance is not altered after an acute bout of exercise, even at high intensities. Conversely, after walking for approximately 1 hour, we found a clear shortening of the muscle fascicles, suggesting that a change in tendinous tissue compliance did occur in response to this relatively low intensity task. Since our data regarding strain rate sensitivity and hopping suggest that outer Achilles tendon stiffness is resistant to change after acute exercise, we suggest that the apparent disparity between these findings and our walking data may be attributable to a change in the compliance of aponeurotic tissues. These findings collectively highlight the complex interaction between muscle, aponeuroses and outer tendon during in vivo human movement.

A. Gupta^{1,2,3*} ■ C. Purdam¹ ■ J. Cook⁴ ■ G. Allison^{5,6}

¹Australian Institute of Sport ■ ²La Trobe University ■ ³University of Western Sydney ■ ⁴Monash University ■ ⁵Curtin University ■ ⁶Royal Perth Hospital

Introduction: The purpose of this research was to evaluate the mechanical characteristics of the patellar tendon (PT) in elite level jumping athletes. Patellar tendon (PT) mechanical properties including strain, stiffness, stress, elastic modulus, cross-sectional area (CSA) and mechanical work done were measured a mean of 344 days, range 254-512, apart.

Methods: Real-time ultrasound imaging of the PT and maximal voluntary isometric contraction (MVIC) force of the knee extensors, were synchronously recorded for the left and right sides of 13 athletes (17.9 years of age, range 16-24, 201cm in height, range 196-209 and 91kg in weight, range 81-108) participating in volleyball or basketball on a full-time basis at the Australian Institute of Sport. All participants volunteered providing written and informed consent. Four of the 13 participants had patellar tendinopathy at the time of testing and were not included in the analysis. A repeated 2x2 ANOVA was used to compare PT mechanical properties before and after a competitive season and between sides. For each side, a 2-way ANOVA was used to compare the PT CSA between the proximal, mid and distal sites along the PT and before and after the competitive season.

Results: The main findings were that PT elastic modulus at near maximal effort (70% to 80% MVIC) was significantly lower during session 2 ($p = 0.03$) and there was a significantly greater percentage of mechanical work done in session 2 compared to session 1 from mid-range to maximal efforts (50 to 100% MVIC) ($p < 0.02$). Patellar tendon elastic modulus and stiffness were significantly greater on the right compared to left side at mid-range MVIC efforts (40 to 50% MVIC) ($p < 0.05$).

Conclusions: The PT may adapt its ability to withstand tensile load at mid-range to near-maximal knee extensor isometric efforts. These contraction efforts are similar to those used during training and competition in jumping activities such as volleyball and basketball. These findings are similar to those of strengthening programs targeted at treating patellar tendinopathy. Thus, the loading history of the PT may influence its ability to withstand tensile load especially as there was no change in mechanical characteristics (stiffness or strain), PT force or CSA. This is the first study that examined the mechanical characteristics of the PT prospectively over one year of training and competition in elite level athletes. The findings indicate that any observed change in mechanical properties must be specific to the sample being tested rather than generalised to a broader population.

A. Blazejch^{1*} ■ T. Korff² ■ F. Fath² ■ C. Waugh² ■ ¹Edith Cowan University ■ ²Brunel University, United Kingdom

Introduction: As increases in muscular strength occur with age or increased physical activity, a simultaneous adaptation in the tendon must be achieved to allow the efficient transmission of the larger muscular forces to the bone with a minimal risk of tendon injury. It is known that tendons adapt to chronic loading and specific exercise training in adults and, in addition to an increased rate of muscle activation, this is thought to strongly influence the rate of muscular force production. It was therefore hypothesised that: (1) resistance training could alter tendon mechanical properties in pre-pubescent children, and (2) that such changes would impact on the rate of force development.

Methodology: Eighteen prepubertal children (aged 8.9 ± 0.3 years) were divided into control (non-training) and experimental (training) groups. The training group completed 10 weeks of plantarflexor strength training consisting of 2 - 3 sets of 8 - 15 plantarflexion efforts performed twice-weekly on a recumbent calf raise machine. Training was completed as part of a class-based physical education lesson. Achilles tendon stiffness (slope of the tendon force-elongation curve), rate of force development (RFD; slope of the force-time curve), rate of EMG rise (RER; slope of the EMG-time curve) and electromechanical delay (EMD; time between the onset of muscle activity and force) were measured during isometric plantarflexion contractions performed with a maximum rate of force development before and after training.

Results: There were no changes in any variable in the control group. In the experimental group, however, tendon stiffness and Young's modulus increased significantly (~35% and ~33%, respectively) whilst tendon CSA was unchanged. Peak tendon stress showed a trend towards increasing after training as a consequence of increased plantarflexor force production, whereas peak tendon elongation and strain showed a trend to decrease. A decrease in EMD (~13%) was found after training for the experimental group which correlated with the increase in tendon stiffness ($r = 0.59$). Nonetheless, RFD and RER were unchanged after training.

Discussion: The present data show that the Achilles tendon adapts to strength training in prepubertal children, which was associated with an increased rate of muscular force production (particularly a decrease in EMD) and therefore may influence movement performance in tasks requiring fast force production. The mechanisms underpinning rapid force production were different to those found in adults as RFD was not influenced by the changes in tendon stiffness. This may help explain differences in movement performance between these populations.

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Exercise for reducing visceral adiposity: Aerobic or resistance training?

N. Johnson^{1*} ▪ I. bin Ismail¹ ▪ S. Keating¹ ▪ M. Baker² ▪ ¹University of Sydney ▪ ²Edith Cowan University

Introduction: It has been well documented that obesity increases cardiovascular and metabolic morbidity and mortality. However, it is increasingly recognized that the location of excess adiposity, particularly increased deposition of visceral adipose tissue (VAT), is of greater importance in determining the adverse health effects of overweight and obesity. Although exercise is widely believed to benefit abdominal adiposity, there has been no systematic examination of the independent, comparative and synergistic benefits of aerobic exercise and progressive resistance therapies for VAT modulation. Methods: A systematic review and meta-analysis was performed to assess the efficacy of exercise interventions on VAT content/volume in overweight and obese adults. Relevant databases were searched to March 2011. Included studies were randomised controlled designs in which AEx or PRT in isolation or combination was employed for 4 weeks or more in adult humans. Studies were selected if computed tomography or magnetic resonance imaging were used for quantification of VAT area/volume pre- and post-intervention.

Results: The original search netted 12,196 studies and three more were found from the reference lists of the manuscripts retrieved. Following removal of duplicates and elimination of papers based on the eligibility criteria, 35 studies remained involving a total of 2,107 adult participants. After excluding outliers there was a significant pooled effect size (ES) for the comparison between AEx therapy and control (-0.29, 95% CI: -0.42 to -0.17; $P < 0.01$), but not for the comparison between PRT therapy and control (-0.03, 95% CI: -0.21 to 0.14; $P = 0.71$). Of the available nine studies which directly compared AEx with PRT, the pooled ES did not reach statistical significance (ES = 0.19, 95% CI: -0.04 to 0.41; $P = 0.105$ favouring AEx). The pooled ES did not reach statistical significance for interventions that combined AEx and PRT therapy versus control (-0.15, 95% CI: -0.35 to 0.04; $P = 0.12$), for which only seven studies were available.

Conclusion: The data show that when compared with a control intervention, aerobic exercise therapy prescribed in accordance with current public health recommendations is effective in lowering VAT. However resistance training in isolation or in combination with aerobic exercise failed to induce a statistically significant reduction in VAT when compared with the control group. These data suggest that aerobic exercise may be a superior training modality for achieving reduction in VAT but further investigation is needed regarding the efficacy and feasibility of multi-modal training as a means of reducing VAT.

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High velocity power training with weight-bearing and balance exercises improves bone density and function in high risk older adults: A 12-month RCT

J. Gianoudis^{1*} ▪ C. Bailey¹ ▪ P. Ebeling¹ ▪ C. Nowson² ▪ K. Sanders¹ ▪ K. Hill³ ▪ R. Daly^{1,2} ▪ ¹Department of Medicine, University of Melbourne
²Centre for Physical Activity and Nutrition Research, Deakin University ▪ ³Faculty of Health Sciences, La Trobe University and Northern Health

Introduction: Multi-component exercise programs incorporating progressive resistance training (PRT) and weight-bearing activities are recommended for preventing osteoporosis, falls and fractures. However, few studies have evaluated their effectiveness in a 'real world' community setting in older adults at increased risk of falls and fracture. Recent evidence suggests that power training, characterised by high-velocity movements, may be more effective for improving physical function than traditional PRT. Therefore, the aim of this community-based 'research to practise' RCT, termed 'Osteo-cise: Strong Bones for Life', was to investigate the effects of a multi-component exercise program coupled with an osteoporosis education/awareness and behavioural change program, on bone density, body composition and functional power and performance in older adults. Method: 162 men and women (mean 67 years, range 59 to 86) at increased risk for falls and fractures were randomised to: 1) the 'Osteo-cise' exercise, education and behavioural program ($n=81$) or 2) a usual-care control group ($n=81$). Exercise consisted of high-velocity PRT, weight-bearing activities (60-180 impacts/session) and balance training 3 days per week for 12 months. All participants were given calcium-vitamin D supplements. DXA was used to assess total body fat mass (FM) and lean mass (LM), total body BMC and hip and spine BMD at baseline and 12 months. Lower limb and back one-repetition maximal muscle strength and functional power [stair climbing test] and performance [4-square test, functional reach, timed-up-and-go (TUG), sit-to-stand] were assessed at baseline, 6 and 12 months.

Results: A total of 150 participants (93%) completed the study and the groups were matched at baseline. Exercise attendance averaged 59%. After 6 months, there were significant exercise-induced improvements in back and leg muscle strength [net gains 13% and 12%, $P < 0.01$], which were maintained after 12 months. There was no effect of exercise on weight, LM or FM. However, exercise resulted in a significant net gain of 1.0% and 1.1% in femoral neck and lumbar spine BMD relative to controls (both $P < 0.05$). In addition, there were significant improvements in stair climbing power [net gain 4.7% (1.0, 8.4), $P < 0.05$], sit-to-stand [12.7% (6.0, 19.3), $P < 0.001$] and the 4-square balance test [0.4 sec (-0.7, -0.1), $P < 0.05$] after 6 months training. These benefits were maintained after 12 months, with a further 7% improvement observed in the sit-to-stand test. Conclusion: The 'Osteo-cise: Strong Bones for Life' multi-component community-based exercise program is effective for improving bone density, muscle strength and functional muscle power and performance in older adults at risk of fracture.

P. Cormie¹ ■ D. Galvao¹ ■ N. Spry^{2,3} ■ R. Newton^{1*} ■ ¹Edith Cowan University Health and Wellness Institute, Edith Cowan University

²Department of Medical Oncology, Sir Charles Gairdner Hospital ■ ³Faculty of Medicine, University of Western Australia

Introduction: Clinical guidelines advise patients with breast cancer related lymphoedema (BCRL) to avoid vigorous, repetitive or excessive upper body exercise. However recent evidence indicates that exercise does not appear to initiate/exacerbate BCRL. Resistance exercise has great potential to aid in the management of BCRL but little is known regarding the acute response of performing resistance exercises with the affected limb. The purpose of this study was to examine the acute impact of upper body resistance exercise intensity (heavier vs. lighter weights) on the amount of swelling and feelings of discomfort, pain, heaviness and aching in the arms of women with BCRL.

Methodology: 17 women aged 61±9 years with BCRL (defined as a bioimpedance spectroscopy [BIS] score of >10) participated in this study. Participants completed a high- and low-intensity exercise session consisting of 2-sets of 5-exercises in a randomised order separated by a 10-12day wash-out period. Lymphoedema status was assessed using BIS, arm circumference measurements and dual energy x-ray absorptiometry. The severity symptoms were assessed using the visual analogue scale and a modified brief pain inventory. Measurements were taken pre-exercise, immediately, 24hours and 72hours post-exercise.

Results: No change in lymphoedema status (i.e. BIS score, limb volume and circumference) or the severity of the symptoms was observed between pre-exercise and immediately-post, 24hours-post or 72hours-post exercise. No differences in the response to the high- vs. low-intensity exercise were observed.

Conclusions: Upper body resistance exercise does not acutely increase swelling or feelings of discomfort/pain, heaviness or aching in the affected limb of BCRL patients when performed at either high- or low-intensities. While future study is required to determine the long-term effect, it appears that BCRL patients can safely perform upper body resistance training without fear of exacerbating their lymphoedema. High-intensity resistance exercise induces larger benefits in healthy individuals and is therefore recommended for BCRL patients until further research is conducted.

K. Cox^{1*} ■ E. Kane¹ ■ V. Burke¹ ■ L. Beilin¹ ■ ¹University of Western Australia

Introduction: Home-based programs with minimal intervention that optimize physical activity (PA), fitness and health are an attractive strategy for older adults. Motivational interviewing has been used successfully in other settings. Its effect on PA has not been fully evaluated. We aimed to evaluate the short and long-term effect of a 6-month PA program and educational and counselling approaches on retention, adherence, PA and fitness of 50-80 year olds.

Methods: Healthy but sedentary participants (n=149) were recruited from the community and randomised to receive either a standard (SE) or behavioural education (BE) program, with standard counselling (SC) or motivational interviewing (MI). Participants were given a manual and attended an intervention specific workshop. Additional counselling was delivered via 4 phone calls over a 6-month period. The PA program comprised three 50-minute sessions/week of moderate intensity walking. Sessions were recorded in exercise diaries and returned fortnightly. After the initial 6-months, participants continued their PA for another 6 months with no further counselling. At baseline, 6, and 12 months PA stage and fitness (6-min walk) were assessed.

Results: Mean age of the group was 60.3 (± SD 7.1) years; 84% were women. Each group received similar numbers of telephone counselling calls, 3.98 (0.01). Retention rate (77% for SE versus 82% for BE; 82% for SC versus 79% for MI) at 6 months or 12 months (64% for SE versus 60% for BE; 61% for SC versus 62% for MI) did not differ significantly between groups. Adherence rates were similar across the groups (63% and 66% for SE versus BE and 66% and 63% for SC versus MI) for 6 months and 12 months (55% and 57% for SE versus BE and 58% and 54% for SC versus MI). PA stage improved from sedentary at baseline to 78% and 72% reporting doing regular PA at 6 and 12 months. Mean improvement in fitness was 4.8% and 5.7% after 6 and 12 months respectively with no between-group difference.

Conclusion: In these older adults, participation in a home-based physical activity program achieved high retention rates, modest adherence, an increase in the stage of PA participation and increased fitness in the short and long-term. The addition of a behavioural education program or motivational interviewing produced no additional benefit. These results demonstrate that a minimal intervention using telephone contact is effective in improving participation and performance of PA.

W. Payne^{1,2*} ■ J. Harvey² ■ S. Dharmage³ ■ ¹Victoria University ■ ²University of Ballarat ■ ³University of Melbourne

Introduction: High levels of physical inactivity contribute to diseases such as cardiovascular disease. Both physical inactivity and cardiovascular disease are particularly prevalent in first generation immigrants in Victoria, especially those from Southern Europe and South Asia. Among the largest foreign-born communities from these zones, which thereby represent the largest population-attributable risk in Victoria, are those from Italy and Sri Lanka respectively. This study set out to identify and quantify barriers and facilitators to participation in sport and physical activity (PA) by adult first generation members of the Victorian Italian and Sri Lankan migrant communities, and a reference sample of Australian born counterparts.

Methodology: 414 respondents aged ≥40 years (90 Italian-born and 95 Sri Lankan-born recruited through immigrant community organisations; 229 Australian-born randomly selected from the electoral roll) returned a mail-out self-completion form which included questions on participation in sport and PA and on factors affecting participation.

Results: Statistically significant and substantive differences between the migrant groups and/or the Australian-born sample ranged across participation patterns and all dimensions of the socio-ecological model. Some findings were as follows. Participation- sports club membership was significantly higher among the Australian-born than the immigrants; overall, golf and tennis predominated in this older segment of the population, while bocce predominated in the Italian community, and cricket in the Sri Lankan community. Intrapersonal- knowledge relating to PA and health was lowest among Italian-born; and self efficacy was lower in both immigrant groups than among the Australian-born. Interpersonal - conflict with cultural or religious expectations or beliefs, and conflict about clothes that should be worn, were more prevalent in the migrant groups than the Australian-born group. Environmental- fear of crime, fear of dogs, fear of traffic, street lighting, air quality, cleanliness, presence of other people, and type of terrain were all more important to both migrant groups than the Australian-born group. Institutional- lack of family-friendly facilities was a bigger issue for both migrant groups than for Australian-born, and affordability of facilities was more likely to be a barrier for Italian-born in particular. Public policy- migrant groups strongly supported government subsidizing PA participation costs, but there was less support for tailoring media PA promotion campaigns to particular ethnic groups. Conclusion: The findings of this study reinforce the importance of using a range of strategies taking account of all elements of the socio-ecological model. They have practice and policy implications, and will assist in developing interventions within particular migrant communities.

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Barriers, motivators and life experiences of physical activity for older home care clients

E. Burton^{1,2*} ■ G. Lewin^{1,2} ■ D. Boldy¹ ■ ¹Curtin University ■ ²Silver Chain

Introduction: Australia's ageing population is increasing, and the majority of older people have a desire to live independently in their own home for as long as possible. Being mobile and maintaining strength and balance are important contributors to remaining independent. The aim of this study was to identify and explore levels of, and barriers and motivators to, physical activity between older home care clients who have participated in a restorative home care program which includes a focus on increasing lifestyle activity, and home care clients who have received 'usual' home and community care (HACC) services.

Method: A random sample of 745 clients who received a restorative service and 745 who received HACC were invited to complete a survey. On completion of the survey participants could identify themselves and consent to involvement in a semi-structured interview. Twenty interviews were conducted to provide further insight into the reasons for being physically active and inactive, and the activity choices of clients across their life. Survey data were summarised using descriptive statistics and analysed using t-tests and chi-squares to identify significant differences between the groups.

Results and Conclusion: Older individuals who had participated in a restorative home care program were more active than similar individuals who had received 'usual' home care. While it was not, because of the nature of the study design, possible to attribute the difference directly to the restorative intervention, the fact that these clients also identified more reasons for being active as they aged, at the very least, supports a link between an understanding of the benefits of exercise and being more active. The main barriers to being physically active for both groups were having an 'ongoing injury/illness' and 'feeling their age/or too old'. The main motivators for being active were for 'health and fitness' and 'wellbeing'. Physical activity experiences of interviewees included minimal structured sport during their childhood due to a lack of facilities and opportunity. As a result, perhaps, the activities they determine as being physically active in later life include walking and exercise through daily activities such as housework, shopping and gardening. Understanding the benefits of activity and that many study participants saw age as a significant barrier indicates the need to raise community awareness and promote the benefits of staying as active as possible, at an individual level. Exercise programs for this age group may be more successful if designed around each person's usual life tasks.

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Long-term effects of 6-months of home-based physical activity and counselling on the mental health of older adults The MOVES Study

K. Cox^{1*} ■ E. Kane¹ ■ V. Burke¹ ■ M. Phillips¹ ■ L. Beilin¹ ■ ¹University of Western Australia

Introduction: Physical activity (PA) interventions designed to improve the mental health of healthy adults have shown inconsistent results. Our aim was to evaluate the effect of a home-based PA program and 2 educational and counselling approaches on the mental health of older adults.

Methods: Healthy, sedentary participants aged 50-80 years (n=149) were recruited from the community. They were randomly allocated to either a standard (SE) or behavioural education (BE) program, with standard counselling (SC) or motivational interviewing (MI). All participants received a home-based PA program comprising of three 50-minute sessions/week of moderate intensity walking for 6 months. During the initial 6-months they received telephone counselling relevant to their group. After 6 months participants continued their PA program without further counselling. Mental health outcomes assessed by questionnaire at baseline, 6 and 12 months included perceived stress; state and trait anxiety and self esteem. Results: Anxiety and stress showed significant reduction during participation in the exercise program, with similar rates of change over the 12 month periods for the MI and SC groups. Perceived stress fell by 0.2 units/month ($p < 0.001$) for all participants over 12 months. The magnitude of the difference in stress between the groups at baseline was maintained over time and this became significant as a consequence of the larger number of observations and greater power of the longitudinal mixed model analysis. The MI group had an average of 1.8 units ($p < 0.05$) higher stress than SC over 12 months. Similarly, state anxiety fell in both groups by 0.15 units/month which was significant over 12 months ($p < 0.05$) but not 6 months. The MI group had an average 2.5 units higher state anxiety than SC over 12 months ($p < 0.05$) but the rate of change was not significantly different between them. Trait anxiety fell in both groups by 0.12 units/month ($p < 0.01$) over 12 months with no difference between groups. There was a significant difference between the two groups for self-esteem when observed over 12 months, with a reduction in the motivational counselling group and an increase in the standard counselling group ($p < 0.05$).

Conclusion: A home-based moderate walking program resulted in reduced perceived stress in the short and long-term and long-term state and trait anxiety. Self esteem was lower with MI in the long-term. Motivational interviewing did not confer any additional improvements in mental health to that of standard counselling. The MI approach may undermine self-esteem in older adults.

30 Exercise is medicine for chronic disease management

INVITED

R. Newton^{1*} ■ ¹School of Exercise and Health Sciences, Edith Cowan University

We have now accumulated extensive evidence, both research and clinical, demonstrating physical exercise as a powerful medicine for the prevention and management of all chronic diseases. As a result a multi-organisational, multi-national initiative was launched by the American College of Sports Medicine and the American Medical Association in 2007 to promote integration of exercise prescription into mainstream medical care. In 2011, Exercise is Medicine® was launched in Australia by Exercise and Sports Science Australia. This presentation details current knowledge and practice of exercise medicine in a range of diseases. For example, being physically active results in a 20%, 30%, 50%, and 70% reduction in risk of lung cancer, breast cancer, colon cancer and prostate cancer respectively. Up to 50% of patients could be prevented from progressing to Type II diabetes if they met physical activity guidelines. Dementia and in particular Alzheimer's disease progression is markedly slowed by appropriate exercise. Exercise is now deemed a critical adjuvant treatment in the management of cancer. Breast cancer survivors halve their risk of dying if they can meet a relatively modest exercise dosage and colorectal cancer patients can increase their disease free survival by 55%. Researchers recently reported 61% lower risk of prostate cancer death if men completed more than three hours per week of vigorous activity. It is now well established that cardiorespiratory fitness is the principal predictor of all-cause mortality and that neuromuscular fitness (strength) is an important predictor of metabolic syndrome and functional ability. The current focus on overweight and obesity by government and the health professions is misguided and not supported by the research evidence. Physical inactivity and the resulting low fitness should be our greatest concern and the target of our research and clinical efforts to stem the increasing incidence of chronic disease. "Fitness not fatness" should be our mantra as rigorous research clearly demonstrates that normal weight people who are sedentary are at far greater risk of morbidity and mortality than overweight people who are physically active and fit. We will explore these research studies and their implications in depth.

31 The relationship between pre-season musculoskeletal screening and injury rates in junior Australian Rules Football players

H. Anderson^{1*} ■ M. Magarey¹ ■ A. Esterman¹ ■ M. Heynen² ■ ¹University South Australia ■ ²Port Adelaide Football Club

Introduction: In 2009 the SANFL introduced a new injury surveillance system to better establish the impact of injury in the Under 18 league. Through the use of a Player Movement Record and associated Injury Report Form data regarding injury incidence, prevalence and mechanism was collected in an ongoing format (database). This provided an optimum opportunity to test the predictive validity of the standardised AFL screening protocol in a junior cohort of Australian Rules Football players and establish trends between the patterns of injury and musculoskeletal data.

Aim: To establish the relationship between results of a pre-season musculoskeletal screening and injury rates in a cohort of Under 18 SANFL players across two consecutive seasons (2010 – 2011).

Methodology: In the pre-season training period of the 2010 and 2011 SANFL football seasons approximately 450 Under 18 SANFL players underwent a musculoskeletal screening. The testing protocol was derived from the standardised AFL screening protocol. The tests included were standing lunge, single leg squat, single leg balance, modified Thomas test (quads), modified Thomas test (hip flexor), hip impingement, hip rotation, squeeze test, single leg hamstring bridge and single leg calf raise. All tests were carried out by qualified physiotherapists and post-graduate sport physiotherapists in adherence to the standardised protocol. Vocal encouragement and correction of technique was provided but players were not provided with feedback regarding their results. All physiotherapists underwent inter-rater and intra-rater reliability testing to ensure quality of results. Each group of players were then monitored through the corresponding season (2010/2011) using the injury surveillance system described previously.

Results and Conclusion: The study is currently ongoing and results will be available by August. A model for the relationship between musculoskeletal screening data and injury rates will be developed on the basis of the 2010 season data and then tested against the data for 2011 season. Should the paper be accepted all results and conclusions would be included in the final presentation.

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The epidemiology of injuries and the relationship between injury rates and pre-season training performance in an elite junior Australian Rules Football cohort

S. Chalmers^{1*} ■ M. Magarey¹ ■ E. Scase¹ ■ M. Heynen^{1,2} ■ A. Esterman¹ ■ ¹University of South Australia ■ ²Port Adelaide Football Club

Introduction: The aim of the research was to establish the injury profile for the 2010 South Australian National Football League (SANFL) competition and to investigate the relationship between injury rates and pre-season training performance.

Methodology: In partnership with all nine SANFL U18 league clubs, injury and fitness test data was collected prospectively throughout the 2010 season. Every player registered for a U18 SANFL squad was invited to participate (n=533). Similar to the methodology of the Australian Football League (AFL) injury surveillance program, injury data was collected through the use of a 'Player Movement Record' and a standardised Injury Reporting Form. The chosen fitness tests of standing/running vertical jump, 5,10 & 20-m sprints, AFL unique agility and the multi stage shuttle run were an AFL recommended battery of tests.

Results: 394 players consented to participate in the injury surveillance study. The 2010 study results were compared to the 2009 SANFL U18 injury surveillance data. There were a total of 204 injuries (187 new injuries and 17 recurrent injuries). The key injury indicators of the 2010 injury surveillance program were injury incidence (19.0/club), recurrent injury incidence (1.8/club), injury prevalence (65.8 missed games/club) and average injury severity (3.2 missed games/injury). The most frequent specific injury type was 'ankle sprains or joint injuries' (2.5/club) whilst the main injury mechanism was identified to be 'collision with player' (15.3% of injuries). 203 players (51.5%) from the injury surveillance study were eligible for inclusion in the analysis of fitness test results and injury status. The left foot running vertical jump approached statistical significance for predicting 'overall injury status' (p=0.059), irrespective of specific injury type.

Conclusions: The research established the injury profile of an elite junior Australian Rules Football cohort, for which there is limited available research. The injury incidence of the 2010 SANFL U18 cohort (19.0/club) was similar to the 2009 cohort (17.1/club), however, the elite senior AFL competition records a much greater rate (37.6/club). In agreement with previous literature and the 2009 SANFL U18 profile, the injury profile highlighted the high incidence of ankle injuries in junior players. Although the left foot running vertical jump test approached statistical significance for predicting injury, this result is most likely an anomaly, with no clinical significance. On the basis of this study, it seems fitness testing cannot predict injury in junior elite Australian Football players, however, further research is necessary to confirm this conclusion.

The predictive validity of a single leg bridge test for hamstring injuries in football players

G. Freckleton^{1*} ■ T. Pizzari¹ ■ J. Cook² ■ M. Young³ ■ ¹School of Physiotherapy, La Trobe University ■ ²Monash University ■ ³North London High Performance Centre

Introduction: Hamstring muscle strain injury (HMSI) is the biggest injury problem in the Australian Football League (AFL). Hamstring injuries were the most prevalent injury during the 2009 season, with 7.1 new injuries per club in the 2009 season and 17% of athletes who sustained a hamstring injury suffering a recurrent strain in the same year. A recent systematic review and meta-analysis conducted by the investigators discovered quadriceps peak torque, increasing age and previous history of HMSI to be risk factors for HMSI, while limb dominance, playing position, ethnicity, dorsiflexion range of motion (ROM) and previous knee injury had inconclusive evidence. Screening of risk for hamstring tears is limited and it has been proposed that the single leg hamstring bridge test could be a useful screening test in Australian Football. This research aims to determine if a single leg bridge test can predict the risk of HMSI in amateur and sub-elite Australian Football players.

Method: The project is a prospective cross-sectional design that includes 488 football players (mean age=20.7 yrs, range=16-34). All players performed the single leg bridge test during the 2011 preseason and are currently being monitored during the playing season for the incidence of a HMSI and any recurrences. The single leg bridge test involved the player placing one leg (slightly bent) onto a 60cm height box and performing repetitions of a bridging motion with full hip extension of the test leg until failure. Univariate analysis using odds ratio and 95% confidence intervals will be used to predict independent risk factors for HMSI.

Results: Mean single leg bridge repetitions for the group were: left leg 26.1 (SD=10.1), right leg 25.7 (SD=9.8). Players with previous right-sided HMSI (n=64) recorded significantly less repetitions on the right leg (p<0.01) and those with previous left-sided HMSI (n=60) recorded significantly fewer repetitions of the left (p<0.01). The predictive validity of the single leg bridge test will be calculated and presented at the conference once the incidence of HMSI is known at the conclusion of the current season.

Conclusion: The single leg bridge test is a screening test promoted in Australian Football as a simple method of identifying hamstring strength deficits and potentially predicting the likelihood of sustaining a HMSI. This research will shed light on the predictive validity of the test.

Injuries at Western Australian Football League Club in season 2010 – a review of reporting system and effectiveness injury management processes

B. Piggott^{1*} ■ B. Raysmith² ■ ¹University of Notre Dame ■ ²Australian Institute of Sport

The Western Australian Football League (WAFL) is a semi-professional competition comprising of nine clubs. The competition involves twenty three rounds plus a finals series in addition to pre-season games. It is common practice for teams to commence pre-season training in early to mid-November and as a result, players complete football skills, conditioning and weight training related activities for a minimum of forty weeks of the year. In addition to the training loads, the majority of players are working, studying or engaged in a combination of both. It is a demanding schedule, and for a team to be successful it is vital to have as many players free from injury and available for selection each week. There is a large amount of published research on injury rates among elite Australian Football League (AFL) Clubs. There is, however, a dearth of literature at the sub-elite level.

Purpose: The purpose of the research is:

- to develop a model of reporting on the injury incidence throughout the playing season at a WAFL Club;
- to investigate the effectiveness of the current training schedule and support service structure in terms of injuries incidence and management

Methods: Injury statistics were collated weekly and categorised by body area using the same method as the Australian Football League. Games missed, recurrence rates and average games missed per player were also recorded.

Results: Throughout the 2010 WAFL playing season, there were 56 players on the senior list. A total of 35 new injuries were recorded and each injury resulted on average of 3.5 games being missed. The most common area of the body to sustain injury was the hip/groin/thigh area with 11 new injuries recorded including 5 hamstring strains.

Conclusion: The model developed is effective for tracking injury data at a sub-elite level. Similar to the elite level of Australian Football League (AFL) the most common injuries in WAFL are to the hamstring and groin related areas. Key areas for effective management of injuries at sub-elite level are the attendance of physiotherapists, doctors and other service providers on game day and at the first training session post game. Effective and efficient communication methods between key stake holders are also critical for effective injury management.

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Is sports safety policy being translated into practice: What do community rugby union coaches know and do about the Mayday procedure?

A. Donaldson^{1*} ■ R. Poulos² ■ J. Searl³ ■ M. Johnston³ ■ ¹Australian Centre for Research into Injury in Sport and its Prevention (ACRISP)

²School of Public Health & Community Medicine, University of New South Wales ■ ³Australian Rugby Union

Introduction: In an endeavour to reduce the risk of neck and spinal injuries among rugby players, the Australian Rugby Union (ARU) introduced the "Mayday" procedure as a "a safety technique put into operation when a player believes that he/she is in a potentially dangerous position in a scrum." It is now included in the ARU Medical and Safety Recommendations and is part of the compulsory SmartRugby training for every coach and referee. This project investigated the level of translation of the "Mayday" procedure into practice among community rugby coaches in New South Wales (NSW) (Australia).

Methods: All (n=179) registered coaches of senior community rugby teams in five zones/associations in the north-eastern NSW were invited to complete an online questionnaire at the end of the 2010 rugby season. The questionnaire was designed around the RE-AIM framework and assessed: reach; perceived effectiveness; adoption, implementation and maintenance of the Mayday procedure.

Results: Seventy (39% response rate) coaches participated but not all answered every question. All coaches indicated awareness of the Mayday procedure but, even though 94% reported attending Mayday procedure training, many were unable to adequately describe the six key Mayday procedure steps for players. Most coaches (74%) believed the Mayday procedure was completely or very effective in preventing injuries and 93% reported training their players in the procedure, albeit infrequently. Coaches were generally confident that their players could implement the Mayday procedure appropriately if required to do so. Most coaches indicated an intention to train their players in the Mayday procedure during the 2011 pre-season (89%) and regular season (94%). Barriers to, or difficulties experienced by, coaches providing Mayday procedure training to players included: not enough players at training; players not taking training seriously; and technical difficulties (e.g. verbalisation of instructions for physical tasks).

Conclusion: The findings of this study suggest that the translation of the Mayday safety procedure has moved beyond the awareness (reach) phase and is well into the adoption, implementation and maintenance phases. However, closer inspection of the findings suggest that translation lacks fidelity and could be improved by building coach, club and zone capacity by: ensuring coaches have the skills, resources and abilities in 'how' to train their players to complement their knowledge on 'what' to train them; setting expectations (through policy) that encourage coaches to provide regular Mayday training for players; and to regularly monitor player competency (via referees) to perform the procedure appropriately.

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Spines in Line – A review of the scrum engagement laws

P. Milburn^{1*} ■ A. Chong² ■ C. Kersten³ ■ T. Winkel³ ■ R. Newsham-West¹

¹School of Physiotherapy & Exercise Science, Griffith University ■ ²University of Southern Queensland ■ ³Raboud University, The Netherlands

There is growing evidence of degeneration in the lumbar and cervical spines in rugby players, particularly those involved in the 'tight' positions in the scrum, where players are exposed to high and sustained compressive and torsional forces coupled with lateral shearing. Furthermore, there is concern referee management of scrums is pedantic, results in re-set scrums, which may exacerbate this exposure. The aim of this study was to measure the compression and three-dimensional changes in alignment of the spines of rugby forwards using a novel close-range photogrammetric technique. The measurement accuracy is ± 0.4 mm within a 800mm x 600mm x 400mm volume. The spines were assessed during scrummaging (i) in the 'set' scrum position prior to engagement, (ii) the 'touch', (iii) during the engagement impact, and (iv) during the 'second-shove' phase of the scrum with players pushing against an instrumented scrum machine. Previous research has shown that when players were tested for their ability to generate forward force in a scrum, the sum of individual players' maximum forward force was 1.75 tonnes (1.75kN), which is more than three times that recorded for a full scrum. In the present study, substantial changes in the dimensions and shape of the thoracic and lumbar spines were found under compressive loading and included translation and rotation, along with buckling. Of particular interest was the observed realignment of props prior to engagement and the confusion that surrounded the 'touch' call and the need to realign their bodies for engagement. The relevance of the touch phase in the rugby union scrummaging needs to be reviewed as it appears to cause as many problems as it potentially helps. Also, players were aligned differently in the shoulder and spine depending on whether they had the feed to the scrum. While this study examined only a limited number of players against a static scrum machine, these results indicate that a considerable proportion of the force in the scrum is dissipated in the elastic and compressive components of the spine, as well as being 'lost' to less efficient lateral and vertical components of force. This is consistent with the early onset of degenerative changes in the cervical and lumbar spines of rugby players that could be attributed to the repetitive spinal trauma experienced throughout players' careers.

D. Mendis^{1,2*} ■ S. Wilson² ■ D. Hayes³ ■ M. Watts³ ■ J. Hides¹ ■ ¹Australian Catholic University ■ ²University of Queensland ■ ³Brisbane Orthopaedic and Sports Medicine Centre

Introduction: Acetabular labral tears are increasingly diagnosed as a source of hip pain in active individuals who participate in sports involving repetitive hip flexion or twisting. The hip flexor muscles contribute to hip joint stability and function. Hip joint stability is known to be compromised with a tear of the acetabular labrum but it is unknown if hip flexor muscle size and function is affected by the presence of labral pathology. Deep muscles that directly cross a joint are thought to atrophy with joint pathology and previous research has found atrophy of the deep hip abductor muscles in hip joints with osteoarthritis. Therefore, this study aimed to investigate hip flexor muscle size and strength in patients with hip labral pathology compared to control subjects. **Methods:** 12 participants (8 females, 4 males), aged 20 to 53 years, with a unilateral acetabular labral tear were recruited from an orthopaedic practice prior to undergoing hip arthroscopy. 12 control participants matched for age and gender were recruited from a general university population. All participants underwent examination of their lumbo-pelvic region with magnetic resonance imaging. Muscle cross-sectional area (CSA) of the iliopsoas, sartorius, tensor fascia latae and rectus femoris muscles on both sides were measured and added together to give hip flexor muscle size. Hip flexion strength was measured on both sides by a hand-held dynamometer.

Results: No difference between groups or sides was found for hip flexor muscle size. There was a significant effect of Gender, with hip flexor muscle size found to be larger in the male subjects. A significant difference between sides and groups was found for hip flexor muscle strength. Strength was reduced on the injured side compared to the non-injured side of patients with a hip labral tear. Strength of the injured side in the labral tear group was also less than the corresponding side in the control group.

Conclusions: Decreased hip flexor muscle strength but not size was found in patients with hip labral pathology. These changes suggest that hip flexor muscle control or activation may be affected by joint pathology and further work should investigate this. Clinical rehabilitation of these patients may need to include strengthening exercises for the hip flexor muscles.

D. Hopper^{1*} ■ T. Walmisley¹ ■ P. Tucker² ■ ¹Curtin University, School of Physiotherapy ■ ²West Coast Eagles

Objectives: Firstly, to determine whether there is a difference in adductor muscle length and relative adductor strength in AFL players with and without groin injury. Secondly, to establish whether age, previous injury or kicking leg predict groin injury in AFL players.

Design: Longitudinal repeated measures conducted over 12 months (pre-season, early, mid and late season, post-season).

Participants: 33 players from one professional AFL club.

Methods: A Bent Knee Fall-Out test measured adductor length and a sphygmomanometer pressure cuff recorded relative adductor strength over 12 months. Two separate within subjects ANOVA with five different time-frames and between subjects (injured and uninjured) were used to assess adductor length and relative adductor strength in AFL players. A logistic regression model was used to predict groin injury.

Results: No significant difference occurred between the uninjured and injured players adductor muscle length but there was a significant decrease in adductor length over time in both groups ($p = 0.003$; $p = 0.007$; $p = 0.001$). Relative adductor strength was significantly lower in the injured players ($p = 0.002$) and was significantly different between early and pre-season and early and mid-season in each of the groups ($p = 0.004$; $p = 0.001$).

A player with previous history of groin injury was 21.4 times more likely to sustain a subsequent groin injury. ($p = 0.007$).

Conclusions: Previous history of groin injury predicts groin injury in AFL players.

SYMPOSIUM

S. Watt^{1*} ■ D. Mullaly^{1*} ■ P. Harcourt^{2*} ■ ¹Australian Sports Anti-Doping Authority ■ ²Australian Sports Medical Advisory Committee

Anti-doping authorities around the world are discovering new doping technologies and methods available to athletes. Athlete support personnel play a vital role in counselling and advising Australian athletes against the risks of doping in sport. To optimise the health and wellbeing of Australian athletes, athlete support personnel need to be aware of the latest developments in doping technology and their rights and responsibilities within the broader anti-doping landscape.

The Australian Sports Anti-Doping Authority and the Australian Sports Drug Medical Advisory Committee are in unique positions to inform athlete support personnel on new and developing risks for athletes. In order to enhance the athlete support person's ability to assist in preventing doping by athletes this workshop will cover several contemporary issues including:

- key global scientific developments in anti-doping;
- clarification and an outline of the official position in relation to the rights and responsibilities of athlete support personnel under Australian sport's anti-doping policies;
- practical considerations and assistance for athlete support personnel from the perspective of the Australian Sports Drug Medical Advisory Committee;
- changes to prohibited substances and methods that will impact athlete support personnel in the lead up to the 2012 London Olympic and Paralympic Games;
- an outline of key changes proposed for the next iteration of the World Anti-Doping Code to come into effect in 2013; and
- an opportunity for athlete support personnel to discuss practical aspects surrounding the prevention of doping with members from the relevant anti-doping authorities.

During the workshop information will be presented from recently formed global anti-doping networks with athlete support personnel able to provide feedback and perspectives related to their practical experience.

A. Spence^{1*} ■ H. Carter¹ ■ L. Naylor¹ ■ L. Dembo² ■ K. George³ ■ D. Green^{1,3}¹University of Western Australia ■ ²Royal Perth Hospital ■ ³Research Institute for Sport and Exercise Sciences, LJMU

Introduction: Understanding cardiac adaptation to exercise is fundamental to our comprehension of human physiology. The "textbook wisdom" that endurance and resistance exercise induce eccentric hypertrophy and concentric remodeling, respectively, is in fact based on a number of assumptions associated with limitations of between-subjects comparisons when comparing athlete groups, poor imaging technologies and inappropriate scaling methods. A particularly contentious issue is the impact of resistance training on cardiac morphology. We present the first prospective, longitudinal randomised study examining the impact of divergent exercise training modalities on indices of cardiac morphology utilising MRI technology.

Methods: Healthy male subjects were randomised into two training groups, aerobic (AER, n=10) or strength (STR, n=13) and completed an intensive, progressive exercise training intervention for 6 months. Measures were taken at baseline, following training and following 6 weeks of detraining. Subjects attended three 1 hr fully supervised sessions per week and compliance was 81%. Cardiac morphology was assessed with MRI, body composition with DXA, aerobic fitness using a graded exercise test and muscular strength using 1RM.

Results: $\dot{V}O_{2\max}$ significantly improved in AER (45.8 to 49.3 mL.kg.min⁻¹, $P<0.05$) but was unchanged in STR. Muscular strength significantly improved in both groups, but to a significantly greater extent in STR (27.3±4.6 vs. 37.5±4.9%, $P<0.001$). Although total fat mass did not significantly change, total lean mass increased in both groups (STR: 59.7±2.35 to 62.0±2.2kg, $P<0.001$, AER: 56.9±2.9 and 58.3±3kg $P<0.05$). Left ventricular mass (LVM) increased significantly following AER (112.8±7.4 to 122.7±6.6g, $P<0.01$) but not in STR (126.8±7.7 to 130.8±6.5g NS). Similarly, end diastolic volume (EDV) increased by 3-fold more in AER (134.1±7.9 to 143.1±7.8mL, NS) compared to STR (147.1±7 to 150.2±7.1mL, NS), although neither change achieved statistical significance. Following detraining, aerobic fitness returned to baseline in AER, whereas both LVM and EDV remained elevated.

Discussion: This study is the first to incorporate highly accurate MRI technology to assess cardiac morphological adaptation to exercise using supervised intensive longitudinal exercise interventions. In contrast with textbook dogma, we observed no evidence in healthy, young and relatively inactive subjects to support the notion that resistance training induces concentric cardiac hypertrophy. Our data are consistent with previous echocardiographic evidence which suggests that endurance training results in increased LVM and EDV, although echo data underestimates LVM relative to MRI possibly exaggerating the magnitude of this effect. These adaptations were maintained for 6 weeks following exercise cessation. In conclusion, endurance exercise induces cardiac morphological adaptations whereas resistance exercise does not, despite the presence of physiological adaptations in strength and body composition. Our data overturns previous assumptions that have been widely adopted in the literature.

D. Galvao^{1*} ■ D. Taaffe² ■ N. Spry³ ■ D. Joseph³ ■ R. Newton¹ ■ ¹Edith Cowan University Health and Wellness Institute, School of Exercise, Biomedical and Health Sciences, Edith Cowan University ■ ²School of Environmental and Life Sciences, University of Newcastle ■ ³Sir Charles Gairdner Hospital, Radiation Oncology

Introduction: Exercise has been proposed as an effective countermeasure for androgen suppression therapy (AST) induced side effects. Given that the magnitude of fat gain and muscle loss are most pronounced during the early phases of AST, it is possible that the exercise response may differ according to the duration of AST. We investigated whether the exercise response might vary according to the prior length of exposure to AST; acute (<6 months) versus later (≥6 months).

Methods: Fifty men (55-84 years) undergoing AST for non-bone metastases prostate cancer completed a progressive resistance and cardiovascular exercise program for 12 weeks - acute (n = 16) or chronic AST exposure (n = 34). The resistance exercises included 8 exercises and was designed to progress from 12 to 6-repetition maximum for 2 to 4 sets per exercise. The aerobic component of the training program included 15 to 20 minutes of cardiovascular exercises (cycling and walking/jogging) at 65-80% maximum heart rate and perceived exertion at 11-13 (6-20 point, Borg scale). Fat and lean mass (dual-energy X-ray absorptiometry), muscle strength, functional performance, quality of life, and blood biomarkers were assessed.

Results: Acute AST patients showed an increase in total body fat (0.9 kg, $p=0.018$) compared to chronic AST although both groups experienced an increase in appendicular skeletal muscle (~0.5 kg, $p<0.01$). Triglycerides decreased in the chronic and increased in the acute AST groups ($p=0.027$) with change in triglycerides associated with change in total body fat ($r=.411$, $p=0.004$). There were no differences between groups for PSA, testosterone, glucose, insulin, total cholesterol, LDL and HDL cholesterol, CRP, homocysteine or quality of life and both groups showed similar improvement in muscle strength and function, and cardiovascular fitness.

Conclusions: Apart from differences in body fat and triglycerides, the beneficial effects of exercise are similar in patients on acute or chronic AST. These results suggest that exercise training should be initiated when AST commences to enhance physical function, and improve the patient's acceptance of hormone therapy. Future trials are warranted examining the role of physical exercise implemented at the onset of androgen suppression therapy on physical and physiological function, as well as quality of life.

E. Howden^{1,2,3*} ■ R. Leano^{2,3} ■ W. Petchey^{2,3,4} ■ N. Isbel^{2,3,4} ■ J. Coombes^{1,3} ■ T. Marwick^{2,3}¹School of Human Movement Studies, University of Queensland ■ ²School of Medicine, University of Queensland³Centre for Clinical Research Excellence – Vascular and Metabolic Health, University of Queensland ■ ⁴Department of Nephrology, Princess Alexandra Hospital, Brisbane

Introduction: Myocardial dysfunction is common in patients with chronic kidney disease (CKD). Cardiovascular event rate is high in this population and effective management strategies are lacking. Therefore we sought to determine effect of a lifestyle intervention that included exercise training on myocardial function in patients with CKD.

Methods: Eighty four patients, stages 3-4 CKD were randomised to either standard medical care (control) or lifestyle intervention (LI). LI involved 8 weeks of gym-based individualised exercise training under supervision of an accredited exercise physiologist followed by home based training with ongoing telephone support and gym refresher sessions for the remaining 12 months. In addition, patients attended 4 week behaviour and lifestyle change program led by a psychologist and dietician. LI included access to multidisciplinary care through a nurse practitioner led CKD clinic,

which included a nephrologist, social worker and diabetes educator. Myocardial function was assessed at baseline and 12 months using standard echocardiography techniques and tissue doppler-derived myocardial velocities. Anthropometric, biochemical and fitness data were collected at both time points. Data was analysed by intention to treat with effect of intervention compared to controls determined using analysis of covariance (ANCOVA). Results: 12 patients were lost to follow-up (LI=34, control =38). Baseline characteristics were similar ($p>0.05$) between groups (LI = 67% male, age 60.7 ± 9.1 , eGFR 39.4 ± 8.9 ; control = 56% male, age 58.7 ± 10.5 yrs, eGFR 39.7 ± 8.8). There were no baseline differences (Table 1). The intervention resulted in a significant 13.3% increase in exercise capacity, with decreases in weight and BMI in LI group. This group also showed improved diastolic function (increased E'). There was no significant change in systolic function or blood pressure. There were no changes in any biochemical parameters between groups.

Conclusion: The lifestyle intervention significantly improved exercise capacity and diastolic function in CKD patients. Lifestyle and exercise interventions may assist in managing the deleterious effects of reduced kidney function on the myocardium.

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Fitness and body composition: Which factors influence heart morphology?

C. Buck^{1*} ■ A. Spence¹ ■ H. Carter¹ ■ L. Dembo² ■ L. Naylor¹ ■ D. Green^{1,3}

¹University of Western Australia ■ ²Royal Perth Hospital ■ ³Research Institute for Sports and Exercise Sciences (Liverpool)

Background: There is considerable inconsistency regarding the methods used to scale cardiac morphology for the influence of body size in studies investigating the Morganroth hypothesis. This has led to disparities on observations and the interpretation of data on athlete's heart. It has been suggested that body composition and cardiorespiratory fitness level are between participant factors that influence cardiac morphology. However, very little research has been done on body composition and fitness as cardiac morphology scaling factors. Therefore, we investigated the relationships between body composition, fitness and cardiac morphology to provide a starting point for future research on cardiac scaling.

Methods: Fitness level, cardiac morphology and body composition was assessed in 25 recreationally active males (mean 27 years, range 20-36). Fitness was assessed in response to a maximal incremental treadmill exercise test, cardiac morphology using cardiac magnetic resonance imaging and body composition using dual-energy X-ray absorptiometry. Pearson correlations were performed between all variables and backwards regression analysis was used to assess the influence of body composition, body surface area (BSA) and fitness on left ventricular cardiac morphology. Results: Left ventricular mass at end diastole (LVMed) was significantly correlated with $\text{VO}_{2\text{peak}}$ ($r=0.73$, $p<0.01$), lean body mass (LBM) ($r=0.83$, $p<0.01$) and fat mass ($r=0.46$, $p<0.05$). Regression analysis revealed that total LBM was a more significant contributor to LVMed ($t=7.19$, $p<0.01$) and left ventricular end diastolic volume (LVEDv) ($t=3.22$, $p<0.01$) than BSA, fat mass and fitness. Analysis of regional components of body composition showed that LBM located around the hips and thighs (gynoid LBM) had the strongest correlation to LVMed ($r=0.84$, $p<0.01$), whilst the LBM of the legs had the strongest correlation to LVEDv ($r=0.86$, $p<0.01$).

Conclusion: Fitness, fat mass, BSA and total LBM were all significantly correlated to LVMed. However, total LBM was the most significant contributor to cardiac morphology. Furthermore, gynoid and leg LBM were identified as stronger correlates to cardiac morphology than total LBM. Together these findings indicate that LBM located specifically in the gynoid and leg region may be the most appropriate scaling factors for cardiac morphology. Thus, scaling cardiac morphology by leg LBM may be particularly useful in resolving some of the disparities observed in studies investigating the Morganroth hypothesis. A potential physiological explanation for the strong relationship between LBM and cardiac morphology is likely to come from the strong influence of the muscle component of LBM on blood flow and hemodynamic loading of the heart.

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The effects of eccentrically-biased versus conventional resistance training in older adults

I. Selva Raj^{1*} ■ S. Bird¹ ■ B. Westfold¹ ■ A. Shield² ■ ¹RMIT University ■ ²Queensland University of Technology

Introduction: We hypothesised that eccentrically-biased resistance training (ECC) would lead to greater strength, muscle architectural and functional gains than conventional training (CONV) in older adults.

Methods: Twelve participants were randomly assigned to CONV (seven males and five females; mean age 67.8 years, range 60-74), 13 to ECC (eight males and five females; mean age 68.2 years, range 60-75) and 13 to wait-list control (7 males and 6 females; mean age 66.5 years, range 60-74). Training was performed twice a week for 16 weeks. Exercises were leg press, toe press, bench press and latissimus pulldown. Participants in ECC performed three sets of 10 bilateral concentric lifts at 50% of one repetition maximum (1RM). Following each concentric lift, the eccentric phase was performed unilaterally, alternating between each leg or arm with each repetition, thus performing five unilateral eccentric contractions in each set. Participants in CONV performed two sets of 10 bilateral eccentric and concentric lifts at 75% of 1RM. Rating of perceived exertion (RPE) was recorded after each set. Isometric and concentric knee extensor strength was assessed on an isokinetic dynamometer from 0°/s to 360°/s. Vastus lateralis (VL) and gastrocnemius medialis (GM) muscle architecture (fascicle length, pennation angle and thickness) was assessed using ultrasonography. The six-metre fast walk test (6MFWT), timed up and go test (TUG), stair climb and descent power, and vertical jump were used to assess functional capacity. Results: Training increased strength at 60°/s ($p<0.05$) and 120°/s ($p<0.01$) in both training groups (6-8%). Isometric strength and strength at fast contraction speeds (240°/s and 360°/s) only increased ($p<0.05$) in ECC (7, 5 and 11% respectively). Training improved performance in the 6MFWT in both training groups ($p<0.01$) by 5-7%. TUG and vertical jump performance improved in CONV ($p<0.01$) by 5% and 7% respectively. Stair climb performance improved in ECC ($p<0.01$) by 5%. VL thickness increased ($p<0.05$) by 5% in ECC. RPE was lower in ECC than CONV for bench press ($p<0.05$) and latissimus pulldown ($p<0.01$).

Conclusions: The improvement in strength at fast contraction speeds in ECC means that this modality may be more effective than CONV when seeking to improve performance at tasks requiring fast contractions such as recovering from a trip. It is inconclusive as to which modality is more effective at improving function. ECC may be more effective at increasing muscle mass than CONV. The lower RPE in ECC may make it preferable to CONV for older adults.

M. Mohamed^{1,2,6} ■ S. Selig^{2,5*} ■ G. Jerums³ ■ D. Hare² ■ I. Levinger^{1,2} ■ ¹School of Sport and Exercise Science, Institute of Sport, Exercise and Active Living (ISEAL), Victoria University ■ ²Department of Cardiology, Austin Health, Melbourne ■ ³Department of Endocrinology, Austin Health, Melbourne ■ ⁴Department of Medicine, University of Melbourne ■ ⁵School of Exercise and Nutrition Sciences, Deakin University ■ ⁶Sport Medicine Unit, Medical Faculty, University of Malaya, Kuala Lumpur, Malaysia

Background: Exercise training improves glycaemic control in people with T2D. To date many studies excluded high risk patients, such as those with symptomatic cardiovascular disease (CVD). The aim of the current study was to examine the effects of combined aerobic and resistance exercise training on glycaemic control and other clinical measures in patients with T2D complicated by CVD.

Methods: twenty-eight men (n=24) and women (n=4) aged 62.4±8.4 yrs and body mass index=31.8±5.6 with T2D complicated by CVD were randomised to training or control (sham exercise). Before and after six-months of intervention, participants underwent standard fasting blood test, anthropometric measures, assessment of vascular reactivity (by flow mediated dilatation, FMD) and aerobic power (VO₂peak) and muscle strength (3RM) assessments. At baseline, no significant differences were observed between groups in any variables (p>0.05). Data was analysed using repeated measures ANOVA. **Results:** Training significantly improved HbA1c (-0.5 versus +1.0, p=0.003), triglyceride (-0.3 versus +0.4 mmol-L⁻¹, p=0.02), compared to the control group. Training also reduced waist circumference (-2.8 versus +1.2cm, p=0.02) and increased muscle strength (+126.2 versus -8.4 kg, p<0.001) and VO₂peak (+5.1 versus -0.6 ml·kg⁻¹·min⁻¹, p<0.001). FMD time to peak was reduced in the training group, compared to the control group (-8.2 versus +3.4, p<0.001), while FMD% increased (+0.2% versus 0%, p=0.006). Changes in VO₂peak were negatively correlated with changes in HbA1c (r = -0.63, p < 0.001), FMD time to peak (r= -0.76, p<0.001) and FMD% (r= 0.66, p<0.001). In addition changes in HbA1c correlated with improvement in FMD measures.

Conclusions: combined aerobic and resistance exercise training improved glycaemic control, other clinical measures, and vascular reactivity in people with T2D complicated with CVD. This form of exercise training is beneficial for people with T2D and CVD.

J. Del Prete^{1*} ■ L. Atherton¹ ■ J. Evans¹ ■ ¹Physical Activity Taskforce Secretariat

Introduction: The Physical Activity Taskforce (Taskforce) was established in 2001 to provide a whole of government, whole of community response to increasing levels of physical activity for Western Australia (WA). In 2009, the structure of the Taskforce was reviewed with a new focus placed on policy coordination and advocacy within government and across the community guiding its work going forward. In the context of the renewed mandate and the review of the Taskforce's governance, the Strategic Directions Project was launched in late 2009. The purpose of this project was to analyse progress to date with respect to policies, services, delivery models and interventions in WA aimed at providing opportunities for physical activity with particular focus on the extent of integration and collaboration between parties and sectors. Gaps, limitations and opportunities that have the potential to impact on organisational and systemic change to support increased levels of physical activity in WA were identified, as were strategic priorities for physical activity in WA. The project led to the development of an overarching planning and outcomes framework for physical activity across WA which informed the development of a five-year state strategy for physical activity in WA.

Methodology: This multi-phase project incorporated an internal review, a diagnosis of current physical activity policies programs and partnerships, consultation with stakeholders from senior and practitioner levels and culminating in a symposium at which the framework and strategy were presented. **Results and Conclusions:** The future work of the Taskforce and stakeholders will be guided by this strategic framework for physical activity in WA. The framework focused increased and improved opportunities for physical activity across WA, and is integral to the core work of other sectors including Planning, Environment, Transport, Health, Sport and Recreation. It also acknowledges a variety of existing strategies and plans; is responsive to national agendas around physical activity and health; provides an overall direction for increasing physical activity opportunities and secures and aligns stakeholder commitment to that direction; gives direction and support to the delivery/implementation plans of stakeholders at both state and local levels, and is evidence based where possible. The framework provides a collective direction for stakeholders to enable the implementation of a shared vision for increasing physical activity in WA and in improving the overall health and wellbeing of its citizens.

N. James¹ ■ T. Shilton^{1*} ■ C. Maitland¹ ■ M. Rosenberg² ■ L. Wood² ■ S. French² ■ P. Ivery² ■ ¹National Heart Foundation ■ ²The University of Western Australia

Introduction: The Draw the Line social marketing campaign aims to prevent unhealthy weight gain among Western Australian (WA) adults by promoting practical ways to make healthier choices. Launched in 2009, the campaign is a collaborative initiative of the Heart Foundation, Cancer Council WA and Diabetes WA, funded by the Department of Health, WA. The campaign features mass media and support strategies, including television and print advertisements which were the focus of campaign evaluations. The five key messages promoted for avoiding unhealthy weight gain are: reduce your portion size, eat less sugar, eat less fat, be more active and sit less. Some of these issues (sit less, reduce your portion size) have not previously been addressed in the Australian social marketing context.

Methodology: Impact evaluation included baseline and post-campaign wave cross-sectional telephone surveys of WA adults conducted from January 2009 to June 2010. March 2011 data is currently being analysed and results will be available shortly.

Results: Results reported are from post-media wave 4 evaluation (June 2010; n=601). Among those aware of the Draw the line campaign, a high level of comprehension (91%) and acceptance (100%) of the campaign message was achieved. The number one tip mentioned by respondents to prevent weight gain was to do more physical activity (75%). This was followed by eat less fat (38%), eat smaller meals (37%) and eat less sugar (24%). Spend less time sitting was by far the least mentioned tip (3%) despite having a similar media weighting as the other four messages promoted as part of the campaign. The cues to action promoted in the campaign are reflected in the reasonably high rates of intention (29%) and action (18%) reported after seeing the campaign advertising. Of the respondents who actually did something as a result of the campaign 47% reported being more active and 6% reported sitting less.

Conclusions: The importance of physical activity as a weight gain prevention strategy was acknowledged by the majority of the surveyed population. However, the importance and benefits of sitting less do not seem to be as well comprehended. This lack of comprehension may be a contributing factor in the lower levels of action on sitting less as opposed to being more active. Further formative research is warranted to inform interventions that encourage people to sit less.

N. Gilson^{1*} ■ A. Suppini¹ ■ G. Ryde¹ ■ H. Brown¹ ■ W. Brown¹ ■ ¹University of Queensland

Introduction: Identifying effective strategies for reducing sedentary behaviour in office workers is an emerging health priority. This novel study assessed the impact of height adjustable 'hot' desks on sedentary work time among Australian employees in an open plan office.

Methods: Volunteers (n=11 from 25 employees [7 women]; 46.9±9.8 years; BMI 25.9±3.5 kg/m²) completed a demographic questionnaire and then wore an armband accelerometer (Sense Wear Pro2) from waking-to-bedtime, for two consecutive working weeks (November 2010). In the first week (baseline), employees maintained their usual office routine. During the weekend between weeks one and two, a pod of four height adjustable desks were fitted into the office space, with IT equipment for day-to-day tasks. Before work, at the beginning of the second week (intervention), employees were briefed on the benefits of reducing sitting time and encouraged to use any desk within the pod to stand and work as often as possible. Over the next five days, employees recorded the frequency, duration and type of use (i.e. standing or adjusted to sitting), through log books on each desk. Accelerometers were then collected, data downloaded and the percentage of daily work times spent in sedentary (<1.6 METs), light (1.6-3.0 METs) and moderate-to-vigorous (3+ METs) intensity categories calculated, relative to the total daily time spent at work (this was identified using office arrival/departure time stamps recorded by employees on their accelerometers). Descriptive statistics for demographics and frequency/duration of desk use were generated and weekly differences in percentage time in each intensity category compared using paired sample t tests.

Results: Mean time spent at work was 8.09±0.31 hours/day across two weeks. At baseline, employees spent 76.8±9.6%, 14.4±4.0% and 8.8±6.9% of their work time in sedentary, light and moderate-to-vigorous intensity categories respectively. During the intervention week, desks were solely used in a standing position, but the frequency (0-9 times/week) and duration (0-575 minutes/week) of their use ranged widely. Compared with baseline values, there were no significant changes in mean percentage time in sedentary (76.3±8.5%), light (14.8±4.6%) and moderate-to-vigorous (8.9±7.7%) intensity categories, with changes in the proportion of sedentary work time ranging from -5.9 to 6.4%.

Conclusions: Some employees regularly used height adjustable 'hot' desks to stand while working and reduced their sedentary work profile. Others engaged only infrequently or not at all. Future research needs to identify and manipulate reasons that underpin the shared use of these desks, if their intervention potential is to be fully explored.

J. Bennie^{1,2*} ■ A. Timperio² ■ D. Crawford² ■ D. Dunstan^{1,2,3,4,5} ■ J. Salmon¹ ■ ¹Baker IDI Heart and Diabetes Institute, Melbourne

²Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University ■ ³School of Population Health, University of Queensland

⁴Vario Health Institute, Edith Cowan University ■ ⁵Department of Epidemiology and Preventative Medicine, Monash University

Purpose: Time spent sedentary (too much sitting, as distinct from too little exercise) increases the risk of several chronic diseases and premature mortality, independent of whether or not adults meet physical activity health guidelines. Limiting sedentary time via participation in regular bouts of non-structured light-intensity physical activity spread out across a day may be an effective strategy to reduce these risks. Given the potential for prolonged periods of time spent sitting at work, employees within desk-based work environments offer the ideal population to promote and support non-structured light-intensity physical activity. However, the feasibility of such behaviours among employees within desk-based settings has not been examined. The aim of this study was to investigate perceptions of feasibility and support for light-intensity physical activity among a sample of employees who commonly sit for working tasks.

Methods: A total of 801 employed adults aged 18-70 years from metropolitan Melbourne, Australia were surveyed in 2009 about their perceptions of the feasibility and support for light-intensity physical activity at work.

Results: Overall most perceived that several strategies feasible to increase light-intensity physical activity at work (e.g. standing up and walking 3 times per work hour). Additionally, while small proportions reported having policy environmental support for light-intensity physical activity during work hours, most considered several workplace initiatives may be implemented to be supportive of this behaviour (e.g. a requirement to stand and walk during work hours or support from management to be active during work hours).

Discussion: Overall, these results suggest that employees are likely to be supportive of some strategies purposely designed to increase light-intensity physical activity during work hours. Further research is required to investigate effective integration of these strategies into workplace practices.

C. Vandelanotte^{1*} ■ M. Duncan¹ ■ K. Mummery² ■ ¹Central Queensland University ■ ²University of Alberta, Canada

Purpose: Continued low adherence to physical activity recommendations illustrates the need to refine intervention strategies and increase their effectiveness. Moreover, new interventions also need to be able to reach large numbers of people at low cost. This study presents outcomes related to the development of a new generation of computer-tailored interventions that use online personally relevant video-messages to increase physical activity.

Methods: A sample of 2152 adult Australians was invited via e-mail to participate in a study that randomised them to either receive an online personal physical activity advice either in text or video format. The Active Australia Questionnaire was used to measure physical activity immediately before gaining access to the website (baseline) and one week later (follow-up). At follow-up participants were also surveyed regarding website usability and acceptability of the physical activity advice. The website was tracked for one week, in order to collect objective data on usage.

Results: A total of 570 participants completed the baseline measure, of these 440 visited the website, and 301 (Text-group=143; Video-group=158) completed the follow-up survey. Website tracking showed that participants in the video-group spent significantly longer (17.3 ± 14.1 min) on the website compared to the text-group (10.6 ± 8.7 min) ($t=16.2$; $p<0.001$). The extra time spent on the website by the video-group was entirely spent on the pages that provide the personally relevant physical activity feedback (11.6 versus 4.6 minutes; $t=31.2$; $p<0.001$). An increase in physical activity levels after one week was observed in both groups: 65 minutes in the video-group versus 39 minutes in the text-group ($p=ns$). Website usability was high in both groups. Ease of use was rated slightly lower in the video-group (ns); however video-group participants liked the website more ($X^2=12.9$; $p=0.01$) and were more likely to recommend it to other people ($X^2=12.6$; $p=0.01$). Although the contents of the physical activity advice were identical in both groups, the acceptability of the physical activity advice was consistently rated higher in the video-tailored group in terms of interest ($X^2=10.7$; $p=0.02$), relevance ($X^2=8.3$; $p=0.04$), credibility ($X^2=14.2$; $p=0.007$), future use ($X^2=4.4$; $p=ns$), persuasion ($X^2=13.7$; $p=0.01$) and more.

Conclusions: Although one week is not long enough to establish behaviour change, these outcomes demonstrate the initial effectiveness and acceptability of this innovative intervention. More research is required to examine the full effect if this intervention in a large randomised controlled trial that evaluates both short and long term outcomes. An example of the intervention will be presented at the conference.

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Impact of changes to the national health strategy on the availability of physical activity and nutrition promotion programs in NZ

J. McPhee^{1*} ■ G. Schofield¹ ■ K. White¹ ■ J. Mann² ■ R. Mclean² ■ ¹AUT University ■ ²Department of Medical and Surgical Sciences, University of Otago

Introduction: The Healthy Eating-Healthy-Action: Oranga Kai - Oranga Pumau (HEHA) Strategy was launched by the Ministry of Health in 2003 in response to increasing concern over the prevalence of obesity and the associated risk of chronic disease in New Zealand (NZ). The strategy advocates a coordinated, multi-sectoral approach to address three population health objectives: (1) improving nutrition, (2) increasing physical activity and (3) reducing obesity. A change of government from Labour to National in NZ in 2008 exposed existing HEHA related programs to the risk of changing funding and health policy.

Methods: As part of the evaluation of the HEHA strategy in 2009, a comprehensive stocktake was undertaken to capture all physical activity and nutrition initiatives underway in NZ in 2007/2008. Programs were categorised by type of program, setting, target population group and Ottawa Charter outcomes, providing information on distribution of programs and funding across target populations. The process was repeated in 2009/2010, enabling an analysis of changes in the availability of physical activity and nutrition programs between the two timeframes.

Results: Comparison of the database at the two time points indicates major impact on availability of physical activity and nutrition promotion programs in NZ. There was a 36% decrease in the number of initiatives across the HEHA and HEHA-related sector between 2007 and 2010. A decrease of 37% in programs for priority population groups – such as Maori, Pacific Island groups – was also observed. The education sector suffered a substantial decrease of 50% in initiative activity over the two time periods.

Conclusion: Changes to physical activity and nutrition promotion progress can be directly associated with both the change of government and the subsequent health policy change occurring in 2008 in NZ.

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Effects of Find Thirty every day: Cross sectional findings from a Western Australian population wide mass media campaign 2008–2010

J. Leavy^{1*} ■ M. Rosenberg¹ ■ F. Bull¹ ■ B. Giles Corti¹ ■ T. Shilton² ■ C. Maitland² ■ R. Barnes¹ ■ A. Bauman³

¹University of Western Australia ■ ²Heart Foundation (WA Division) ■ ³University of Sydney

Introduction: Over the last four decades large scale mass media campaigns have been used to promote physical activity and its associated social and health benefits. In 2002, the first Western Australian state-wide physical activity campaign “Find Thirty. It's not a big exercise” was delivered by the Health Department, Western Australia (WA). In 2007, a new phase of the campaign was implemented. This campaign had a new tag line, ‘Find Thirty every day®’, and promoted physical, mental and social health benefits of regular physical activity. This paper reports on the population effects of the Find Thirty every day® campaign from 2008 to 2010 assessing impact on awareness, intention, beliefs and physical activity behaviour over the two years.

Methods: The evaluation comprised pre- and post- test cross-sectional surveys. Data were collected in May 2008, March-April, 2009 and February-March, 2010. Three cross sectional data sets were collected ($n=972$, $n=938$, $n=937$ respectively). Data were derived from self-reported responses to a random-sample telephone survey.

Results: The samples consisted of approximately equal proportions of males and females with three quarters of each sample residing in metropolitan Perth. More than half at each time point were overweight or obese. Total campaign awareness was 48.5% and significantly different across all sub groups from baseline to time point 3. Almost nine out of ten people recalled the logo. Awareness was higher among women, and among low socio-economic region residents. Overall intention was 21.0% double that achieved at baseline (10.3%). When comparing median physical activity minutes, significant gains were made for walking, vigorous and total physical activity.

Discussion: The campaign achieved almost 50% awareness after two years. This highlights the importance of a sustained ‘Find Thirty’ brand over time. We found the campaign reached women and low SES residents, the latter being a key priority group for the Find Thirty every day® campaign. This positive result reflects careful formative evaluation and substantial execution and implementation efforts for this campaign. Overall, the effectiveness of Find Thirty every day® campaign is consistent with recent systematic reviews of physical activity campaign effects. However, the Find Thirty every day® campaign included multiple data collection points, was delivered over a longer duration, and had dedicated evaluation resources, meeting suggested criteria important for mass-reach campaign evaluation.

REFSHAUGE LECTURE

Australian Sports Medicine Federation Fellows Supported Speaker

K. Fitch^{1*} ■ ¹School of Sports Science, Exercise and Health, Faculty of Life Science, University of Western Australia



Asthma is a capricious condition and the commonest chronic medical condition affecting elite athletes involving around 7% of Summer and Winter Olympic athletes. The relationship of exercise to asthma is paradoxical. It has been known for around 2,000 years that exercise provokes asthma – termed exercise-induced asthma (EIA). Currently, EIA is considered to be caused by respiratory water loss due to attempts to condition (hydrate) increased minute volumes of inspired air. The resulting dehydration of airways results in mediator release, airway injury and inflammation and bronchoconstriction. These consequences may be augmented by conductive heat loss from inspiring cold air and also pollutants including particulate matter, ozone and chloramines. In contrast, for 500 years exercise has been prescribed and demonstrated to be of proven benefit in the physical rehabilitation of asthmatics. Some asthmatics, who heeded this advice and commenced to exercise to assist their asthma, became World and Olympic champions. Intriguingly, during the last 20 years, evidence has and continues to accrue that years of intense endurance training is causing asthma and airway hyperresponsiveness (AHR). This is occurring in many athletes, some of whom are not breathing either very cold or polluted air. This is suggestive that as in other facets of life, if “exercise as medicine” is performed to excess, it may result in undesirable consequences. These subjects will be examined by data accumulated during the Olympic Games 2002-2008 when athletes were required to demonstrate asthma and/or AHR to be permitted to inhale beta 2 agonists. The marked difference in the prevalence of asthma/AHR between athletes who participate in sports with a major endurance component in their training and their Olympic counterparts whose sports are relatively “sedentary” will be disclosed. Data from Australian football codes and also from rugby players in UK and Ireland demonstrates that the prevalence of asthma/AHR may be even higher than in Olympic endurance sports and these implications will be explored. During the author's medical life, the pharmacological management of asthma and EIA has undergone radical changes with anti-inflammatory treatment the current “gold standard”. The past and future of these topics will be examined. As in many aspects of medicine, genetic influences are coming under increasing scrutiny. The genetics of who does and does not develop asthma/AHR has been the recent subject of research while pharmacogenetics may hold the future direction for the development of new drugs to treat asthma and AHR.

SYMPOSIUM

Mark Fenton is a be active wa Physical Activity Taskforce Supported Speaker

T. Shilton^{1*} ■ **F. Bull**^{2,3,4,5*} ■ **J. Del Prete**^{6*} ■ **M. Fenton**^{7*} ■ ¹National Heart Foundation ■ ²Global Advocacy for Physical Activity (GAPA)

³School of Population Health, University of Western Australia ■ ⁴Centre for Built Environment and Health (CBEH)

⁵British Heart Foundation Centre for Physical Activity and Health, Loughborough University ■ ⁶Physical Activity Taskforce Secretariat ■ ⁷Tufts University, Boston MA

In this symposium a panel of international experts will discuss advocacy principles, ideas and successful case studies from Australia, the United States and Globally.

Associate Professor Trevor Shilton will commence the workshop with an outline of the definitions and imperative for a focus on advocacy for physical activity in the 2011 context. He will outline an advocacy model that presents a mechanism for moving from the compelling evidence to policy action. 2010-11 has been a critical period for advancing the arguments for a greater focus on physical activity. This period has also seen the creation of Global Advocacy for Physical Activity (GAPA), the Advocacy Council of the International Society for Physical Activity and Health. Trevor is Deputy Chair of GAPA and he will give an overview of GAPA and the advocacy activities it has prioritised and align these with the model.

Professor Fiona Bull is Chair of GAPA and will outline its flagship achievements so far. The recent very productive period has seen the development and global dissemination of the Toronto Charter for Physical Activity: A Global Call to Action and also the complementary document NCD Prevention: best Investments for Physical Activity. GAPA has taken Global advocacy for physical activity to a new level of sophistication and has been very prominent in advocating for physical activity in the context of the September 2011 United Nations High Level Meeting on Noncommunicable Diseases.

Mark Fenton is an energetic and inspiring speaker who, as an independent public health, planning, and transportation consultant, author and former television host has abundant skills as an advocate. Mr Fenton will lead a discussion based on the above presentations and his perspectives on advocacy, drawn from many year experience in local, state, and national-level initiatives that have created more liveable, sustainable, and successful cities and towns in his native North America. He will highlight the lessons learned in presenting the arguments in ways that resonate with every listener. Achieving the change we need across communities requires a joined-up, whole of Government and community approach. Western Australia has a unique structure in this regard in its Physical Activity Taskforce. Taskforce Manager Jo Del Prete will discuss the advantages, opportunities and successes afforded by having a coordinating and facilitating structure that straddles the silos of Government.

The symposium will conclude with discussion and opportunity for questions.

Program:

Associate Professor Trevor Shilton: Introduction to advocacy, advocacy models and keys to success

Professor Fiona Bull: Global Advocacy for Physical Activity (GAPA) – The success story so far

Jo Del Prete: Winning cross-sector commitment to physical activity, W.A's success in advocacy from within.

Mark Fenton: Advocacy to make a difference – effective examples, lessons learned

Discussion and questions led by Mark Fenton.

FRIDAY 21 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
0800 – 0900	Workshop	Multi-directional instability of the shoulder – one approach to conservative management	Mary Magarey	Orion Room	55
0800 – 0900	Workshop	Measuring muscle-tendon behaviour with ultrasound: Theory and practice, pitfalls and promises	Anthony Blazeovich, Neil Cronin & Glen Lichtwark	Pleiades Room	56
0800 – 0900	Workshop	Sports medicine for elite sporting teams – What does it take?	Carmel Goodman, Peter Harcourt & Craig Purdam	Carnac Room	57
0800 – 0900	Workshop	Exercise-induced leg pain: Physical examination and diagnostic pearls	Richard Bouché	Garden Room	58
0800 – 0900	Workshop	CPR certification	Mark Brown	Rottnest Room	59
0930 – 1030	Keynote	Promoting kids' sport and physical activity in physical education contexts: Can it really make a difference outside of school?	Martin Hagger	Orion & Pleiades Room	60
1100 – 1230	Free papers: Shoulder			Orion & Pleiades Room	
		Can scapular and humeral head position predict shoulder pain in adolescent swimmers and non-swimmers?	Leanda McKenna		61
		Permanent outperforms biodegradable anchors for arthroscopic stabilization for recurrent anterior shoulder instability	George Murrell		62
		Tape versus suture in rotator cuff repair: A biomechanical analysis of footprint compression and repair strength in ovine shoulders	Patrick Lam		63
		Effectiveness of vibration on pain following rotator cuff repair	Kaitlyn Hansen		64
		Can handheld dynamometers diagnose partial-thickness rotator cuff tears?	Jared Millican		65
		A randomized double blind clinical trial evaluating the effects of daily controlled vibration on the strength and range of movement of a shoulder following rotator cuff repair	Geffrey Keighley		66
		Ultrasound changes after rotator cuff repair – Is supraspinatus tendon thickness related to pain?	Ru Xing (Elizabeth) Tham		67
		Intra-operative determinants of rotator cuff repair integrity: An analysis in 500 consecutive repairs	Xiao Wu		68
1100 – 1230	Symposium	Evidence based research to assist with decision making across the AFL		Carnac Room	
		Introduction to the AFL Research Program and its relationship with sport science and sport medicine in Australian Football	Ross Smith		69
		AFL injury surveillance shows that interchange use protects individual players against hamstring injury but increases injury rate for the opposition	John Orchard		70
		AFL illicit drugs policy and responsible use of alcohol strategy	Peter Harcourt		71
		Development and implementation of a concussion management strategy for Australian Football	Gavin Davis		72
		Knowledge translation and establishing community prevention programs for Australian Football	Caroline Finch		73
		First year elite Australian Footballers are at a greater risk of injury compared to mature-aged footballers	David Buttifant		74
		Monitoring trends on the field and informing the laws of the game process	Andrew McKay		75
		Overview of hamstring injury research funded by the AFL Research Board: What has been done to date and what are the future directions?	Anthony Schache		76

FRIDAY 21 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1100 – 1230	Free papers: Biomechanics			Garden Room	
		The affect of Power Balance® wrist bands on dynamic balance of elite Australian Rules Football players	Trentham Furness		77
		Lower limb mechanics during hopping in elite level jumping athletes	Amitabh Gupta		78
		Floor surfaces and injury risk; Changes in dancer landing mechanics on varied dance surfaces	Luke Hopper		79
		Footwear modifies foot and ankle kinematics during stance phase of walking gait	Chris Bishop		80
		The occurrence of multiple force producing events during stretch shortening cycle knee extensions	Jacob Earp		81
		Does a gender difference in cutting technique exist for skill- and anthropometrically-matched Touch Football players?	Cara Mura		82
		Asymmetry in lower body power production during a loaded single-leg step-up: Implications for injury risk assessment	Brendyn Appleby		83
		Knee extension torque elicited by electrical versus magnetic stimulation	Marika Noorkoiv		84
1100 – 1230	Free papers: Physical activity – children and adolescents 1			Rottnest Room	
		Encouraging children to Unplug and Play: Results of research with parents	Trevor Shilton		85
		Behaviour changes following a multidisciplinary intervention for overweight and obese adolescents	Emily Ward		86
		Effect of interrupting sitting time on acute postprandial lipemia in healthy children	Kara Faithfull		87
		Concordance between Actigraph cut-points for sedentary time and sitting/lying and non-stepping time using the activPAL in children	Nicole Ridgers		88
1330 – 1500	Multidisciplinary Grand Round	Multidisciplinary Grand Round: Upper limb		Orion & Pleiades Room	89
1330 – 1500	Free papers: Orthotics and lower limb			Carnac Room	
		Do muscle induced vibrations generated during eccentric ankle exercise play a role in the rehabilitation of Achilles tendinopathy?	Nicole Grigg		90
		Individuals with patellofemoral joint osteoarthritis exhibit different proximal and distal kinematic adaptations to foot orthoses	Natalie Collins		91
		Post-treatment analgesia in chronic lower limb tendinopathies: Is there a difference between clinical responses following radial shockwave treatment and stretching?	Simon Locke		92
		Increasing our knowledge of boot-surface interaction	Paul Fleming		93
		Load bearing improves the limits of agreement for repeated in vivo measures of the speed of sound in human Achilles tendon	James Smeathers		94
		Shoe inserts produce immediate pain relief in individuals with patellofemoral joint osteoarthritis	Natalie Collins		95
		Foot orthotic prescription principles: Two decades in a nutshell	Rachael Bradhurst		
1330 – 1500	Invited	Nutrition and the Brain	Romain Meeusen	Garden Room	96
	Free papers: Supplements				
		Effect of rinsing and ingestion of a carbohydrate solution on maximal sprint performance in competitive male cyclists	Edwin Chong		97
		The influence of varying sodium bicarbonate loading times on repeated sprint performance	Jason Siegler		98
		Does coinciding exercise onset with peak caffeine levels improve cycling performance?	Tina Skinner		99
		Carbohydrate ingestion did not affect 60 km self paced cycling performance during exercise in the heat	Camila Nassif		100

FRIDAY 21 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1330 – 1500	Free papers: Physical activity – children and adolescents 2			Rottneest Room	
		Effective physical education and school sport: A systematic review of physical education and school sport interventions targeting physical activity, movement skills and enjoyment of physical activity	Dean Dudley		101
		Effect of a specialist PE program on body image among children of the Lifestyle of our Kids (LOOK) study	Lisa Olive		102
		Tracking of physical activity during the transition out of secondary school	Anna Timperio		103
		Perceived physical competence mediates health benefits of club sport in adolescent girls beyond the effects of physical activity	Jack Harvey		104
		A test of the theory of planned behavior to predict physical activity in an overweight/obese population sample of adolescents (Alberta, Canada)	Ron Plotnikoff		105
	Invited	Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation	Martin Hagger		106
1545 – 1645	Keynote	Medial Tibial Stress Syndrome (MTSS): 'New thoughts' and proposed pathomechanical model	Richard Bouché	Orion Room	107
1545 – 1645	Invited	Exercise as cardiovascular medicine: An update of the direct impacts of exercise on the heart and arteries	Daniel Green	Pleiades Room	108

WORKSHOP

M. Magarey^{1*} ▪ ¹School of Health Science, University of South Australia

In this workshop a brief overview of the basic pathology and presentation of multi-directional instability of the shoulder will be presented, followed by demonstration of one approach to conservative management of the condition including consideration of injury preventative strategies, acknowledging the fact that the shoulder will always be vulnerable to injury in unpredictable situations.

WORKSHOP

A. Blazeovich^{1*} ▪ N. Cronin^{2*} ▪ G. Lichtwark^{3*} ▪ ¹Edith Cowan University ▪ ²Griffith University ▪ ³University of Queensland

Ultrasound imaging has become an important tool for the study of both muscle-tendon behaviour and muscle-tendon mechanical properties in vivo in humans. Appropriate use of ultrasound imaging techniques allows the valid and reliable observation of dynamic muscle and tendon behaviours, and research using the technique has added considerably to our understanding of the effects of physical activity, disuse, growth and ageing and illness/disease on muscle and tendon properties. However, while there are numerous benefits of the use of this technology, there are also a considerable number of limitations. An understanding of these limitations is essential for both researchers who use the technique and for practitioners/clinicians who put the information presented in research publications into practice. In this workshop, a basic overview of the physics underpinning ultrasound imaging as well as the techniques used in musculo-tendinous imaging will be presented (no consideration will be given to the measurement of cardiac function or blood flow). A demonstration of some of these techniques will also be given. Subsequently, an interactive discussion will be held in order to consider, in detail: 1. the potential benefits of ultrasound imaging, and how to make more reliable and practically useful measurements, and 2. the difficulties in obtaining valid and reliable measurements, and what problems need to be considered when reading research that has used ultrasound imaging techniques.

WORKSHOP

P. Harcourt^{1*} ▪ C. Goodman^{2*} ▪ C. Purdam^{3*} ▪ ¹Victorian Institute of Sport ▪ ²Western Australian Institute of Sport ▪ ³Australian Institute of Sport

Being a sports medicine practitioner for an elite sporting team is a role which is aspired to by many sports medicine practitioners. Many Sports Medicine Australia members from a varied range of disciplines have experienced the fulfilment which comes with providing the support to a touring athlete or team to enable them to play at their best. The role of a sports medicine practitioner for an elite sporting team is often much more complex than applying discipline specific skills to bring out an athlete's best and in many instances sports medicine practitioners are required to provide support that extends beyond those of their specific discipline. This forum will bring together some of Australia's leading elite sporting team practitioners to discuss the pathways and pre-requisites for practitioners aspiring to be part of an elite sporting team.

WORKSHOP

Asics Supported Speaker

R. Bouché^{1*} ▪ ¹The Sports Medicine Clinic, Seattle, USA

This workshop will provide a comprehensive review of exercise-induced leg pain which will include common overuse injuries, claudication syndromes and miscellaneous exercise-related conditions. The classification for leg pain in the athlete will be reviewed followed by a suggested lower extremity evaluation protocol with emphasis on musculoskeletal examination of the leg. Indications and review of diagnostic testing procedures will also all be discussed. There will be special focus on differentiating medial tibial stress syndrome vs. stress fracture vs. chronic compartment syndrome vs. vascular claudication syndromes via history and clinical examination. Case studies will be presented to underscore the importance of a comprehensive and systematic clinical evaluation.



WORKSHOP

M. Brown^{1*} ▪ A. Green² ▪ Sports Doctors Australia³ ▪ ¹SMA QLD ▪ ²University of Queensland ▪ ³Sports Doctors Australia

This Workshop is designed to provide a CPR update with a Sports Medicine flavour. It provides an ideal opportunity for Sports Medicine Clinicians to up skill in a credentialed emergency resuscitation hands on session. It is primarily provided for Doctors, Physiotherapists, Podiatrists or any other health professionals who require an annual update for their daily work and to fulfil the requirements for their professional education or registration. The workshop will fulfil the updated 2011 guidelines of the Australian Resuscitation Council and all participants will receive a Statement of Attainment as Nationally Recognised Training.

KEYNOTE

M. Hagger^{1*} ▪ ¹School of Psychology and Speech Pathology, Curtin University

Acknowledging the increasing problems associated with physical inactivity and a rise in obesity, and, particular, juvenile obesity, health promoters and policymakers have been keen to develop interventions to promote physical activity among young people. A context that has been a target for these interventions is the school as it is a useful 'existing network' in which those interested in promoting physical activity have a captive audience and has the potential to reach as many children as possible. However, there has been little research examining whether promoting physical activity and sports in schools really does lead to increased motivation and actual physical activity and sport participation outside of school. In this presentation, I will outline some of the key motivational factors that influence children's physical activity, demonstrate how health professionals and PE teachers can capitalise on these factors in designing and implementing interventions to promote physical activity in school contexts, and how such interventions in school can lead to increased extra-mural motivation and physical activity participation among children. I will also outline how the components from these interventions are applicable in other public health contexts that focus on changing behaviour and promoting increased physical activity in other populations.

L. McKenna^{1*} ▪ L. Straker¹ ▪ A. Smith¹ ▪ ¹Curtin University of Technology

Introduction: The purposes of this study were to determine whether scapular and humeral head position can predict the development of shoulder pain in 46 adolescent swimmers and 43 non-swimmers, and describe the annual prevalence and incidence of shoulder pain in adolescent swimmers and non-swimmers.

Methods: Subjects were examined prospectively by questionnaire, by scapular and humeral head position measures and with anthropometric measures. The scapular measures included the distances between the inferior border of the spinous process of T7 and the inferior scapula ('Inferior Kibler') and the inferior border of the spinous process of T3 and the medial spine of the scapula ('Superior Kibler'). The humeral head position was measured by palpation and photography as a horizontal anterior position in relation to the acromion. Anthropometric measures included height, weight, BMI and chest width. Demographic and training covariates were assessed questionnaire at baseline. Subjects were re-assessed for shoulder pain 12 months later by questionnaire. Predictors were evaluated using multivariate logistic regression.

Results: Annual prevalence of shoulder pain was 23.9% for swimmers and 30.8% in non-swimmers ($\chi^2 = 0.22$, $p=0.614$). Shoulder pain in swimmers was best predicted by a larger BMI (OR = 1.47 $p=0.049$), a smaller distance between the scapula and spine in abduction (eg. Inferior Kibler OR = 0.90, $p=0.009$) and a smaller horizontal distance between the anterior humeral head and the anterior acromion (OR = 0.76, $p=0.035$). No variable was found to significantly predict shoulder pain in non-swimmers.

Conclusions: Shoulder pain in adolescent non-swimmers is as prevalent as in adolescent swimmers. A scapular position that is closer to the spine, a humeral head position that is more posterior and a high BMI increased swimmers' risk of future shoulder pain. Shoulder pain in Western Australian adolescents appears to be relatively common and further investigation into the risk factors for this group is required. Scapular and humeral head position can be used as a preseason screening tool for adolescent swimmers.

G. Murrell^{1*} ▪ K. Peters¹ ▪ ¹St George Hospital Orthopaedic Research Institute

Introduction: The aim of this study was to determine the clinical outcomes of arthroscopic stabilization of patients with anterior glenohumeral instability using knotless suture anchors made from four different materials with the primary outcome being recurrence rate.

Methods: A prospective cohort study was performed. Considered for inclusion were all patients who had an arthroscopic anterior shoulder stabilization for unidirectional anterior instability by a single surgeon using one of four devices: Suretac® resorbable tac made of a resorbable synthetic co-polymer, poly-gluconate-B; PGA (Smith and Nephew), the BioKnotless® resorbable suture anchor made of a slower degrading poly-D-L-lactic acid; PLLA (DePuy Mitek), the OPUS® Labrafix® knotless anchor (ArthroCare) made from stainless steel and the Pushlock® knotless anchor made from high density plastic, PEEK, (Arthrex). Standardized patient-determined and examiner-determined outcomes were obtained before operation and 6, 12, 24 weeks after operation and up to 10 year follow-up.

Results: One hundred and fifty five patients met the inclusion criteria (41 patients in the Suretac group, 52 in the BioKnotless group, 18 in the Labrafix group and 44 in the Pushlock group). Kaplan-Meier analysis for re-dislocation showed a fall in survival curves from one year (90% stable) to three years (40% stable) in the Suretac group then a plateau to 10 years; and a fall in stability survivorship for the BioKnotless group from one year (90% stable) to five years (60% stable). Survivorship curves for the two non-resorbable anchors were more encouraging with over 90% stable out to three years (Pushloc) and four years (Labrafix); $p < 0.001$.

Conclusion: These data support the hypothesis that arthroscopic stabilization for traumatic anterior instability leads to excellent outcomes when using non-resorbable knotless devices (6% and 5% recurrence at 3-5 years). However, medium term data on resorbable anchors showed an alarmingly high (40-60%) recurrence rate at 5 years post arthroscopic stabilization.

Tape versus suture in rotator cuff repair: A biomechanical analysis of footprint compression and repair strength in ovine shoulders

P. Lam^{1*} ■ H. Shepherd¹ ■ G. Murrell¹ ■ ¹St George Hospital Orthopaedic Research Institute

Introduction: Clinical studies have shown that rotator cuff repair with an arthroscopic tension band technique lead to a lower re-tear rate compared to simple suture-anchor technique, probably due to higher compression at the tendon-bone interface (footprint). Advances in suture anchor systems have allowed a thicker tape to be used for rotator cuff repairs. We hypothesized that tape use in conjunction with the tension band repair construct will provide higher footprint compression and failure load compared with repairs using traditional suture.

Methods: Rotator cuff tears of the infraspinatus tendon were created in vitro in 16 ovine shoulders. The tendons were re-attached to the footprint using the tension band repair technique with two different types of sutures; suture repair group (Fiberwire, Arthrex, Florida, USA) and tape repair group (FiberTape, Arthrex). Following repair and cyclical loading, footprint contact pressure was measured with 10, 20, 30 N across the tendon and at -10°, 0°, 10° abduction angles. Repair strength was determined by a pull-to-failure test.

Results: Rotator cuff repair using tape rather than suture improved footprint contact pressure three-fold (7.2 ± 0.6 N vs 2.3 ± 0.3 N, $p < 0.0001$, mean \pm SEM) at -10° abduction with a 30 N load across the tendon. The footprint contact pressure increased as the tendon was loaded from 10 N to 30 N and as the tendon was adducted, and these effects of enhanced footprint contact with more load and more adduction were amplified with tape repair, ie. the slope of the rotator cuff load - footprint compression curve and rotator cuff adduction - footprint compression curve were greater with tape repair compared with suture repair. The majority of (15 of 16) repairs failed with sutures pulling through the tendon, 1 suture pulled out from the anchor in the suture repair group. Ultimate failure load of tape repair was higher than suture repair (217 ± 28 N vs 144 ± 14 N, $p = 0.05$). There were no significant differences between the two groups in total energy ($p = 0.14$) and peak energy ($p = 0.13$) to failure, or stiffness ($p = 0.22$).

Discussion: This study showed that tape provides a three-fold increase in footprint compression and a 1.5-fold increase in construct strength compared with suture in a tension-band suture anchor rotator cuff repair.

Effectiveness of vibration on pain following rotator cuff repair

K. Hansen^{1*} ■ P. Lam² ■ G. Keighley¹ ■ G. Murrell² ■ ¹University of New South Wales ■ ²St George Hospital Orthopaedic Research Institute

Background: Rotator cuff tears are often debilitating and require surgical repair. Pain is frequently experienced by patients after such operations. Vibration therapy for analgesia from chronic musculoskeletal pain and spontaneous temporomandibular pain has been found to be effective with the application of 100Hz vibration for 25-45 minutes at the site of pain. The use of segmental and whole body vibration at 20Hz has been effective in rehabilitation by reducing muscular stiffness and maintaining muscle integrity with bed rest. To our knowledge, however, vibration therapy has not been assessed for post-surgical pain.

Aim: The aim of this study was to determine the clinical effectiveness of high frequency, low amplitude vibration (80Hz) compared to rehabilitation exercise alone, on pain after surgical arthroscopic repair of full thickness rotator cuff tears.

Materials and Methods: Sixty-seven patients with full thickness rotator cuff tears that required surgical repair were randomly assigned a vibration device. The active device vibrated at 80Hz, whilst the sham device vibrated at 20Hz. Patients and assessors were blinded with respect to the vibration device. Patients used the device for five minutes daily in addition to rehabilitation exercises which began one day after surgery and continued for three months. A further 44 historical patients who had no intervention after rotator cuff repair were used as a control group to assess the potential placebo (Hawthorne) effect of using a device.

Results: Marked reductions in shoulder pain with overhead activities ($p < 0.05$) from preoperative values to those at 6 and 12 weeks follow up were observed for all three groups. Furthermore, all groups experienced declining levels of pain at rest ($p < 0.01$), during sleep ($p < 0.01$) and with extreme pain ($p < 0.01$) from before surgery to 6 and 12 week follow up. This was also evident with lower recorded levels of overall shoulder pain ($p < 0.01$) and the frequency of pain during activity ($p < 0.01$). Vibration provided no additional reduction in pain as all three groups reported similar reductions in pain with overhead activities ($p > 0.05$) and all secondary outcome measures ($p > 0.01$) at 6 and 12 weeks post surgery. A Hawthorne effect was not evident from this result.

Conclusion: The results showed that 5 minutes daily use of high frequency (80Hz), low amplitude vibration was not effective in reducing pain with overhead activities after arthroscopic full thickness rotator cuff repairs. It was also not effective in reducing the frequency or severity of shoulder pain with daily activities, rest and during sleep.

Can handheld dynamometers diagnose partial-thickness rotator cuff tears?

J. Millican^{1*} ■ G. Murrell¹ ■ ¹St George Hospital Orthopaedic Research Institute

Background: Partial tears of the rotator cuff tendons of the shoulder are common and a cause of significant pain and disability. Whilst there are a number of clinical diagnostic tests for the shoulder, none have been found to reliably diagnose a partial-thickness rotator cuff tear. Quantitative shoulder strength tests, as measured by handheld dynamometer, have demonstrated good sensitivity and specificity in the diagnosis of full-thickness rotator cuff tears. The aim of this study was to determine if handheld dynamometer measurements could predict the presence of a partial thickness rotator cuff tear (as opposed to no tear and full-thickness tears) in patients with shoulder pain sufficient to require surgery.

Methods: Handheld dynamometer measurements, range of motion and signs of impingement were collected prior to surgical evaluation and analyzed retrospectively on consecutive patients with a partial-thickness rotator cuff tear ($n = 150$), full-thickness rotator cuff tear ($n = 150$) or no rotator cuff tear ($n = 150$) undergoing surgery.

Results: Patients with partial-thickness tears did not have significantly different strength compared to patients with no rotator cuff tears. Patients with full-thickness tears had a significant decrease in supraspinatus and external rotation strength ($p < 0.001$). Patients with any rotator cuff tear were much more likely to have signs of internal impingement ($p < 0.001$) and external impingement ($p = 0.004$) than patients without tears.

Conclusion: Handheld dynamometer measurements were unable to reliably distinguish patients with partial-thickness rotator cuff tears from patients without rotator cuff tears and were not as useful as the internal and external impingement tests. The supraspinatus muscle strength test and external rotation muscle strength test demonstrated similar performance to the internal and external impingement tests for distinguishing partial-thickness rotator cuff tears from full-thickness rotator cuff tears.

A randomized double blind clinical trial evaluating the effects of daily controlled vibration on the strength and range of movement of a shoulder following rotator cuff repair

G. Keighley^{1*} ■ P. Lam¹ ■ K. Hansen¹ ■ G. Murrell¹ ■ ¹St George Hospital Orthopaedic Research Institute

Introduction: Rotator cuff tears of the supraspinatus are very common and often require surgery. Vibration therapy is a relatively novel approach for musculoskeletal disorders. The aim of our study was to evaluate the effects of a portable vibration device applied directly to the affected shoulder following an arthroscopic repair of a full thickness rotator cuff tear on strength and range of shoulder movement.

Methods: For this double-blinded randomized control trial, patients, recruited following arthroscopic repair of the supraspinatus, were randomly assigned either an active (80Hz, 70µm) or non-active (20Hz, <20µm) vibration device and shoulder strap. Patients placed the device directly on the affected shoulder for 5 minutes every day for the 6-month rehabilitation period. The range-of-motion and strength of their shoulder was measured at pre-operative, 6-week and 12-week follow-up visits.

Results: 34 patients were assigned active vibration devices and 32 patients were assigned non-active devices. Patients in the active vibration group had greater external rotation between pre-operative and 6-week assessments ($p=0.01$) and between pre-operative and 12-week assessments ($p=0.01$). Lift-off strength was statistically significant between pre-operative and 6-week assessments ($p=0.05$) and pre-operative to 12-week assessments ($p=0.05$). No other measurements were found to be statistically significant, and specifically the active vibration group had the similar shoulder range of motion and strength pre-operatively, 6 weeks and at 12 weeks post rotator cuff repair as compared with the non-active vibration group.

Conclusion: This pilot study found the use of direct vibration on the rotator cuff following surgery to be of no benefit, as compared with placebo vibration, in increasing the range-of-motion or strength of the shoulder at 6 weeks and 3 months post arthroscopic rotator cuff repair.

Ultrasound changes after rotator cuff repair – Is supraspinatus tendon thickness related to pain?

R. Tham^{1*} ■ G. Murrell² ■ L. Briggs² ■ ¹University of New South Wales ■ ²St George Hospital Orthopaedic Research Institute

Introduction: Surgical repair for rotator cuff tears is common, but little is known about the healing tendon after surgery. The purpose of this study was to determine whether there are changes after rotator cuff repair in tendon thickness, anatomical footprint, tendon vascularity, subacromial bursa, capsular thickness, and whether tendon and bursal thickness correlate with pain.

Method: Fifty-one patients completed a validated pain questionnaire and had their shoulders scanned by the same experienced ultrasonographer with a General Electric Logiq E9 (GE Corp, Fairfield, CT) ultrasound machine with a linear ML6-15MHz transducer using a standardised protocol at 1 week, 6 weeks, 3 months and 6 months post arthroscopic rotator cuff repair by a single surgeon. The contralateral shoulders, if uninjured, were also scanned. Data is presented as mean (SD).

Results: Forty-four of the 51 rotator cuff repairs were intact at 6 months. Four re-tore at 6 weeks, while three re-tore at 3 months. At 6 weeks, the repaired tendon thickness was 4.2 (0.9) mm, and increased to 4.6 (0.8) mm at 6 months ($p < 0.05$) – similar to the contralateral uninjured side: 4.8 (0.8) mm. There was a significant increase in bursal thickness at 1 week [2.0 (0.8) mm] compared with the contralateral shoulder [0.8 (0.4) mm] ($p < 0.001$); which decreased at each time point so that by 6 months it was 0.7 (0.5) mm ($p < 0.001$). There was a significant increase in the width of the anatomical footprint, from 7.0(2.0) mm at 1 week to 9.2 (1.5) mm at 6 months ($p < 0.001$). Vascularity of the tendon decreased from mild at 1 week, to none at 6 months ($p < 0.001$). At 1 week there was a significant increase in the ipsilateral posterior capsule thickness 2.3 (0.8) mm, which gradually decreased to 1.3 (0.6) mm at 6 months ($p < 0.001$). There was no difference in the contralateral posterior capsule thickness, which was 1.2 (0.5) mm at 1 week and 1.2 (0.4) mm at 6 months. The frequency and severity of pain decreased at 6 months, and the patient-ranked overall condition of the shoulder improved ($p < 0.001$). There was no correlation between tendon thickness or bursal thickness with pain.

Conclusion: This study yielded some novel findings. (1) After supraspinatus repair, the tendon thickness increased only 10% between 6 weeks and 6 months. Many other tendons (e.g. Achilles) increase several-fold after repair. (2) The width of the anatomical footprint of the repaired supraspinatus was 30% narrower at 1 week and gradually increased over 6 months to be comparable with the contralateral uninjured shoulder. (3) Ipsilateral bursal thickness, tendon vascularity (as per other studies) and posterior capsule thickness increased significantly compared with the contralateral shoulder at 1 week post surgery and then gradually decreased over 6 months. An increase in glenohumeral joint capsule thickness following rotator cuff repair was unexpected and may help explain the shoulder loss of range of motion sometimes seen post shoulder trauma.

Intra-operative determinants of rotator cuff repair integrity: An analysis in 500 consecutive repairs

X. Wu^{1*} ■ G. Murrell¹ ■ ¹St George Hospital Orthopaedic Research Institute

Background: Rotator cuff repair has a relatively high (20-90%) chance of re-tear. Patients with an intact rotator cuff six months post surgery have better subjective and objective outcomes at six months and two years following rotator cuff repair than those who do not have an intact repair. The aim of this study was to determine if, and if so, which, intra-operative factors predict an intact repair six months after rotator cuff repair.

Methods: The study consisted of a cohort of 500 consecutive patients who had an arthroscopic rotator cuff repair performed by a single surgeon and an ultrasound evaluation of the repair six months post repair using standard protocols. Exclusion criteria included previous fractures or shoulder surgery, incomplete or partial rotator cuff repair and concomitant arthroplasty. Rotator cuff tear size was measured intra-operatively and mapped. The quality of the tendon, tendon mobility and repair quality were assessed and ranked based on pre-determined scales (1 to 4) and recorded on a specifically designed form. Logistic regression analysis was performed with cuff integrity at 6 months as the dependent variable and repair factors as the independent variables.

Results: The overall post-operative re-tear rate was 19 % at 6 months post repair. The best predictor of rotator cuff integrity was pre-operative tear size (correlation coefficient, $r = 0.33$, $p < 0.001$). Patients with small (≤ 2 cm²) rotator cuff tears were least likely to re-tear (re-tear rate: 10 %). As the tear-size increased, the re-tear rate increased in a linear fashion: ≤ 2 cm² (10 %), 2-4 cm² (16 %), 4-6 cm² (31 %), 6-8 cm² (50 %), >8 cm² (57 %). Other surgeon-ranked intra-operative assessments did correlate (negatively) with re-tear, but the correlations were relatively weak: repair quality ($r = -0.17$, $p < 0.001$), tendon mobility ($r = -0.15$, $p < 0.001$), tendon quality ($r = -0.14$, $p < 0.01$). Regression analysis showed that the re-tear rate at 6 months was best predicted from the preoperative tear size and surgeon-ranked repair quality: chance of re-tear = $0.4 + (0.02 \times \text{tear size in cm}^2) - (0.08 \times \text{repair quality})$. Tendon quality and tendon mobility did not contribute significantly to this prediction.

Conclusion: Tear size was the best intra-operative predictor of repair integrity post-rotator cuff repair, with tears less than 2 cm² twice as likely to heal than tears greater than 6 cm².

SYMPOSIUM

R. Smith^{1*} ■ ¹AFL Research Board

Introduction: Australian Football has established itself as a world leader with injury prevention, treatment and rehabilitation, sport science, coaching, umpiring and volunteer administrators. The AFL Research Board was formed in 1999 to administer the selection of research priorities, allocation of research funding, organization of industry sport science and medicine events and to guide individual research projects. The work commissioned by the Research Board is one of the key reasons why the AFL has the reputation it does on the international stage. The projects commissioned on an annual basis have benefited the game at all levels. The strength of the program is that topics are nominated by industry partners, meaning they address problems or answer questions that people working in the industry have identified as priorities. While the AFL competition projects usually receive the most attention, such as the annual AFL Injury Report (which has been running for 19 consecutive years), the projects focused on the development of the game at community level have been just as critical in ensuring the continued strength of the sport across all levels of participation. The board comprises a mix of professionals with playing, coaching, business, administration and academic experience. The program has been successful in translating knowledge into action and impact across a number of different areas: Developing the capacity of volunteers; Enhancing the skills of coaches; Reducing and improving treatment of injuries at elite and community level; Improving community football environments and respect for umpires; Using research as the platform for policy development and evaluation; Improving the talent pathway; and Improving the preparation of playing surfaces.

Conclusions: This presentation will cover the background and responsibilities of the AFL Research Board, including the process used to select research priorities and commission projects, collaborating with industry partners to leverage external funding and summarise the wide ranging impact of the outcomes which result from the projects funded.

J. Orchard^{1*} ■ H. Seward² ■ ¹University of Sydney ■ ²AFL Research Board

Introduction: AFL injury surveillance is in its 20th season, with all causes of missed games through injury in players/teams accounted for over the past 14 seasons. There is a gradual move from descriptive surveillance to more analytical research. The most common and prevalent injury in the AFL has consistently been the hamstring strain in every season of the survey.

Methods: The definition of a hamstring injury was one which resulted in a match missed through injury. Further analysis was undertaken of players in home & away games over the period 2003-2010 between rounds 2 and 21. Logistic regression was undertaken to compare 55447 player matches where no hamstring injury occurred to 413 player matches where a hamstring injury was sustained. For the index team, recent history of interchange was analysed as interchange use during a game was directly affected by the occurrence of injuries during that game by reducing the effective size of the bench. **Results:** Over the period 2003-2010 inclusive there was a substantial increase in interchange usage in the AFL competition by all teams, and a slight but gradual rise in injury prevalence for injuries as a whole and specifically hamstring injuries. Five variables predicted hamstring injury in the model, those being recent hamstring injury (RR 4.34, 95% CI 3.23-5.83), past history of ACL reconstruction (RR 1.68, 95% CI 1.22-2.30), player having made 7 or more interchanges in the last 3 weeks (protective RR 0.73, 95% CI 0.58-0.91), opposition making 60 or more interchanges during the game (RR 1.39, 95% CI 1.12-1.72) and player age 23 or over (RR 1.24, 95% CI 1.00-1.55).

Discussion: This study confirmed recent history of hamstring injury, player age and past history of ACL reconstruction as being risk factors for hamstring injury. It showed a conflicting relationship of player interchanges to risk of hamstring injury whereby high levels of interchange afforded protection to the individual players who were interchanged but conferred an increase in risk on players in the opposition team.

Conclusion: Interchange use increases the risk of hamstring injury in the opposition team, through mechanisms not explored in this study but possibly related to changing relative levels of fatigue between the index player and his opponent(s). This increase in risk is despite interchange use being protective for the player(s) who make them. Interchange use substantially increased over the period 2003-2010 along with a slight but gradual increase in risk of hamstring injury.

P. Harcourt^{1*} ■ ¹AFL Medical Commissioner

Introduction: The AFL has 2 anti doping policies or rules – the Anti Doping Code (ADC) and the Illicit Drugs Policy (IDP). The ADC is compliant with the World Anti Doping Agency (WADA) Code, its primary purpose being the management of performance enhancing drugs in sporting competition. During 2004 the AFL decided to introduce an IDP to augment the ADC and better manage the abuse of illicit substances by players. After wide consultation with the AFL community including clubs, club doctors, AFLPA and players as well as industry experts and industry peak bodies the IDP was launched in February 2005. It was based on the harm minimisation approach – confidentiality, intervention, education and rehabilitation – based on a three strikes approach where the third detection results in an open hearing. Since 2005 there has been an increase in the number of tests (472 in 2005 to 16 in 2010) and a reduction in the incidence of illicit substance detections (4.03% in 2005 to 0.39% in 2010) indicating significant behaviour change in the player group. Alcohol is a key aspect to occasional illicit drug use. Alcohol is a significant cause of morbidity (72000 hospitalisations pa) and mortality (3100 deaths pa) in the Australian community. AFL players have a high incidence of risky alcohol consumption (51% binge drink, 26% practice 'at risk' drinking behaviour, in some cases drink cards are provided at night clubs and 26% of players reported having had an altercation while drinking). In 2005 the AFL commenced researching the alcohol consumption behaviour of players as the first phase of a Responsible Use of Alcohol Strategy. The five phases were Research (2005-06), Policy Development (2007-08), Policy Implementation and Innovation (2009-10), Review and Performance evaluation (2011-12) and Industry-wide behaviour change (2012). A wide range of projects have been implemented from policy to grass roots as a means of impacting 'at risk' alcohol consumption.

G. Davis^{1,2*} ■ M. Makdissi^{3,4} ■ P. McCrory^{5,6} ■ ¹Department of Neurosurgery, Cabrini Hospital, Melbourne ■ ²Austin Hospital, Melbourne
³Melbourne Brain Centre, Florey Neurosciences Institute, University of Melbourne ■ ⁴Olympic Park Sports Medicine Centre, Melbourne
⁵Centre for Health, Exercise and Sports Medicine, University of Melbourne ■ ⁶Melbourne Brain Centre, Melbourne

Introduction: The management of concussion has evolved significantly over the past decade. The development of international guidelines and a desire to establish a leading position stimulated the local development and implementation of guidelines for the management of concussion in Australian Football. This process required analysis of existing data on concussion management in AFL, and synthesis of this data, in conjunction with published international guidelines, into practical guidelines that accommodate the unique elements of Australian Football, whilst conforming to the scientific evidence from the published international guidelines.

Methodology: The authors, active participants in the international meetings on concussion in sport, assessed the existing data on the management of concussion in AFL. Based upon significant evidence from the literature, we drafted guidelines for the management of concussion in AFL. In conjunction with the Australian Football League Medical Officers Association (AFLMOA) these guidelines were subjected to an intensive review process, and were approved by the AFLMOA and subsequently the AFL. A national roll out of the AFL concussion guidelines coincided with publication of guidelines for general practitioners. The implementation of the new concussion management paradigm was enhanced by guidelines issued by the AFL.

Results: The 2011 AFL season saw the successful implementation of the AFL concussion guidelines. In conjunction with the interchange and substitution rules, the management of concussed players has developed, and is consistent with recommendations from the international guidelines.

Conclusion: The careful, considered management of concussion is critical for the long-term welfare of all footballers. Development and implementation of these guidelines has been successful at all levels, but will require evolution as new concussion data emerge. The pathway from draft paper to published guidelines provides an insight into the translation from scientific research to practical game-day management; this in conjunction with support and rule changes from the governing body, demonstrate the critical processes that must be pursued in implementing change.

C. Finch^{1*} ■ ¹Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), Monash Injury Research Institute (MIRI), Monash University

Introduction: Community Australian Football is known to be both a popular sport and a common setting for injury. Accordingly, there has been an increasing amount of research attention given towards preventing injuries in this context over the past 10-15 years.

Methodology: This talk will provide an overview of previous injury prevention research in community Australian Football, with a particular focus on studies which have investigated safety attitudes, practices, barrier and motivators. It will also give an overview of current research into knowledge translation and how best to implement prevention programs for lower limb injuries in this sport.

Results: Several studies have previously been undertaken to understand the context for injury prevention in community Australian Football. These have included reports of player attitudes towards, and practices in relation to, protective equipment use (such as mouth guard and helmets) and exercise training interventions. Very few studies have reported the same factors in relation to coaches. A small number of studies have reported injury prevention policies and practices at a club or association level, including in relation to ground conditions, local club safety policy and modified rules for juniors. A current large-scale study is implementing a community-based lower limb injury exercise training program in community Australian Football.

Conclusion: It is known that sports delivery occurs within a multi-level ecological setting (involving players, parents, coaches, administrators, clubs and associations) and that injury prevention measures also need to be implemented within this context. Australian Football research, in partnership with the AFL and other agencies, is currently setting new international standards for implementation research into the design, delivery and evaluation of community based sports injury prevention programs.

D. Buttifant^{1*} ■ J. Berry² ■ S. Ullah² ■ C. Finch³

¹Collingwood Football Club, Melbourne, Australia ■ ²School of Human Movement and Sport Sciences, University of Ballarat ■ ³Monash Injury Research Institute (MIRI) Monash University

Introduction: Training and match loads are important for ensuring optimal performance outcomes and achievements of footballers and also have an impact on injury and illness amongst the players. There had been no prospective study of the training/playing loads of first year Australian Football League (AFL) players and associated influence on injury rates. AFL clubs are faced with consistent physical development/musculoskeletal management issues with 1st-year players into the AFL system. The aim was to measure the training and match loads and determine the relationship between loads and injury risk in the first year AFL football players and then compare this to mature 3+ years AFL players.

Methods: Data was collected through a systematic prospective documentation of the 2009 training-playing loads in all first year AFL players, and a subset of 3+ years players. Data was collected by the club's conditioning or sport science staff weekly for the 2009 competitive season.

Results: 64 first year and 58 3+ years players from nine of the 16 AFL clubs were participated in the study. The first year players had significantly higher injury incidence and prevalence rates compared to 3+ years players, leading to both missed matches and missed training sessions. By the end of the 22 matches of the competitive season, the first year players had collectively missed 4.3 times as many matches and 2.6 times as many training sessions as the 3+ years players due to injury.

Discussion: The first year players had significantly higher numbers of injuries, injury incidence rates and injury prevalence rates than the 3+ year old players in terms of injuries that led to both missed matches and missed training sessions. When the numbers of players available at any round was taken into account, the first year players were 14.3 times more likely to miss a match because of injury and 1.4 times more likely to miss training because of injury than the 3+ years players. Finally, there was a significantly reduced probability of first year players remaining match injury free, compared to the 3+ years players, as the match time increased. Similarly, after 5 hours average weekly training volume, the 3+ years players had a higher probability of not missing training due to injury than the first year players.

A. McKay^{1*} ■ S. McCurry¹ ■ ¹Australian Football League

Introduction: The game of Australian Football is in great shape at the elite and community level, with record match attendances, TV audiences and participation levels in recent years. It has become a first choice option for many children becoming involved in sport for the first time. Ensuring the game is safe to play at all levels through the enforcement of rules and policies that protect players from injury has contributed towards this outcome. The Laws of the Game process has undergone several enhancements in recent years; some of these related to the personnel associated with the Laws of the Game Committee and the appointment of a Game Analysis Manager. There has also been the introduction of a rigorous consultation and stakeholder engagement strategy covering a range of industry partners including clubs, coaches, players, state and community football bodies and specialist groups such as Medical Officers, Physiotherapists and Fitness Staff. Another integral part of the Laws process is the extensive research that is fed into the process to assist the Laws Committee in their deliberations on various topics. Annual projects such as the AFL Injury Report (in its 20th consecutive season in 2011), GPS player workload report, TRAK Performance game trends analysis and other ad hoc reports on areas of focus such as knee, hamstring and shoulder injuries provide an evidence base to assist decision making. AFL fan research indicates that the attractiveness of the game is one of the main drivers of match attendance, and as such making sure the game remains spectacular to watch is one of the AFL's strategic priorities. Rule changes introduced in recent years have been introduced to make the game more continuous in line with supporter expectations, to protect players from injury, and to enhance some of the traditional aspects of the game such as marking contests. Such changes and the rationale behind their introduction will be discussed as part of this presentation including the background to the substitute rule which was introduced at the beginning of the 2011 Season.

Conclusion: The Laws of the Game process is more thorough and consultative than ever before in the past and is based on the development of evidence-based research which is used to assist decision making when considering whether to make any modifications to the rules of the game.

A. Schache^{1*} ■ H. Seward² ■ S. McCurry² ■ R. Smith² ■ ¹University of Melbourne ■ ²AFL Research Board

Introduction: Hamstring strain-type injuries continue to display the highest incidence and prevalence rates amongst all injuries in the Australian Football League (AFL). Research specifically investigating hamstring strain-type injuries in the AFL is therefore considered of great importance. The overall objective of the AFL Research Board in this regard is to facilitate an incremental and multi-factorial research program to obtain new knowledge that can be readily transferred into practice.

Methods: The AFL Research Board achieves its objective by seeking advice regarding specific projects or areas of research related to hamstring strain-type injuries that are rated of highest priority by various professional parties in the AFL community, such as the AFL Medical Officers Association, the AFL Physiotherapists and the AFL Sports Science Advisory Group. An appropriate research group is then commissioned and provided with funding to complete the desired work.

Results: Since its inception in 2000, the AFL Research Board has funded a total of nine projects specifically addressing factors related to hamstring-strain type injuries in the AFL. A number of significant findings have been discovered, including (but not limited to) the identification of clinical and radiological prognostic indicators, the identification of risk factors for recurrent injury, the role of muscle stiffness in determining injury risk, as well as a detailed synopsis of current practice regarding the management of hamstring strain-type injuries in the AFL. The majority of projects completed to date have been published in a variety of top-tier sports medicine journals.

Conclusion: It is envisaged that the translation of new knowledge gained from projects funded by the AFL Research Board to industry will lead to an improvement in management and prevention practices for hamstring strain-type injuries, ultimately manifesting in reduced incidence and prevalence rates.

T. Furness^{1*} ■ C. Joseph¹ ■ D. Buttifant² ■ G. Naughton¹ ■ J. Crowe³ ■ ¹Australian Catholic University ■ ²Collingwood Football Club ■ ³RMIT University

Introduction: Currently, a number of balance-aid products are commercially available that claim to improve performance. However, based on an extensive literature search, the products appear to lack scientific evidence, moreover, lack actual investigation. Therefore, given the most common claim of balance-aid products is in the improvement of balance, we selected and investigated the effect of the Power Balance® wrist band on dynamic balance performance in elite athletes.

Methods: Fifteen Australian Football League players were recruited from the Collingwood Football Club (21.87 ± 2.0 years, 90.40 ± 10.29 kg, 192.33 ± 8.32 cm). A randomized, cross-over, controlled double-blind trial with three conditions was used to test a hypothesis that the Power Balance® improved balance with a hologram encased wrist band. The conditions were; 1) no band (control), 2) 'sham' Power Balance® wrist band with the holograms removed and, 3) 'real' Power Balance® wrist band. Participants performed 24 trials in total, measured on the Biodex balance system™. Testing was randomised into three blocks (condition) of two, 20 second balance trials using their preferred and non-preferred legs (limb). Each block consisted of one set of two practice trials and one set of two trials during which data were recorded. Leg preference was determined by preferred kicking limb. Reliability for the balance procedure has been previously established (ICC = 0.94). Participants were asked if they were 'aware' of the wrist band, but not given knowledge of results for dynamic balance. Data were checked for normality and a 3 x 2 ANOVA was computed to describe the difference within and among condition and limb. Significance was accepted at $\alpha \leq 0.05$.

Results: No main effect of condition ($p = 0.81$) or limb ($p = 0.50$) was observed for results of dynamic balance performance in this group of elite athletes. No interaction effect was found on dynamic balance performance among condition and limb ($p = 0.93$).

Discussion: No effect of the Power Balance® wrist band could be reported for dynamic balance tests in Australian Rules Football players.

Furthermore, there was no placebo effect of wearing the band and no difference in balance scores between the preferred and non-preferred limbs across all conditions. These findings suggest that the Power Balance® band worn on the wrist did not alter dynamic balance of highly trained Australian Football League players when standing on the Biodex balance system™.

A. Gupta^{1,2,3*} ■ C. Purdam¹ ■ J. Cook⁴ ■ G. Allison^{5,6}¹Australian Institute of Sport ■ ²La Trobe University ■ ³University of Western Sydney ■ ⁴Monash University ■ ⁵Curtin University ■ ⁶Royal Perth Hospital

Introduction: The purpose of this study was to evaluate the change in neuromuscular behaviour of the lower limb during hopping in a group of elite level athletes. This study measured kinetic, kinematic and muscle activation variables with the primary aim to determine the change in mechanical behaviour of the ankle and knee joints.

Methods: Nine elite level, full-time, male athletes (18.4 years of age, range 17-21; 200.2cm in height, range 190-208cm; 90.8kg in weight, range 83-101kg) from the Australian Institute of Sport competing in the sports of either volleyball or basketball volunteered to participate and provided informed consent. Each athlete performed a series of 8 hopping tasks, in random order with the conditions of pace (self-selected or fixed at 1.8Hz), task (double-leg or alternate-leg) and surface (flat or decline) changed. Synchronous recording on both legs of vertical ground reaction force on dual force plates (Kistler, NY, USA), 3D motion (VICON, Oxford, UK) and muscle activation via electromyography (Noraxon, Az, USA) were made for trials of each hopping condition. The following derived variables were calculated for the first half of the ground contact phase: vertical stiffness, joint stiffness, joint mechanical work done, peak activation amplitude (lower limb muscles) and normalised pre-loading activation amplitude of the medial gastrocnemius. Repeated 3-way ANOVA were performed for a comparison across hopping conditions with statistical significance accepted at $p < 0.05$ (SPSS v.14).

Results and Discussion: For the hopping efforts tested, a change in joint mechanics occurred primarily at the ankle joint with a maintenance of similar vertical stiffness at common hopping frequencies ($p > 0.05$). However, when ankle joint function was constrained by hopping on a decline board, knee joint mechanics adapted to maintain the performance of hopping. The reduction in the mechanical work done and stiffness at the ankle joint, when hopping on the decline compared to the flat surface ($p < 0.01$), was concomitant to an increase in the medial gastrocnemius pre-loading activation amplitude ($p < 0.05$) and an increase in mechanical work done at the knee joint ($p < 0.01$) that maintained similar joint stiffness across all hopping conditions. This finding implicates the series elastic component of the knee extensor muscles to have to adapt by increasing the storage and release of elastic energy when ankle joint function is reduced, especially as there was no change in the vastus lateralis peak activation amplitude between trials on different surfaces.

L. Hopper^{1*} ■ J. Alderson² ■ B. Elliott² ■ T. Ackland² ■ ¹University of Notre Dame Australia ■ ²University of Western Australia

The relationship between elite dance performance on hard, non-compliant floors and injury has been the subject of much debate. A large body of evidence exists demonstrating the high incidence of injury in dancers to structures that cross the ankle joint. Dancers perform numerous landing tasks during training and performance and the ankle joint has been suggested to have specific mechanical limitations during landings. It is generally assumed that safe dance practice must incorporate the use of a 'sprung' or force reducing floor in order to decrease injury risk exposure. Humans demonstrate efficient regulation of lower limb dynamics during locomotion across varied surfaces yet it is unclear whether a connection between these locomotion dynamics and lower limb injury exists. The landing kinematics and kinetics were assessed in 14 elite level dancers performing single leg forefoot drop landings from 0.2 m onto dance surfaces with quantified varied mechanical properties. In addition to linear stiffness, the force reduction magnitudes of the test surfaces were quantified using sport surface testing apparatus, the Advanced Artificial Athlete (Metaalmaatwerk, NL). Landing mechanics were modelled from data captured at 250 Hz using a 12 camera opto-reflective system and integrated force platform. Ankle joint sagittal plane kinematics (dorsiflexion; peak range of motion, angular velocity and acceleration) and kinetics (peak joint power and total work) were significantly affected ($p < 0.02$) by the floor surfaces during a phase bound by the forefoot and heel contact events of the landing cycle. Dependent variable magnitudes increased in conjunction with decreases in surface force reduction and had a latency of < 100 ms after forefoot contact. Flexion range of motion was the only variable analysed at the knee joint to significantly change across surfaces ($p < 0.02$). Under the analysed drop landing conditions and in association with decreasing surface force reduction, the reported change in ankle joint mechanics may be interpreted as an increase in mechanical demand at the ankle joint. Further investigation of the stress applied to the soft tissues that cross the ankle joint under these conditions would be beneficial. The short latency of the changing dependent variables post-forefoot contact suggest that these dynamics occur during a period of limited cognitive motor control which may have further injury risk implications regarding joint stabilisation. Although evidence has been provided suggesting potential surface related injury risk mechanisms, further validation of these findings is required incorporating a broader range of tasks and different cohorts.

C. Bishop^{1*} ■ G. Paul¹ ■ D. Thewlis¹ ■ ¹University of South Australia

Introduction: Footwear is designed to reduce injury and enhance performance. However, the effect footwear has on foot and ankle kinematics currently remains unknown. Acknowledging the need for improved understanding, the aim of this study was to describe the effect footwear has on the kinematics of a multi-segment foot during stance phase of walking gait.

Methodology: Fourteen participants (mean age of 21.8 yrs (± 3.5 yrs), height of 1.75 m (± 0.09 m) and body mass of 71.0 kg (± 10.6 kg) were recruited. In order to quantify the effect of footwear independent of technical design features, an ASICS Onitsuka Tiger- Mexico 66 shoe was used in this study. A newly developed marker set was implemented, which tracked shod and in-shoe kinematic of the foot and ankle. The marker set was applied in four experimental conditions; barefoot, shod, modified shod and in-shoe. To define in-shoe kinematics, 10 mm diameter holes were punched in the shoe upper, with custom tracking markers developed to mount a marker on a 25 mm wand through the shoe. Participants completed five trials in each experimental condition during one session. Kinematic data were captured using a 12 camera VICON MX40 motion capture system (Vicon Motion Systems Ltd., Oxford UK) at 100 Hz and processed in Visual3D (C-Motion Inc, USA). A four segment foot and ankle model was developed. Segment angles were extracted in the sagittal, coronal and transverse planes at initial contact, loading response, midstance and propulsion.

Results: At midstance, the in-shoe forefoot angle was significantly more plantarflexed than the barefoot condition (mean difference = 8.32° , $P \leq 0.001$). The in-shoe forefoot angle was significantly more abducted than the shod condition (mean difference = 3.4° , $P = 0.023$). At propulsion, the in-shoe hallux angle was significantly less dorsiflexed than the barefoot condition (mean difference = 10.63° , $P = < 0.001$).

Conclusion: This study demonstrates that footwear has significant effects on sagittal and coronal plane kinematics during stance phase of walking gait. Important in the context of these significant findings, the modification of footwear did not significantly alter the shod kinematics of the hindfoot or forefoot during stance. This paper presents a method for describing the in-shoe kinematics of the foot and ankle during stance phase of walking gait. In conclusion, the model proposed provides a realistic representation of the effect footwear has on multi-segment foot and ankle kinematics during stance phase of walking gait.

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The occurrence of multiple force producing events during stretch shortening cycle knee extensions

J. Earp^{1*} ■ A. Blazeovich¹ ■ P. Cormie¹ ■ R. Newton¹ ■ ¹Edith Cowan University

Introduction: Stretch shortening cycles (SSC) occur when muscle-tendon unit lengthening (eccentric phase) is followed immediately by a rapid shortening (concentric phase), and are often associated with increases in movement performance. However, studies have found that such benefits are both person- and movement-specific. During SSC movements, muscle fascicles commonly operate quasi-isometrically and uncontrolled elongation of fascicles will result in the dissipation of stored energy and decrease in concentric movement performance. In the present study, force production patterns and fascicle behaviour during SSC knee extensions of varying loads were investigated.

Methodology: Thirteen healthy, physically active subjects performed loaded SSC leg extensions during which vastus lateralis (VL) muscle force and fascicle behaviour were assessed. Maximal leg extensions were performed with the aim of projecting an external load at the end of the concentric phase. Subjects performed three repetitions at 6 different loads (0, 20, 40, 60, 80 and 90% of one-repetition maximum) and the repetition with the highest concentric angular power was further analysed. Knee angles were measured using an electrogoniometer (1000 Hz) and VL force was estimated by inverse dynamics. VL fascicle behaviour was recorded using ultrasonography (94 Hz) and synchronized with force data. Instances where muscle force was above zero were termed 'force-producing events' (FE's). Kinetic data and fascicle behaviour during these events were compared between loads using paired t-tests ($p < 0.05$).

Results: Multiple FE's were observed at all loads but the incidence FE's tended to increase as load increased (0%-6/13, 20%-6/13, 40%-8/13, 60%-8/13, 80%-11/13 and 90%-10/13). The first FE (FE1) was significantly greater than the second (FE2) in all cases and occurred at a greater angle of knee flexion (FE1: 122 ± 6 deg FE2: 25 ± 11 deg). FE1 occurred during the late eccentric phase, when joint angular and fascicle-shortening velocities were slow (-2.1 ± 0.81 rad/s, 3.4 ± 17.8 cm/s) while FE2 occurred midway through the concentric phase when joint angular and fascicle-shortening velocities were faster (7.5 ± 1.9 rad/s, 31.3 ± 18.1 cm/s).

Discussion: Initial force development occurred as the knee transitioned from flexion to extension. However, VL did not always behave quasi-isometrically during FE1, as would be predicted from results of previous jumping studies. The occurrence of FE2 at heavier loads demonstrates an inability to maintain a high force output throughout the movement. The current findings are significant as they are the first to show muscle fascicle behaviour during force development differs between individuals and loads.

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Does a gender difference in cutting technique exist for skill- and anthropometrically-matched Touch Football players?

C. Mura^{1*} ■ B. Munro¹ ■ J. Steele¹ ■ ¹University of Wollongong

Introduction: Similar to many other sports, female Touch Football players incur more ACL injuries than their male counterparts, particularly when performing cutting manoeuvres. Although numerous studies claim to have identified a "risky" cutting technique that predispose females to ACL injury compared to males, most of these studies have failed to match their male and female participants for factors likely to affect technique such as sport, skill level and anthropometry. This study aimed to identify whether male and female athletes, matched for age, sport, skill level and lower limb anthropometry displayed differences in cutting technique.

Methods: 15 male (20.8 ± 1.5 yr) and 15 female (19.8 ± 1.0 yr) representative Touch Football players from mixed-gender teams, matched for age and lower limb anthropometry, were recruited. Carrying a football, each subject reacted to an unanticipated visual directional cue and performed a randomly assigned cutting manoeuvre while three-dimensional kinematic data were collected (200 Hz; OPTOTRAK 3020 motion analysis system) together with video images of their technique (25 Hz). Lower limb joint angles and segmental motion were determined at initial foot-ground contact (IC) and at the time of the peak resultant ground reaction force (FR) using Visual3D software. Independent t-tests ($p \leq 0.05$) were used to determine whether there were any significant between-gender differences in cutting technique.

Results & Discussion: Qualitative assessment of cutting technique revealed that all males performed the cut by adopting a lateral foot plant strategy, whereas only 7 of the females displayed this technique; the remaining 7 females adopted a more anterior-posterior central foot plant strategy. Compared to males, females displayed significantly less ankle inversion ($F = 0.5^\circ \pm 5.5^\circ$, $M = 6.5^\circ \pm 5.2^\circ$, $p < 0.01$) and thigh abduction ($F = 13.3^\circ \pm 2.9^\circ$, $M = 16.4^\circ \pm 3.1^\circ$, $p < 0.01$) at IC and greater thigh flexion ($F = 39.8^\circ \pm 5.6^\circ$, $M = 34.7^\circ \pm 6.2^\circ$, $p = 0.03$) and less thigh abduction ($F = 12.4^\circ \pm 1.8^\circ$, $M = 17.0^\circ \pm 3.9^\circ$, $p < 0.01$) at FR. These values characterised differences between the two foot plant strategies and did not support any of the other between-gender differences in cutting technique previously reported in the literature.

Conclusion: Touch players who adopt a more anteriorly-directed foot plant strategy may be at an increased ACL injury risk as this technique is likely to increase anterior shear loading of the ACL during the vulnerable weight acceptance phase of the cutting cycle. However, further research is warranted to ascertain whether one of these two foot plant strategies, as opposed to merely being female, predisposes athletes to ACL injury.

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Asymmetry in lower body power production during a loaded single-leg step-up: Implications for injury risk assessment

B. Appleby^{1*} ■ P. Cormie² ■ ¹RugbyWA ■ ²School of Exercise, Biomedical and Health Sciences, Edith Cowan University

Introduction: Team sports such as rugby union (RU) require running and change of direction at speed. These physical capacities require symmetrical performance (i.e. equal ability to change either direction). Further, muscle asymmetry has long been acknowledged as an injury risk (e.g. hamstring strain/tear). The awareness of bilateral asymmetry in athletes may prove a useful injury prevention and performance improvement tool. The purpose of this investigation was to assess symmetry in a box step-up.

Methods: Twenty-four elite male rugby union players (24.6 ± 3.8 years and 104.8 ± 10.8 kg) performed 30cm box step-ups as part of their pre-season strength training program. This exercise was performed using a loaded barbell placed on the shoulders (similar to a back squat) of a subject who then stepped forward onto a solid wooden step. A linear position transducer (GymAware, Kinetic, Canberra, Australia) was attached to the barbell to measure power output for each load. Athletes performed box step-ups incrementally across a range of loads until one repetition maximum (1RM) was achieved. The mean concentric power of each repetition was converted to a percentage of each leg's best power output for each subjects load range.

Results: The load that produced the maximum mean power was $78\% \pm 11\%$ of 1RM. The average difference between legs at maximum mean power was $2.7\% \pm 4.3\%$. The difference between legs at mean power output was 0.0% to 14.7%. At 1RM, the average asymmetry was $6.1\% \pm 5.6\%$. The difference in power between legs at 1RM ranged from 0.7% to 24.7%.

Conclusion: The results of this study indicate that elite RU players are relatively symmetrical in the box step-up exercise. However, six subjects demonstrated imbalances greater than 5%. At 1RM, 13 subjects had an imbalance greater than 5%, four were in excess of 10%. At higher percentages of 1RM, the box step up may be a useful tool for diagnosing lower limb asymmetry.

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Knee extension torque elicited by electrical versus magnetic stimulation

M. Noorkoiv^{1*} ■ K. Nosaka¹ ■ A. Blazeovich¹ ■ ¹Edith Cowan University

Introduction: Magnetic stimulation has been used in rehabilitation and in neuromuscular research as a non-painful alternative to electrical muscle stimulation. Since the stimulation field during magnetic stimulation is larger than with electrical stimulation, the aim of the present study was to compare the knee extensor torque magnitudes between rapid-pulse magnetic stimulation of the femoral nerve, electrically elicited double twitch (femoral nerve) and maximum voluntary contractions (MVC), and compare the shapes of the torque-angle relationships.

Methods: Six men (27.5 ± 2.7 years) knee angle torque was measured with 4 different protocols at 6 knee angles (40, 50, 60, 70, 80 and 90°, 0°=full knee extension). The protocols were: MVC, doublet electrical twitch (140% of maximal M-wave intensity) of the femoral nerve, and 2-s magnetic stimulation at 40Hz (70% of maximum output of unit) and 25Hz (90% output). Magnetic stimulation was applied through the custom-built coil (50-mm double coil, maximal field strength 2.22T) using MagStim Rapid2 (The Magstim Company Ltd, USA) stimulator. The stimulation site was located by real-time ultrasound. The subjects were seated in a custom-built force chair with hip angle at 135° to have better magnetic coil access to the femoral nerve. Knee angle-dependent differences between protocols were tested using 2-way repeated measures ANOVA ($P < 0.05$).

Results and Conclusions: There were no differences in the shapes of the torque-angle relationships, however there were differences in the peak torque magnitudes elicited by the different stimulation protocols ($P = 0.002$). The average electrically stimulated twitch was $50.2 \pm 15.7\%$ of MVC, the magnetically elicited torque at 90° intensity was $66.2 \pm 39.9\%$ and at 70° intensity $46.0 \pm 38.0\%$ of MVC. This data shows that it is possible to elicit relatively high knee extensor torques using magnetic stimulation of the femoral nerve, and that the relative torque magnitudes at different knee angles (i.e. muscle lengths) do not differ from MVC or electrically-elicited torques. Importantly, it was not possible to achieve torque levels equivalent to MVC with magnetic stimulation. It may be that the larger area of stimulation (i.e. large magnetic field area) of magnetic stimulation as compared to electrical stimulation increases antagonist activation during magnetic femoral nerve stimulation. Therefore agonist and antagonist recruitment during magnetic stimulation should be examined in the future.

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Encouraging children to Unplug and Play: Results of research with parents

N. James¹ ■ T. Shilton^{1*} ■ C. Maitland¹ ■ J. Granich² ■ M. Rosenberg² ■ L. Wood² ■ R. Solomon² ■ ¹National Heart Foundation ■ ²University of Western Australia

Introduction: Sedentary behaviour contributes to unhealthy weight gain. Less than half of Western Australian (WA) primary school aged children meet the Australian recommendations for physical activity and electronic media use. In 2008, the Heart Foundation developed the Unplug and Play campaign, funded by the Department of Health WA, in response to the increasing time children spend engaged in sedentary behaviour, especially the use of electronic media. The campaign features radio and print advertising, a supporting brochure delivered to parents through schools and public relations activities.

Methodology: To inform Phase 2 campaign development, qualitative research was conducted with parents of ten to twelve year-old children ($n=33$) through a brief survey and nine small group discussions. Data was analysed using thematic analysis. Subsequently, campaign materials were developed and tested with parents of children aged six to twelve years via four metropolitan focus groups ($n=35$) and regional online surveys ($n=126$). Campaign impact evaluation occurred in 2008, 2009 and 2011 using cross-sectional telephone surveys of WA parents ($n=600$). 2011 data is currently being analysed.

Results: Qualitative formative evaluation identified key themes:

- Organised recreation activities appear to have a protective factor against after school screen-time.
- Most families establish household rules around electronic media use, however enforcing rules and keeping up with technology is challenging.
- Parents feel reliant on electronic media for reasons including safety concerns, lack of time and feeling that children need 'down time.'
- Parents were equally as motivated by perceived social and emotional benefits for children, as by improving physical health.

Impact evaluation results included:

- Awareness of the campaign was 42% in 2008 and 45% in 2009.
- The most effective communication mode was the school brochure followed by radio advertisements.
- A significantly greater proportion of parents aware of the campaign (51%) correctly reported on electronic media use guidelines than those that were unaware (31%).

Conclusions: Interventions to limit children's screen-time and encourage active play are warranted. Recommendations from this research suggest the need to increase parental awareness of Australian physical activity recommendations, and the amount of time children spend using electronic media and being active. Promoting the benefits of organised physical activity, benefits other than physical health and the normalcy of household rules regarding electronic media use would be worthwhile campaign directions. Results demonstrate that a well researched and targeted, limited budget campaign can achieve acceptable awareness levels.

E. Ward^{1*} ■ L. Straker¹ ■ K. Smith¹ ■ D. Kerr¹ ■ M. Davis¹ ■ A. Fielding¹ ■ A. McManus¹ ■ ¹Curtin University

Introduction: Around one quarter of Australian adolescents are overweight or obese. Recent reviews have highlighted the gap in evidence around the effectiveness of interventions to prevent the progression to morbid obesity, especially during adolescence. Therefore the purpose of this study was to develop and evaluate a multi-disciplinary, family-centred intervention targeting activity, food and behaviour change in overweight/obese adolescents. **Method:** 30 adolescents completed an 8 week program in school terms 2, 3 and 4 in 2009 and terms 2 and 3 in 2010. Curtin University's Activity, Food and Attitudes Program (CAFAP) consisted of twice weekly sessions of 2 hours duration. Adolescents participated in a 1 hour exercise program at each session followed by education and support sessions. Parents participated in education and support sessions for both hours, sometimes with their children. Sessions were facilitated by physiotherapy, dietetics, psychology and social work professionals and undergraduate/postgraduate students. The goal of the program was sustainable behaviour change in relation to physical activity, healthy diet and a positive attitude, rather than weight loss.

Results: Activity initially increased after the program (pre daily accelerometer count mean 856 (95% confidence interval 619-1093); post 916 (577-1255)) but was reduced at 3 month follow-up (720 (603-838) n=7). Daily serves of vegetables and fruits were greater at follow-up (e.g. vegetables pre 1.2 (0.6-1.7), post 1.4 (0.7-2.1), 3 month 1.4 (0.2-2.7)). Daily intake of extras and fats were reduced at follow-up (extras pre 4.0 (1.8-6.1), post 3.1 (2.2-3.8), 3 month 3.4 (1.6-5.1)). Qualitative data were also collected. The results will be presented in relation to attitudes and reported activity for up to 6 months follow-up.

Conclusion: Participation in the CAFAP program resulted in some pleasing changes in behaviours by adolescents with regards to increased daily intake of fruit and vegetable serves and decreased intake of fat. There were also initial changes showing increased physical activity levels, however this was not sustained. Whether behaviours can be sustained is the focus of ongoing research.

K. Faithfull^{1*} ■ E. Hinckson¹ ■ ¹AUT University

Introduction: Sedentary behaviour in children has been associated with unhealthy dietary intake, and obesity levels in adulthood. Interrupting sitting time has been shown to improve metabolic health in adults but to date no studies have been conducted on metabolic risk factors in children. The aim of this study was to investigate the effect of interrupting sitting time on acute postprandial plasma triacylglycerol (TAG) in healthy children during the day following four high fat meals.

Methods: Twelve children (20.70 ± 2.23 kg.m⁻²) underwent two 8.5 hour testing sessions separated by 7 days. On day 1 (d1) participants interrupted sitting with moderate intensity exercise every 30 min. On day 2 (d2) participants remained sedentary. Four meals high in fat (breakfast, 90 g; morning tea, lunch and afternoon tea, 40 g respectively) were consumed to simulate daily eating patterns in children. Triglycerides found in the blood stream were compared between d1 and d2 at each test (baseline, two, four, six and seven hours from baseline). Data were log transformed and presented as percent mean changes. The smallest standardized change was assumed to be 0.20. The value of 0.20 gives chances that the true effect is at least small. To make inferences about true (population) values, the uncertainty in the effect was expressed as 90% confidence limits (CL) and as likelihoods that the true value of the effect represents substantial change (negative or positive). If the likely range overlapped substantially positive and negative values, we inferred that the outcome was unclear.

Results: Overall, combined responses showed higher levels of TAG on d1 than d2 and the difference was 8.1%; (90%; CL (± 37.6)) but the effect was unclear. After reviewing individual data, TAG levels were higher on d2 compared to d1 in eight participants. The change in the mean was large, 35.1%; (± 15.7). The results two, four and six hours after baseline for the eight participants showed a likely change in the mean between TAG concentrations on d2 compared to d1; 21.6% (± 15.6); 48.7% (± 38.8) and 56.5% (± 75.1) respectively. The results of the remaining four participants highlighted increased TAG on d1 at two, four and six hours after baseline compared to d2. The change in the mean was -28.2% (± 31.8); -53.1% (± 129.0) and -54.0% (± 98.2).

Conclusion: Interrupting sitting time with moderate-high intensity activities seems to delay postprandial clearance in some children but not all. A larger sample size is needed to investigate these differences.

N. Ridgers^{1*} ■ J. Salmon¹ ■ K. Ridley² ■ E. O'Connell¹ ■ L. Arundell¹ ■ A. Timperio¹ ■ ¹Deakin University ■ ²Flinders University

Introduction: Emerging evidence suggests that objectively assessed sedentary time is associated with poor health outcomes in children. Actigraph accelerometers are often used to measure sedentary behavior, however cutpoints used to define sedentary vary between studies. More recently, the activPAL has been used to distinguish sitting from standing. The aim of this study was to examine the concordance between various published Actigraph cut-points for sedentary time and objectively assessed periods of sitting/lying and non-stepping time using the activPAL in children.

Methodology: Forty-eight children (26 boys, 22 girls) aged 8 to 12 years wore a waist-mounted Actigraph and thigh-mounted activPAL for two consecutive school days (9-3:30pm). Actigraph (AG) data were analyzed using 17 cut-points, ranging from 50 to 850 counts-min⁻¹, including four published cut-points (AG100, AG200, AG500, AG800), to determine sedentary time during class-time, breaks and the school day overall. Sitting/lying time and non-stepping time (defined as sitting/lying plus standing not stepping) was obtained from the activPAL for each of these periods. Paired-t-tests were used to examine differences between Actigraph and activPAL data. Spearman's Rho was used to explore agreement between AG50 to AG850 sedentary time and sitting/lying and non-stepping time, and limits of agreement were computed to evaluate bias.

Results: No significant differences between AG100 sedentary time and activPAL sitting/lying time were observed for break time and the school day. The strongest correlation between activPAL sitting/lying time and Actigraph sedentary time was AG100 for class time ($r=0.39$), AG200 for break time ($r=0.62$), and AG150 for the school day ($r=0.46$). The smallest bias between activPAL sitting/lying time and Actigraph sedentary time was AG150 for class time (-3.8 minutes), AG50 for break time (-0.8 minutes), and AG100 for the school day (-5.2 minutes). For non-stepping time, the smallest bias was observed for AG850 for class time (-4.7 minutes), break time (-1.1 minutes) and the school day (-5.8 minutes).

Conclusions: In comparison to the activPAL, an Actigraph cut-point ranging from 100-150 counts-min⁻¹ provided a good estimate of sitting/lying time whilst 800-850 counts-min⁻¹ provided a good estimate of non-stepping time during the school day in children.

K. Copeland¹ ■ ¹Alphington Sports Medicine Clinic, Victoria

A highly experienced and interactive multidisciplinary panel will discuss real and complex patient presentations. Particularly in the upper quadrant differential diagnosis is vitally important however can at times be confusing with overlapping signs and symptoms. Real case studies will be presented that lend themselves to the Multidisciplinary treatment model, with differential diagnosis and treatment strategies discussed. This session aims to be both very clinical and interactive between the expert panel members and the audience.

Do muscle induced vibrations generated during eccentric ankle exercise play a role in the rehabilitation of Achilles tendinopathy?

N. Grigg^{1*} ■ S. Wearing² ■ J. Smeathers¹

¹Institute of Health and Biomedical Innovation, Queensland University of Technology ■ ²Faculty of Health Sciences and Medicine, Bond University

Introduction: High frequency vibrations generated during eccentric, but not concentric, ankle exercise have been hypothesized to underlie the beneficial effect of eccentric loading in the rehabilitation of Achilles of tendinopathy. While such vibrations (8.5-11.5 Hz) have been noted in healthy individuals, no research to date has established whether this phenomenon also occurs in individuals with Achilles tendinopathy. The purpose of the current research, therefore, was to evaluate the frequency characteristics of vertical ground reaction forces (VGRF) recorded during eccentric and concentric ankle exercise in individuals with and without Achilles tendinopathy.

Methods: Eleven male adults with unilateral mid-portion Achilles tendinopathy and nine control male adults without tendinopathy participated in the research. A force platform, sampling at 1000 Hz, was used to measure VGRF during the performance of isolated unilateral eccentric and concentric Triceps Surae exercises. Participants with tendinopathy performed the exercise protocol on two occasions, separated by 4-7 days, to ensure the symptomatic limb was exposed to both exercise conditions. The VGRF for each exercise repetition was high pass filtered (1.5 Hz), bodyweight normalised and a Discrete Fourier Transform was used to estimate the total power between 7.5 and 14.5 Hz.

Results: In control individuals, eccentric loading of the Triceps Surae (622.5 ± 23.2 N2/Hz) was characterized by a significantly greater power than concentric exercise (331.5 ± 23.2 N2/Hz) over the measured frequency bandwidth ($p < 0.05$). In Achilles tendinopathy, however, there was no significant difference in power during eccentric (238.6 ± 20.3 N2/Hz) and concentric (255.6 ± 20.5 N2/Hz) loading. The tendinopathy group was characterized by a selective decrease in power during eccentric loading ($p < 0.05$).

Discussion: Consistent with earlier research, eccentric exercise invoked high frequency vibrations in healthy individuals. The effect, however, was not evident in Achilles tendinopathy, with eccentric and concentric loading generating similar power spectra over the high frequency bandwidth. The selective loss of power at higher frequencies during eccentric exercise in Achilles tendinopathy suggests that either changes in tendon compliance with Achilles tendinopathy may act to dampen high frequency vibrations during eccentric loading or that symptomatic individuals employ different muscle activation patterns during performance of eccentric exercise. While further research is required to elucidate mechanisms underlying the selective loss of high frequency vibration during eccentric loading in Achilles tendinopathy, the findings of this study question, for the first time, the potential role of high frequency vibrations generated during eccentric exercise in the rehabilitation of Achilles tendinopathy.

Individuals with patellofemoral joint osteoarthritis exhibit different proximal and distal kinematic adaptations to foot orthoses

N. Collins^{1,2*} ■ H. Ozturk¹ ■ T. Dorn¹ ■ A. Schache¹ ■ M. Pandey¹ ■ K. Crossley^{1,2}

¹Department of Mechanical Engineering, University of Melbourne ■ ²Department of Physiotherapy, University of Melbourne

Patellofemoral joint (PFJ) osteoarthritis (OA) is becoming increasingly recognised as an important source of knee pain and morbidity associated with degenerative knee joint disease, a common sequelae of sport-related injuries. Considering limitations of current surgical strategies for PFJ OA, it is vital to develop an understanding of simple, conservative strategies to reduce the burden of this common condition. While previous studies have shown that foot orthoses reduce pain, improve function and change kinematics in young adults with PFJ pain, their effects have yet to be investigated in an older cohort with OA. The aim of this study was to investigate the kinematic changes during walking with and without foot orthoses in individuals with PFJ OA.

Methods: A within-subjects, repeated measures trial was conducted using 20 individuals with PFJ OA (osteophytes on skyline radiographs, anterior knee pain during activities that load the PFJ e.g. steps or squatting). Data was collected during level walking under two conditions: i) running sandal (Nike Strap Runner); and ii) sandal with prefabricated foot orthoses (Vasylis International). Knee joint kinematics were measured using a six-camera VICON motion analysis system (Oxford Metrics, Oxford, UK), in conjunction with two AMTI force plates. A customised eight-segment biomechanical model was constructed using OpenSim software (Simbios, Stanford University, CA, USA) and used to compute all joint kinematic and torque data.

Results: Consistent kinematic adaptations were seen at the foot and ankle, with 16 out of 20 participants demonstrating reductions in peak subtalar joint eversion and peak ankle dorsiflexion with orthoses compared to the sandal alone. In contrast, adaptations to foot orthoses seen at the knee and hip were more variable. For knee flexion/extension, hip abduction/adduction and hip rotation, approximately 50% of participants demonstrated decreases in peak angles, while the remaining 50% demonstrated increases in peak angles.

Conclusions: In individuals with PFJ OA, it appears that kinematic gait adaptations to a local foot intervention are more consistent at distal lower limb joints, and more variable at the proximal joints. This is consistent with previous findings in asymptomatic populations, and suggests that individual responses may be more important when interpreting outcomes of orthoses studies, and when prescribing foot orthoses for PFJ OA.

Post-treatment analgesia in chronic lower limb tendinopathies: Is there a difference between clinical responses following radial shockwave treatment and stretching?

S. Locke^{1,2,3*} ■ M. Huo^{1,2,3}

¹Queensland Centre for Sport and Movement ■ ²Centre of Excellence, Queensland Academy of Sport ■ ³School of Human Movement studies, University of Queensland

Introduction: Radial shockwave therapy (RSWT) provides effective and persistent analgesia in various upper and lower limb tendinopathies well described in numerous randomised controlled trials (RCTs). Persistent analgesia may be related to local sensory nerve destruction causing depletion of substance P and other peptides. RSWT may also decrease the expression of substance P and other related peptides in the dorsal root ganglion, which may contribute to persistent analgesia. The purpose of this investigation was to study whether the degree of persistent analgesia provided by RSWT differs between applications to insertional Achilles tendinopathy (IAT), mid Achilles tendinopathy (MAT) and plantar fasciopathy (PF).

Method: A prospective clinical analysis of patients treated with a standard dose of RSWT combined with usual stretching protocols in one clinic was performed. Pain intensity was measured using a 1–10 numerical rating scale (NRS). The pain intensities upon rising in the morning and for the previous 24 hours were rated. The primary outcome measure was the change in the pain intensity score from the initial consultation to follow-up (8 months). Substantial clinical improvement was defined as >50% reduction in pain intensity. The secondary outcome measures were the patient global impression of change, and patient relevant outcome measures. Continuous data (pain intensity scores) were analysed nonparametrically because of a skewed distribution.

Results: The average age of patients was 54±1.4 years (all data, mean±SEM), and 62% were women. The average symptom duration was 9±1.0 months, and follow-up duration was 8±0.5 months. The mean initial pain score upon rising in the morning was 6.2 (95% CI 5.7–6.8). Sixty-seven percent (95%CI 54–79%) of patients achieved a substantial clinical improvement in pain intensity noted upon rising in the morning. Sixty-five per cent (95%CI 50–75%) of patients achieved a substantial clinical improvement in pain in the previous day. Fifty-nine per cent (95%CI 36–78%) of patients with IAT, 69% (95%CI 42–87%) of patients with MAT and 68% of patients with PF (95%CI 49–82%) achieved substantial clinical improvement upon rising in the morning. The analgesic effect did not differ between patients grouped according to pathology (MAT, IAT and PF) for both individual scores and in patients who made substantial clinical improvement upon rising ($p=0.9$). Similar results were seen for the previous day's pain for all diagnostic categories ($p=0.3$).

Conclusion: RSWT combined with usual stretching protocols provides similar and effective persistent analgesia when used to treat MAT, IAT and PF.

Increasing our knowledge of boot-surface interaction

P. Fleming^{1*} ■ ¹Loughborough University

Over the past 10 years Loughborough University has been investigating player surface interactions through a variety of research projects, primarily on artificial turf systems. Recent work has focused on evaluating a range of mechanical test methods with a variety of stud patterns on a range of carefully prepared surfaces. This has included stud penetration under different normal loads. The findings are as expected to a degree, and show that artificial surfaces deform before they shear to a greater extent than natural turf surfaces. The stud size, spacing and configuration has a somewhat complex inter-related relationship but in general larger studs lead to higher traction, as do larger studs on the periphery of the boot due to the lever arm effect. However closer stud spacing can reduce the peak resistance values as the maximum resistance, for artificial surfaces, is not fully mobilized before a rotation or translation motion encounters the path of a preceding stud. When combined with surface hardness (and hence the penetration resistance) the traction is then further affected by the boot's ability (or the wearer) to generate full penetration. Lower penetration leads to lower traction. The surface state plays a key role in this interaction as the key surface factor appears to be a form of 'yield' strength of the artificial infill (or soil/root) and this controls both penetration and resistance to shearing in translation or rotation. The surface materials' 'yield' strength are in general both load rate dependent and compressive stress magnitude dependent. Currently, mechanical test methods aiming to provide data for player performance or safety on surface systems' behaviour are limited in many aspects and on especially, they apply a fixed normal load during testing. Test devices ideally need to be 'biofidelic' (i.e. mimic the athlete loading scenario) in their methodology or they risk being invalid with regard to their interpretation for player comfort or injury risk. However, the effective measurement of surface traction and a deeper understanding of surface system behaviour in providing traction is somewhat clouded by the many differing test devices used in research around the world that have differing input parameters or test protocols. Issues for future research include a key one in bridging the gap between the human and mechanical test devices.

Load bearing improves the limits of agreement for repeated in vivo measures of the speed of sound in human Achilles tendon

J. Smeathers^{1*} ■ S. Wearing² ■ S. Hooper³ ■ S. Locke³ ■ N. Grigg¹ ■ ¹Institute of Health and Biomedical Innovation, Queensland University of Technology

²Faculty of Health Sciences and Medicine, Bond University ■ ³Centre of Excellence for Applied Sport Science Research, Queensland Academy of Sport

Axial acoustic wave propagation has been widely used in evaluating the mechanical properties of human bone in vivo. However, application of this technique to monitor soft tissues, such as tendon, has received comparatively little scientific attention. Laboratory-based research has established that axial acoustic wave transmission is not only related to the physical properties of equine tendon but is also proportional to tensile load to which it is exposed (Miles et al., 1996; Pourcelot et al., 2005). The reproducibility of the technique for in vivo measurements in human tendon, however, has not been established. The aim of this study was to evaluate the limits of agreement for repeated measures of the speed of sound (SoS) in human Achilles tendon in vivo.

Methods: A custom built ultrasound device, consisting of an A-mode 1MHz emitter and two regularly spaced receivers, was used to measure the SoS in the mid-portion of the Achilles tendon in ten healthy males and ten females (mean age: 33.8 years, range 23–56 yrs; height: 1.73±0.08 m; weight: 68.4±15.3 kg). The emitter and receivers were held at fixed positions by a polyethylene frame and maintained in close contact with the skin overlying the tendon by means of elasticated straps. Repeated SoS measurements were taken with the subject prone (non-weightbearing and relaxed Achilles tendon) and during quiet bipedal and unipedal stance. In each instance, the device was detached and repositioned prior to measurement.

Results: Limits of agreement for repeated SoS measures during non-weightbearing and bipedal and unipedal stance were ± 53 , ± 28 and ± 21 m/s, respectively. The average SoS in the non-weightbearing Achilles tendon was 1804 ± 198 m/s. There was a significant increase in the average SoS during bilateral (2122 ± 135 m/s) ($P < 0.05$) and unilateral (2221 ± 79 m/s) stance ($P < 0.05$).

Conclusions: Repeated SoS measures in human Achilles tendon were more reliable during stance than under non-weightbearing conditions. These findings are consistent with previous research in equine tendon in which lower variability in SoS was observed with increasing tensile load (Crevier-Denoix et al, 2009). Since the limits of agreement for Achilles tendon SoS are nearly 5% of the changes previously observed during walking and therapeutic heel raise exercises, acoustic wave transmission provides a promising new non-invasive method for determining tendon properties during sports and rehabilitation related activities.

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Shoe inserts produce immediate pain relief in individuals with patellofemoral joint osteoarthritis

N. Collins^{1,2*} ■ H. Ozturk¹ ■ A. Schache¹ ■ R. Hinman² ■ K. Crossley^{1,2}

¹Department of Mechanical Engineering, University of Melbourne ■ ²Department of Physiotherapy, University of Melbourne

Patellofemoral joint (PFJ) osteoarthritis (OA) is emerging as a distinct clinical entity that affects a large number of Australians, and is associated with considerable pain and morbidity. As such, it can have a profound negative impact on participation in a physically active lifestyle. The unique biomechanics of the PFJ mean that traditional interventions for tibiofemoral OA are unlikely to sufficiently address PFJ OA symptoms. Findings of a recent randomised clinical trial suggest that shoe inserts are an effective intervention for PFJ pain in young adults. However, this simple intervention has not been investigated in a PFJ OA cohort. Therefore, the current study sought to determine the immediate effects of shoe inserts on pain during functional tasks in people with PFJ OA.

Methods: A within-subjects, repeated measures, randomised cross-over trial utilised 20 individuals with PFJ OA (osteophytes on skyline radiographs, anterior knee pain during activities that load the PFJ e.g. steps or squatting). Participants rated their pain on an 11-point numerical rating scale (NRS) while walking and performing a step down task, under three conditions: i) running sandal (Nike Strap Runner); ii) sandal with prefabricated orthotic (Vasyl International); and iii) sandal with flat EVA insert. Repeated measures analysis of variance and post hoc tests of simple effects were conducted to determine differences in pain between the three conditions for each functional task ($p=0.05$).

Results: There was a significant main effect for the step down task ($p=0.03$). Pairwise comparisons revealed that, compared to the sandal alone, significant reductions in pain occurred for both orthoses (mean difference 1.03, 95% CI 0.15 to 1.9) and flat inserts (1.2, 0.32 to 2.08). There were no significant differences between the two inserts (-0.2, -1.08 to 0.68). Main effects for the walking condition approached statistical significance ($p=0.08$).

Conclusions: Study outcomes show that shoe inserts, be it prefabricated foot orthoses or flat EVA inserts, can produce immediate and significant reductions in perceived pain during activities that typically aggravate symptoms associated with PFJ OA. Furthermore, the magnitude of the change in pain may represent a clinically meaningful effect. This indicates that shoe inserts are likely to be an effective intervention for PFJ OA, and warrant further investigation using randomised clinical trials to determine longer-term effects.

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Nutrition and the Brain

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R. Meeusen^{1*} ■ ¹Department of Human Physiology, Vrije Universiteit Brussel, Belgium

The brain and periphery carry on a constant conversation; the periphery informs the brain about its metabolic needs and the brain provides for these needs through its control of somatomotor, autonomic, and neurohumoral pathways involved in energy intake, expenditure and storage. This constant interaction will also be present during prolonged exercise, and it has been hypothesized that a disturbance in the provision of neurotransmitter precursors could be the cause of fatigue. This 'central fatigue' hypothesis is mainly based on an increased concentration of the neurotransmitter serotonin (5-HT). Serotonin has been linked to fatigue because of its well-known effects on sleep, lethargy and drowsiness and loss of motivation. Several nutritional and pharmacological studies have attempted to manipulate central serotonergic activity during exercise, but this work has yet to provide robust evidence for a significant role of 5-HT in the fatigue process. The original central fatigue hypothesis suggested that an exercise-induced increase in extracellular serotonin (5-HT) concentrations in several brain regions contributed to the development of fatigue during prolonged exercise. There is limited or only circumstantial evidence to suggest that exercise performance can be altered by nutritional manipulation through tryptophan (TRP) or branched chain amino acids (BCAA) supplementation. While there is some additional evidence of BCAA ingestion influencing ratings of perceived exertion (RPE) and mental performance, the results of several apparently well-controlled laboratory studies have not demonstrated a positive effect on exercise capacity or performance. No ergogenic benefit has been reported during prolonged fixed intensity exercise to exhaustion, prolonged time trial (TT) performance or incremental exercise. Another nutritional strategy that may influence serotonin synthesis, and potentially the development of central fatigue, is carbohydrate (CHO) feeding. The ingestion of CHO suppresses lipolysis, lowering the circulating concentration of plasma FFA and consequently limiting the exercise-induced rise in free-TRP. Recent work has demonstrated that CHO ingestion during exercise attenuated the cerebral uptake of TRP as well as preventing the development of hypoglycaemia, but the peripheral role of CHO ingestion cannot be ruled out. The beneficial effect of CHO supplementation during prolonged exercise could also relate to increased (or maintained) substrate delivery for the brain, with a number of studies indicating that hypoglycaemia affects brain function, and cognitive performance.

Reference: Meeusen R, Watson P, Hasegawa H, Roelands B, Piacentini MF. Central Fatigue – the serotonin hypothesis and beyond.

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E. Chong^{1*} ■ K. Guelfi¹ ■ P. Fournier¹ ■ ¹School of Sport Science, Exercise and Health, University of Western Australia

Introduction: There is evidence that mouth rinsing or ingesting carbohydrates (CHO) during exercise can improve 1-h high-intensity exercise performance, thus suggesting that the ergogenic effect of CHO is mediated by the stimulation of the sweet taste receptors in the oral cavity. In contrast, we recently showed that CHO mouth rinsing has no effect on sprint performance. Given the presence of sweet taste receptors in the upper intestine (Dyer et al., 2005), the primary aim of this study was to investigate whether the combined stimulation of the taste receptors in the oral cavity and gut can improve the performance of a maximal sprint.

Methods: Twelve competitive male cyclists ($\text{VO}_{2\text{peak}}$ 57.8 ± 4.7 mL·kg⁻¹·min⁻¹; mean \pm SD) each ingested and rinsed their mouth with 100 mL of one of the following solutions on separate occasions and following a randomised double blind counterbalanced design; (a) 10% glucose solution [Glu], (b) 0.05% aspartame solution [Asp], (c) 9.1% maltodextrin solution [Mal], or (d) water [Wa] as a control, followed by repeatedly mouth rinsing with 11 boluses of 15 mL of the same solution. Then, each participant performed a 45-s maximal sprint effort on a cycle ergometer and performance was assessed.

Results: The Asp and Mal trials were not significantly different from Wa across all indicators of sprint performance (maximal power output and mean power outputs, $p > 0.05$). In contrast, the Glu trial improved maximal power output during the sprint effort by 14.7% ($p < 0.05$) compared to Wa and by 9 and 16% ($p < 0.05$) compared to the Asp and Mal trials, respectively. Blood glucose levels increased to a similar extent in response to the Wa and Glu trials.

Discussion: Our findings suggest that combining the rinsing and ingestion of a glucose solution improves maximal sprint performance. This ergogenic effect is unlikely to be related to sweetness since the Asp trial had no effect on performance despite sweetness matching that of Glu. The benefit of Glu is also unlikely to result from a rise in blood glucose level as Mal resulted in a similar rise but without affecting performance. Given earlier findings from this laboratory that mouth rinsing alone had no effect on maximal sprint performance, we suggest that the ergogenic effect of glucose ingestion on maximal sprint performance is likely to be mediated via the stimulation of the CHO receptors in the esophageal.

J. Siegler^{1*} ■ J. Bray² ■ C. Towilson² ■ ¹University of Western Sydney ■ ²University of Hull, United Kingdom

Purpose of the Research: Although a considerable amount of published literature exists on the ergogenic potential of ingesting sodium bicarbonate (NaHCO₃) prior to various forms of short-term, high intensity exercise, very little exists on the optimization of loading sequences prior to the exercise bout. Therefore, the purpose of this study was to determine whether blood buffering responses and subsequent repeated sprint performance is influenced by varying NaHCO₃ ingestion times.

Data Collection & Processing: Eight ($n=8$) recreationally active males completed three trials of ten, 10 s sprints separated by 50 seconds of active recovery (1:5 work-to-rest) on a non-motorised treadmill in a randomised, counter balanced design. Prior to each trial, participants ingested either 0.3 g·kg⁻¹ body weight (BW) one, two or three hours prior to exercise. Coinciding the ingestion sequence, any side-effects from the NaHCO₃ ingestion were assessed via a Visual Analog Scale (VAS) every 30 min prior to the exercise bout. Repeated sprint performance, blood buffering and VAS scores were assessed using a two-way (condition \times time) ANOVA with repeated measures.

Results: Whole blood pH and bicarbonate (HCO₃⁻) were not different at pre-exercise times (pH 1hr: 7.453 ± 0.006 ; 2hr: 7.462 ± 0.008 ; 3hr: 7.458 ± 0.004 ; $p = 0.667$; HCO₃⁻ (mmol·L⁻¹) 1hr: 30.2 ± 0.4 ; 2hr: 30.9 ± 0.6 ; 3hr: 31.2 ± 0.6 ; $p = 0.36$). Although average sprint speed progressively declined over the 10 sprints ($p < 0.001$), there was no difference between conditions. Average power (W) throughout the ten sprints did not differ between conditions (1hr: 646 ± 46 ; 2hr: 639 ± 38 ; 3hr: 631 ± 41 ; $p = 0.54$), nor was average distance covered different (1hr: 45.6 ± 1.2 m; 2hr: 44.8 ± 1.1 m; 3hr: 44.7 ± 1.1 m; $p = 0.22$). VAS scores indicated a peak in symptoms at 90 min post ingestion ($p < 0.001$) however these symptoms had subsided by 150 min. In conclusion, ingestion times did not influence the ergogenic potential of NaHCO₃. However, VAS scores would indicate that three hours post ingestion will most likely provide more favourable gastrointestinal conditions for participants.

T. Skinner^{1*} ■ D. Taaffe² ■ M. Leveritt³ ■ J. Coombes¹ ■ D. Jenkins¹ ■ ¹University of Queensland ■ ²University of Newcastle ■ ³Griffith University

Introduction: Caffeine's ability to enhance endurance performance is well documented, however the optimal dose and timing of supplementation remains unclear. The ergogenic effect of caffeine is often assumed to be related to the levels of circulating drug present within the blood. The aim of this study was therefore to determine whether coinciding peak serum caffeine concentration with the onset of exercise would result in further improvements in performance compared with beginning exercise a standard 60 min post-supplementation.

Methods: In this randomised, placebo controlled, double-blind crossover study, 14 male trained cyclists and triathletes (age 31 ± 5 yr, body mass 75.4 ± 5.7 kg, $\text{VO}_{2\text{max}}$ 69.5 ± 6.1 mL·kg⁻¹·min⁻¹ and peak power output 420 ± 35 W, mean \pm SD) consumed 6 mg·kg⁻¹ caffeine or a placebo either 1 hour (C1h) prior to completing a 40 km time trial (TT40) in the laboratory or when the start of exercise coincided with individual peak serum caffeine concentrations (Cpeak). Cpeak was determined from a separate 'caffeine profiling' session that involved monitoring caffeine concentrations in the blood every 30 min over a 4-hour period. The trials were preceded by a standardised pre-exercise meal (2 g·kg⁻¹ carbohydrates) and subjects were tested for hydration and caffeine abstinence. Venous blood was sampled at baseline, 65 and 20 min prior to exercise and 6 min post-exercise for the measurement of serum caffeine, plasma glucose, catecholamine and blood lactate concentrations.

Results: Following caffeine ingestion, peak serum caffeine occurred at 120 min in 12 participants and 150 min in 2 participants. Time to complete TT40 was significantly faster (2%; $p=0.002$) in C1h compared to placebo. A 1% improvement in performance was noted in Cpeak versus placebo, although this was not statistically significant ($p=0.240$). Whilst no differences in metabolic markers were found between Cpeak and placebo conditions, significant increases in glucose ($p=0.005$), norepinephrine and epinephrine ($p=0.002$) were observed in the C1h trial 6 min post-exercise versus placebo.

Discussion: The present study suggests that endurance cycling performance is enhanced when caffeine is ingested one hour prior to exercise. However, no significant improvements in performance were observed when peak serum caffeine concentrations coincided with the onset of exercise. Consequently, it appears that it is the temporal proximity of caffeine supplementation to the commencement of endurance exercise, rather than the achievement of peak serum caffeine concentration, that influences the ergogenic potential of caffeine.

C. Nassif^{1,2*} ■ A. Gomes³ ■ D. Soares³ ■ J. Cannon¹ ■ E. Silami-Garcia³ ■ F. Marino¹

¹Charles Sturt University ■ ²Waikato Institute Technology ■ ³Federal University of Minas Gerais, Brazil

Introduction: The effect of carbohydrate (CHO) supplementation on endurance performance has been extensively studied but its placebo (PLA) effect can make the ergogenic qualities of CHO more difficult to determine. This study tested the effect of double blind ingestions of PLA and 6% CHO in capsules (c) and in a beverage (b) during a 60 km self-paced cycle time trial in the heat (32 °C and 50% relative humidity).

Methodology: Ten well trained male subjects (means 26 years old, range 22 - 31; 64 kg of body weight, range 55 - 77 and 71 mL.kg⁻¹.min⁻¹ maximal oxygen consumption, range 53 - 80) completed 5 x 60km cycling time trials (TT) punctuated with 4 x 1 km sprints at 14, 29, 44 and 59 km in a 5 x 5 latin square design. Trials consisted of 5 treatments, PLA in beverage (PLAb) and capsule (PLAc) form and CHO (CHO_b and CHO_c) in similar forms and a control water trial (H₂O). Beverages or capsules were ingested at 5 km, after each sprint and at 55 km. Each subject received an average of 284 mL of distilled water and capsules (4 mL/kg of body mass) or beverage depending on the treatment. The amount of CHO and PLA powder in capsules was calculated to match the volume of water so that the mixture of the water and powder or water and capsules would correspond to a 6% CHO solution. The mean number of capsules consumed during each treatment was 116 for PLAc and for CHO_c. Thus, the mean number of capsules per ingestion was 24. Statistical analyses were performed using a 5 x 1 factorial ANOVA with repeated measures. Where a significant main effect was observed, a LSD post-hoc test was used to identify the source of significance.

Results and Conclusions: There were no differences in TT among treatments (means H₂O 138 min, range 117 - 181; PLAb 130 min, range 109 - 151; CHO_b 140 min, range 110 - 161 ; PLAc 143 min, range 114 - 220 and CHO_c 137, range 108 - 148). An increase in blood glucose was observed in the treatments where CHO was ingested compared with PLA and H₂O treatment (p< 0.05). It is concluded that CHO ingestion independent of the mode of ingestion, either capsule or beverage, did not affect prolonged self paced cycling performance compared to either PLA or H₂O.

D. Dudley^{1*} ■ A. Okely² ■ P. Pearson² ■ W. Cotton³ ■ ¹Charles Sturt University ■ ²University of Wollongong ■ ³University of Sydney

Objective: To review the published literature on the effectiveness of physical education in promoting participation in physical activity, enjoyment of physical activity and movement skill proficiency in children and adolescents. **Design:** Systematic review. **Data sources:** Literature search using Ovid, A+ Education, ERIC, Sports Discus, Science Direct, PsychInfo up to June 2010.

Review methods: Three independent reviewers assessed studies against the following inclusion criteria: if they reported on a physical education/school sport intervention targeting children or adolescents, with a mean age between 5 and 18 years; reported movement skill development and/or physical activity participation; and/or enjoyment of physical activity, physical education or school sport; were pilot controlled trials, controlled trials, randomised controlled trials or cluster randomised trials; and were published between 1990 and 2010. Papers were rated independently by three reviewers on a 10-item methodological quality scale derived from the CONSORT 2010 statement.

Results: The literature search yielded 27,410 potentially relevant publications. Fifty-four references were identified as potentially relevant and retrieved in full text with 23 papers meeting the inclusion criteria. Nineteen were controlled trials delivered in primary and secondary schools and targeted promoting physical activity participation. Four studies targeted improving movement skills in primary school settings and a further seven studies reported enjoyment of physical education/school sport (PESS) as an outcome and were delivered in secondary school settings (Note: six studies reported on two or more of the outcomes). Thirteen studies reported statistically significant intervention effect on physical activity participation. Four studies reported statistically significant intervention effect on movement skill development and one study reported statistically significant effect on enjoyment of physical activity.

Discussion: The most effective strategies to increase children's levels of physical activity and improving movement skills in physical education were direct instruction teaching methods and providing teachers with sufficient and ongoing professional development in using these PE instruction methods. For adolescents, using a combination of prescribed PESS curriculum with elements of student choice and substantial teacher professional development combined with sufficient teaching resources appear to be the most efficacious. There was a lack of high quality evaluations and statistical power to draw conclusions concerning the effectiveness of interventions conducted in PESS to improve enjoyment outcomes. Adequately powered interventions that target movement skills in secondary schools and evaluate school sport curriculum are urgently needed.

L. Olive^{1*} ■ D. Byrne¹ ■ R. Cunningham¹ ■ R. Telford¹ ■ ¹Australian National University

Aim: This study investigates the effects of specialist-lead PE on improving body image among primary (elementary) school children.

Method: Data from the Lifestyle of our Kids (LOOK) study involving 736 initially grade 2 children (370 boys M age = 8.18; 366 girls M age = 8.13) from 29 primary schools were analysed. Schools were randomly allocated to intervention (13 schools) or control groups (16 schools). Intervention groups received 90 min/week of PE from visiting specialists as part of, and not in addition to the recommended 150 min/week of PE set out by the Australian Government. Control groups received all of their 150 min/week of PE from classroom teachers. Approximately 86% of the children had one or both parents of Caucasian descent, 8% of Asian descent, 3% Australian Aboriginal or Torres Strait Islander or 1% Polynesian, and we had no data on 2% of the families. Participants completed assessments of Appearance Beliefs in Children Scale (ABC-S) in grade 2 prior to the commencement of the intervention and again in grade 3 after receiving approximately one year of the intervention.

Results: Children receiving specialist-lead PE reported greater improvements in overall body image (p=0.042) and on the appearance satisfaction subscale (p=0.028) compared to children of the control group. There was some evidence of similar trends toward improvements in self-perceptions (p=0.050) and perceptions by others (p=0.087) and less evidence for physical attributes (p=0.116) subscales.

Conclusion: PE programs utilising specialist PE teachers may improve body image among children beyond that which is achieved through PE delivered by classroom teachers. The improvements reported here stemmed from the existing time allocated to PE in schools. No additional time was added for PE meaning there was no disruption to the existing school curriculum. Our findings provide support for the role of PE in improving body image and suggest that investment in specialist PE teachers who are able to provide quality PE programs in primary schools may be beneficial in improving aspects of mental health.

A. Timperio^{1*} ■ M. Rosenberg² ■ J. Granich² ■ M. Knuiman² ■ ¹Deakin University ■ ²University of Western Australia

Introduction: The transition out of secondary school is hypothesized to be associated with increased risk of obesity due to adverse changes in behaviour in response to major life changes, however very little research has examined behaviour change over this specific transition stage. Existing studies include small samples and examine transitions only to College in the US or commence during mid-adolescence. This study aims to examine annual tracking of recreational physical activity among rural youth over two years after their final year of secondary school.

Methodology: Two year longitudinal study design. 688 Year 12 students were recruited from secondary schools in rural areas of Western Australia. Baseline interviews were conducted using a Computer Assisted Telephone Interview (CATI) and repeated twice at 12 month intervals for 382 participants. The Minnesota Leisure-Time Physical Activity Questionnaire was administered at each time point, modified to separate activities undertaken at school and outside of school at baseline. Only data for outside school are used here and the analytical sample comprised 377 participants for whom data regarding sex were available. Spearman's rank-order correlation coefficient (Rho) was used to determine strength of tracking over one and two years. **Results:** The sample comprised 52% males and mean baseline age was 17.4 (± 0.3) years. Mean duration of recreational physical activity was 330 (± 206.1) mins/week at baseline, declining to 278.2 (± 165.2) and 257.4 (± 156.7) mins/week at each successive year after Year 12. Overall, there was moderate tracking of recreational physical activity over one (Rho=0.53) and two years (Rho=0.42). Over one year, tracking was stronger among males than females (Rho=0.55 vs Rho=0.46) and those that did not re-locate following secondary school compared to those who moved (Rho=0.55 vs Rho=0.48). There was little difference in strength of tracking between males and females over two years (Rho=0.42-0.44), however tracking remained stronger among those that did not relocate following secondary school (Rho=0.49 vs Rho=0.41).

Conclusions: Although physical activity declined across the sample, a moderate degree of tracking was found. This suggests that the magnitude of declines varies in individuals in response to outside influences. Moving town after secondary school may particularly de-stabilise recreational physical activity among rural youth. Strategies should be devised to skill students to remain active following secondary school. Further research should examine tracking of specific physical activity behaviours and physical activity in other domains over this transition period, as well as correlates of physical activity change.

J. Harvey^{1*} ■ R. Eime^{1,2} ■ C. Symons² ■ M. Craike³ ■ R. Polman² ■ W. Payne^{1,2} ■ ¹University of Ballarat ■ ²Victoria University ■ ³Deakin University

Introduction: Physical activity (PA) levels decline during adolescence, especially for females and for participation in club sport. Club sport can deliver additional benefits compared to other types of PA. Therefore, this study aimed to investigate the relationship between club sport participation and levels of perceived physical competence, body mass index (BMI) and perceived health status among adolescent females.

Methodology: A survey of 732 female adolescent school students (521 metropolitan, 211 non-metropolitan; 489 Year 7 (age 12 yr), 243 Year 11 (age 16 yr)) was conducted. This incorporated: a perceived physical competence scale derived from a bank of items by principal components analysis; body mass index (BMI) calculated from self-reported height and weight; self-reported general health status; and two self-report measures of PA (a general 5-point self-assessment and a more detailed and specific measure - total MET-minutes estimated from a 24-hour PA recall diary). The effects of sports club membership on BMI and general health status were analysed using analysis of variance/covariance and ordinal logistic regression, with adjustments for moderating effects of region and year level, and for PA level. The associations between sports club membership and each of BMI and general health status were further explored in a series of mediation analyses, with perceived competence and the two PA measures as potential mediators. **Results:** Sports club membership was significantly associated with decreased BMI ($p=.003$) and increased general health ($p<.001$). In multi-factorial moderated models with adjustment for PA level, significant sports club effects persisted for general health status, but not for BMI. In a single-mediator model for BMI, perceived competence partially mediated the association between club membership and BMI. In two multiple-mediator models for BMI, the mediation effect of perceived competence was subsumed by self-assessed PA level, but not by 24-hour recall total MET-minutes. In a single-mediator model for general health status, perceived competence partially mediated the association between club membership and general health. In two two-mediator models for general health status, both PA level and perceived competence were partial mediators; a full mediation effect was found for self-assessed PA level and perceived competence.

Conclusion: The associations between sports club participation and health benefits are explained by the contribution of sports club participation to perceived physical competence over and above the contribution to PA levels. This finding highlights the importance of psycho-social aspects of participation in club sport and suggests that sport clubs should foster and promote physical competence in their members.

R. Plotnikoff^{1*} ■ D. Lubans¹ ■ S. Costigan¹ ■ L. McCargar² ■ ¹University of Newcastle ■ ²University of Alberta

Introduction: To examine the utility of the Theory of Planned Behaviour (TPB) for explaining physical activity (PA) intention and behaviour amongst a large population sample of overweight and obese adolescents (Alberta, Canada), using a web-based survey. Secondary objectives were to examine the moderating effects of weight status and mediating effects of the TPB constructs.

Methods: A sub-sample of 427 overweight and 133 obese participants ($n=560$), completed a self-administered web-based survey on PA health behaviours including assessment of attitude, subjective norm, perceived behavioural control (PBC) and intention to participate in regular PA. Structural equation models were examined using AMOS 17.0.

Results: 62% of the variance in intention was accounted for by attitude, subjective norm and PBC; while 44% of the variance in PA behaviour was explained by PBC and intention. When examining the TPB separately in overweight and obese subsamples, 66% and 56% of the variance for PA intention was explained for overweight and obese subsamples, respectively; and 38% and 56% of the variance in PA behaviour was accounted for in the overweight and obese subsamples. Overall, attitude was the strongest predictor of PA intention; while PBC was the strongest predictor for PA behaviour. Intention was not predictive of PA behaviour.

Conclusions: These results provide partial support for the utility of TPB in explaining PA behaviour in a sample of overweight and obese adolescents. In particular, strong associations regarding attitude and PBC were evident across each subsample. These findings have implications for tailoring PA programs in this population.

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Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation

INVITED

M. Hagger^{1*} ■ N. Chatzisarantis² ■ ¹School of Psychology and Speech Pathology, Curtin University ■ ²National Institute of Education, Singapore

Based on self-determination theory, the present study developed and evaluated the utility a school-based intervention to change pupils' physical activity intentions and self-reported leisure-time physical activity behaviour. The study evaluated utility of the intervention to promote physical activity participation over a 5-week interval of time. A cluster randomised design targeting 215 pupils from 10 schools with schools as the unit of randomisation was adopted (Male = 106, Female = 109, Age = 14.84, SD = 0.48). Results indicated that pupils who were taught by autonomy-supportive teachers reported stronger intentions to exercise during leisure time and participated more frequently in leisure-time physical activities than pupils in the control condition. Autonomous motivation and intentions mediated the effects of the intervention on self-reported physical activity behaviour. It is concluded that self-determination theory provides a useful framework for the development of school-based interventions that ultimately affect leisure-time physical activity participation.

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Medial Tibial Stress Syndrome (MTSS): 'New thoughts' and proposed pathomechanical model

KEYNOTE

Asics Supported Speaker



R. Bouché^{1*} ■ ¹The Sports Medicine Clinic, Seattle, USA

MTSS is the most common cause of exercise-induced leg pain and is prevalent in athletes and military personnel. Though there is much written about this entity there is much controversy concerning many aspects of this problem including its pathology, pathomechanics, pathoanatomy, clinical presentation, diagnostic imaging, treatment & prevention. Two popular theories have been proposed to account for this condition: tibial bending and fascial traction. This presentation begins with a brief review and summarizes current thinking and concerns about the present state of MTSS. Based on a critical review of the literature and personal clinical experience, a proposed pathomechanical model involving fascial traction is suggested. A study was performed to evaluate the role of fascial traction as a possible mechanism responsible for MTSS.

Study Description: Level 5, Grade D descriptive laboratory pilot study, Hypothesis: With contraction of the deep flexors of the leg, tension would be imparted to the tibial fascial attachment at the medial tibial crest. It was also speculated that circumferential straps would dampen tension directed to the medial tibial crest.

Materials and Methods: Three cadaver legs were tested mounted on a loading frame. A central rod applied load via a pneumatic actuator. Posterior tibial (PT), flexor digitorum longus (FDL) and soleus aponeurosis (SA) tendons were attached via cables to additional pneumatic actuators. Force of pull on tendons were determined using calculation of cross-sectional area of midstance muscles. Four strain gauges attached to the tibial fascial insertion recorded strain. Tension on these three tendons and strain from 4 locations (3, 6, 9 & 12 cm. proximal to medial malleolus) were measured. Six scenarios x six trials were conducted.

Results: When tibia was loaded without muscle tension applied there was no strain on fascia. When tibia was loaded and muscle tension applied there was a linear strain on fascia (0.0002 mm/N, $P < .0001$) with visible fascial "tenting" on observation. With use of high and low shin "straps" there was no decrease in fascial strain.

Study Summary: Fascial traction does occur at medial tibial crest. Tibial traction theory may have merit. Suggested pathology: tibial fasciitis > localized bone-stress reaction of tibia at medial fascial insertion. Based on this pathomechanical model, clinical presentation is discussed in detail including history, physical examination, diagnostic testing and predisposing factors. Rational treatment and prevention strategies are proposed based on current research and clinical experience. Further study and research is needed to validate these proposed thoughts.

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Exercise as cardiovascular medicine: An update of the direct impacts of exercise on the heart and arteries

INVITED

D. Green^{1,2*} ■ ¹School of Sports Science, Exercise and Health, University of Western Australia ■ ²Research Institute for Sport and Exercise Sciences, Liverpool John Moores University

In this talk I will focus on presenting recent evidence pertaining to the physiological and health benefits of exercise on the heart and arteries of humans. Concepts pertaining to the impact of exercise training on the human heart have been dominated since the 1970's by the "Morganroth hypothesis", the idea that the form of cardiac loading associated with different exercise modalities induces differential cardiac morphological adaptations.

Hence resistance or power training induces "concentric" remodeling as an adaptive response to repetitive afterload burden, whereas endurance training induces eccentric remodeling in response to repeated increases in preload. Recent evidence, utilizing MRI technology and carefully designed repeated measures experiments, casts some doubt over the "Morganroth" paradigm, especially as it relates to adaptations in resistance athletes and this evidence will be reviewed. I will also introduce research using contemporary echocardiographic techniques which is characterizing, for the form time, cardiac twist and untwist during systole and diastole. Vascular adaptations to training will be considered in the context of exercise physiology and health. Endurance training is associated with increased cardiac output, but decreased blood pressure at matched exercise workloads. The functional and structural vascular adaptations which permit this increase in conductance will be addressed. I will also review the concept of the "risk factor gap", the idea that the impact of exercise on cardiovascular risk cannot be fully explained by the "secondary" effects of training on cardiovascular risk factors. The direct effects of training on arteries, including systemic effects on vessel distant from the working muscles, may provide some explanation for the impressive benefits of training in humans and a rationale for exercise training beyond the purported effects on traditional risk factor profiles. The concept that exercise is a direct form of vascular "medicine" will be introduced and the implications discussed.



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FRIDAY 21 OCTOBER POSTERS AT A GLANCE

Deakin University Sponsored Session



Please note: The scientific poster session will be held from 1700 – 1830 in the Island Suite.

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J. Cochrane^{1*} ■ D. Lloyd^{2,3} ■ T. Ackland² ■ ¹Edith Cowan University ■ ²University of Western Australia ■ ³Griffith University

Introduction: Strength training has, for many years, been used by athletes to improve sports performance. Recently, balance training has become popular to assist in the reduction of knee injuries. However, the underlying neuromuscular changes resulting from these different training modes have not been evaluated in a consistent, comprehensive fashion. This paper aimed to establish the neuromuscular effects from different types of training by investigating how different training affects the knee muscle activation patterns and strength on isometric and isokinetic tests as well as standing balance. The training programs were: 1) Machine-Weights; 2) Free-Weights; 3) Balance-Training; and 4) Machine-Weights + Balance training. Identifying these effects will assist in our understanding of mechanisms which change from training and their possible effect on joint stability.

Methods: Fifty healthy subjects were allocated to either a control group or one of four 12 week training programs. Subjects were tested pre and post training. Muscle strength and electromyography (EMG) for each subject were measured whilst performing isometric, eccentric and concentric leg extension and leg flexion exercises with the preferred limb on an isokinetic dynamometer. Stability tests were also conducted to assess changes in standing balance. The maximum load that subjects could lift for only three repetitions (3RM) on their specified training apparatus was also measured.

Results: All strength training groups increased strength specific to the training equipment used in their respective programs. The Free-Weights group experienced improvement on isometric and quadriceps eccentric strength, and decreases in co-contraction and greater agonist activation on the isometric and isokinetic tests. The Machine-Weights group did not experience any significant changes in strength measures on the isometric and isokinetic tests, however there were some decreases in co-contraction. Balance training resulted in increased hamstring muscle activation and flexor torque, as well as a decrease in extensor torque. Improvements in the standing balance measures were also seen in groups that underwent balance training. (Reported changes are significant, $p < 0.05$).

Conclusion: Different types of training elicit a variety of neuromuscular changes on controlled tests. These provide greater understanding of the mechanisms resulting from training, which have the potential to map over into sporting manoeuvres, with possible effects on joint stability and support. However, smaller than expected changes were measured, especially with no significant strength increases measured on the isometric and isokinetic tests following some training, even though improvements in strength were observed on the training equipment. This indicates that these tests are not sensitive to all outcome measures.

C. Gosling^{1*} ■ A. Forbes¹ ■ A. Donaldson¹ ■ B. Gabbe¹ ■ ¹Monash University

Introduction: The epidemiology of triathlon injury encompasses injury events that occur during training and competition and is not well understood. Injury surveillance studies have mainly focused on providing information on the incidence, nature and outcome of triathlon injuries. To date, studies have not investigated competition safety and its impact on injury outcomes in participants. To understand the nature of the injury problem in triathlon events it is important to identify the environmental and behavioural factors that impact on injury risk and outcome. This study aimed to explore perceptions of behaviour and environment related to injury risk.

Methods: Five focus groups were held with representation from triathlon race organizers, coaches, experienced and inexperienced competitors ($n=18$). The sample consisted of 12 males and 6 females, aged 18-68 years with 1-27 years experience. Participants were questioned on their perceptions of safety in triathlon races using the PRECEDE-PROCEDE model focusing on behavioural and environmental factors contributing to increased injury risk in triathlon competition. Content analysis was performed and key themes identified.

Results and Conclusion: Injury was identified as occurring in the cycle leg of the race by most groups with muscle injuries, blisters and cuts while running also identified. All groups consistently identified environmental and behavioural risk factors that contribute to injury within a race. Environmental factors included water conditions, weather, road conditions, the nature of corners, athlete crowding and the funneling of competitors into narrow sections of the course. Behavioural risk factors included triathlete experience, personal awareness, skill level, feelings of vulnerability, the "gung-ho" male competitor and triathlon club culture. Triathlon race course design, section and location were also explored with the cycle leg and the mount/dismount sections featuring prominently with all groups. The swim leg was also identified by all groups; mainly in relation to feeling vulnerable and uncomfortable rather than linked to injury risk. The role of race management in risk mitigation in triathlon was deemed in general to be positive with organisers improving in response to challenges, developing appropriate safety policies and having the athletes' best interests a foremost priority. These concepts will be explored and presented in terms of modifiable, potentially modifiable and non-modifiable factors. Further testing of these themes is required before recommendations are made for the alteration of current practice. It was acknowledged in all focus groups that triathlon racing carries some risk to competitors regardless of experience or skill level and by competing an individual accepts those risks.

C. Gosling^{1*} ■ A. Forbes¹ ■ J. McGivern² ■ B. Gabbe¹ ■ ¹Monash University ■ ²Corio Bay Sports Medicine Centre

Introduction: Triathlon race injury surveillance has often been limited to single race events without comparisons over time. This study compared the rate and profile of injuries presenting for medical assistance during two triathlon race seasons.

Methodology: A standardised injury reporting form was used to collect information from race entrants who presented for medical aid at each of the races conducted in Melbourne Victoria over the 2006-07 and 2010-11 seasons. Races comprised of "Fun", Sprint and Olympic distance races at various bayside locations. Frequency data are presented and injury rates were calculated for each leg of the triathlon race and the action performed at the time of the injury.

Results: 19,996 individual starters took part (10,197 in Season 1 (S1) and 9,799 in Season 2 (S2)). The total number of presentations by participants for medical assistance decreased between the seasons (235 by 217 athletes vs 173 by 166 athletes; $\chi^2=6.99$, $p=0.008$). The rate of presentation for injury was 14.1 per 1000 hours of competition or 1.8% of race starters in S2 compared with 20.1 per 1000 hours or 2.3% of total race starts in S1.

The proportion of injury events across race stage were similar for the run (39% vs 43.2%) and cycle (20.6% vs 20.1%) legs although the proportion of triathletes running at the time of injury increased (54.1% vs 62.1%). A difference between the total number of injuries was noted between seasons (316 vs 224, $\chi^2=12.6$, $p<0.001$). The proportion of lower limb injuries in S2 was higher than S1 (59.5% vs 67.4%). The most common types of injuries were abrasions across both surveillance periods (28.6% vs 31.1%). The injury rates for individual race legs were lower in most race sections between seasons (S1 vs S2), with notable decreases in rates for the run (10.61 (95% CI: 8.67, 12.98) vs 9.29 (95% CI: 7.56, 11.41) per 1000 race starts) and cycle (9.04 (95% CI: 7.26, 11.24) vs 6.12 (95% CI: 4.75, 7.89) per 1000 race starts) legs. Injury rates for the action performed at the time of injury also decreased across most actions, except for athletes mounting/dismounting their bicycle (1.57 (95% CI: 0.93, 2.65) vs 2.76 (95% CI: 1.89, 4.02) per 1000 race starts).

Conclusion: These results indicate that injury patterns were similar across seasons. Some variations were noted which may have been due to differences in race organiser introduced safety initiatives, environmental conditions and athlete experience across seasons.

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Injury management and return-to-play experiences of elite rugby union retirees

P. Handcock^{1*} ■ ¹University of Otago

Investigations of rugby injury have identified premature return from injury as a preventable cause of injury. New Zealand rugby return-to-play practices have been explored with team management personnel at club, provincial and Super rugby levels, revealing that players routinely return to play before full recovery. The process for evaluating readiness is typically poorly defined and communicated, and is not standardised within a team. This study sought to describe player's experiences with the management of their injuries and their eventual return to play. Using a sample of convenience, ten recently retired professional rugby players were interviewed. Six backs and 4 forwards (mean of 11.3 seasons of professional rugby) participated. Participants were asked about their injury history, how their injuries were managed, how decisions regarding their return to play were made, and the impact of rugby related injuries on their present health. Interviews were transcribed verbatim and submitted for participant checking. A thematic analysis was then applied to the data. The main themes emerging were that pressures within the team, the team environment, and sometimes from the players themselves, often meant that injuries were poorly managed. Decisions regarding readiness to return to play were often left to the player. The 'rugby culture' and attitude to injury meant that at times players felt pressured to return early or play on through injury. As most participants had ongoing disability as a consequence of their rugby careers, participants felt that they could have benefited from treatment and advice by health care practitioners not allied to the team. It was also suggested that a standardised return-to-play assessment could have helped protect them from a premature return to competition. Overall this study demonstrated that the health and wellbeing of professional rugby players could be enhanced with more objective return to play assessments to supplement current decision making mechanisms. Current practices appear to leave players vulnerable to pressures to prematurely return to play.

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Fit to serve. A review of the New Zealand Police Physical Competency Test

P. Handcock^{1*} ■ P. Dempsey¹ ■ ¹University of Otago

Police work can be extremely physically demanding and dangerous. Although extreme efforts are not frequently required, a sworn police officer must always be capable of responding. The paradox is that for the remainder of their work time, police work is not physically active enough to adequately maintain fitness and preparedness. In 1986 the New Zealand Police introduced a Physical Competence Test (PCT) that all sworn staff are required to pass every 18 months. The test includes specific tasks that are individually challenging and cumulatively fatiguing. Recruiting policies, technological advances and the policing environment have all changed in the 25 years since the test was first introduced. This study explored the physiological demands of the PCT and how these match the physical demands of current frontline policing. Seventy one participants completed baseline fitness testing (a graded maximal treadmill run) and then on separate occasions completed 1) a submaximal paced PCT that was paced according to age and gender specific norms, 2) a maximal effort PCT, and 3) a maximal effort modified PCT. Modifications to the PCT were made to better represent the physical demands of contemporary frontline policing, and to improve the safety of the test. Heart rate, VO_2 and post-exercise lactates were collected on all trials. Results demonstrated that the NZ Police PCT is a high-demand functional test. Performance of the test provoked high heart rates that for some individuals approached their maximum. The test also provoked high oxygen consumption and the accumulation of high levels of plasma lactate. Performance of the P2 paced PCT required between 9.5 and 10.5 METs. This study demonstrated that the PCT precipitates high cardiovascular stress and presents potential for cardiovascular events for those with elevated risk. By inference, it can be assumed that extreme police work in the field would be at times similarly stressful. To achieve their target times younger participants had to exercise at a higher percentage of their maximum capacity than older participants indicating that younger participants, particularly males were disadvantaged by the test target times. Recommendations for improving the validity, safety and fairness of the PCT were made. It was also suggested that the New Zealand Police consider a broader approach to physical activity and health for their employees.

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Injury prevention and management program for competitive swimming: Design and implementation

J. Hardt^{1*} ■ S. Gordon¹ ■ N. Benjanuvatra¹ ■ ¹University of Western Australia

Introduction: The purpose of this study was to investigate injury prevention and management plans in competitive swimming in order to design a profiling tool for swim clubs. Using interviews and questionnaires, current coach-implemented injury prevention and management practices were determined as well as perceptions of how injuries should be prevented and managed in competitive swimming. Swimmers also reported their perceptions and experiences of their coaches' injury prevention and management plans. Finally, sports medicine professionals were included in the interview phase as a triangulating data source regarding their impressions of coach-implemented injury management programs.

Method: Phase one of this study incorporated collecting qualitative data through one-on-one interviews with coaches (N=12), sports medicine professionals (N=6), and injured or previously injured swimmers (N=5). Data were analysed following a grounded theory process of inductive analysis, where key quotes were grouped into a hierarchy of categories. The information in these categories was then combined with knowledge gained from the extant literature on injury prevention and management procedures to form items for a profiling tool on injury prevention and management for competitive swimming programs. For each item, participants were asked the degree to which they (or their coach) enacted the behaviour and also how important they perceived that behaviour to be for injury prevention and management. Once developed, the Injury Prevention and Management Profile (IPMP) was implemented with 10 coaches and their swim clubs. Additional swimmers (N=136) and coaches (N=15) also completed the IPMP as individuals independent of particular clubs in order to form a more complete picture of current injury prevention and management practices and perceptions. Results and Conclusions: Data from interviews indicated a four-phase model of injury management starting with injury prevention and cycling through short-term management, long-term management, and finally return to full training. Based on these results, items for the IPMP were developed and organised into four categories representing the four phases of injury management. This design appeared to have good face and content validity according to expert feedback from elite swim coaches. Similarly, it seemed effective at capturing injury prevention and management behaviours. Implementation of this profiling tool was deemed appropriate, which warranted another phase of research into injury prevention and management in swimming. Results from this investigation will be discussed in another presentation entitled "Injury prevention and management program for competitive swimming: Intervention and evaluation".

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Injury prevention and management in competitive swimming: Intervention and evaluation

J. Hardt* ■ S. Gordon¹ ■ N. Benjanuvatra¹ ■ ¹University of Western Australia

Introduction: The purpose of this study was to implement and evaluate an injury prevention and management program with a competitive swimming squad. In addition to traditional training and rehabilitation behaviours, this intervention focussed on areas of increasing communication and social support among injured athletes.

Method: A coach-implemented injury prevention and management program was developed based on the findings from 2 previous studies. Participants included coaches (N=3) and swimmers (N=35) from 3 leading swim clubs in a Western Australian metropolitan area. The intervention lasted the duration of a short-course competitive season (5 months), with one club receiving the coach training intervention. Prior to the outset of the season, the coach of this club underwent consultation and training with the primary investigator to create an injury prevention and management program for their squad. Specific strategies were outlined for each of the 4 phases of injury management: injury prevention, short-term injury management, long-term injury management, and return to full training. To measure the effectiveness of the injury prevention and management program, all swimmers and their coaches completed the Injury Prevention and Management Profile (IPMP) prior to and at the completion of the intervention. The IPMP measured the extent to which the coach performed (or was perceived to perform) a particular management behaviour and how important that behaviour was for injury management. Injury rates and training volume were also measured.

Results and Conclusions: IPMP data indicated that for most behaviours, swimmer perceptions of their coach did not alter significantly, regardless of the intervention. Given that no athletes sustained a major injury during the intervention, it was understandable that their perceptions of injury management behaviours would not change significantly. Qualitative data revealed that the swim coach from the intervention squad felt more prepared to manage injury and more at ease with preparing training plans for injured swimmers following the intervention. Despite higher training volumes, the elite swimmers (N=9) reported no injuries over the course of the intervention. However, 11 out of the 26 sub-elite swimmers sustained minor or moderate injuries. It was speculated that elite swimmers had higher body awareness as a result of greater training, and they were more likely to address pain when it was small before it developed into an injury. Future research will aim to implement longer interventions and more sensitive injury measurements to more accurately capture injury data in competitive swimming.

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Eccentric hamstring muscle asymmetry in the female athlete

C. Hill* ■ ¹Sunshine Coast Rugby Union

Introduction: The purpose of the research was to examine isokinetically the eccentric Hamstring strength of a population of female athletes.

Methodology: Thirteen female subjects underwent isokinetic strength testing for the Hamstring and Quadriceps muscle groups utilising a Biodex 3. n=13, age 23 ± 4(yrs), Weight 61.4 ± 5.7 (kg), Height 1.67 ± 0.07 (m)

Results and Conclusions: Significant differences were found in Eccentric Hamstrings in the 30°/s (Left 132N.m ± (17) to Right 120N.m ± (15) P<0.05. Concentric Hamstrings in the 60°/s (Left 95N.m ± (19) to Right 87N.m ± (22) P<0.05. Significant differences were found in the Functional Eccentric 30°/s Hamstrings: Concentric 240 °/s Quadriceps ratio (Left 1.12 ± (0.21) to Right 1.06 ± (0.20) P<0.05.

Discussion: This investigation found that Hamstring muscle asymmetries were a characteristic of female athletes. The investigation found significant Eccentric & Concentric muscle asymmetry for female athletes in the low velocity high intensity Hamstring contractions of 10%. The findings of the functional ratios are greater than the recommended functional ratio of >.9 Croisier (2004) for reduction of hamstring risk. The use of the functional ratios Ecc 30 H /Con 240 Q presently may not be applicable to female athletes mainly due to a combination of relatively low eccentric Hamstring strength and low Concentric Quadriceps strength. The measurement of Con 60/240 H: Con 60/240 Q may also be an insignificant factor for female athletes due to the low strength scores in both Concentric Hamstring and Quadriceps strength. The use of both low and high velocity eccentric Hamstring contraction investigations and measurements may be of greater significance due to the potential identification of muscle strength asymmetries for risk of female non contact ACL and Hamstring injuries. As bilateral differences of 15% are regarded as modifiable risk factors for Hamstring injury, it is recommended that female athletes undergo Hamstring strength assessment as well as undergo unilateral hamstring strengthening programs. This is to decrease unilateral muscle asymmetry and the risk of both potential ACL & Hamstring injury.

The development of a prospective musculoskeletal screening tool to identify semi-professional Australian Football athletes at risk of sustaining a high prevalence injury: A pilot study

A. Jeyabalan^{1*} ■ E. Pacecca² ■ ¹Curtin University ■ ²Edith Cowan University

Background: There are no precedents in the literature on this specific topic of a prospective nature that examines the musculoskeletal risk factors for high prevalence injuries in Australian-Rules football.

Method: 67 Australian-Football Athletes between the ages of 18 and 27 were recruited for this study. 10 screening tests were performed: knee to wall test, unsupported single leg heel raise, prone passive fallout, hip internal rotation in 90° hip flexion, squeeze test, supine bent knee fallout, FABER test, straight leg raise (SLR), SLR neural tissue mechanosensitivity test, single leg hamstring bridge. Correlations with hamstring, groin, ankle and knee injuries were assessed.

Results: Hamstring injuries had a positive correlation ($p < 0.05$) with prone passive fall out, a negative correlation ($p < 0.05$) with hip internal rotation in 90° flexion and a positive correlation ($p < 0.05$) with SLR neural tissue mechanosensitivity test. Groin injuries had a negative correlation ($p < 0.05$) with the number of repetitions performed during the single leg unsupported heel raise protocol and a positive correlation ($p < 0.05$) with the squeeze test performed in hip neutral. Ankle injuries had a negative correlation ($p < 0.05$) with SLR neural tissue mechanosensitivity test, a positive correlation ($p < 0.05$) with the number of episodes of loss of balance during the single leg unsupported heel raise protocol, a positive correlation ($p < 0.05$) with prone passive fall out and a negative correlation ($p < 0.05$) with hip internal rotation in 90° flexion. Knee injuries had a positive correlation ($P < 0.005$) with SLR neural tissue mechanosensitivity, a negative correlation ($P < 0.005$) with the number of repetitions performed during the single leg unsupported heel raise protocol, a positive correlation ($P < 0.005$) with the number of episodes of loss of balance during the single leg unsupported heel raise protocol, a negative correlation ($P < 0.005$) with prone passive fallout, a positive correlation ($P < 0.005$) with hip internal rotation in 90° flexion, a negative correlation ($P < 0.005$) with opposite hip internal rotation in 90° flexion, a positive correlation ($P < 0.005$) with bent knee fallout, a positive correlation ($P < 0.05$) with the knee to wall test, a negative correlation ($P < 0.05$) with bent knee fallout in the opposite limb and a positive correlation ($P < 0.05$) with the FABER test.

Conclusion: Athletes that sustained hamstring injuries demonstrated increased neural tissue mechanosensitivity and variances in hip internal rotation. Athletes that sustained groin injuries demonstrated decreased plantar flexor strength and increased pain reproduction during the squeeze test.

Athletes that sustained ankle injuries demonstrated decreased neural tissue mechanosensitivity, deficits in balance and variances in hip internal rotation.

Development of an integrated 3D stereoscopic system to measure coupled perceptual-motor skill

M. Lee^{1*} ■ S. Tidman¹ ■ P. Bourke² ■ J. Alderson¹ ■ D. Lloyd¹ ■ B. Lay¹

¹School of Sport Science, Exercise and Health, University of Western Australia ■ ²IVEC@UWA, University of Western Australia

Purpose: A stereoscopic system that projects videos with accurate scale and depth may provide researchers with more realistic stimuli to study visual perception. This paper describes the development of an integrated stereoscopic system (ISS) via the integration of a three-dimensional (3D) stereoscopic system, an opto-reflective motion analysis system and a gaze tracker, thereby allowing the investigation of coupled perceptual-motor (PM) skill. A secondary aim was to present pilot data comparing gaze behaviour and movement response collected with the ISS.

Methods: Component parts of the ISS were synchronised via a custom built interface and infrared timing gates. Polarised lenses were attached to the gaze tracker to enable stereoscopic viewing and tracking. Following synchronization, the ISS was used in an applied study. Ten males performed a simulated interception of either a two-dimensional (2D) or 3D video projection of an oncoming offensive opponent, who sidestepped either left or right. The ISS recorded the time required by participants to initiate a defensive interception of the projected opponent (TTI), and the participants' gaze behaviours. TTI was calculated from the onset of the projected opponent's sidestep, to the first measurable shift of the participants' pelvis. Gaze behaviour data consisted of mean number and duration of fixations in total, and according to locations on the display.

Results: Participants spent significantly less time (16%) fixating on the trunk and more time outside the body (23%) of the 3D projected opponent, compared with the 2D condition. TTI in both 2D and 3D conditions were not significantly different.

Conclusion: The ISS allowed coupled PM skill to be assessed, while delivering visual stimuli that accurately replicate the participants' 3D visual field, as if in situ of the sport-specific environment. Depth cues in the 3D stimuli could have enabled participants to perform the interception task equally well in both the 3D and 2D conditions; inferred from the non-significant differences in TTI, even though less time was spent fixating on the 3D projected opponent's body. Systematically increasing stimuli and task complexity could result in further differences in PM performance. Consequently, this research group applied the ISS in a series of studies to investigate the biomechanics of evasive sidestepping in response to multiple opponents, and discussed the implications for ACL injury prevention.

Study the prevalence and types of sports injury during floor exercises 8 to 11 years Iranian elite girl artistic gymnasts

B. Shahtahmassebi^{1*} ■ A. Ebrahimi Atri² ■ S. Hashmi Javaheri² ■ M. Hecimovich¹ ■ G. Shahtahmassebi³

¹Murdoch University ■ ²Ferdowsi University of Mashhad ■ ³University of Plymouth

Introduction: Among the variety of sport fields, gymnastics is a basic sport. This sport with its varied apparatuses and movements patterns and learning possibilities for children of all ages, contributes in providing physical and motor fitness. Additionally it provides an introduction of skills which can be used in a variety of other sports. Women's Artistic gymnastics is a competitive and popular sport that starts at an early age with elite female gymnasts reaching their prime in mid-teenage years. Due to the involvement of various instruments and complex movement patterns there is high degree of injury risk for the gymnasts, most notably in floor exercises. Therefore we conducted a study on the prevalence and types of injuries in Iranian elite-level artistic gymnasts during floor exercises.

Methods: Our study was descriptive and field-based using retrospective techniques. Statistical sample included 40 Iranian elite-level girl artistic gymnasts who participated in the national championships (2006) in Tehran. We collected the data through a gymnastics injury questionnaire and also conducted interviews with the gymnasts. The mean time frame for recording the injuries was approximately four years, beginning when the athlete first started the sport. The Cronbach's Alpha coefficient for the questionnaire utilized was 0.90. Descriptive statistics (mean and frequency tables) were utilized for the investigation of the rates of prevalence of sport injuries in elite girl artistic gymnasts during floor exercises. For statistical analysis, SPSS version 11.5 was employed.

Results and Conclusion: Results indicated 1004 total injuries for the gymnasts whilst performing floor exercises. These results were from the beginning of their participation in the sport to present. The prevalence of sport injuries during floor exercises and type of injuries (e.g. muscular, bone, skin etc) on different part of the body of the gymnast revealed muscle injuries (74.3%) as the predominant injury, skin injuries (16.4%), joint injuries (8.6%) and bone injuries (0.7%). The most prevalent muscle injuries during floor exercises were muscle spasm (41%), and muscle strain (32.4%). The most prevalent skin injury was abrasion (96.3%). The most prevalent joint injury was sprain (86.2%) and the most common type of bone injury was capillary fracture (50%). Most of injuries occurred in the thigh and groin regions. Due to the high prevalence of injuries coaches, trainers, doctors, parents and gymnasts should consider more appropriate diagnostic criteria to identify those who are more prone to injury and utilize specific training techniques for the floor exercises with a view to reduce the overall prevalence of injuries in the sport.

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"The Hurt Locker": Heat strain in explosive ordnance disposal

I. Stewart^{1,2*} ■ A. Rojek^{1,2} ■ A. Hunt^{1,2} ■ ¹Queensland University of Technology ■ ²Institute of Health and Biomedical Innovation

Introduction: Bomb technicians perform their work while encapsulated in explosive ordnance disposal (EOD) suits. Designed primarily for safety, these suits have an unintended consequence of impairing the body's natural mechanisms for heat dissipation. This research provides the first field based analysis of heat strain in bomb technicians.

Method: Six participants undertook task simulations wearing the Med-Eng EOD 9 suit and helmet over standard issue coveralls. The combined weight of the ensemble was approximately 35kg. During all simulation activity core temperature (CorTemp, HQ Inc, Palmetto FL, USA) and heart rate (Polar S625x, Polar, Kempele, Finland) were continuously monitored, and a physiological strain index (PSI) calculated. On day one a 420m course was walked, which included stairs and manual dexterity tasks. Day two involved a similar 420m walk plus a tractor tyre flip, 75kg body drag and trolley push, followed by a 10 min break then a 410m walk interspersed by two prone crawls. All activity was undertaken at the participant's own pace. Following the completion of the tasks participants were asked to report the extent to which any symptoms of heat illness were experienced.

Results: The climatic conditions were significantly different between the two days (WBGT Day One: 28.3±0.6, Day Two: 25.7±0.7 °C, p<0.001), with day one hot and dry, and day two cooler and overcast. Maximum and change in core temperature (37.92±0.21, 38.69±0.10 °C, p<0.001; 0.44±0.16, 1.02±0.24 °C, p=0.003; respectively) were all significantly greater on day two. The rate of rise in core temperature (0.05±0.007, 0.07±0.028 °C/min; p=0.190) was not statistically different between days, but was significantly higher than values previously reported for military scenarios in similar environments. Maximal heart rate (175±9.0, 183±9.4 bpm; p=0.045) and PSI (6.76±0.11, 8.42±0.19; p<0.001) were also both significantly higher on day two. The associated symptomology highlighted that fatigue and thirst were universally experienced, with 50% of participants also describing muscle weakness and heat sensations. Two participants reported neurological symptoms of light-headedness, dizziness and confusion. **Conclusion:** All participants demonstrated high levels of heat strain, evidenced by elevated heart rate, core body temperature, and PSI, and were symptomatic for heat illness. This was exacerbated by the more intense physical activity of day two, despite being undertaken in a cooler environment. The universal experience of heat strain in this sample has significant implications for the health of bomb technicians and additional research examining methods to improve temperature regulation and performance is warranted.

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Is the level of uniformity of hardness and traction associated with injury risk on community level Australian Football fields?

D. Twomey^{1*} ■ P. Fleming² ■ ¹University of Ballarat ■ ²Loughborough University, UK

Introduction: Ground hardness and traction have been the two surface properties most frequently associated with an increased injury risk, particularly in sports played on natural turf surfaces. In more recent times, there has been speculation that uniformity across the playing surface may have a greater impact on injury rates than the absolute hardness and traction measures. Currently, no evidence exists to support or refute this assertion. The aim of this paper is to investigate if level of uniformity of hardness and rotational traction on community level Australian Football fields is related to the number of injuries sustained.

Methods: Hardness was measured using a 2.25 kg Clegg hammer and rotational traction using a studded boot apparatus on eight community level football fields during the 2007 playing season. A total of 36 individual ground assessments were recorded and hardness and rotational traction measures were recorded at nine locations on each ground. Injury details including, nature, body region, mechanism, severity and location on the ground were collected as part of the Preventing Australian Football Injuries through Exercise project (PAFIX). The mean, range, coefficient of variation (CV), and coefficient of uniformity (CU) were calculated for hardness and rotational traction on each ground. As the data were normally distributed, Pearson Correlation Coefficient was used to examine the relationship between the number of injuries and the coefficient of uniformity for hardness and rotational traction.

Results: A total of 83 injuries were recorded on the tested grounds and on seven occasions no injuries were sustained. The number of injuries ranged from 0-5 injuries, the hardness CV from 12 – 28%, the rotational traction CU from 72 – 88%, the rotational traction CV from 17 – 65% and the rotational traction CU from 35 – 83%. The relationship between the level of uniformity and the number of injuries sustained was poor for both hardness (r=-0.16, p=0.37) and rotational traction (r=0.13, p=0.46).

Conclusions: The results of this study provides some evidence to suggest that the level of uniformity of surface properties such as hardness and rotational traction may not be a major contributing factor to an increased injury risk in community level Australian Football. However, due to the relatively low injury rates further research with a larger sample is necessary.

122 Illicit drugs and community sport: A Be Drug Aware resource

F. Boys^{1*} ■ D. Bow^{1*} ■ ¹Sports Medicine Australia (WA Branch)

Introduction: The use of illicit drugs in sport and in the broader community is of concern. Sports Medicine Australia (WA Branch) with the support from the Department of Sport Recreation of WA has produced "Be Drug Aware" an illicit drug resource for community sporting clubs.

Discussion: The resource aims to provide support staff (coaches, sports trainers, administrators) of community sporting clubs with information about illicit drugs and how to address the issue within their club. A key objective of this resource is to encourage sporting clubs to develop an illicit drug policy and codes of conduct that are well documented, implemented and promoted within their club. The important role of support staff as role models, confidants and mentors is acknowledged. Providing these personnel with information about illicit drugs and ensuring they have a clear understanding of the clubs policy and procedures in addressing illicit drug issues is essential. The Be Drug Aware Resource also provides information on illicit drug classification, reasons why people use drugs and the behavioural signs and symptoms of drug use. The issue of a Sporting Club's legal obligation regarding illicit drug use is addressed. The emphasis on identify, inform and refer is considered as well as dealing with medical emergencies. A number of drug related scenarios are provided as well as sample policies and drug referral agencies.

Conclusion: Sporting Clubs require a planned approach to prevent and manage drug related incidents. The Be Drug Aware resource for sporting clubs provides coaches, sports trainers and administrators with information and practical advice to develop an illicit drug policy and procedures to support a drug free sporting culture.

123 Morphometric analyses of the hamstring muscles using MRI: What is the best way?

T. Brancato^{1*} ■ C. Engstrom¹ ■ J. Fripp² ■ ¹University of Queensland ■ ²Commonwealth Scientific and Industrial Research Organisation

Introduction: Associations between injury and muscle asymmetries, as determined with magnetic resonance (MR) imaging, have been investigated in a number of sports medicine-based studies. For interventional or prospective studies into musculoskeletal injuries, it is important to determine the repeatability of the morphometric procedures used for quantifying muscle asymmetries. This study examines the intra-observer repeatability of manual segmentation for determining bilateral volumes of the individual hamstring muscles.

Methods: Contiguous 10mm axial images of the hamstring muscles were acquired from 10 male semi-elite Australian Football League (AFL) players using a 1.5T MR scanner. Players had a mean age 24 ± 4 years and playing history (semi-elite level) of 6 ± 4 years. Overall, 8 players had a history of hamstring injury (4 bilateral hamstring strains) and 6 had suffered at least 1 recurrent injury. Segmentation procedures for the MR images were extensive and involved a priori in-depth anatomical analyses, with the development of detailed templates for identifying each muscles unique topographical characteristics from origin to insertion. Manual segmentations were conducted bilaterally, for each individual hamstring muscle volume, 3 times over a 12 month period. Intra-observer reliability was analysed using coefficients of variation (CV), intraclass correlation coefficients, Bland Altman plots and the Dice index. In addition, slice sampling and statistical shape modelling (SSM) approaches were used to investigate the potential for more efficient methods for obtaining morphometric data.

Results: Manual segmentation of axial MR images by an experienced analyst was shown to have high intra-observer reliability for determining bilateral hamstring muscle volumes in semi-elite AFL players. The various statistical analyses showed very good repeatability with CV's ranging from 1.1% for semimembranosus to 2.7% for short head of biceps femoris. Bland Altman plots demonstrated no large, systematic bias among the test-retest measurements. Dice index analyses for individual muscle volume test-retests consistently demonstrated a mean between 0.94-0.96 (i.e., 96% of the pixels/voxels were exactly the same in the repeated segmentation attempts). Data from the partial sampling and SSM analyses indicated potential roles for these approaches for increasing the efficiency of segmentation procedures, although further analyses on a larger dataset is required.

Conclusion: The detailed manual segmentation procedures used in this MR-based morphometric study provided high intra-observer reliability well suited for providing robust morphometric data for prospective/interventional studies on hamstring muscle volume measures in sports medicine studies.

124 A preliminary investigation into asymmetry of in-shoe pressure in cyclists, leg dominance and its relationship to unilateral lower limb pathology

D. Clark^{1*} ■ C. Potter¹ ■ ¹Townsville Podiatry Centre

Introduction: Optimizing symmetry of force production through the pedal stroke has been shown to improve cycling efficiency. The authors postulate that there is a relationship between asymmetry of force production and an increased likelihood of unilateral injury to the dominant pedaling leg (as measured by peak plantar pressure).

Methodology: A pilot study of 7 competitive road cyclists (4 males, average age 36.2; 3 females, average age 32.1) was performed. Each cyclist regularly rode an average of at least 100km a week. Height, weight, cadence, Foot Posture Index and lower limb injury history was recorded. Important exclusion criteria were riders with no history of injury, current injury or bilateral injury. Each rider cycled at a constant, self-selected power best matched to their riding ability on a windtrainer. The F-scan's Wireless in-shoe pressure system was used to measure peak plantar pressures, impulse load and peak force of both feet through the pedal stroke. The foot with the higher peak plantar pressure and impulse load was then compared to the limb with a history of symptomology.

Results: Of the 7 subjects, 85% showed a positive correlation between the foot with higher peak plantar pressure and impulse load with previous injury to that sided limb. 85% of subjects had a positive correlation between the limb generating the higher peak force and the limb with a history of injury. 85% of subjects had a positive correlation between the limb with the higher impulse load and the limb with a history of injury.

Conclusion: These results suggest an important relationship between asymmetry of peak plantar pressure during pedaling and the increased incidence of cycling related unilateral lower limb injury to the dominant leg. Further study is warranted to investigate whether reducing asymmetry in peak plantar pressures and impulses whilst cycling will impact upon the rate of a cycling related injury. The larger, follow-up study based on this trial should include a control group of asymptomatic and bilaterally symptomatic cyclists to assess the influence of symmetry versus asymmetry of peak plantar pressure and unilateral lower limb pathology.

N. Mathavan¹ ■ M. Kersh¹ ■ M. Pandey¹ ■ A. Schache¹ ■ K. Crossley^{1,2} ■ N. Collins^{1,2*}

¹Department of Mechanical Engineering, University of Melbourne ■ ²Department of Physiotherapy, University of Melbourne

Introduction: Knee osteoarthritis (OA) affects almost one-third of adults aged over 65 years and is associated with significant personal and economic burden. The patellofemoral joint (PFJ), one of the three knee joint compartments, is the focus of this research since it is frequently affected by symptomatic OA and contributes significantly to the morbidity associated with the disease. The lateral portion of the PFJ experiences greater forces than the medial, and this reflects the disease pattern in this joint, with the lateral compartment being predominantly affected by the OA process. Interventions such as increasing vastus medialis function have the potential to reduce the stress on the lateral facet. Unfortunately, there is no method available to accurately measure joint loading non-invasively, making it challenging to develop effective treatments to reduce load. Computational modelling is the only means available to quantify muscle and joint loading in vivo. The aim of the current study was to determine the effect of enhancing vastus medialis force on the magnitude and distribution of PFJ cartilage stress in people with PFJ OA.

Method: Patient-specific data from biomechanical gait experiments (kinematic marker data, ground reaction forces, and fluoroscopy images) was combined with magnetic resonance imaging (MRI) in people with PFJ OA (osteophytes on skyline radiographs and anterior knee pain with rising from sitting and/or squatting). For each patient, a finite element (FE) model of the lower-limb bones and cartilage was built from high-resolution MRI. In parallel, a twelve segment (31 degree-of-freedom linkage) musculoskeletal model was developed and used to calculate lower-limb muscle forces during stair-climbing. The time histories of muscle loading and kinematic motion of the bones were input into a three-dimensional, deformable, finite-element model of the knee joint to determine stress patterns within the PFJ cartilage. Once baseline stress patterns were generated, the vastus medialis force was increased by 5% and 10% from the initial value, and the resultant changes in size and position of PFJ stress were calculated.

Results: In patients with PFJ OA, enhancing the force in the vastus medialis resulted in patient-specific changes in the magnitude and distribution of PFJ stress. Preliminary results reveal decreases in baseline peak stress values, and a shift of the stress distribution towards the medial aspect of the patella.

Conclusions: This study has identified that a conservative intervention (improving vastus medialis force) has the potential to affect PFJ stress.

The results of this study have implications for the rehabilitation of this subgroup of people with OA.

H. Dadgostar^{1*} ■ G. Soleimani^{1*} ■ S. Movasaghi¹ ■ E. Dadgostar² ■ ¹Tehran University of Medical Science ■ ²SportsMedicine Federation of Islamic Republic of Iran

Purpose: to evaluate alternation of bone mineral density (BMD) of Iranian elite female athletes who undergone Amenorrhea/Oligomenorrhea in two years.

Methodology: This study is observational research conducted on female athletes who were diagnosed as a functional hypothalamic menstrual disorder (FHMD) about two years ago. All of them were invited to re-evaluate their bone mineral density again in the same centre and by same machine that was measured two years before. They were asked about their medical problem, drug history, change in pattern of menstruation and their time training per week in a questionnaire.

Results: A total of 22 athletes were evaluated with a mean age of 23.5 ± 5.4 years old. No significant difference between BMI of athletes through these two years ($p=0.75$). Z-score is used to compare BMD of the athletes through these years. No significant difference in their Z-score is observed after this time.

Conclusion: This finding shows that among athletes who undergone functional hypothalamic menstrual disorder, no significant increase in BMD is happened if any treatment is achieved for them. Although playing sports can improve BMD of athletes, this changes are not seen among female athletes who undergone FHMD as well.

A. Dunsford^{1,2*} ■ M. Magarey² ■ S. Chalmers² ■ E. Boesch² ■ ¹Good Country Physiotherapy ■ ²School of Health Sciences, University of South Australia

Introduction: The injury rates in Australian Rules Football (ARF) are well documented at the elite adult level but research in junior level elite athletes is still in its early stages. Furthermore, preliminary research has been conducted into the correlation between injury rates and musculoskeletal and fitness screening characteristics of these players but little research has been completed investigating the correlation between injury rates and training load in junior elite athletes. The aim of this pilot study was to establish baseline data pertaining to the South Australian National Football League (SANFL) Under 18 players participating in the South Australian team which competed in the ARF National Championships in 2010. These data were collected in conjunction with a larger research project undertaken by the University of South Australia, investigating injury prevalence in junior ARF in South Australia.

Methodology: Data were collected regarding fitness and musculoskeletal screening results for the State squad players. Data were also collected on all injuries which occurred during the course of the National Championships program (two months). Formal reporting was not performed as this was a pilot study to gauge the usefulness of these data. Informal reporting of all injuries was completed, including those injuries which resulted in missed games (to correlate with other studies in this area) and missed training sessions (which is more relevant to this subject group).

Results: Forty players from nine participating SANFL clubs were tracked through the National Championships program. These players consistently performed well in the fitness testing conducted by the SANFL prior to the program. Only two of these players demonstrated sound musculoskeletal screening test results, with twenty-seven having abnormal findings. Of this latter group, twenty-two reported injuries during the program.

Discussion and Conclusion: The injury rates in the state squad were high and there was some positive correlation with adverse musculoskeletal screening findings. The effect of playing load on these players is difficult to measure but worthy of further consideration. The findings of this pilot study highlight an area requiring further research, which will be ongoing with this playing group.

C. Engstrom^{1*} ■ A. Green¹ ■ P. Hay¹ ■ P. Friis¹ ■ P. Myers¹ ■ J. Fraser² ■ J. Schafer²

¹School of Human Movement Studies, University of Queensland ■ ²School of Medicine, University of Queensland

Introduction: The teaching and assessment of practical skills for sports medicine personnel should be provided by expert clinicians and ideally be available in a flexible, access on-demand manner to permit repeated practice. Similarly, assessment of practical skills should be consistent with individualised feedback from experts. We present an innovative video-based online system for clinical assessment of practical skills (eCAPS) for joint examinations.

Methods: The eCAPS system involved 3 components. Firstly, a five-week online sports medicine knee joint module was provided to a cohort of medical students (N=40) at a leading public Australian university. This involved the development of online videos by sports medicine experts demonstrating the skills underlying a systematic physical examination of the normal knee joint supplemented with short videos of patients with pathology exhibiting positive clinical signs. The second component (asynchronous video assessment) required students, in their usual problem-based learning groups to produce and upload, to a private video-sharing website, a video clip of themselves performing the generic and special tests for a knee joint examination based on a clinical scenario. Expert clinical assessors reviewed the online repository and provided targeted feedback, via annotated video, on selected students' videos. This feedback was available to all students in a community of practice model. The third component (synchronous video assessment) required the students to demonstrate a real-time knee joint examination (from a clinical scenario) assessed remotely by an expert via video conferencing. Qualitative data were collected from individual semi-structured interviews and quantitative data derived from the experts scores for the baseline, asynchronous and synchronous videos of the knee joint examinations.

Results: The qualitative analyses revealed that the medical students greatly valued the expertise of the online presenters, the consistency of the content message and the coherence between content and assessment expectations. The students benefited from the peer support provided in practicing and producing their asynchronous videos and the ready accessibility of the online resources and feedback. There were significant performance improvements for knee physical examinations from the baseline scores to the subsequent scores for asynchronous and synchronous videos.

Conclusion: eCAPS provided access to expert teaching, assessment and feedback for the learning of practical joint examination skills. This was highly valued by students and resulted in a significant improvement in their knee joint examination scores. eCAPS offers exciting future possibilities for teaching and assessing a range of practical skills for all members of the sports medicine team.

J. Head^{1*} ■ S. Smith¹ ■ ¹Shepparton Foot Clinic

Introduction: Plantar fasciosis is the most common injury of the heel and plantar foot. It is commonly chronic and often resistant to treatment.

Aims: This paper aims to produce a logical and practical clinical treatment regime for a more effective cure rate of plantar fasciosis.

Methodology: The authors will review the current theories on the etiology of the condition with emphasis on the anatomy and biomechanics of the common function of the plantar fascia in combination with the flexor digitorum brevis muscle. The presentation will review the literature and explore the success rates of current treatment modalities including strapping, orthoses, needling, cortisone, extra corporeal shock wave therapy, deep tissue massage and autologous blood injections.

E. Hotson^{1*} ■ J. Tuccia¹ ■ R. Chen^{3,4} ■ E. Dent^{2,3} ■ T. Lambert^{2,3} ■ ¹Australian Diabetes Council ■ ²Concord Centre for Cardiometabolic Health in Psychosis (ccCHIP)

³University of Sydney ■ ⁴Concord Hospital Department of Endocrinology and Metabolism

Introduction: Cardiometabolic health is often overlooked when mental illness is the primary diagnosis. In persons suffering mental illness cardiometabolic risk is 2-3 times greater than in the general population. This population is particularly susceptible to sedentary lifestyle, poor nutrition, smoking, obesity, hyperglycaemia and dyslipidaemia. The use of some second generation anti-psychotic medications has been shown to exacerbate obesity, hyperglycaemia and dyslipidaemia, further compounding risk. Lifestyle interventions including physical activity and dietary education have proven effective in non mental health populations and also in improving symptoms of mental health, including mood, anxiety, depression and quality of life as well as improving cardiometabolic health parameters. There is a need for such programs in community mental health services.

Method: Clinical data was collected from 12 outpatients visiting a mental health service participating in a 2 hour once weekly group program, over 12 weeks. One hour physical activity session and one hour practical lifestyle education, covering various topics including diet and lifestyle. Pre and post-program metabolic and anthropometric measures; BMI, waist circumference, Blood Pressure, Fasting Blood Glucose Levels, Lipid Profile and Vitamin D; Exercise tests; 6 Minute Walk (6MWT), Balance, 30 second Sit to Stand; Seated Medicine Ball Throw; Clinical quality of life questionnaires; SWN, PETIT, and SF-12. Participant satisfaction, diet and exercise history, attendance, and Framingham risk were also recorded. Age, gender, ethnicity and diagnosis matched controls were selected from the non intervention, outpatient clinic list.

Results: 12 completed the program 3 excluded from analysis with incomplete data. Attendance rate of 78% is significant in a Mental health population, with 7/12 >80% and 5/12 participants with 100% attendance. Satisfaction was high (\bar{n} CSQ-8 = 28.4 out of 32). We recorded statistically significant reductions in LDL 0.6mmol/L ($p=0.008$) and total cholesterol of 0.63mmol/L ($p=0.032$) when compared with matched controls, and a statistically sig. 0.7 point ($p=0.012$) reduction in coronary heart disease risk using the Framingham CHD risk tool. Improvements in 6MWT 37.3m (approaching clinical significance), upper body strength, lower limb strength, and balance were also recorded however not statistically significant.

Conclusion: This program shows great promise in helping to address cardiometabolic health in a population at greater risk. The combination of practical intervention and education, engaged and retained participants from a cohort where repeat attendance to such programs is notoriously difficult. From here a train the trainer program is being developed with the goal of establishing like programs in as many community based mental health services as possible.

J. Kemp^{1,2*} ■ N. Collins² ■ M. Makdissi³ ■ A. Schache² ■ Z. Machotka⁴ ■ K. Crossley^{1,2} ■ ¹School of Physiotherapy, University of Melbourne

²School of Engineering, University of Melbourne ■ ³Centre for Health Exercise and Sports Medicine, School of Physiotherapy, University of Melbourne

⁴International Centre for Allied Health Evidence (iCAHE), Adelaide

Introduction: Hip pathology is a recognised cause of pain and reduced function in adults. Hip arthroscopy is rapidly increasing in occurrence and aims to improve pain and function in people with intra-articular hip pathology. The purpose of this study was to conduct a systematic review to investigate pain and physical function outcomes following hip arthroscopy with and without femoral osteotomy, for various and co-existing intra-articular hip pathologies.

Methods: A comprehensive search strategy was utilized to identify studies that investigated hip arthroscopy for intra-articular hip pathology. Only studies which followed patients for at least three months and used patient-reported outcomes for pain and/or function were included. Scopus, MEDLINE, CINAHL, PEDro, PubMed, Sportdiscus, Ausport, Google Scholar, PsychINFO databases and the full Cochrane Library were searched. The Downs and Black scale was used to rate methodological quality. Effect sizes were calculated where sufficient data was present.

Results: Of 40 suitable studies, 29 of moderate methodological quality were included. Fifteen studies investigated hip arthroscopy alone (i.e., no osteotomy performed). Of these, effect sizes could be calculated for two studies, with large effects (3.12 to 5.46) noted at one to two year follow-up. For the remaining studies (13/15), post-operative improvements in pain and function were consistently reported (median improvements of 47%) over longer follow-up periods (up to 10 years). Fifteen studies investigated hip arthroscopy with osteotomy. Effect sizes calculated for nine of these studies showed mostly large effects (0.78 to 2.93) over six to 28 months. Femoral and/or acetabular osteotomy appeared to produce similar short-term results to those obtained for hip arthroscopy alone. The likelihood of improved outcomes was reduced in the presence of pre-existing osteoarthritis, for both non-osteotomy and osteotomy groups. Adverse events were minimal (7% of participants in 12 studies) and were mostly transient neuropraxia (83%).

Conclusions: The best available evidence indicates that hip arthroscopy results in significant improvements in pain and function in patients with intra-articular hip pathology. While this improvement can be obtained up to 10 years post-surgery for hip arthroscopy without osteotomy, the long-term follow-up (i.e., beyond three years) for hip arthroscopy with osteotomy is yet to be evaluated. The risk of adverse events is not high. Further high-quality comparative studies are required, particularly investigating the role of rehabilitation in this patient population.

J. Kemp^{1,2*} ■ A. Schache² ■ Z. Machotka³ ■ K. Crossley^{1,2} ■ ¹Melbourne School of Physiotherapy, University of Melbourne

²Melbourne School of Engineering, University of Melbourne ■ ³International Centre for Allied Health Evidence (iCAHE), Adelaide

Introduction: Tests of physical function of the hip are commonly used in clinical practice, yet knowledge of performance on these tests in healthy people is generally under-reported and the reliability of these tests in healthy adults requires consideration. In healthy adults, this study aimed to:

i) evaluate the reliability of strength and range of motion measures of hip function; ii) compare the differences in these measures between dominant and non-dominant sides; and iii) compare the ratio of strength between antagonistic hip muscle groups of the dominant and non-dominant limbs.

Methods: The intra-rater and inter-rater reliability of clinical tests of hip function (range of motion and strength using a hand held dynamometer) were examined and ICC and SEM values established. Subsequently, in tests with good reliability, values of strength and range of motion were established in healthy adults.

The difference in these tests between dominant and non-dominant limbs, and between opposing muscle groups of the hip were established ($p=0.05$).

Results: Good to excellent intra-rater and inter-rater relative reliability of ROM (intra-rater ICC=0.82–0.92; inter-rater ICC=0.72–0.92) and strength (intra-rater ICC = 0.83–0.98; inter-rater ICC=0.86–0.97) was observed in all tests. In all tests of hip ROM, there was no difference found between dominant and non-dominant limbs. In tests of hip strength, hip internal rotation at neutral hip flexion was greater in the dominant leg ($p < 0.05$), but no other significant differences were observed. Furthermore, strength of hip external rotators was significantly greater than hip internal rotators in both dominant ($p < 0.05$) and non-dominant ($p < 0.05$) limbs.

Conclusions: Reliable and meaningful measures of hip physical function are essential for clinical practice. This study is important as it provides clinicians with a battery of reliable, clinically-applicable tests to examine the physical function of the hip. In addition, it provides clinicians with a set of values describing the normal physical function of the hip that can be used as a reference for screening or for assessment and re-assessment purposes. Such information will enable clinicians to provide targeted rehabilitation programs for their patients, and to set realistic objective goals in physical function.

D. Kuah^{1*} ■ ¹NSW Institute Of Sport

The author will present a literature review on current evidence and use of platelet rich plasma (PRP) in musculoskeletal (MSK) medicine. Reports of PRP use was first made in 1987 by Ferrari et al in open heart surgery. Since then, there has been extensive use in a wide range of medical fields including, orthopaedics, sports medicine, dentistry, ENT, neurosurgery, cosmetic/aesthetic medicine, wound healing, cardiothoracic and maxillofacial surgery. Much of the evidence on the use in musculoskeletal (MSK) medicine has been in animal studies, anecdotal or case series. It is only in recent years that randomized controlled trials in PRP use has been published. Whilst much of the research and use of PRP in MSK medicine has been in treating tendon pathologies (particularly chronic tendinopathies), PRP is also used in bone, joint, muscle and ligament injuries. This has included augmentation for acute orthopaedic procedures such as joint replacement, internal fixation of fractures (particularly for non unions), arthrodesis and tendon repairs. These uses and any evidence will be presented by the author. It is generally accepted that growth factors play a central role in tissue healing and regeneration. In blood, platelets have a role in clotting, but also contain alpha granules which contain various growth factors including TGF-beta, PDGF (platelet derived growth factor), EGF (endothelial growth factor), VEGF (vascular endothelial growth factor), FGF (fibroblast growth factor) and IGF (insulin growth factor). It is understood that these growth factors perform a variety of tasks including regulation of cellular migration and proliferation, stimulation of cell replication, stimulation of angiogenesis, and acceleration of mesenchymal stem cell replication and osteoid production. The author was an invited presenter at a landmark invitation only international seminar on use of growth factors in sports medicine held in Qatar in February 2009 where the medical directors of both IOC and WADA were present. At this seminar, a randomized controlled trial on use of PRP in hamstring muscle tears was designed, targeted at the national football competition, which were a captive audience. Following this, WADA released its 2010 guidelines which included recommendations specifically on PRP, allowing use in MSK conditions apart from into muscle. The 2011 WADA guidelines now allow the use of PRP for all MSK areas.

K. Laudner^{1*} ■ B. Noel¹ ■ T. Deter¹ ■ K. Meister² ■ ¹Illinois State University ■ ²Texas Metroplex Institute for Sports Medicine and Orthopedics

Introduction: Due to the repetitive nature of many overhead sports, such as baseball, these athletes are particularly vulnerable to the development of numerous shoulder dysfunctions. More specifically, baseball players often present with increased anterior shoulder laxity due to the ballistic external rotation experienced during the cocking phase of the throwing motion and posterior shoulder tightness due to the large eccentric forces, which accumulate during the deceleration phase of the throwing motion. As such, many clinicians have hypothesized that a relationship exists between these common characteristics. However, currently no data are available that detail if this association really exists. Therefore, the purpose of this study was to determine the strength of the relationship between anterior shoulder laxity and posterior shoulder tightness.

Methodology: Forty-four professional baseball pitchers (mean age = 22.6 yrs, range = 19-29; mean height = 188.7 cm, range = 180.3-200.7; mean mass = 88.2 kg, range = 72.7-104.6) with no recent history of upper extremity injury participated. Anterior shoulder laxity of the throwing arm was measured with an instrumented arthrometer. Bilateral shoulder internal and external rotation ranges of motion (ROM) were measured in a position of 90° of abduction with a digital inclinometer. The difference in bilateral internal rotation ROM was used to determine the amount of glenohumeral internal rotation deficit (GIRD) of the throwing arm. Throwing shoulder horizontal adduction ROM was also measured with a digital inclinometer. A multiple regression analysis was used to determine the strength of the relationships between the aforementioned variables ($p < .05$).

Results: A preliminary t-test showed a significant difference in the bilateral total arc of motions suggesting that alterations in shoulder ROM were most likely due to soft tissue rather than bony adaptations. A large portion of anterior shoulder laxity was explained by the summation of shoulder adduction ROM and GIRD ($r^2 = .54$, $p = .001$). Furthermore, increased anterior shoulder laxity had a moderate relationship with both decreased GH horizontal adduction ($r^2 = .54$, $p = .001$) and increased GIRD ($r^2 = .36$, $p = .002$).

Conclusions: The results of this study suggest that decreased shoulder horizontal adduction ROM and increased GIRD may be considered partial predictors for increased anterior shoulder laxity in the throwing arm of baseball players. Because of the association between these variables clinicians may find it advantageous to address posterior shoulder tightness during the prevention, diagnosis, and treatment of shoulder injuries associated with anterior shoulder laxity.

D. Mendis^{1*} ■ J. Hides¹ ■ H. Littleworth² ■ ¹Australian Catholic University ■ ²Physio Performance Ltd

Introduction: Elite track cycling places unique demands on the body with cyclists required to perform at a maximal intensity level over a short duration. To achieve a more aerodynamic position on the bike, cyclists are required to adopt postures that put the lumbar spine and hip in increased flexion with a loss of the lumbar lordosis. Previous research has found that a flexed posture and loss of lumbar lordosis decreases multifidus function, which is important for spinal stability. In cycling, a stable lumbar spine and pelvis could be important for the efficient function of the lower limb muscles to generate power in the propulsive phase of cycling. This case report describes how assessment and treatment of individual lumbo-pelvic muscle asymmetry and function was used to treat a cyclist who presented with low back, buttock, and leg pain associated with a loss of power during cycling.

Methods: A 27 year old female elite track cyclist presented with left sided pain in the lumbar, gluteal and adductor region with hamstring pain and tightness. Symptoms were aggravated by training loads greater than 300 watts for longer than 2 minutes, prolonged sitting greater than 20 minutes and lumbar extension. When aggravated, aching in the left calf and foot was also present. Easing factors included hamstring stretches and massage of adductor and lateral thigh muscles. She had a previous 3 year history of intermittent lumbar and thoracic pain and a L5/S1 spondylolisthesis defect diagnosed by Xray investigation. Magnetic resonance imaging (MRI) and real-time ultrasound (RTUS) examination of her individual lumbo-pelvic muscles demonstrated muscle asymmetry and altered function. Physical therapy treatment focused on specific re-training of her multifidus, transversus abdominis, iliopsoas and gluteal muscles with feedback from RTUS.

Results: Within 3 weeks of commencing weekly motor control retraining, less intensity of pain was noted and training loads were increased. Re-assessment with MRI and RTUS 6 months later revealed improvement in muscle size and function. In addition, lumbar and gluteal pain had improved with only intermittent adductor and calf muscle tightness still a problem.

Conclusions: Individual lumbo-pelvic muscle asymmetry and altered function contributed to the patient's symptoms. The physical demands and adopted postures of certain sports can result in muscle asymmetry, which may be related to injuries. Addressing imbalances in muscle size and function can help to treat injuries and optimise performance.

B. Mitchell^{1*} ■ R. Rose¹ ■ A. Barnard¹ ■ ¹Metro Spinal Clinic

Background: Prolotherapy is a non-surgical treatment for chronic musculoskeletal pain in damaged ligaments or tendons. Prolotherapy involves injecting a soluble solution such as dextrose into the ligament and tendon sites. This causes the body to produce a localised inflammatory response, which stimulates the growth of collagen fibres and connective tissue. This process is thought to thicken, tighten and strengthen the weakened tissue, and consequently decrease the amount of pain. Although prolotherapy has been used for many years, few controlled studies have properly evaluated the efficiency of this therapy. However, there is good evidence supporting the specific use of prolotherapy around the sacroiliac joint, with one study reporting a functional improvement in 76% of treated patients. This study assessed the treatment outcomes of patients who underwent sacroiliac joint prolotherapy.

Methods and Materials: Over a two year period, we assessed 26 patients who underwent prolotherapy treatment around the sacroiliac joint. This process involved outlining the deep interosseous ligament with contrast material under direct fluoroscopy, which was then injected with 1.5ml Narapain 0.75% and 10ml 50% glucose over multiple sites. This procedure was repeated three times, at six week intervals. Outcome measures assessed via surveys and patient histories were; pain relief, back/ hip/ pelvis strength, analgesic use, disability (Oswestry Disability Index) and patient satisfaction. Fourteen patients responded to the questionnaire, with an average follow up period of 7 months (range: 1-16 months).

Results and Conclusions: Prolotherapy reduced pain in half of the assessed patients, with the remaining patients observing no change to their condition. No patients reported an increase in pain following the series of injections. Of the patients receiving pain relief, an average pain reduction of 64% (30-85%) was reported. Sixty four percent of patients reported positive back/ hip/ pelvis strengthening following the treatment, with an average improvement in strength of 63% (30-85%). Interestingly, degree of disability did not vary greatly following treatment. Of the four respondents that reported no improvement in strengthening, 3 of these patients also reported no pain relief. Reduction in analgesic use was observed in over one-third of the patients. Patient satisfaction was reported by all but two of the respondents, with most patients either very or completely satisfied with their outcome. These findings suggest that prolotherapy can be an effective treatment for decreasing pain and increasing strength in patients with sacroiliac pain.

137 Ankle syndesmosis injuries in rugby union players: A retrospective analysis

J. Morellato^{1*} ■ N. Trist¹ ■ K. Rae ■ T. Leahy ■ K. Refshauge¹ ■ C. Hiller¹ ■ ¹University of Sydney

Introduction: Ankle Syndesmosis injury (ASI) is more severe than other ligamentous ankle injuries, prolonging time away from training and playing. Our aim was to explore potential predisposing factors for ASI and to clarify the injury mechanism in rugby union athletes. Methods: Five-year retrospective analysis of ASIs to players in the Sydney University Rugby Club. The medical and game records were examined with respect to position played, phase of play, footwear/stud pattern, game timing, location, surface condition and mechanism of injury. Pre- season physical parameters such as body weight, squat strength, bench press, vertical jump, and endurance testing were also reviewed.

Results: We identified 48 ASIs, of which 37 were reviewed. The mean age, height and weight (\pm SD) were 21 ± 3 yrs, 1.83 ± 0.1 m, and 95 ± 5 kg respectively. The majority of ASIs occurred in back positions ($n=24$, 64%) as compared with forwards. Ball carrying was the phase of play with highest risk of injury comprising 29 injuries (78%). Blade-style stud patterned footwear was worn by 19 players (51%) compared with removable studs ($n=10$) and molded studs ($n=8$). Most ASIs occurred in the last half of the game or training ($n=20$). There were no trends with respect to location, surface condition, or weather. A multi-player or tackle was a common scenario ($n=28$, 76%) with players describing an external rotation of the ankle. With respect to the physical parameters, only decreased vertical jump height was associated with ASI when compared with controls ($p=0.003$).

Discussion: We found ASI was predominantly a ball-carrying injury where backs were at increased risk, likely due to their increased frequency of ball-carrying. Interestingly it appears a blade-type stud pattern may put players at risk of these injuries, as we believe the results are out of proportion to current footwear trends. These boots, developed for soccer and engineered for greater lateral traction, have been speculated to inhibit release from the surface in certain contact situations. An external rotation-type mechanism was supported by our data, which concurs with existing knowledge. Most injuries occurred in the latter half of a game/training and supports the idea that fatigue may be a factor in ASI. Similarly, an athlete with a lesser vertical jump may be susceptible to this injury.

Conclusion: We have cast some descriptive insight into ASI, however, additional studies are required to determine predictors of injury and recovery, and aid in prevention.

138 The effectiveness of low-dye taping, in patients with plantar fasciitis for the short term treatment of pain in the heel

E. Nicolandis^{1*} ■ J. Habitzel¹ ■ ¹University of South Australia

Background: Low-dye taping used commonly to treat plantar fasciitis for heel pain has been considered in the past as inflammation of the plantar fascia or a complaint of heel pain, is now considered as an unknown pathology and plantar fasciosis which is micro tears of the medial column of the plantar fascia, Merck Manual 2007.

Objective: To assess the evidence for the effectiveness of low-dye taping for the treatment of pain in the plantar aspect of the heel, over a short period of time.

Methods: A systematic review of published literature. Electronic search of databases of clinical trials, included; Medline, Cochrane Library, CINAHL, Pub Med, PEDRo and Google Scholar. An assessment of the quality of studies was conducted using the NHMRC (National Health and Medical Research Council) Hierarchy of evidence, due to the limitation of articles we were required to use the McMasters Critical Appraisal Tool to evaluate the low hierarchy studies appropriately. Foreign language papers were excluded.

Results: Two randomised controlled trials were included in the review. These evaluated the improvement of pain for the short term by using low-dye taping for a period of a week. Using the visual analogue scale (VAS), it was reported that there was an improvement in pain at the final outcome measure. Even though, the other three studies were regarded as low evidence, they reported improvement in pain scores at the final outcome measure. The sample sizes and concealment of treatment allocation to the study population was considered weak, possibly preventing the researchers to state that low-dye taping is effective in treating plantar fasciitis. Conclusion: Plantar fasciitis is a topic discussed, written and researched in abundance. The few randomised controlled trials involve small sample sizes and there is inconclusive evidence of the effectiveness of low-dye taping especially as the techniques have been modified from the original 'Dye rest strap'.

139 Ways of perceiving participation and factors affecting the current activity level after non-reconstructed ACL-injury phenomenographic approach

A. Osterberg^{1,2*} ■ J. Kvist¹ ■ M. Abrandt Dahlgren³ ■ ¹Division of Physical Therapy, Department of Medicine and Health Sciences, Linköping University, Sweden
²Physical Therapy, Kullbergsga Hospital, Katrineholm, Sweden ■ ³Division of Community Health, Department of Medicine and Health Sciences, Linköping University, Sweden

Purpose: to describe ways of perceiving participation in activities of all day living, at work/in school, in and sports, in people with non-reconstructed ACL-injury. The aim was also to describe their feelings about participation in activities and their views on aspects affecting their currently achieved activity level.

Methodology: Semi-structured interviews were conducted with 19 informants, strategically selected from four different orthopaedic units. The informants were 18-43 years of age, had a unilateral ACL-injury sustained 1-5 years ago and without complex injuries. Phenomenographic approach was used for analysis.

Results and Conclusions: Five qualitative different categories were identified: A) full participation, B) participation as conditioned to risk appraisal, C) participation as conditioned to perceived control of the knee, D) participation as conditioned to perceived knee impairment, E) participation as conditioned to neglect of the knee injury. Most of the informants were positive about their activity level or participation. Negative feelings concerned frustration, loss of function and not being able to be active on their own terms, were expressed in the perceived knee impairment category. In the risk appraisal-category, some informants expressed it tiresome to be more cautious, when participating in activities. Even though fear of (re)injury was discernible in the risk appraisal-category, the informants were able to re-orientate to participate in a different way or finding other less risky activities. Physical and psychological factors were most apparent affecting the activity level. Factors facilitating or relating to return to pre-injury activity level were regaining physical function, re-learning movement patterns, regaining trust in the knee and overcoming fear. The factors were described as improving over time. Physical therapy was a source for regain physical function and retrieving information. They also expressed that adherence to the prescribed exercise was of importance. Factors hindering return to pre-injury activity level were recurrent and uncontrollable giving way and fear of re-injury, which were most commonly in the categories of participation as conditioned to risk appraisal and perceived knee impairment. This study shows that non-reconstructive management of an ACL-injury can result in a satisfactory knee function and activity level, were the individuals are able to participate to various degrees. This study also contributes to the knowledge of how participation in activities are performed, what to attend to during the rehabilitation and expectations of achievable activity level after non-reconstructed management of an ACL-injury.

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Upper limb muscle strength deficit as an indicator of cervical spine pathology

K. Peek^{1*} ■ ¹Calvary Rehabilitation Hospital

Introduction: To determine whether upper limb muscle strength testing using a Gatherer Load cell could be a reliable indicator of cervical spine pathology. **Methodology:** Eight subjects were referred by their General Practitioner or treating Physiotherapist for upper limb testing using a Gatherer Load cell testing device. All eight had cervical spine symptoms on both subjective and objective physiotherapy examination. All had been excluded for bony injury following a cervical x-ray. The muscle strength testing involved Maximal Isometric Voluntary Muscle Contraction (IMVCmax) of the cervical musculature and all bilateral upper limb myotomes. The results were analysed to provide a provisional diagnosis, which was then compared to CT / MRI scan results. **Results:** Testing demonstrated an ipsilateral strength deficit on cervical side flexion in all eight subjects. Additionally, all subjects demonstrated ipsilateral upper limb muscle strength deficits within at least one myotome. The myotome showing the greatest deficit formed the basis of the provisional diagnosis. Cervical pathology was demonstrated at the same level on subsequent CT/ MRI scanning in all eight subjects. **Conclusion:** The results of this preliminary study appear to demonstrate that upper limb muscle strength deficit can be accurate indicator of cervical spine pathology. The Gatherer Load Cell provides an objective measure of muscle strength particularly when compared with more arbitrary testing tools such as the Oxford Scale. Strength improvements can be monitored, aiding in rehabilitation quantification. The tool itself provides a cost effective alternative to repeated CT / MRI scanning, as well as being simple to use, replicate and analyse. The initial promising findings suggest a more detailed study with larger sample size and a control group is warranted. Nevertheless, the load cell has the potential to be a vital adjunct in the testing of musculo-skeletal injuries, as well as an objective measure of cervical spine pathology and it's recovery.

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Unilateral symptomatic adult acquired flat foot case presentation – The importance of post surgical rehabilitation

K. Robertson^{1*} ■ ¹Newcastle Family and Sports Podiatry

A 36 year old female presented for assessment on referral from an orthopaedic surgeon for a 'sagging arch' on the left foot. 16 weeks prior she had open reduction with internal fixation for stage 3 tarsometatarsal joint fracture/dislocation on that side. The foot was immobilised for 10 weeks and she was advised to walk for rehabilitation. Pain was present on weight bearing, with morning stiffness, difficulty with stairs, and difficulty finding comfortable footwear. Pain was localised around the Lisfrancs joint and coursing along tibialis posterior (TP). Medial longitudinal arch height was significantly reduced and subtalar joint (STJ) range of motion was reduced. Passive inversion resistance produced pain in TP. Biomechanically, she measured a resting calcaneal stance position of 10° everted on the left, 4° everted on the right and calf circumference was 2.2cm smaller on the left with significant muscle weakness. Gait was antalgic to the left with valgus heel strike and the foot remained pronated throughout gait. **Diagnosis:** Stage 2 posterior tibial tendon dysfunction (PTTD) with unilateral symptomatic adult acquired flatfoot; secondary to prolonged immobilisation following surgery. **Discussion:** PTTD is multifactorial in aetiology with excessive STJ and midfoot pronation placing an increased eccentric load on the TP tendon. The Patient's Lisfrancs joint injury and immobilisation, without appropriate muscle rehabilitation, brought about significant muscle atrophy and weakness. Coupled with, early removal of K-wires, this has lead to a cascade of tissue attenuation of the supporting ligamentous structures of the foot. Management consisted of rigid prescription functional foot Orthoses and appropriate replacement athletic footwear. A 12 week rehabilitation program was implemented including strength, proprioception, mobilisation, agility, plyometric exercises and running. By week 9 she had met her major goal of being pain free when wearing the footwear with the orthoses, she can also now ascend and descend stairs and her quality of life has been greatly improved. Without referral to the appropriate therapist, in this case the Podiatrist, there is a risk that her PTTD may have progressed to a stage that was beyond conservative management. Immobilisation is a necessary evil. While it is imperative for adequate healing following surgical intervention; it will have a profound effect on the musculature and supporting structures in that segment. This case highlights the need for appropriate post-operative management following surgery and immobilisation. This should include a multidisciplinary approach to ensure all aspects of rehabilitation are covered to gain optimal recovery.

J. Saunders^{1*} ■ R. Shnier² ■ M. Khagra¹ ■ ¹Sydney University Medical School ■ ²Southern Radiology, Miranda NSW

Aim: To identify possible areas of compression of the sciatic nerve in the pelvis.

Method: Ten matched pairs of athletes presenting with buttock and leg pain, not identified as having discal pathology or local muscle pathology in the thigh undertook an MRI examination of the pelvis according to a previously validated protocol. All subjects and their controls also undertook a full history and physical examination. Pain charts, VAS scores and neurological examination were also undertaken. The MRI's were reported by an experienced radiologist. The physical examinations were conducted by an experienced Sport and Exercise Physician.

Results: Three subjects demonstrated irritation and surrounding inflammation of the sciatic nerve at the level of the ischial tuberosity. These were in association with tendonopathy of the nearby common tendon of the biceps femoris and semitendinosus. One subject showed compression of the sciatic nerve as it entered the sciatic notch. No abnormality was demonstrated in the remaining subjects.

Discussion: Irritation of the sciatic nerve away from the intervertebral disc is possible. It would appear that the commonest place for this to occur is at the level of the ischial tuberosity and is associated with tendonopathy of the hamstring tendon origins. Concurrent studies also were undertaken to ascertain morphological features of the hamstrings (reported separately) which may explain this finding.

G. Sole^{1*} ■ A. Radzimski¹ ■ A. Mündermann^{1,2} ■ ¹University of Otago, New Zealand ■ ²University of Constance, Germany

Footwear modifications have been investigated as conservative interventions to decrease peak external knee adduction moments (EKAM) and pain associated with knee osteoarthritis (OA). Further, sportspeople with previous knee injuries have been shown to exhibit increased EKAM compared to uninjured individuals. It may thus be important to implement strategies to decrease these moments in people with knee injuries. The aim of this review was to evaluate the literature on the effect of different footwear and orthotics on the peak EKAM during walking and/or running.

Methods: A systematic search of databases resulted in 33 included studies.

Results: Seventeen studies included healthy individuals and 19 studies included subjects with medial knee OA. An average quality of 73.1% was found for the studies with a modified Downs and Black quality index. The most commonly used orthotic was the lateral wedge, with 3 studies on the medial wedge. Lateral wedging was associated with decreased peak EKAM in healthy participants and participants with medial knee OA, whilst increased peak EKAM were reported with the use of medial wedges. Footwear (subjects' own shoe, "stability" and "mobility" shoes, clogs) was likely to increase the EKAM in individuals with medial knee OA, whilst innovative shoes ("variable stiffness") decreased the EKAM compared to barefoot walking. Similarly, shoes with higher heels, sneakers and dress shoes increased EKAM in healthy individuals compared to barefoot walking. Shoes increased EKAM compared to barefoot running in healthy individuals. Practitioners are facing a dilemma for the prescription of footwear for people with knee OA. One approach is to focus on assessment of the foot, with emphasis placed to reduce the amount of foot pronation by the use of medial wedges and arch supports. However, this review has found that these may be associated with increased EKAM, indicating increased joint loading at the knee. The alternative approach includes use of lateral wedges with the aim of decreasing knee pain and joint loading. However, a reliable method of assessment for appropriate individual prescription has yet not been defined.

Conclusions: There is evidence that lateral wedging decreases the first peak EKAM during walking, and shod conditions increase the first peak EKAM compared to barefoot walking and running. Further research may be warranted to develop shoes which result in similar knee loading as barefoot walking, and to determine whether footwear modifications can be used to decrease risk for future OA in individuals with previous knee injuries.

D. Spurrier^{1*} ■ ¹Australian Institute of Sport

High performance sport places increasing physical demands on the athlete with lower limb amputation. The ability to maintain dynamic posture through stance and propulsive phases of gait are challenged by forces specific to the individual sport and also to the physical characteristics of the prosthetic limb. Reduced proprioceptive awareness and musculoskeletal balance restrict force production in the athlete with amputation. Extrinsic factors place further demands on the limb and prosthesis that can increase the risk of injury. There is an ever increasing demand to maintain musculoskeletal awareness of posture and dynamic control of the prosthetic limb, particularly when high level execution of skilled exercise is required in order to participate in high performance sport. The effects of physical disuse on muscle and bone place relatively higher loads on the side of the amputated limb. This presentation highlights the physical demands placed on the high performance athlete with amputation and introduces concepts aimed at improving muscle balance and preventing injury. Methods for the progression of exercises aimed at improving muscle strength and control of movement between the amputated and non amputated limbs will be discussed.

I. Wee^{1*} ■ ¹Perth Integrated Health

Introduction: This research project examined the importance of Bike Ergonomics in relation to the biomechanics of the human body. The presenting complaints of cyclists reveal a very crucial role that health professionals play in the proper set up of cyclists on their bike taking into account the many variables associated with the sport.

Methodology: The research which was conducted over one hundred cyclists. Clinical measurements relating to bike fit and human geometry and clinical observations via high speed photography were employed to obtain the required data and results for the patient. Coaching observational methods were also utilized as a follow up procedure to this research.

Results and Discussion: This research demonstrates the crucial link of a qualified health professional sound in the knowledge of biomechanics, cycling techniques, cycling technical knowledge and coaching methods in the completion of a proper bike ergonomics program. The research also raised the issues of bike fit competency, whether there is proper understanding of health professionals in their clinical advice to cyclists and if there should be an establishment of an ergonomics screening criteria for the benefit of cyclists.

I. Wee^{1*} ■ ¹Perth Integrated Health

Introduction: The research reviews five years of cumulated data on pre and post fitness assessments of more than two hundred cyclists involved with a national accredited cycle skills training program.

Methodology: This special cycle skills program was created from a blank template and involved the educational aspects of biomechanics for cyclists, nutrition and hydration as well as performance enhancement techniques. It required the input of national qualified cycling coaches, occupational therapists, physiotherapists, biomechanical podiatrist and exercise physiologists. The cycle skills course which is over 10 weeks in duration, sees participants evaluated with aspects of their health from heart rate, VO_2 max, blood pressure, percentage fat as well as posture analysis as well as developing specific skills related to strength endurance, and cardiovascular fitness.

Results and Discussion: The results of this program reveal the importance of cycling as an extremely crucial activity promoting health and wellness through various demographic profiles in the Australian community.

T. Cates^{1*} ■ M. Spittle² ■ S. Malcolm² ■ ¹La Trobe University ■ ²Deakin University

Introduction: This study explored the factors related to engagement of primary school aged children in a school-based physical activity program from the perceptions of teachers, facilitators, a school principal, and the children themselves. Three Victorian Primary schools received a complimentary fun based 10-week exploratory physical activity program. Classroom teachers actively participated with their students.

Methodology: Systematic thematic analysis was conducted on three sources of qualitative data collected following the program. Adult program contributors completed open ended response items regarding program effectiveness, outcomes for the children and suggested improvements. Children provided unsolicited pictures and comments reflecting their experiences of participating in the program. Common themes were revealed in each of the three individual sources of data during initial thematic analyses. Focused and selective themes relating to children being willingly engaged in physical activity were revealed during analysis of the pooled data from all parties when data saturation was reached.

Results and Discussion: These most prominent themes included a positive/supportive environment, a sense of inclusiveness, social dynamic, activity variety, acknowledgement and fun/enjoyment. The deliberate inclusions of program delivery focused on fostering a positive and supportive environment, using the children's names, providing individualised constructive feedback and highlighting the improvement potential within each child were highlighted as positive elements of the program. Adults and children participating together contributed to creating a supportive environment by fostering positive role modelling and promoting learning. Inclusivity was enhanced as ability and skill level were not perceived as participation barriers eliminating the fear of failure. Teachers and facilitators noted that the children worked more effectively as a whole class team, students encouraged each other and normally reserved children became actively involved. The variety and fun nature of the program were strong themes identified by all. The weekly variety increased the enjoyment potential for all children involved. Despite all the positive themes that emerged, teachers challenged the sustainability of such a program over time, based on cost and the teacher's own ability to deliver a program with the same level of enthusiasm and authenticity as external providers.

Conclusion: In conclusion, children's physical activity programs may have a greater chance of successfully engaging children when incorporating the themes of fun, variety, inclusiveness and when presented in a supportive environment with positive role modelling.

K. Chan^{1*} ■ S. Hui¹ ■ ¹Department of Sports Science and P.E., CUHK, Hong Kong

Introduction: System for Observing Fitness Instruction Time (SOFIT) is a developmental observation instrument applied specifically in physical education. The validity of a revised system (SOFIT6) was examined for original SOFIT (SOFIT5) with the TriTrac (vector magnitude) functioned as a concurrent validity criterion in 2002. The correlation for SOFIT6 with TriTrac ($r=0.68$) was higher than that for SOFIT5 ($r=0.60$). However, the TriTrac is quite sensitive to sedentary motions so that incorrect estimation of energy expenditure may exist.

Purpose: To validate the modified SOFIT scale with the use of heart rate (HR) monitor for measuring activity levels in PE lessons.

Methodology: Four male participants (mean 10.6 years, range 10-11) in two classes from a local primary school consented to be monitored for HR. Each class was video-recorded for class observation. Five minutes were deducted each from the beginning and the closing of the class due to transitional periods. A HR belt (Polar S610i) and a wrist receiver were attached on the student's body. The HR monitor was programmed to automatically record at 5-second interval. SOFIT codes were entered into a spreadsheet and matched to HR data by time interval. Pearson product-moment correlation coefficient was generated between over 300 pairs of codes and HR data. Percentages of physical activity of moderate-to-vigorous intensity (MVPA) and vigorous intensity (VPA) were compared for both SOFIT scales.

Results: For an average 26.3-minute class period, the amount of MVPA recorded with the SOFIT6 was substantially less than (22.7%) than that recorded with the SOFIT5 (40.4%). The amount of VPA recorded with the former was also less than (3.5%) than that recorded with the latter (8.5%). Correlation exists between the SOFIT6 codes and HR ($r=0.794$, $p<0.01$).

Conclusions: Results indicate that the modified scale reflects a great ability to register movements associated with a variety of intensities. The findings support the construct validity of the SOFIT6 in assessing physical activity during PE lessons. Limitation for use of HR as an estimate of energy expenditure is discussed since there is a basic assumption accepting a tight and linear relationship between HR and a direct measure of energy expenditure. Such relationship is especially true throughout a large proportion of the aerobic work range. It has an important implication for redefining the design structure with giving careful consideration to the characteristics of the content taught in the class observed.

B. Dapeng^{1*} ■ ¹Beijing Sport University

The recent results of the Global Longitudinal Study of Osteoporosis in Women on the lack of self-perceived risk of fracture are just one set of a series of publications that will contribute to the enhancement of osteoporosis assessment and will help to develop new and specific interventions for fracture prevention and ultimately decrease mortality secondary to fractures. The failure of women to appreciate their own risk of fracture is a barrier to scarcity early diagnosis parameter. To explore the possibility of make muscle physical parameters as postmenopausal osteoporosis early diagnosis parameter, the study focus on the correlation between muscle physical properties and BMD. 259 postmenopausal women (aged 68.2±5.1years) were measured with Dual-Energy-X-ray-Absorptiometry (DXA) at the femneck, troch, Ward's tri, femshaft, lumbar 2 to 4 and total body, while the tonic, the stiffness, the flexibility of gastrocnemius were measured by Myoton-3, analysis the correlation between muscle physical parameters with BMD. The relationship between the Frequency to represent the muscular flexibility with the BMD of femneck, femshaft and the whole hip was significant ($P<0.01$), moderate with the BMD of troch, lumbar ($P<0.05$). Muscular flexibility can be more sensitive to react the state of muscles and bone, and operating more simple economic; it can be used as the early diagnosis of osteoporosis forecasting parameter.

R. Eime^{1,2*} ■ J. Harvey¹ ■ M. Craike³ ■ C. Symons² ■ R. Polman² ■ W. Payne² ■ ¹University of Ballarat ■ ²Victoria University ■ ³Deakin University

Introduction: Despite an abundance of research on physical activity (PA) participation in adolescent girls, determinants of particular types of PA are unknown. This study therefore investigated the association between household socioeconomic status (SES) and participation in club sport, and potential mediators of that association.

Methodology: A survey of 732 female adolescent school students (521 metropolitan, 211 non-metropolitan; 489 Year 7 (age 12 yr), 243 Year 11 (age 16 yr)) was conducted. We assessed current sports club membership (dichotomous: yes/no), and three measures of SES: Socio-economic Indices for Areas (SEIFA) Index of Relative Socio-economic Advantage and Disadvantage for home postcode; highest educational qualification of parent(s)/caregiver(s) (dichotomous: less than Year 12 vs. Year 12 and above); and employment status of parent(s)/caregiver(s) (dichotomous: two parents/caregivers both employed F/T or P/T vs. lower levels of employment). The association between sports club membership (dependent variable) and each of the three SES variables was investigated using logistic regression. Each of these associations was investigated further in a multiple mediation analysis. The three potential mediators were summated scales indicating access to facilities, family support, and peer support respectively, derived using principal components analysis and inter-item reliability analysis.

Results: Sports club membership was significantly associated with higher levels of all three SES measures: SEIFA score (OR 1.006; CI 1.004, 1.009; $p<.001$); parent/caregiver education (OR 2.31; CI 1.48, 3.62; $p<.001$); and parent/caregiver employment (OR 2.24; CI 1.60, 3.13; $p<.001$). Sports club membership was also significantly positively associated with all three potential mediators: access to facilities (OR 2.43; CI 1.74, 3.38; $p<.001$); family support (OR 5.69; CI 4.25, 7.62; $p<.001$); and peer support (OR 3.19; CI 2.48, 4.09; $p<.001$). Family support fulfilled the remaining mediation criteria (significant association with SES and a significant indirect (partially mediated) effect of SES on sports club membership) for all three SES measures. Access to facilities partially mediated the association with SEIFA only, and peer support partially mediated the association with parent/caregiver employment only. Similar results were obtained for each of Year 7, Year 11, and metropolitan cohorts; some differences in results, mainly for the non-metropolitan cohort, will be discussed.

Conclusion: These findings suggest that, while access to and affordability of sports facilities tend to be higher in areas with higher SES, the strongest determinant of higher sports club participation among adolescent girls in high-SES households is family support. This has practice and policy implications, and will assist in developing interventions within low-SES communities.

L. Gunning^{1*} ■ ¹Comcare

All Australian employers have a duty of care to ensure that the workplace is safe for employees and free of known sources of harm such as trip hazards and unsafe manual handling techniques. Yet, the standard posture for many modern occupations is seated at a computer undertaking data entry, knowledge-based work or telephone based customer services. As such, a large proportion of employees may spend more than 7 hours per day sitting. Research has found that adults who sit more during the day have a higher risk of early death, particularly due to cardiovascular disease. Evidence from studies on television watching, which is a common sedentary leisure activity of a large proportion of the population, has shown that adults who watch more than two hours of television a day are more likely to suffer from type 2 diabetes or obesity. In addition to this, prolonged sitting has also been shown to contribute to lower back pain. Breaking up prolonged periods of sitting may be advantageous to workers. Research on bank tellers has shown that discomfort in the upper limb is greater when tellers just sit and discomfort in the lower limb and back is more prevalent for the just standing posture. Alternating between sitting and standing produces the least discomfort and was reported by most subjects as the preferred posture. If sedentary practices are a potential source of harm and can be associated with negative health outcomes, it is important that workplaces look at implementing policies and practices to reduce the total sitting time of workers. Activities that enable workers to move between sitting and standing postures may therefore be a cost effective, easily achieved way for employers to positively influence the health of workers. With assistance from Baker IDI Heart and Diabetes Institute, Comcare is implementing a four week pilot program to test the impact of sit-stand workstations on reducing the sedentary time of Comcare workers. The presentation will discuss the results of the pilot and how Comcare will use the findings to support the health and wellbeing of all workers in the Comcare scheme.

J. Harvey^{1*} ▪ W. Payne² ▪ S. Dharmage³ ▪ ¹University of Ballarat ▪ ²Victoria University ▪ ³University of Melbourne

Introduction: High levels of physical inactivity contribute to diseases such as cardiovascular disease. Physical inactivity and cardiovascular disease are reportedly particularly prevalent in first generation immigrants in Victoria, especially those from Southern Europe and South Asia. Among the largest foreign-born communities from these zones, thereby representing high population-attributable risk, are those from Italy and Sri Lanka respectively. This study set out to measure, compare and correlate levels of physical activity (PA) and health and wellbeing across adult first generation members of the Victorian Italian and Sri Lankan migrant communities, and a reference sample of Australian born counterparts.

Methodology: 414 respondents aged ≥ 40 years (90 Italian-born and 95 Sri Lankan-born recruited through immigrant community organisations; 229 Australian-born randomly selected from the electoral roll) self-completed a 5-point Likert scale self-assessment of current PA level, an audit of disability and disease, and the SF-12 questionnaire from which two summary scores were derived – the Physical Component Score (PCS) and the Mental Component Score (MCS). A subset of 198 respondents (25 Italian-born, 39 Sri Lankan-born, 134 Australian-born) also completed the long form of the International Physical Activity Questionnaire (IPAQ), from which were derived overall and domain- and intensity-specific energy expenditures in MET-minutes/week, and a 3-category (low/moderate/high) overall PA level classification.

Results: Prevalence of angina ($p < 0.001$), high blood pressure ($p < 0.001$) and diabetes ($p < 0.001$) were significantly higher in both immigrant cohorts than in the Australian cohort. The prevalence of muscle/joint/bone conditions was higher in the Italian-born cohort and lower in the Sri Lankan-born cohort than in the Australian-born cohort ($p = 0.002$). Mean PCS was lower, by a clinically significant amount, for Italian immigrants than for Australian-born ($p < 0.001$) and Sri Lankan-born ($p = 0.003$) cohorts. There were no significant differences between MCS means. There were no significant differences between the cohorts in overall energy expenditure or in overall IPAQ PA categories, but there were significant differences for the Vigorous and Vigorous leisure sub-totals ($p = 0.022$, 0.005 respectively), and marginally significant differences ($p < 0.10$) for moderate domestic and moderate leisure sub-totals, suggesting different patterns of PA in the three cohorts. The only significant correlation between the 15 IPAQ energy expenditure scales and the two SF-12 scores was between vigorous leisure PA and PCS ($r = 0.24$, $p = 0.001$).

Conclusion: Differences were identified between the immigrant and Australian-born cohorts with regard to physical wellbeing and the levels of different types of PA undertaken. A consistent and interesting finding was an association between vigorous PA and physical wellbeing.

R. Hashim^{1*} ▪ M. Mazuki¹ ▪ M. Ahmad¹ ▪ Z. Baharud-din¹ ▪ ¹Universiti Teknologi Mara (UiTM), Malaysia

The world of work, for the most part involves sitting and using computers. This is especially true in the university setting thus leading to limited physical activity. Hence, the purpose of this gender study is double-pronged - to determine if sports participation influences the female university students and staff's performance - academically or at work. The cross-sectional survey resulted in a 60.8% (608/1000) and a 95% (190/200) response rates for the student and staff where the distribution by gender were 66.8% female students and 36.6% female staff. The Chi-square tests showed that for both scopes, there are significant evidences ($p < .05$) that sports participation influences the students' grades and the staff's annual performance appraisal. There is now sufficient empirical evidence to ensure that the campus populace should seriously include regimental physical activities in their daily lives for health is wealth. Besides, the obvious benefits of exercise, it is hoped that the university will promote campaigns on lifestyle and quality of life in its policy while continuing to support and emphasize sports as an outlet for social networking and wellness.

J. Walsh¹ ▪ M. Climestein¹ ▪ I. Heazlewood^{2*} ▪ K. Adams³ ▪ M. DeBeliso⁴ ▪ S. Burke¹ ▪ J. Kettunen⁵ ▪ ¹Australian Catholic University ▪ ²Charles Darwin University
³California State University Monterey Bay, USA ▪ ⁴Southern Utah University, USA ▪ ⁵Arcada University of Applied Sciences, Finland

Introduction: Masters swimmers may display an age related increase to the range of pathologies present as well as physiological changes due to the aging process. There are possibilities of reduced physical activity levels, reduced metabolism and thus altered BMI compared to younger, active populations. It was hypothesized that due to a rigorous physical activity at older ages, the BMI of the swimmers at the Sydney WMG was such that a lower percentage would be classified as obese ($\text{BMI} \geq 30 \text{ kg/m}^2$) than an appropriate comparative general population. This was despite the propensity for an increase in muscle mass from adherence to sport and the possibility of buoyancy advantages in swimming from a greater fat mass.

Methods: An online survey was utilized to investigate participants' demographics. Electronic invitations were sent to masters games athletes who provided a valid email address.

Results and Discussion: From this sub-sample ($n = 527$), 262 (49.7%) of the participants were male, whilst 265 (50.3%) were female. The ages ranged from 25 to 91 years (mean = 54.27). Obesity based on BMI was a health risk factor for 9.1% of the total sub-sample. Given the majority represented Australia (69% of the 527 athletes), it was deemed that the Australian general population would be the most appropriate to compare to in terms of obesity incidence. There was significantly ($\chi^2 = 44.9$, $p < 0.001$) lower BMI than ABS values. Comparison to samples from the other most represented countries, Canada, U.K., New Zealand and U.S.A. also showed significantly less (all $p < 0.001$) obesity than the national populations. The same trends were evident in gender based comparisons with the ABS data ($p < 0.001$). Results indicated significantly improved values of one health risk factor for these masters athletes compared to adult (age > 18 years) Australians. Given that incidence of obesity increased in the ABS sample with age and the highest proportions of obese individuals in the general Australian population were within our sample age range, the observed differences between the general Australian population and our sample could in fact be statistically even larger than revealed in this study.

Conclusion: For masters swimming at the Sydney WMG, it is shown that a key index of health, namely obesity as a health risk factor, is far lower in incidence than appropriate international populations, including the Australian population aged 18 years and over.

J. Walsh¹ ■ M. Climstein¹ ■ I. Heazlewood^{2*} ■ K. Adams³ ■ M. DeBeliso⁴ ■ S. Burke¹ ■ J. Kettunen⁵ ■ ¹Australian Catholic University ■ ²Charles Darwin University
³California State University Monterey Bay, USA ■ ⁴Southern Utah University, USA ■ ⁵Arcada University of Applied Sciences, Finland

Introduction: There is growing evidence that physical activity across the lifespan is beneficial for improved health. However older athletes may display an increased range of pathologies and physiological changes due to aging. These factors may result in changes to patterns of injury incidence, when compared to younger populations, engaged in competitive sport. The World Masters Games (WMG) is the largest international sporting competition in terms of participant numbers. Despite these large numbers, this cohort of athletes remains proportionately under investigated. The study aim was to investigate trends in injury type and location for a representative sample from this population. It was hypothesized that injury trends (acute and overuse) would be similar in incidence and location to an elite European soccer population. It was thus expected that muscle/tendon sprain was significantly the most common injury and the lower extremities (excluding knees, feet and ankles) were the most commonly injured location.

Methods: This study investigated the 2009 Sydney WMG football code athletes (soccer, touch football, rugby union) as a sub-sample of the Sydney WMG population. An online survey was utilized to investigate participants' health histories. Electronic invitations were sent to masters games athletes who provided a valid email address. Location and injury classification were analyzed statistically and compared to trends published on 4,483 injuries reported in elite European soccer athletes.

Results and Discussion: 931 athletes (Age 29-72yrs, mean 47.6, SD=7.1, 52.5% male, 47.5% female) participated. Injury classifications and locations distributions were examined using contingency tables. The most common classifications of injury reported were muscle/tendon strain (13.0%, $\chi^2=232.8$, $p<0.01$), inflammation (6.1%, $\chi^2=17.2$, $p<0.05$), joint pain (6.0%, $\chi^2=15.7$, $p<0.05$) and ligament sprain/tear (5.8%, $\chi^2=13.1$, $p<0.05$). Comparatively punctures (0.1%, $\chi^2=31.2$), dehydration (0.1%, $\chi^2=31.2$), lacerations (0.3%, $\chi^2=27.4$) (all p-values <0.01) and dislocation (0.6%, $\chi^2=22.2$, $p<0.05$) were significantly less common. A total of 346 of the injuries were designated according to specific locations of the body. Analysis indicated that the most common injury location was the legs (11.2%, $\chi^2=37.2$, $p<0.01$), this figure excluded injuries to knees, feet and ankles, which were not significantly different to expected values, using a contingency tables. Comparing the 13 injury locations: face, head (other), chest, eye, abdomen/pelvis, hand, spine/back, hip and shoulder were all proportionately under represented (all p-values <0.01).

Conclusion: As hypothesized, results for injury location and classification in preparation for the Sydney WMG show similarities in location and injury type to a younger population of elite, professional soccer athletes.

J. Walsh¹ ■ M. Climstein¹ ■ I. Heazlewood^{2*} ■ K. Adams³ ■ M. DeBeliso⁴ ■ S. Burke¹ ■ J. Kettunen⁵ ■ ¹Australian Catholic University ■ ²Charles Darwin University
³California State University Monterey Bay, USA ■ ⁴Southern Utah University, USA ■ ⁵Arcada University of Applied Sciences, Finland

Introduction: There is growing evidence that physical activity across the lifespan is beneficial to health, however older athletes may display an increased range of pathologies and physiological changes due to the aging process. This may result in increased injury incidence when participating in or preparing for highly competitive sport. The World Masters Games is the largest international sporting competition in terms of participant numbers. In 2009, the SWMG (SWMG) attracted 28,089 competitors who represented 95 countries competing in 28 sports. Despite these large numbers, this cohort of athletes remains proportionately under investigated. The aim of this study was to investigate whether there was greater incidence of injury in this population than comparative sporting populations. It was hypothesized that despite greater age, there would not be a greater incidence of injury in this masters football population than for younger athletes competing in other amateur and elite sports.

Methods: This study investigated the 2009 SWMG football code (soccer, touch football, rugby union) athletes as a sub-sample of the SWMG population. An online survey created using Limesurveytm was utilized to investigate participants' demographics and medical health histories. Electronic invitations were sent to masters games athletes who provided a valid email address.

Results and Discussion: 931 masters athletes (Age 29-72, mean=47.6, 52.5% male, 47.5% female) participated. Analysing injury demographics indicated 23.1% of respondents suffered an injury in the four years of preparation/exercise training for the SWMG. Comparison to other research indicated injuries were significantly lower in incidence than those for numerous studies on amateur athletes in football codes (all $p<0.01$) as well as for several studies on athletes competing in professional football codes (all $p<0.01$). Causation was also considered, namely it was possible that some masters athletes did not register to compete in the SWMG due to injuries sustained in preparation for the tournament. Using logic, any causation of this nature however was assumed to be slight. The possibility, that athletes with some inherent ability to resist injury were able to continue physical activity across the lifespan and were therefore more likely to be involved in masters sport was also discussed.

Conclusion: Despite benefits of exercise, it is possible that due to age related changes, increased risk of injury will be associated with highly competitive sport for the aging athlete. For football athletes at the SWMG, incidence of injury during the years of preparation is significantly less than for many other competing football populations.

M. Kingsley^{1,2*} ■ L. Mason¹ ■ P. Ali³ ■ I. Hilldrup⁴ ■ V. Aithal⁴ ■ A. Mikhail⁴ ■ ¹CQUniversity ■ ²Swansea University, UK ■ ³Singleton Hospital, UK ■ ⁴Morriston Hospital, UK

Introduction: Kidney transplant recipients experience poor physical functioning and reduced quality of life; furthermore, these patients are at increased risk of new onset diabetes mellitus and are at high risk of cardiac events. Although patients are generally encouraged to undertake physical activity, the feasibility of individualised intensive exercise training is yet to be established in this clinical population. The current study investigated the feasibility of a 24-week intensive exercise training programme on physical functioning in renal transplant recipients.

Methods: Following ethical approval, ten renal transplant recipients (Mass mean 92.1, range 59 – 112 kg, Height mean 1.66, range 1.58 – 1.78 m) were recruited for the study. Baseline measures included body composition analysis (Dual Energy X-ray Absorptiometry) and symptom-limited maximal incremental cycling test. Patients then undertook three one hour sessions of individualised progressive exercise for 24 weeks, which incorporated upper and lower body resistance training with individualised cycle training. Baseline tests were repeated at 24 weeks.

Results: Five patients completed 24 weeks of training and are included in the analyses. Reasons for patients not completing the 24 week training programme were time and location of training (2 patients), musculoskeletal injury not associated with training (2 patients), and complication associated with allograft (1 patient). Peak work rate increased from mean 73 W, range 45 – 95 W at baseline to mean 99 W, range 75 – 125 W at 24 weeks ($P < 0.01$). Peak oxygen consumption increased from mean 1.27 L·min⁻¹, range 0.61 – 1.78 L·min⁻¹ at baseline to mean 1.54 L·min⁻¹, range 0.85 – 2.20 L·min⁻¹ at 24 weeks ($P = 0.04$), which corresponded to a mean increase in peak work capacity of 1.2 METs, range 0.1 to 2.9 METs. Body composition did not change from baseline (mean 38.1 %Body fat, range 32.7 – 48.7 %Body fat) at 24 weeks (mean 35.1 %Body fat, range 24.8 – 42.7 %Body fat; $P = 0.14$).

Conclusions: These findings suggest that structured intense exercise training programmes is feasible and effective in improving the physical functioning of patients following kidney transplantation. Given the high risk of cardiovascular events in this group, supervised exercise training might provide a valuable therapy for this population.

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Relationship between physical activity levels and blood pressure in Iranian children

F. Movaseghi^{1*} ■ F. Movaseghi² ■ ¹Islamic Azad University, Sepidan Branch ■ ²Eghlid Health Center

Introduction: Elevated blood pressure (BP) during childhood and adolescence is not so rare and increases the risk of hypertension in adulthood. Physical activity (PA) is considered a key component for the prevention and treatment of hypertension in children and adolescents. Thus, the purpose of our study was to assess the level of PA in Iranian children and its relation to BP levels.

Methods: The study included 100 female students aged 12-14 years who were enrolled on a volunteer basis. All children were subjected to blood pressure and heart rate measurement in the morning during a routine school day. Information of PA was obtained by the physical activity questionnaire for older children (PAQ-C).

Results: Systolic blood pressure ($r = -0.214$, $p = 0.03$) and diastolic blood pressure ($r = -.220$, $p = 0.02$) were inversely associated with physical activity. High physical activity was associated with lower blood pressure. In contrast no significant relationship was observed between physical activity and pulse pressure ($r = -.024$, $p = .812$) and physical activity and heart rate ($r = -.08$, $p = .429$).

Conclusion: higher levels of PA were associated with lower systolic and diastolic BP, in healthy children. As early adolescence is a critical period for the development of physical characteristics factors that determine lifelong physical activity habits, PA should be practiced in everyday life of children.

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Triple G (Girls Get Going): Design of an intervention to foster and promote sport and physical activity among adolescent girls

M. Casey¹ ■ A. Mooney¹ ■ J. Harvey¹ ■ R. Eime^{1,2} ■ A. Telford¹ ■ J. Smyth¹ ■ W. Payne^{1,2*} ■ ¹University of Ballarat ■ ²Victoria University

Introduction: Physical activity (PA) levels, particularly club sport and organised PA, decline during adolescence, especially for females. Inadequate links between school and community settings, and an over-emphasis on skills and competitive sport, are thought to contribute to this decline.

This study aims to investigate the effect of a newly designed school-community links program on the PA level and wellbeing of adolescent girls.

Methodology: The Triple G program methodology was developed during 2010, after consultation with Year 9 girls in eight schools in regional towns/cities across Victoria, in collaboration with state- and local-level representatives of tennis, football (soccer) and the YMCA. During 2011, the program is being trialled in Years 7-9 in the same schools. The program consists of school-based components for each of the three PA types/settings, focused on enjoyment and "game sense" pedagogical principles, followed by community club/centre-based components. Each school-based component consists of six lessons jointly taught by Physical Education teachers and coaches and/or representatives of community clubs/centres. Each student is exposed to two activities – non-competitive active recreation at the YMCA and either tennis or football. Students also complete self-management activities targeting cognitive and behavioural skills. Girls who enrol in the research study proceed into community-based programs after each school-based component. Resources have been developed for schools and clubs/centres, and professional development activities have been undertaken jointly by teachers and sport/club/centre coaches/representatives. The research methodology is a cluster-randomised controlled trial. Eight intervention schools were recruited, randomly selected within constraints of availability of tennis, football and YMCA facilities and personnel. Eight control schools were selected and recruited, matched to intervention schools with regard to community demographic profiles and facilities. Control schools will be provided with all program resources at the conclusion of the study. Baseline, follow-up and process evaluation data are being collected via self-completion participant questionnaires, school and community facilities audits, lesson evaluation forms, teacher round-table discussions, attendance records, and post-intervention interviews with selected program deliverers and participants. Participant surveys and facilities audits will also be conducted in control schools/communities.

Results: As of March 2011, 969 completed baseline student questionnaires have been returned, 618 from seven of eight intervention schools and 351 from seven of eight control schools. Baseline and process data will be analysed during 2011.

Conclusion: This innovative study is applying new strategies to the problem of declining PA in adolescent girls. Participant uptake has satisfied design targets. Preliminary baseline and process findings will be presented.

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Psychological perspectives of development in and through community sport: The future in youth Soccer project, Baucau, East Timor

M. Pink^{1*} ■ J. Butcher¹ ■ C. Peters¹ ■ ¹Australian Catholic University

Introduction: The people of Baucau are recovering from the struggles of East Timor's fight for independence. The post-conflict environment is one of poverty, lack of infrastructure and the debilitating effects of over four centuries of foreign control and a recent "aid culture". For the large youth population, the social landscape has led to disengagement from the broader community. Many of the youth are involved in Martial arts gangs that are territorial and often result in violence that feeds disengagement. The Future in Youth Soccer project (FIY) was a one month program in 2010 that aimed to engage the broader youth community and enhance their social and sporting capacity. The focus of this paper was to provide an analysis of the influence of the program from a psychological perspective.

Methods: structured focus groups were conducted at the completion of the program for the participants, Timorese coaches and Australian coaches. Inductive content analysis was used to identify a hierarchy of themes and relationships. Appropriate psychological theory was used to interpret these themes.

Results: The establishment of the FIY "space" was dependant on the development of positive relationships. The youth were able to develop both in their sporting capacity (in sport) and socially through the sporting environment (through sport). An interrelated process between relationships and motivations, learning and capability and issues of sustainability were identified in creating and maintaining the FIY space. Relatedness and competence emerged as key issues and outcomes of FIY. Recommendations for future FIY projects and research avenues are discussed.

Conclusion: The results identify that physical activity promotion through sport can have psycho-social influences on the participants as well as physical health and skill development in a disadvantaged community. The research highlights that physical activity through organised sport has benefits for the participating community beyond physiological measures. The interrelated nature of relationships, motivations, learning, capability and issues of sustainability should be considered when establishing a program of this nature.

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Preliminary physical activity findings from a home-based Physical Activity and Nutrition Program for Seniors (PANS)

L. Burke^{1,2} ▪ J. Jancey^{1,2} ▪ P. Howat^{1,2} ▪ A. Lee^{1,2} ▪ D. Kerr^{1,2} ▪ T. Shilton^{3,1*} ▪ A. Hills⁴ ▪ A. Anderson⁵

¹Curtin University, School of Public Health ▪ ²Curtin University, Centre for Behavioural Research in Cancer Control ▪ ³National Heart Foundation

⁴Queensland University of Technology, Institute of Health and Biomedical Innovation ▪ ⁵University of Dundee, Centre for Public Health Nutrition Research

Introduction: Worldwide seniors are a growing segment of the population. Reduced levels of physical activity have contributed to over 60% of older Australians being overweight or obese. Inactive seniors are a difficult group to target and researchers use a variety of approaches to engage them. As the population ages there is an urgent need to develop sound interventions capable of making a positive change to health status with consequent reduction in costs to the health care system. This study aimed to confirm if a low-cost, accessible physical activity and nutrition program could improve levels of physical activity and enhance dietary intake of insufficiently active 60-70 year-olds.

Methodology: The intervention program was designed as a 12-month RCT for older adults of low and medium Socio Economic Status from 60 Perth suburbs. The intervention comprised a specially designed booklet that provided participants with information and promoted dietary and physical activity goal setting. Supplementary materials were an exercise chart, calendar, bi-monthly newsletters, resistance bands and pedometers. Trained group guides provided support for participants. A self-administered questionnaire was completed by control and intervention groups at baseline (pre- intervention), 6-months (post-intervention) and 12-months (6-months post-intervention). Physical activity was measured using The International Physical Activity Questionnaire (IPAQ). A strength exercise question based on recommendations from the American Heart Association was included to ensure the main components of the home-based exercise program were also measured.

Results: There was a significant change in the intervention group's level of physical activity, but no change in the control group. The intervention group results showed a reduction in sitting time and waist to hip ratio measurements and a significant increase in behavioral improvements including participation in strength exercises and walking activity.

Conclusion: The positive results from the PANS program demonstrate that a minimal contact, low-cost and home based physical activity program can influence changes to seniors physical activity. Longer term studies should be implemented to obtain more data on the effectiveness of such interventions. This physical activity and nutrition program offers a unique approach compared to other such programs previously conducted with older people in Australia, as the project was designed to evaluate the effect of combining both physical activity and nutrition to improve the health of seniors. This project provides guidelines for the development, implementation and evaluation of a minimal, home-based tailored physical activity and nutrition intervention program.

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North American medical and health history survey of 2009 Sydney World Masters Games participants

M. DeBeliso¹ ▪ M. Climestein^{2*} ▪ K. Adams³ ▪ J. Walsh² ▪ S. Burke² ▪ I. Heazlewood⁴ ▪ J. Kuttunen⁵ ▪ ¹Southern Utah University, USA ▪ ²Australian Catholic University
³California State University Monterey Bay, USA ▪ ⁴Charles Darwin University ▪ ⁵Arcadia University of Applied Science, Finland

Introduction: World Masters Games athletes have either pursued a physically active lifestyle for an extended period of time or have initiated exercise/sport in later life. Regardless of their motivation(s), this unique cohort of middle- to older-aged adults remains relatively uninvestigated with regards to the incidence of diverse chronic disorders. The purpose of this investigation was to document the different aspects of health of the Sydney 2009 World Masters Games North American participants.

Methodology: An online survey was utilized to investigate three primary areas of interest: participant's demographics, physiological measures of health, and medical health history (diseases and disorders diagnosed by participant's GP/specialist as well as prescribed medications).

Results: A total of 928 participants from Canada and the United States (age 52.6±9.8 yrs, range 27 to 87 yrs) completed the survey, 55% reported having previously competed in the World Masters Games. Top 5 sports in which participants competed were football (25.6%), track/field (15.4%), swimming (8.4%), volleyball (8.2%), and softball (7.8%). A very few (2.5%) reported currently smoking with a current average 65 cigs/wk, 13.6 % were ex-smokers; alcohol consumers (82.0 %) with an average consumption of 4.7 drinks/wk, and 0.6% were ex-drinkers. Top 5 chronic disorders reported by participants were: rheumatoid arthritis or osteoarthritis (10.0%), hypertension (HTN, 9.1%), hyperlipidemia (8.0%), asthma (6.5%), and depression (5.3%). Participants also reported angina (0.9%) and acute myocardial infarction (0.9%). Top 3 operative treatments reported were: knee replacement/repair (12.2%), hernia repair (6.1%) and herniated disc surgery (2.0%). Top 4 Rx'd meds taken by participants were: anti-HTN (6.9%), thyroid hormones (6.6%), hypolipidaemic (6.0%), and meds to increase bone strength (5.9%).

Conclusions: Based upon normative comparisons, the incidence of chronic diseases/disorders reported by North American participants of the 2009 World Masters Games appears to be low for the incidence of HTN, hyperlipidemia, arthritis, asthma, and depression.

M. Climstein^{1*} ■ J. Walsh¹ ■ S. Burke¹ ■ K. Adams² ■ M. DeBeliso³ ■ J. Kuttunen⁴ ■ I. Heazlewood⁵ ■ ¹School of Exercise Science, Australian Catholic University
²California State University Monterey Bay, USA ■ ³Southern Utah University, USA ■ ⁴Oroton Institute, Invalidisaatio Helsinki, Finland ■ ⁵Exercise and Sports Science, Charles Darwin University

Introduction: The World Masters Games (WMG) has the largest number of competitors of any multi-sporting event in the World. Despite high participation in the WMGs since its inception in 1985, there is a lack of scientific data available on WMG competitors. The purpose of this study was to attain demographics on competitors in the 2009 Sydney WMG (SWMG).

Methodologies: A cross-sectional, observational study was completed using an on-line web-based questionnaire (LimeSurvey). The survey consisted of four sections: basic demographics (gender, age, SWMG sport(s) participation, education, occupation, smoking/drinking status), medical history (personal and familial, surgical procedures, Rx'd medications), injury history (type of injury, body part injured) and physiological measures (Ht, Wt, waist, lipid profile, fasting plasma glucose).

Results: (t-test for independent samples between genders, $p < 0.05^*$): A total of 7,210 SWMG participants (25-91yrs, 51.4% males) representing 81 countries and competing in all 28 sports completed the survey (29.4% response rate). Results represent "SWMG cohort"/ "males"/ "females". Age (yrs) 51.6/ 53.7/ 49.4*, Wt (kg) 76.9/ 84.1/ 69.2*, BMI (kg/m²) 25.6/ 26.3/ 25.1*, waist circumference (cm) 85.5/ 89.4/ 80.2*, SBP (mmHg) 120.9/ 124.6/ 117.0*, DBP (mmHg) 74.9/ 77.0/ 72.7*, total cholesterol (mmol/L) 4.47/ 4.46/ 4.48, HDL's (mmol/L) 1.77/ 1.68/ 1.92*, LDL's 2.92/ 2.93/ 2.90, fasting glucose (mmol/L) 5.03/ 5.08/ 4.97. The majority (75.6%) of competitors were non-smokers, and most (83.7%) consumed alcohol. Top 5 chronic diseases/disorders were HTN (9.5%), OA/RA (8.9%), asthma (8.7%), dyslipidemia (6.4%) and depression (6.3%). The top 4 prescribed medications were anti-HTN (7.4%), hypolipidemic (4.9%), NSAID's (4.6%), and bronchodilators (4.0%). Physiological categorical results: BMI's (underweight 1.0%/ normal 48.4%/ overweight 37.4%/ obese 12.7%), waist circumference's (optimal 66.8%, gender specific), SBP's (normotensive 30.4%, Pre-HTN 13.1%, HTN 13.1%), DBP's (normotensive 56.0%, Pre-HTN 37.4%, HTN 6.5%), total cholesterol's at target (85.5%), HDL's at target (95.0%), LDL's at target (18.9%), fasting plasma glucose's at target (87.2%).

Conclusions: This data represents the first collection of main outcomes of demographics (basic, personal/familial and physiological) in WMG competitors. SWMG competitors represented a diverse population which appeared, on average, to have a lower incidence of some chronic diseases and disorders (obesity, arthritis, HTN, dyslipidemia and diabetes) and favorable physiological parameters (BMI, SBP, DBP, cholesterol, HDL's, glucose) as compared to the Australian general population. Furthermore, SWMG female competitors, on average, appeared to be healthier with regard to physiological demographics as compared to SWMG male competitors.

M. Climstein^{1*} ■ J. Walsh¹ ■ J. Best² ■ K. Adams³ ■ M. DeBeliso⁴ ■ S. Burke¹ ■ J. Kettunen⁵ ■ I. Heazlewood⁶ ■ ¹Australian Catholic University ■ ²School of Medical Science, University of NSW ■ ³California State University, USA ■ ⁴Southern Utah University, USA ■ ⁵Arcada University of Applied Sciences, Finland ■ ⁶Charles Darwin University

Introduction: Recent investigations into the health of retired National Football League (NFL) players have identified increased cardiac risk factors/premature cardiovascular disease, cardiometabolic risk and type 2 diabetes. Surprisingly, there is no data available investigating the health of veteran rugby union players. The Golden Oldies World Rugby Festival (GORF) is held every two years for veteran rugby union players over the age of 35 years. Rugby union is one of the most popular team sports in Australia and New Zealand, with competitors similar in stature and physical abilities to NFL players. Therefore the purpose of this study was to investigate the medical and health demographics of competitors (aged 35+) of the 2010 GORF.

Methodologies: A cross-sectional, observational study was completed using an on-line web-based questionnaire (LimeSurvey). The survey consisted of four sections. These results pertain to medical history (chronic diseases/disorders, prescribed medications) and physiological measures (Ht, Wt, waist, lipid profile, fasting plasma glucose) sections.

Results: A total of 254 participants (35-78yrs, X = 51.2yrs) completed the survey. Data analysis was completed using independent (<50 yrs (n=102) versus >50 yrs (n=152)) and one sample (between populations) t-tests. Several measures such as body mass and cigarettes/wk differed significantly (all $p < 0.05$) between <50 yrs and >50 yrs. Results were: BMI (30.4 vs 29.6Kg/m², NS), waist circumference (86.4 vs 92.3cm, $p < 0.05$), SBP 122.2 vs 125.2mmHg, NS) and DBP (78.6 vs 77.1mmHg, NS). There were no significant differences between groups for cholesterol panel (Total cholesterol (4.6 vs 5.0mmol/L), HDL-cholesterol (1.3 vs 1.5mmol/L), LDL-cholesterol (2.1 vs 2.8mmol/L), triglycerides (2.8 vs 2.4mmol/L)) or blood glucose (5.5 vs 5.9mmol/L). As a cohort, GORF competitors had the following incidence of chronic disorders (top 5): hypertension (15.3%), arthritis (OA/RA, 8.6%), asthma (8.6%), hypercholesterolemia (7.8%), diabetes (all types, 6.3%). When compared to the Australian general population (Australian Bureau of Statistics data, n=15,779), GORF competitors had significantly higher incidence of anxiety ($p < 0.01$), depression ($p < 0.01$), diabetes ($p < 0.05$) and hypertension ($p < 0.01$). Collectively, GORF competitors were taking the following prescribed medications (top 5): anti-hypertensive (12.5%), non-steroidal anti-inflammatory (6.3%), anti-diabetic (insulin or oral, 5.1%), anti-coagulant (4.3%) and bronchodilators (2.7%).

Conclusions: This data represents the first collection of main outcomes of medical and health demographics in GORF competitors. GORF competitors presented with increased cardiovascular and metabolic risk, similar to that found in retired NFL linemen however, there was little difference between the two groups (<50 yrs versus >50 yrs). Preventative measures and further investigation in this cohort are warranted.

J. Walsh¹ ■ M. Climstein^{1*} ■ I. Heazlewood² ■ S. Burke¹ ■ K. Adams³ ■ M. DeBeliso⁴ ■ J. Kettunen⁵¹Australian Catholic University ■ ²Charles Darwin University ■ ³California State University, USA ■ ⁴Southern Utah University, USA ■ ⁵Arcada University of Applied Sciences, Finland

Introduction: Growing evidence suggests exercise across the lifespan improves health and decreases the incidence of various diseases and disorders. Masters athletes may display an age related increase to the range of pathologies present in this population as well as physiological changes due to the aging process. There are therefore possibilities of reduced physical activity levels, reduced metabolism and thus elevated BMI in this under-investigated population. The hypothesis of this study was due to increased physical activity, there would be lower obesity as determined by BMI (≥ 30) in football code athletes at the Sydney WMG as compared to the Australian population.

Methodology: Electronic invitations to an online demographics survey were sent to Sydney WMG athletes who provided a valid email address. BMI was derived using the participants' heights and body masses.

Results: The Sydney WMG featured 28,089 competitors representing 95 countries and competing in competing in 28 sports. Of the athletes representing Australia and competing in one of the three football codes, a total of 535 masters athletes completed the online survey tool. Of the respondents of this sub-sample, 362 (67.7%) indicated that they were registered for soccer, 61 (11.4%) rugby union and 114 (21.3%) touch football. Two of the soccer masters athletes, included in the study also competed in touch football. 344 (64%) of the participants were male, whilst 191 (36%) were female. The ages ranged from 31 to 72 years with a mean of 47.4 years. 50 (14.5%) males and 13 (7.3%) females had a BMI ≥ 30 , indicating that obesity was a health risk factor for 11.8% of the sample. Overall, our results indicate significantly ($\chi^2 = 36.9$, $p < 0.001$) reduced obesity in the athletes compared to Australian Bureau of Statistics (ABS) National Health Survey figures. Only 0.6% of the sub-sample were underweight, which is significantly ($\chi^2 = 5.5$, $p < 0.05$) less than the corresponding proportion in ABS data.

Discussion: BMI profile for Sydney WMG athletes shows significant differences in comparison to ABS NHS figures, though causation must also be considered. Namely does WMG football comparatively reduced BMI plus lower associated health risks and do individuals with lower BMI's preferentially participate in masters sport.

Conclusion: For football athletes at the Sydney WMG, it is shown that a key index of health, namely obesity as a health risk factor, is far lower in incidence for both males and females when comparison is made to open age Australians.

K. Adams¹ ■ M. DeBeliso² ■ J. Walsh³ ■ S. Burke³ ■ I. Heazlewood⁴ ■ J. Kettunen⁵ ■ M. Climstein^{3*}¹California State University Monterey Bay, USA ■ ²Southern Utah University, USA ■ ³Australian Catholic University ■ ⁴Charles Darwin University ■ ⁵Arcada University, Finland

Introduction: The World Masters Games are based on a philosophy that promotes and encourages mature athletes to compete in sport throughout life and thereby improve fitness, socialize, improve friendship and understanding across cultures, and set an example for all related to successful aging. World Masters Games athletes have either pursued a sport for an extended period of time or have initiated a sport in later life. It is important to understand why this unique cohort of masters athletes participates in sport. The purpose of this study was to investigate competitor's motivations for participation in their sport at the World Masters Games.

Methodology: Data was collected at the Sydney 2009 World Masters Games using an online survey. Participants were asked to rate on a scale of 1 thru 7 the importance of three reasons to participate in their sport (1 = item is not a reason, 7 = item is a very important reason). The reasons were: (1) to compete with others, (2) to socialize with other participants, and (3) to improve my health.

Results: A total of 8,070 participants responded (response rate = 29%) with a mean age of 52 yrs (range 25 to 91yrs). Competitors from 83 countries completed the survey, with 25% reported having previously competed in the World Masters Games. On a scale of 1-7 results for reasons to participate were (mean (SD)): to compete with others = 5.2 (1.7); to socialize with other participants = 5.7 (1.5); and to improve my health = 5.6 (1.7). ANOVA revealed a significant difference ($p = 0.000$) in reasons to participate. Post hoc analysis showed significant differences between all three reasons ($p = 0.000$), with socializing with other participants being the strongest reason, followed by to improve my health. Competition with others was the weakest reason for participation.

Conclusions: Results show that socialization was the most important personal motivation for sport participation in the 2009 Sydney World Masters games. And, that competition is a less important motivator to masters level participants than either health or socialization. Based on these findings, those promoting sport participation in older adults may benefit by highlighting the social aspects of involvement.

C. McLellan¹ ■ D. Lovell² ■ D. Ferris¹ ■ M. Climstein^{1*}¹Faculty of Health Sciences and Medicine, Bond University ■ ²School of Health and Sport Sciences, University of the Sunshine Coast

The purpose of the research: The aim of the present study was to identify neuromuscular and biochemical markers of fatigue following elite Rugby League match-play.

Methodology: Seventeen elite male Rugby League players were monitored for a single match. Peak rate of force development (PRFD), peak power (PP) and peak force (PF) were measured during a countermovement jump (CMJ) on a force plate pre and post match-play. Blood samples were collected 24 hr pre-match, 30 min pre-match, 30 min post-match and then at 24 hr intervals for a period of 120 hr to determine plasma creatine kinase concentration ([CK]).

Results: There were significant ($p < 0.05$) reductions in PRFD and PP up to 24 hr post-match with PF significantly ($p < 0.05$) reduced 30 min post-match. Plasma [CK] significantly ($p < 0.05$) increased 30 min post-match with a peak [CK] occurring 24 hr post-match. Plasma [CK] remained significantly ($p < 0.05$) elevated for at least 120 hr post-match in comparison to 24 hr pre-match levels. There were significant correlations between plasma [CK] and PRFD 30 min post-match ($p < 0.05$, $r = -0.64$) and 24 hr post-match ($p < 0.05$, $r = -0.58$) compared to 30 min pre-match values.

Conclusions: Results demonstrate that neuromuscular function is compromised for up to 48 hr following elite Rugby League match-play. Plasma [CK] remained elevated despite 120 hr recovery indicating that damage to muscle tissue following Rugby League match-play may persist for at least 5 days post-match. These data indicate that while a return to pre-match neuromuscular function is evident on day 3 post-match, training load should however be monitored for at least 5 days post-match to achieve full recovery and optimise subsequent performance following skeletal muscle damage sustained during elite Rugby League match-play.

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Compulsive exercising: Validating a measurement construct

E. Aidman^{1,2*} ■ A. Zoontjens³ ■ ¹DSTO ■ ²Kingston University London, United Kingdom ■ ³University of Adelaide

The growing prevalence of compulsive exercising among those who participate in sports and fitness has highlighted the question of what it is exactly that differentiate between a healthy commitment to exercising and harmful dependence on it. Answering it has been a challenge compounded by the lack of conceptual clarity about constructs involved and doubtful quality of measurement instruments available. We revised one of the leading instruments, the Exercise Dependence Scale (EDS, Hausenblas & Downs, 2002) and examined reliability and construct validity of the resulting 19-item tool, the Exercise Habits Survey (EHS). Like EDS, the contents of EHS is DSM-IV based, covering all seven elements of dependence (withdrawal, tolerance, continuance, lack of control, imbalance, time and intention effects). EHS showed impressive internal consistency ($\alpha=.88$) and temporal stability (re-test $r(81)=.82$). Construct validity of EHS was supported by its DSM-IV – compatible factorial structure ($N=189$) and theoretically predictable pattern of associations between EHS total score and measures of disordered eating, depression, perfectionism, self-esteem and obsessive-compulsiveness. Obligatory exercise was not associated as strongly with appearance-related concerns as eating disorders were, suggesting a differentiation of motivational bases for compulsive exercising and eating disorders. Future directions in the convergent and discriminant validation of the new construct are discussed.

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Fifteen minutes of yoga postures or guided meditation in the office can elicit psychological and physiological relaxation

G. Melville¹ ■ D. Chang¹ ■ B. Colagiuri² ■ P. Marshall¹ ■ B. Cheema^{1*} ■ ¹University of Western Sydney ■ ²University of New South Wales

Introduction: Psychological stress in the workplace is an independent risk factor for cardiometabolic diseases and related mortality. This exploratory study compared the effect of acute (15 min) yoga posture and guided meditation practice, performed while seated in the office workspace, on psychological and physiological markers of stress.

Methodology: A within-subjects crossover design was utilized. Each participant completed three conditions, including yoga postures, meditation, and control (usual work), separated by >24hrs. Perceived stress and blood pressure were evaluated before, immediately after, and at 3x 5-min intervals post intervention. Heart rate, respiratory rate and parameters of heart rate variability (HRV) were collected continuously, before, during and post intervention. Twenty adults (39.6 ± 9.5 yr) completed the study.

Results: The yoga and meditation interventions significantly reduced perceived stress versus control. This effect was maintained throughout the 15-min post-intervention period. Yoga postures increased heart rate while meditation reduced heart rate versus control (both $p<0.05$). Respiratory rate was reduced during both yoga and meditation versus control ($p<0.05$). Time and frequency domains of HRV (i.e. SDNN and log-total power) were significantly improved during yoga versus control. Additional HRV outcomes (LF and LF:HF) indicated increased parasympathetic modulation during yoga versus control. Meditation improved HRV outcomes versus control only during the initial 5-minutes of the 15-min intervention period. All physiological parameters generally regressed to baseline during the post intervention period. Blood pressure indicated normotension during the baseline recording in all conditions and did not improve in yoga versus control. Meditation induced a reduction in both systolic and diastolic blood pressure at 5-min post intervention versus control ($p<0.05$).

Conclusions: Yoga postures or meditation performed in the office environment can acutely improve several psychological and physiological parameters associated with the stress response. Use of such practical interventions to mitigate stress in the workplace may reduce the risk of cardiometabolic diseases and enhance job satisfaction, productivity and quality of life.

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Effects of synchronous music use in ultra distance events

M. Curran^{1*} ■ P. Terry¹ ■ ¹University of Southern Queensland

Introduction: Music use during physical activity has been associated with enhanced psychological responses, reduced perceived exertion, improved performance and, to a lesser extent, physiological efficiency. Whether such benefits apply to ultra-distance athletes is unknown. The present study examined effects of music on a range of indices among athletes competing in 24 hr and 48 hr events.

Method: Ten elite ultra-distance walkers and runners (male = 7, female = 3, age range = 39-63 yr.), competing in events in Brisbane, Caboolture and Melbourne, participated in a field experiment. Participants were provided with a 120 min intervention (30 min each of motivational music, neutral music, audio book, silence) pre-loaded onto iPods, to which they listened three times during pre-assigned 6 hr blocks (i.e., hours 6-12, 18-24, 30-36, 42-48). Music tempo was individually synchronized to match stride rate, and motivational qualities of music were rated by each participant using the BMRI-2. Participants were monitored using the BRUMS, FS, RPE, and HR. Lap times were recorded for each participant.

Results: As a group, participants derived a significant performance benefit from synchronous motivational music compared to the other three conditions during the crucial 18-24 hour period ($F_{3,556} = 15.1$, $p < .001$), with each 400 m lap completed faster, on average, by 14 s (v no music, $p = .003$), 18 s (v neutral music, $p < .001$) or 27 s (v audio book, $p < .001$). No group differences in FS, RPE, and HR were found. Individual differences were very apparent, however, with some participants deriving benefits from motivational music and others deriving no benefits or, in some cases, a disadvantage. For example, Participant 7 completed laps 36 s to 62 s faster while listening to motivational music whereas Participant 3 was 18 s to 23 s slower with motivational music compared to the other three conditions.

Conclusions: A performance benefit from listening to synchronous motivational music may accrue for some individuals in ultra-distance events but not for others. The enhanced psychological responses, reduced perceived exertion and improved physiological efficiency found in previous studies were not apparent among ultra-distance athletes in the present study.

J. Fransen^{1*} ■ J. Pion¹ ■ J. Vandendriessche¹ ■ B. Vandorpe¹ ■ R. Vaeyens¹ ■ M. Lenoir¹ ■ R. Philippaerts¹ ■ ¹Ghent University, Department of Movement and Sports Sciences

Introduction: The Developmental Model of Sports Participation proposes two distinct pathways towards reaching an expert level of performance: early specialization and early diversification. This study investigated the effect of sampling various sports and of the amount of time spent in sports on physical fitness and gross motor coordination.

Methods: The basic performance characteristics of 735 boys aged 6-12, divided into three age groups (6-8: n=161, 8-10: n=310, 10-12: 264) were assessed by a test battery containing anthropometrical, physical fitness and coordinative tests. Data on sports participation were obtained through the use of the Flemish Physical Activity Computerized Questionnaire.

Results: In the eldest age group, (M)ANCOVA showed better strength, speed, agility, endurance and gross motor coordination ($p < 0.05$) for boys participating in various sports versus in a single sport while an effect of many hours spent in sports was apparent from the youngest age group on. Also in the eldest group, a post-hoc analysis revealed that boys spending many hours in various sports were the strongest ($p < 0.05$) and possessed the best gross motor coordination ($p < 0.001$).

Discussion: A slow and rapid performance improvement is associated with early diversification and early specialization respectively. Therefore, the importance of spending many hours in various sports towards the development of physical fitness and gross motor coordination was highlighted in this study.

L. Fraser^{1*} ■ G. Fogarty² ■ ¹University of the Sunshine Coast ■ ²University of Southern Queensland

Introduction: Career planning and development is a particularly salient issue in regards to elite athletes. Although many of these individuals may devote much of their lives to their dream of becoming a professional athlete, there are limited long-term opportunities to build a career in this area. It is therefore important that athletes continue to actively explore a variety of vocational options. Engagement in career-planning activities has also been found to have positive repercussions for athletes in relation to psychosocial development and performance. Studies have revealed, however, that the physical and psychological commitment required to be successful in elite sport can restrict athletes from exploring these options. Individuals with a strong athletic identity have been found to be less likely to plan for their future vocations before retirement, with young male athletes involved in high-revenue sports, such as football, golf, and tennis, identified as being more likely to avoid such planning. High levels of athletic identity have also been shown to be significantly related to particular types of career decision-making difficulties experienced by younger athletes. These difficulties include general indecisiveness, and a lack of knowledge about occupations. The current study aimed to explore the career decision-making difficulties of Australian elite athletes from different age groups (teenage/emerging adults/adults) and sports, and the relationship these difficulties may share with their levels of athletic identity. The types of career choices being considered by these athletes were also explored.

Method: The participants in the study were 908 athletes on sporting scholarships linked with the Australian Institute of Sport. Participants were surveyed using the Athletic Identity Measurement Scale and the Career Decision Difficulties Questionnaire.

Results and Discussion: Career decision-making difficulties were found to decrease significantly with age. The strongest relationships between athletic identity levels and career decision-making difficulties were found to occur for athletes aged between 18-25 years. Only a small percentage of athletes identified the occupation of being a "Professional athlete" as the only career option they were willing to consider in the future. These and other findings will be discussed.

A. Gupta^{1,2,3*} ■ C. Purdam¹ ■ J. Cook⁴ ■ G. Allison^{5,6}

¹Australian Institute of Sport ■ ²La Trobe University ■ ³University of Western Sydney ■ ⁴Monash University ■ ⁵Curtin University ■ ⁶Royal Perth Hospital

Introduction: The purpose of this research was to evaluate and compare the mechanical properties of patellar tendons with and without tendinopathy in elite level jumping athletes.

Methods: Real-time ultrasound imaging of the patellar tendon (PT) and maximal voluntary isometric contraction force of the knee extensors, were synchronously recorded for the left and right sides of 40 elite male athletes participating in volleyball (n = 23, 18.9 years of age, range 16-28, 200cm in height, range 180-213 and 91kg in weight, range 71-108) and basketball (n= 17, 17.0 years of age, range 16-19, 196cm in height, range 178-212 and 88kg in weight, range 66-115) at the Australian Institute of Sport. All participants volunteered, providing written and informed consent. Patellar tendon mechanical properties were compared between individual players with tendinopathy to the mean and 95% CI of the volleyball and basketball groups that each included data from players with normal and healthy patellar tendons bilaterally.

Results: Of the 40 participants, 9 had patellar tendinopathy. Eight athletes had patellar tendinopathy on the left and 3 of these 8 participants also had patellar tendinopathy on the right side. Only one player had unilateral right sided imaging tendinopathy (non-painful). There were no systematic differences in PT mechanical properties between athletes with and without patellar tendinopathy with the values for strain, stiffness, cross-sectional-area (CSA), stress and elastic modulus generally with the 95%CI of the group means for volleyball and basketball player groups that had normal patellar tendons bilaterally.

Discussion: Proportionately, more tendons with tendinopathy had strain that was greater or less than the 95% CI for the comparative group with normal patellar tendons in both sporting groups. All other mechanical properties were similar between patellar tendons with and without tendinopathy. Elastic modulus (ratio of force normalised to CSA and PT deformation normalised to PT length at rest) describes the loading behaviour of the PT. This value for tendons with tendinopathy, remained within one standard deviation from the mean of the comparative group with normal tendons bilaterally. This investigation provides the impetus for an investigation of differences in PT strain that may identify an increased risk of patellar tendinopathy; however, the current study suggests that patellar tendons with tendinopathy have a similar ability to withstand tensile force compared to tendons without tendinopathy.

J. Han^{1,2*} ■ G. Waddington¹ ■ J. Anson³ ■ R. Adams⁴ ■ ¹Faculty of Health Sciences, University of Canberra ■ ²Physical Education and Coaching Department, Shanghai University of Sport, Shanghai, China ■ ³Faculty of Applied Sciences, University of Canberra ■ ⁴Faculty of Health Sciences, University of Sydney

Background: To control precise and dynamic movements of the hand and fingers the brain relies on proprioceptive information regarding the position of the fingertips. In sports from shooting to climbing, finger tip discrimination varies greatly from precise single handed pinch movements against elastic resistance, such as a gun trigger, to different, simultaneous two handed pinch movements, as when climbing. While not found to be significant in upper limb movement discrimination, the role of elastic resistance in fine movement control is unknown. It is also unknown if different fine movement tasks, performed concurrently, hinder, enhance or have no effect on performance. Some authors have suggested for some tasks there is a limit to an individual's total processing capacity and performance deteriorates with serial rather than parallel processing.

Methods and Measures: Eight right handed (4F, 4M) and 6 left handed (4F, 2M) participants were tested with a purpose built finger Active Movement Extent Discrimination Apparatus (AMEDA). Handedness was determined by the Edinburgh Handedness Test. For each test condition, participants undertook 50 trials (10 for each of 5 different displacements) presented at random. The different conditions were: with and without elastic resistance, using the dominant and non-dominant hands separately, and with two hands simultaneously undertaking the same or different discrimination displacements. Paired two-sample t-tests, with statistical significance at $p < 0.05$, were conducted on the discrimination score to test for the conditions of with and without elastic resistance, using the dominant and non-dominant hands separately. A 5×2 factorial analysis between subjects repeated measures ANOVA was conducted on the discrimination score to test for 5 different task performances between handedness.

Results: Pinch movement discrimination was not affected by elastic resistance ($p > 0.05$). Non-dominant hands showed significantly better pinch discrimination than dominant ($p < 0.05$). Two hands undertaking the same discrimination task simultaneously were significantly better than using one hand only ($p < 0.001$). In contrast, two hands simultaneously undertaking different pinch tasks were significantly worse ($p < 0.001$) than when either hand alone was used.

Conclusion: Finger pinch discrimination, as with the upper limb, is unaffected by elastic resistance. Better pinch movement discrimination by the non-dominant hand supports the current view of hemisphere predominance in movement control. Two identical, simultaneous movement discrimination tasks may be processed in parallel and enhance each other; in contrast, two different simultaneous discrimination tasks exceed motor attention capacity and may be processed in serial.

K. Kaneda^{1,2*} ■ Y. Ohgi¹ ■ B. Burkett² ■ ¹Keio University, Japan ■ ²University of the Sunshine Coast

Introduction: There are many activity monitors applying not only for walking and/or running but also for many kinds of life activities. For future developing of the sophisticated activity monitor for water exercise, we need a classification function of the exercise forms of our water exercise.

Purpose: The aim of this study was to discuss about attachment position of the accelerometer for classifying exercise forms of water exercise.

Methods: Fifteen males (age = 28.4 ± 7.1 yr, height = 173.1 ± 4.8 cm, weight = 71.7 ± 7.2 kg and %fat = 16.5 ± 5.1 %) conducted simple exercise forms of water exercise such as forward walking, backward walking, side walking (right and left side), jogging and deep-water running at 1.1 m depth pool. The subjects walked in the swimming pool about 30 second, 2 times in each exercise form with attached 3-axis accelerometer on occipital region of head and chest. Accelerometer data in 20 second were taken out from total exercise duration and analyzed by neural network model using a cross-validation procedure for classifying each exercise form. The input variables were mean, variance and skewness values of each axis acceleration.

Results: Using the chest acceleration data as input variables, the percentage of correct classification was much higher than that of head acceleration. In side walking, almost half data of right side was miss-classified as left side, it was similar as for data of left side.

Discussion and Conclusions: The accelerometer should be attached on chest for monitoring water exercise. When the accelerometer is attached on head, there are artifacts such as the head movement to look at the ground. The basic head position is always not changing by exercise forms because of equilibrium sense, it is hard to extract the feature from acceleration data. The disadvantage of attaching accelerometer on chest is that the accelerometer sometimes submerges during water exercise, it makes real time monitoring much hard task. It would be hard to classify side walking to right or left side. To improve the accuracy of the prediction, we need more consideration about the input variables. There are more exercises styles in water exercise other than simple exercise forms adopted in this study. Using chest acceleration and the neural network for the classification of the water exercise considerably worked well in this study. For the future research, authors should examine another water exercises for applying actual water exercise scene.

J. Berry¹ ■ D. Kennedy^{2,3*} ■ C. Hosford⁴

¹Northland Community and Technical College ■ ²Neuroscience Research Australia ■ ³University of New South Wales ■ ⁴University of North Dakota, USA

Introduction There are a limited number of studies that have investigated the incidence of injuries among collegiate female hockey players sustained in practice or during competition. The purpose of this study was to investigate the incidence, distribution, and types of musculoskeletal injuries sustained during the 2009-2010 season by NCAA Division I female hockey players.

Methods: A link to an online survey was emailed to the head coach for all NCAA Division I Women's Hockey programs at the end of the 2009-2010 season with directions to forward the link onto their team's athletes. The survey was completed by 68 subjects and included questions regarding demographics and injury history during the season. Pearson correlations were used to determine significance between variables.

Results: During the 2009-2010 season 62 subjects competed in 1872 games and sustained 80 injuries (.043 injuries/game). Of Injuries sustained during competition, 44 resulted in medical treatment (.024 injuries/game). A significant and positive relationship was found between subject age and injury incidence during practice ($r^2 = .097$, $p = .01$), but a significant relationship was not found during competition ($r^2 = .024$, $p = .23$). No significance was found among subjects' height or body mass index with injuries sustained during practice ($r^2 = .007$, $p = .49$; and $r^2 = .0006$, $p = .84$, respectively) or competition ($r^2 = .012$, $p = .40$; and $r^2 = .036$, $p = .14$, respectively), but significant and positive relationships were found between subjects' weight and injuries during competition ($r^2 = .072$, $p = .035$) and those injuries requiring medical attention ($r^2 = .105$, $p = .01$). Additionally, a positive but underpowered trend associating BMI to competition injuries requiring medical attention was noted ($r^2 = .059$, $p = .058$, power $\approx .48$).

Conclusions: Overall, injury rates per game were higher than previous studies. Future studies with more subjects across more than one season may be necessary to determine if injury rates are rising in Women's NCAA Division I Hockey and if there is a significant association between weight/BMI and more severe injuries.

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Differences in power production and fatigue during two types of Wingate tests

D. Kennedy^{1,2*} ■ R. Roberts^{3,4} ■ M. Zuhl⁴ ■ J. Beam⁴ ■ R. Salgado⁴ ■ H. Sheng⁴ ■ G. Sierra⁴ ■ A. Majumdar⁴

¹Neuroscience Research Australia ■ ²University of New South Wales ■ ³Charles Sturt University ■ ⁴University of New Mexico

Introduction: The purpose of this study was to examine the differences between two types of Wingate Anaerobic Test (WAnT) protocols by measuring force, power, and fatigue.

Methods: 19 subjects performed a 30s standard WAnT and Modified WAnT on a mechanically braked cycle ergometer. A 30min rest period separated each trial. Standard WAnT: Subjects increased pedal cadence to maximal revolutions over 5 seconds at which time resistance was increased to 7.5% and 9.1% for females and males respectively. Modified WAnT: Subjects completed a 30s bout following a 5s count down in a static position with the same respective resistance as the Standard WAnT already loaded.

Results: Mean Peak Power for the traditional test was 21% higher than for the static test (995.72 ± 302.83 , 711.31 ± 190.52 ; $p < 0.0001$ for traditional and static tests, respectively) suggesting that the traditional test overestimates peak power. Fatigue Ratios calculated for the two types of tests revealed a significant difference with the traditional test again overestimating the amount of fatigue by 42% ($59\% \pm 8.6\%$ and $34\% \pm 10\%$; $p = 0.006$ for traditional and static tests respectively). During the static test, the relationship between peak power and time to peak power was modest ($r = 0.40$). Additionally correlations between the duration from peak power to the end of the test to each of the rate and velocity of fatigue was also variable ($r = 0.31$ and $r = 0.14$ for rate and velocity respectively).

Conclusion: The traditional protocol for the WAnT appears to overestimate both peak power and the fatigue ratio, which may be a less accurate measure of high intensity exercise performance/capacity than using a static start protocol. The time to peak power and cadence at peak power variables of the static protocol may also have determinants directly linked to muscle motor unit proportions.

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Assessment of umpire perceptual and decision-making skill in Australian Football

P. Larkin^{1*} ■ J. Berry¹ ■ B. Dawson² ■ ¹University of Ballarat ■ ²University of Western Australia

Introduction: Australian Football (AF) is a complex team sport given the game speed, the number of athletes, and the combative nature of contests. Consequently, unique perceptual and decision-making demands are placed on the umpires to adjudicate and make 'correct' decisions. This study sought to validate the use of a video-based protocol for the assessment of domain-specific perceptual and decision-making skill for AF umpires. The main purpose of the study was to investigate the presence of any perceptual/decision-making differences between AF umpires across two distinct skill levels (national and state leagues). In addition, the study investigated whether AF umpires and AF athletes (national league) differ in the way they perceive the same game-play information.

Method: Video clips of specific AFL game-play lasting approximately 8 seconds were adapted for the video-based protocol which consisted of three tasks: 1) 'Infringement Identification' evaluated the umpire's ability to correctly identify rule infringements from the scenarios presented; 2) 'Pattern Recall' assessed the ability to recall the on-ground player locations from game-play information presented; and 3) 'Play Prediction' examined the ability to predict the next play outcome from the game-play information presented.

Results: Participants included elite umpires (AFL $n = 15$; mean \pm SD age = 32.1 ± 3.1 y; 81 ± 67 AFL games), sub-elite umpires (WAFL $n = 23$; 23.1 ± 4.3 y; 46 ± 57 WAFL games; SANFL $n = 13$; 31.5 ± 6.1 y; 156 ± 121 SANFL games) and elite athletes (AFL $n = 23$). Significant between group differences were found on the infringement identification and pattern recall tasks. The elite umpires performed significantly better than the sub-elite umpires on the infringement identification task (WAFL: $p = 0.027$; SANFL: $p = 0.004$). The athletes performed significantly better than both umpire skill groups on the pattern recall task (elite umpires $p < 0.001$; Sub-elite umpires $p < 0.001$). There was no significant difference between groups on the play prediction task.

Conclusion: The elite umpires demonstrated an increased ability, compared to the sub-elite umpires, to correctly interpret the perceptual information which leads to accurate infringement decisions. The results also indicated that elite athletes perceive structured patterns within game-play information significantly better than an umpire cohort. This confirms that umpires and athletes perceive the same game-play information in skill-specific ways. This study validates the use of a video-based testing protocol for the assessment of umpire decision-making skill in AF. The findings demonstrate the potential for video-based testing to be utilised for the development of umpire skill benchmarks, ongoing assessment and monitoring of performance, and talent identification initiatives.

179 Video-based training to improve umpire decision-making

P. Larkin^{1*} ■ J. Berry¹ ■ C. Mesagno¹ ■ M. Spittle² ■ ¹University of Ballarat ■ ²Deakin University

Introduction: Umpires are responsible for maintaining the flow, control and safety of a game by applying the laws of the game in a fair and consistent manner. Australian Football (AF) is arguably the most difficult football game to adjudicate, given the large number of players on the field ($n=36$) combined with the physically combative nature and hectic speed of the game. This dynamic game environment is visually complex requiring umpires to utilise refined perceptual-cognitive skills to make correct and timely decisions. While it is accepted better skilled umpires progress to more elite levels of competition, minimal research has been conducted on the perceptual and decision-making skills of umpires, and whether these skills can be effectively trained. The aim of this investigation was to examine whether a 12-week video-based training program would improve AF umpire's decision-making skill. **Method:** Sub-elite AF umpires ($n=52$; mean \pm SD age= 33 ± 12 y; years umpired 10.5 ± 8.2 y) from metropolitan and regional Victorian division one football competitions were allocated to one of two groups; intervention ($n=21$), or control ($n=31$). The intervention group completed a 12 week video-based training program in addition to normal training procedures, whereas the control group completed no additional training. Intervention training sessions contained video clips of player contest scenarios, where participants applied the rules of the game to correctly identify infringements from the presented scenarios. Participants were assessed by an 80 clip video-based decision-making test on three occasions; pre and post intervention, and following a retention period.

Results: A one-way ANOVA illustrated a significant difference between the percentage improvement, from Test 1 to Test 3, for the intervention and control groups, ($F(1,50)= 4.933$, $p= 0.031$). The effect size of this change was calculated at 0.299. Descriptive statistics showed the intervention group improved 8.18% (SD = ± 13.9) compared to the control groups 0.19% (SD = ± 11.87) from Test 1 to Test 3.

Conclusion: Results showed that umpire decision-making skill was improved following a 12 week video-based decision-making training intervention. This study enhances the current knowledge regarding video as a valid training tool for the development and assessment of decision-making skills of Australian Football umpires. The results also demonstrate the efficacy of video-based programs to assess and monitor performance, while enhancing decision-making skills within Australian Football.

180 Acute muscle activation and fatigue following the rest-pause resistance exercise method

P. Marshall^{1*} ■ ¹University of Western Sydney

There is no consensus on how to best manipulate resistance training variables in an acute session. One of the primary goals of an acute resistance exercise session is to facilitate high threshold motor unit recruitment, according to Henneman's well documented size principle. A resistance exercise technique with no scientific evidence investigating its acute effects is the rest-pause method. This method involves an initial failure set followed by subsequent sets with very short (i.e. 20s) inter-set rest intervals. This study compared acute fatigue and muscle recruitment patterns between the rest-pause method, and comparable volumes of exercise that did not involve failure, and varied inter-set rest intervals. Fourteen resistance trained males were randomly assigned to one of three sessions. Each session was 20 squat repetitions performed at 80% of a 1-repetition maximum. Protocol A; 5 sets x 4 repetitions with 3 min rest intervals, Protocol B; 5 sets x 4 repetitions with 20s rest intervals, and the rest-pause method. Muscle activation (surface electromyography; EMG) was measured from several leg and hip muscles before, during, and after each protocol. Maximal squat force, and rate of force development (RFD) were measured pre, post, and 5 minutes post each protocol. There were no between group differences for changes in maximal force or RFD. Maximal force was reduced from pre immediately post each session ($p<0.05$). Maximal force 5 minutes post was the same as pre. Muscle activation for all muscles measured during the squat repetitions significantly increased during the rest-pause method compared to protocols A and B ($p<0.05$). There was no change in muscle activation for protocol A. While an advanced training protocol that should only be recommended for resistance trained individuals, the rest-pause method was the most effective protocol for eliciting the greatest change in muscle activation. With no between protocol effects for measures of fatigue, it appears that the rest-pause method does not have adverse consequences for performance when an appropriate volume (i.e. 20 repetitions) is prescribed. Based on these results we believe the rest-pause method is likely the most efficacious method for a chronic training program.

181 Using the Anterior Line Method (ALM) to find subtalar neutral foot position

A. Najjarine^{1,2,3,4,5,6,7,8*} ■ ¹International College of Biomechanics ■ ²Australian Podiatry Association (NSW) ■ ³ICB Medical ■ ⁴ICB Laboratory ■ ⁵ICB Gait and Posture Clinics
⁶Therapy Learning Centres ■ ⁷Greenoaks Medical centres ■ ⁸Australian National Sports Club

Podiatrists have argued for many years whether subtalar joint neutral exist and what is normal position. Most podiatrist are trained in the talonavicular method (TNM), malleolar folds techniques, bisection of the calcaneus and lower tibia technique, talonavicular drop technique and others. The Foot Posture Index (FPI) is a great method, bringing all the different techniques. Some practitioners use all the techniques and still having confusion. So, which technique is quick and reliable? Which one should be used? These are some of the questions constantly raised by Podiatrist. A technique known as the ALM has been used in Australia and around the world for the past 10 years. The technique is simple, effective, fast and reliable and repeatable. The technique involves –

- 1: Finding the depressions on either side of the talus head, and mark the points. Mark the centre of these two points and this will give you the centre of the ankle. You can use the medial and lateral malleolar as a reference also, in finding the anterior mid ankle position.
- 2: On the dorsal of the foot mark out the 2nd metatarsal head, join a dotted line to the centre point of the ankle.
- 3: Lastly, mark the apex of the anterior tibial crest (only concentrating on the lower one third of the tibia). Also join a dotted line to the centre point of the ankle.

This presentation evaluates ALM technique with the talonavicular technique and assesses its practical applications, from diagnosing neutral foot alignment to aiding in the casting of the feet.

F. Nameni* ■ H. Poursadra¹ ■ ¹Islamic Azad University, Varamin Phishva Branch

Introduction: Studied have demonstrated that exercise induced considerable physiology change in the innate immune system. The interaction between exercise stress and the immune system provide a unique opportunity to evaluate the role of underlying stress and immune physiological mechanisms. The purpose of the study was to comparison of two types exercise on innate immune.

Materials and Methods: Eighteen active female, healthy volunteers participated in the study. Subjects were assigned in one of two groups: aerobic exercise (n=10)(age :21.6 ±1.71years, height: 161.45 ± 2.71cm.,weight: 57.25±6.99 kg. and $VO_{2,max}$ 34.18 ± 2.ml.kg⁻¹.min⁻¹) and, exhaustion exercise(n=8),(age:24.25 ± 4.30 years, height: 159.81 ± 4.86cm ,weight :54.69±3.82kg.and maximal oxygen consumption $VO_{2,max}$:36.1±3.79 ml.kg⁻¹.min⁻¹). The experimental protocol was approved by the ethics committee and all subjects were informed of the risks and purposes of the study before their written consent was obtained. Blood samples (n = 18) were drawn from the antecubital vein before and immediately after aerobic exercise and exhaustion exercise (Bruce protocol). For cytokines measurement 11ml blood sample was drawn .Plasma was separated from the cells and analysis for IL6 , IL1 and TNF α . Statistical analyses ,tables , graph , means ± M±ME , t test used for measurement TNF α , IL1 and IL6 response (α was set at 0/05).

Results: Means showed the mean plasma concentration of TNF α increased ,IL1 decreased and IL6 no changed after exhaustive exercise and the concentration of TNF α and IL1 decreased and IL6 no changed after endurance exercise .T- test showed changes of TNF α after endurance exercise was but another changes were not significant.

Discussion: The exhaustion exercise is not very intensive or prolonged so, subjects were active and carbohydrate intake was not controlled in the present study and subjects can be assumed to be well loaded. Therefore changes of TNF α , IL1 and IL6 were not significantly. Recent studies show that several cytokines can be detected in plasma during and after strenuous exercise. Endurance physical activity might reduce endothelial cell secretion of al IL1 and TNF α , both induces of an acute phase inflammatory response. More sensitive of kits and specific assays may be due to the fact that cytokines is produced locally and is rapidly cleared from the circulation. Both cross sectional and longitudinal studies support an inverse relationship between inflammatory cytokines and physical activity levels in healthy individual. Studied reported increased plasma TNF α 2 h after completing a 2-5 h run (2 h 30 min) and 1 h after a 5 km race, respectively, but other studies have failed to detect TNF α after exercise. Endurance exercise induces a decrease in the pro-inflammatory cytokines TNF α .In conclusion, regular exercise protects against diseases associated with chronic low-grade systemic inflammation.

F. Nameni* ■ ¹Islamic Azad University, Varamin Phishva Branch

Introduction: Recently, sport immunology has been noticed by many researchers of sport science, physiology, immunology and behaviour sciences. It has been found that there is significant relationship between neuro-hormonal and immune systems. Sport effectively alters hormone level and neural system functions. Findings indicated increase of testosterone and growth hormones level.

Methodology: Since control of all effective factors on variables of the research was not possible, hence it was done in a semi experimental method. Athlete group were with mean age of 23.4±1.4 years, height 166±4.43 cm and weight 61±3.2 Kg and non athlete group with age of 22±2.3 years, height 168±4.15 cm and weight of 63±3.26 Kg were selected. Blood samples were collected from the left hand brachial vein before, immediately after, and 2 h after vibration. For data analysis, the inferential statistic methods such as variance of analysis (ANOVA) with repeated measurements and following test of LSD were used.

Results: One session vibration training has significant effect on the serum testosterone concentration in the athletes and non-athletes girls ($P \leq 0.05$). Serum testosterone concentration in the athlete girls immediately after training and after training showed significant difference compared to the before training, but insignificant 2 h after training compared to immediately after training. Also serum testosterone concentration in the non athlete girls immediately after training showed significant decline compared to the before training, and had significant difference 2 h after training compared to immediately after training. Insignificant difference was noticed between before training and 2 h after training. Conclusion and

Discussion: We found increase of testosterone. One of them is increase of hormone secretion though stimulation of hypothalamus and hypophysis - adrenal. Testosterone - cortisol ratio is an anabolic to catabolic index. Findings of the present study indicated that one session vibration training at 40 Hz frequency causes decrease of testosterone significantly. The reason could be attributed to the nature of vibration, intensity, time or amplitude of vibration performance, further relevant studies are suggested.

F. Nameni* ■ ¹Islamic Azad University, Varamin Phishva Branch

Introduction: Exercise is the strongest stress to which the body is ever exposed .The body response to this stress through a set of physiological changes in its metabolic, hormonal and immunological systems. The purpose of the study was to examine the effect of 2 months endurance trainingon plasma immune cells and humoral responses. The immune system components are cellular or soluble which are splashed from the specific cells and have a particular operation in the particular active conditions.

Methods and Materials: Eighteen active women that were college student, participated in the study. They performed selected endurance training for two months. Before and after training, blood sample were obtained. Data was analyzed using paired sample t - test. Concentration CD4, IgA and CD4 / CD8 increased and CD8 decreased significantly.

Results: Means showed the mean plasma concentration of CD4, IgA and CD4/CD8 increased after 8 weeks exercise, the mean plasma concentration of CD8 decreased and IgA secretion rate did not change significantly after exercise. T-test showed IgA response was not significantly but CD4, CD8 and CD4/CD8 response were significantly ($P \leq 0/05$).

Conclusion: It has been well established that prolonged endurance exercise is associated with muscle cell damage and local inflammation. It has been hypothesized that natural auto antibodies may be used to assist macrophages in disposal of muscle cell breakdown products. It is possible that these antibody leave the circulation to carry out this same function in tissues. It was showed that endurance training may induces changes in lymphocyte subsets and CD8, CD4 function adapted in experimental group. We conclude that endurance training may result in significant alteration in T lymphocyte number, but their actual significant for immunity is seen controversially.

185 The comparison of two types of training on HSP 70

F. Nameni^{1*} ■ ¹Islamic Azad University, Varamin Phishva Branch

Introduction: Excessive exercise will induce DNA damage in peripheral leukocytes. The moderate stress in form of regular exercise/training may have protective effects against exercise-induced DNA damage. Up-regulation of endogenous antioxidant defence systems and complex regulation of repair systems such as heat shock proteins (HSP 70, HSP 27) are seen in response to training and exercise. Up-regulation of antioxidants and modulation of the repair response may be mechanisms by which exercise can beneficially influence our health. Exercise increased body temperature to encourage HSP70 release. The aim of this study was to examine the effect of two types training (endurance and acute) on HSP70 expression.

Methodology: 14 female taking part in the intervention volunteered to give blood samples. Subjects were divided two groups, endurance training: with mean age of 23.1 ± 1.4 years, height 159 ± 4.13 cm and weight 59 ± 1.3 Kg and acute training: with mean age of 21.4 ± 1.8 years, height 161 ± 1.43 cm and weight 57 ± 3.2 Kg. Blood samples were collected from the left hand antecubital vein before and immediately after exercise. Plasma HSP 70 was analyzed. Data are reported as means \pm standard error (SE). Student's paired t test was used to assess differences within groups (baseline and after follow-up).

Results: HSP70 expressions were measured before and after one bout endurance and acute training. Endurance and acute training increased significantly HSP70. These findings demonstrate that prolonged and exhaustion training can induce enhancement of HSP70 expression.

Conclusion and Discussion: To conclude, the metabolic changes caused by exercise are similar to induce stress protein synthesis. Physical exercise can elevate core temperature and muscle temperatures. HSP70 could provide a vital link in the mechanism of exercise-induced mitochondrial biogenesis. It is possible the HSP 70 response to exercise in relation to the tissue assayed (skeletal muscle, lymphocyte, venous, arterial serum). The expression pattern of HSP70 due to training status may be attributed to adaptive mechanisms. The differences observed when HSP70 in the present study may be related to the mode of exercise and the amount of protein damage associated with the exercise.

186 Kinematical measurement of the sporting leg prosthesis on the amputee sprinters

Y. Ohgi^{1*} ■ T. Horiuchi² ■ ¹Keio University, Japan ■ ²Rakuten Inc.

Introduction: An athletic prosthesis for the leg amputee has been popular in the last decade. Up to date, several manufacturers have been developed the component parts for the leg prosthesis. However, the quantitative assessment of the newly developed prosthesis has been difficult. Because each subject has his own shape and condition of the amputated leg. In addition, both the measurement of the whole stride motion and the precise rotational motions of the lower leg are exclusive to observe by the video methodology.

Purpose: The authors aimed to examine the kinematics of the leg prosthesis by using an inertia sensor.

Methods: Two males and females leg amputees and one healthy adult participated in our experiment. The authors adopted an inertia sensor, which has triple accelerometer/gyroscope inside with flash memory. These 6DOF signals were sampled at 200Hz or 1kHz during runner's training session. The sensor data logger was attached on the foot spring part just below the knee joint. As for the healthy subject, the sensor device was attached on the shank below the knee. A high-speed video camera was used for the validation of the sensor data.

Results: Kinematical data showed us precise behaviour of the prosthetic leg during whole sprint event. The acceleration data along with the longitudinal axis of the prosthetic leg clearly showed the ground contact timing by its impact acceleration over 20G for the shank amputee and over 30G for the thigh amputee runner. The angular velocity of the knee flexion/extension showed the foot-off timing and the maximum knee extension timing.

Discussion: We can easily calculate both of the stance and swing phases by using acceleration and angular velocity. It leads the amputee runners improve their running performance. Prosthetists and amputees are interested in the impact shock at the moment of the maximum knee extension, so called "terminal impact". Amputee runners deeply dislike large impact acceleration at the terminal impact. By using the knee extension/flexion angular velocity's zero crossing timing, we can easily detect the maximum knee extension. At this moment, we can also detect a distinct peak on the tangential acceleration. The authors confirm that this peak would be available for the assessment of the terminal impact.

Conclusion: The authors examined the kinematics of the leg amputee sprinters' motion during their training session. The inertia sensor device will be possible for the phase classification and the assessment of the terminal impact on the sporting prosthesis.

187 Does a bout of DOMS improve physical performance?

S. Papalia^{1*} ■ D. De Plater¹ ■ ¹University of Western Sydney

Anecdotally a 'good' bout of delayed onset muscle soreness (DOMS) following training has been associated with improved training and competition performance some time later. The purpose of this study was to investigate the effect of DOMS on physical performance. Specifically, to determine if a bout of DOMS-inducing exercise resulted in greater physical performance improvements compared to a bout of non-DOMS-inducing exercise.

Methodology: Participants were 30 athletes, matched for age, gender and sporting level. One athlete from each pair was randomly assigned to the control or experimental DOMS intervention group. Physical performance testing was performed pre and at 2, 5, 10 and 14 days following the exercise intervention. Measures included DOMS severity using a visual analogue scale (VAS) and pressure pain threshold (PPT) testing using an algometer. Physical performance capacity was measured by range of motion (ROM) assessment of the hip and knee, a vertical jump test and isokinetic peak torque test of the knee extensors. The control group performed 3 sets of 10 repetitions at 30% 1RM on a leg extension machine. The DOMS experimental group performed 8 sets of repetitions to failure at 80%1RM using a leg extension machine, followed by 3 sets of squats to failure using a Smith machine. Analysis was by repeated measures analysis of variance (ANOVA). Where significant interactions were found, paired t-tests were utilised to isolate individual intervention and time differences ($p < 0.05$).

Results and Conclusions: No significant muscle soreness or changes in performance over the testing period were reported by the control group. The DOMS group exercise protocol induced muscle soreness and tenderness which peaked at 48 hours with full soreness recovery within 5 days, thus DOMS was successfully induced. For the DOMS group, the exercise significantly decreased pressure pain threshold, ranges of motion and peak knee extension torque. Not all performance measures had fully returned to pre-intervention levels after 14 days. The time course of performance affects associated with a bout of DOMS differed from the time course of its overt symptoms. There were trends in measured variables for the DOMS group, when compared to the control group, that suggest a bout of DOMS could be used to elicit a supercompensation effect which may transfer to improved physical performance. Further research is needed to incontrovertibly prove that a bout of DOMS results in improved physical performance.

L. Barnett¹ ■ T. Hinkley² ■ K. Hesketh³ ■ A. Okely² ■ J. Salmon^{3*}¹Health and Social Development, Deakin University ■ ²Wollongong University ■ ³Centre for Physical Activity and Nutrition Research, Deakin University

Purpose: Review evidence suggests fundamental motor skill is associated with physical activity. And yet there is little information on what factors influence movement skill.

Methods: In 2009 Australian preschool-aged children were recruited as part of a cohort study (Healthy Active Preschool Years - HAPPY).

Parent proxy-report of child (child sex, requests to be active, parent perception of child skill level, participation in structured and unstructured activity), parent (confidence of own skill to support child's activity, parent-child physical activity interaction, parent physical activity) and environmental factors (play space visits, equipment at home) was collected. Physical activity (Actigraph GT1M accelerometer) and movement skill (Test of Gross Motor Development-2) were also assessed. After age adjustment, survey variables and physical activity (counts per minute and time in moderate-to-vigorous physical activity) were checked for association with raw object control (e.g. catching, throwing) and locomotor (e.g. jumping) scores. Variables with associations of $p < .20$ with either skill type were entered into two standard multiple regression models with locomotor and object control scores as respective outcome variables.

Results: Movement skills were assessed for 76 (42 female, 34 male) children aged 3-6 yrs; 71 had complete parent proxy report and 53 had valid physical activity data. Child age, structured swimming participation, physical activity (cpm) and equipment explained 39% of locomotor skill variance; but equipment did not reach significance. Child age and sex, not participating in structured dance, moderate to vigorous physical activity (%), parent confidence of own skill and equipment explained 34% of object control variance; but child sex and parent confidence of own skill did not reach significance.

Conclusion: Movement skill correlates differ somewhat according to skill type and are context specific. Whilst there is some evidence of correlates being multidimensional, child level correlates appear more important.

A. Semciw^{1,2*} ■ T. Pizzari^{1,2} ■ R. Green^{2,3}¹Department of Physiotherapy, La Trobe University ■ ²Musculoskeletal Research Centre, La Trobe University ■ ³Department of Human Biosciences, La Trobe University

Introduction: Anatomical research suggests that gluteus minimus has two intramuscular segments (anterior and posterior) and gluteus medius has three (anterior, middle and posterior), each with unique functional roles based on independent fascicular orientation. Hip abductor muscle dysfunction may therefore potentially be explained by altered activation patterns of segments within these muscles. Previous intramuscular electromyography (EMG) research aimed at defining the roles of these segments fails to compare multiple segments within a muscle and only the posterior gluteus medius electrode location has been verified. The aim of this case study was first to verify electrode placement guidelines for the proposed segments of gluteus minimus and gluteus medius according to unique fascicular arrangement, and second to assess these locations in vivo.

Methodology: Anatomical research and cadaver observations aided the development of electrode placement locations with reference to major surface landmarks. To verify the locations developed, the gluteal region of one male cadaver was marked for fine wire electrode insertions. Five spinal needles were used to insert electrodes into the marked regions of gluteus minimus (anterior and posterior) and gluteus medius (anterior, middle and posterior). Following insertion, the gluteal region was carefully dissected and the location of the electrodes confirmed. The orientation of fascicles surrounding these electrodes was described. The same electrode placement procedure was repeated in vivo and electrodes were inserted with the additional aid of real-time ultrasound. Segmental EMG characteristics were then compared during a functional task.

Results: The electrodes were successfully inserted into the described segments of gluteus minimus and gluteus medius in the cadaver, and the fascicle orientation surrounding these electrodes was consistent with segments described in past anatomical research. Unique segmental EMG characteristics in vivo were successfully illustrated during pilot testing and results will be presented at the conference.

Conclusion: The electrode placement guidelines developed were verified according to fascicle orientation and unique EMG characteristics displayed in each segment. Further studies investigating the role of these muscle segments in health and dysfunction are currently underway in our laboratory.

P. Cross¹ ■ A. Shim^{1*} ■ A. Verhulst¹ ■ A. Trost¹ ■ R. Schmidt¹ ■ R. Lynde¹ ■ P. Hauer¹ ■ ¹The University of South Dakota, USA

Purpose: The purpose of the study was to determine if various cost affordable body composition measurements are adequate for measuring body composition in female college athletes when compared to the BOD POD.

Methods: Thirty-two Division I track and field and basketball female athletes participated in the study. Within one hour, all subjects underwent body composition assessments via waist-to-hip ratio (WHR), body mass index (BMI), BOD POD, skinfold measurements, and bioelectrical impedance analysis (BIA).

Results: No significant differences were found between basketball and track athletes and data was normalized. Per Pearson correlations, moderate correlations existed between body fat percentages obtained by BOD POD and BMI ($r = .531$) and between BOD POD and skinfold ($r = .689$). Low correlations existed between WHR and percentage body fat estimated by BOD POD ($r = .403$), as well as between body fat percentages estimated by BOD POD and BIA ($r = .447$).

Conclusions: Results indicate that the skinfold technique had the highest correlation when compared to the BOD POD. Skinfold measurements may be used as a quick, affordable, and reliable technique when performed by an expert assessor.

B. Scott¹ ■ D. Taaffe^{1*} ■ ¹University of Newcastle

Time-motion analysis of match performance in elite soccer has been studied extensively in recent years. To date, however, no published research has been conducted to analyse the movement characteristics of complete field training sessions in elite soccer.

Purpose: The current study aimed to quantify the movement characteristics of field training for elite soccer during the competitive season.

Methods: 15 professional soccer players (age 24.9; range 18-36 yrs; mass 77.6 ± 7.5 kg) encompassing a range of field playing positions were monitored across 23 field training sessions (n=94) during the 2010-2011 Australian A-League season. Players completed training sessions whilst wearing a Minimaxx GPS device (Firmware v6.59; Catapult Innovations, Scoresby, Australia) recording at 5 Hz. The GPS unit was positioned in a pocket located between the scapulae, in an undergarment worn by the player. Session-RPE was recorded using a Category Ratio-10 scale 30 minutes post session to quantify training intensity and internal training load (TL).

Results: Session duration ranged from 38.2–117.1 min. Total distance (TD) travelled was 4474.3 ± 1335.6 m, with meterage measuring 61.9 ± 8.9 m·min⁻¹. Players covered 3907.6 ± 1129.0 m in low-intensity running (LIR; <14.4 km·h⁻¹). Time spent in LIR was 70.3 ± 16.7 min, equating to $97.4 \pm 1.0\%$ of the total training duration. Distance covered and time spent in high-intensity running (HIR; >14.4 km·h⁻¹) were 561.9 ± 268.2 m and 1.9 ± 0.9 min, with very high-intensity running (VHIR; >25.2 km·h⁻¹) contributing 143.0 ± 107.1 m and 0.4 ± 0.3 min. Session-RPE recordings ranged from 1–8, (mean = 4.2 ± 1.6), and session-RPE internal TL was 320.4 ± 168.9 .

Conclusions: It is evident that in-season field training sessions for elite soccer involved extensive periods of LIR and a lower contribution of HIR and VHIR to TD and duration. These findings are likely related to extensive technical and tactical activity and low-intensity in-season training to allow for adequate recovery from frequent match-play. However, it is also possible that due to a strong emphasis on small-sided games and drills in small areas, the distance and duration of HIR bouts may be restricted, resulting in fewer high-velocity efforts. The results of the current study highlight that in-season field training in elite soccer contains a large volume of LIR. Whilst low-intensity post-game recovery is a vital component of in-season training, coaches should ensure a sufficient high-intensity training stimulus so that players maintain the physiological parameters required for elite soccer performance.

B. Kennedy¹ ■ B. Appleby^{2*} ■ B. Piggott³ ■ ¹West Coast Fever Netball Team, Perth ■ ²Western Force, Rugby WA, Perth ■ ³School of Health Sciences, Notre Dame University

Introduction: Netball is an intermittent court-based sport contested at an international level. The majority of research to date has focused on the prevalence of injury. The purpose of this investigation was to gain some insight into the intensity of match play at the elite level. Members of an elite provincial team were provided with a Polar Team 2 heart rate transmitter during four home matches. Due to player preferences and substitutions, not all positions are equally represented.

Methods: A total of 44 quarters of data across six positions were analysed. Logistics prevented the assessment of maximum heart rate (MHR) from field testing and MHR was determined for each player according to the Polar Team 2 Software. Heart rate (HR) during play was categorized to be under 85% MHR or above 85% MHR. Playing positions were grouped into Centre Court (CC) (Wing Defence, Centre and Wing Attack), GD (Goal Defence) and Circle (Goal Keeper, Goal Shooter).

Results: The percentage time above 85% MHR during the game for the position groups were: CC = 82%, GD = 87% and Circle = 70%. The percentage time above 85% MHR throughout the game averaged across all positions was: 1st quarter = 85%, 2nd = 74%, 3rd = 83% and 4th = 61%.

Conclusion: The results of this study indicate that the majority of playing time at the elite level is played at a high percentage of MHR. There is a tendency for GD and CC players to spend more time above 85% MHR than Circle. This may be attributed to the greater court coverage of these positions. However, Circle still spend considerable time above 85% MHR. These findings suggest that elements of conditioning for netball should incorporate sustained periods of high intensity training. The decrease in time spent above 85% throughout the match indicates an element of fatigue during the match with players unable to maintain high HR's as the game progresses. This may have a role in strategic substitutions of players to maintain match intensity and speed.



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SATURDAY 22 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
0800 – 0900	Workshop	Ultrasound guided injections for tendinopathies: A user's guide	Jeni Saunders	Orion Room	193
0800 – 0900	Workshop	How to read a wrist MRI: Review of wrist anatomy and common wrist pathologies	Eamon Koh	Pleiades Room	194
0800 – 0900	Workshop	Your sports medicine practice Q and A	Michael Kenihan & Judy Barnesby	Carnac Room	195
0800 – 0900	Workshop	Taping foot and lower limb – the different and difficult	Ron Naish	Garden Room	196
0930 – 1000	Invited	First Metatarsophalangeal Joint (MTPJ) arthrodesis in the athlete: Does the foot function?	Richard Bouché	Orion Room	197
1000 – 1030	Invited	Stretching and injury prevention: An enigmatic relationship	Erik Witvrouw	Orion Room	198
0930 – 1030	Free papers: Rehabilitation and return to sport after injury			Pleiades Room	
		The long term impact of hospitalised orthopaedic sport and active recreation injuries on health related quality of life and physical activity levels	Nadine Andrew		199
		Investigating characteristics of head impacts in paediatric snowsport participants: The application of the Head Impact Telemetry (HIT) System™ and the GPSports SpiElite data logging device	Gordon Waddington		200
		Medium-term return to sport outcomes after ACL reconstruction surgery: Uptake, maintenance or cessation of sport?	Clare Ardern		201
		Influence of attentional focus on spinal reposition performance in people with and without a history of low back pain	Xian Wei Bernard Liew		202
		Exercise performance and quality of life in patients with atrial fibrillation	Gary Brickley		203
		Does fear of re-injury impact on sports participation in the medium-term after anterior cruciate ligament reconstruction surgery?	Clare Ardern		204
0930 – 1030	Symposium	Debating SMA's position on drugs in sport: Policy and paradigm alternatives in the management of drugs in sport	Jason Mazanov, David Bolzonello and Bob Stewart	Carnac Room	205
0930 – 1030	Free papers: Response to strenuous exercise			Garden Room	
		Cytokine profiles and salivary IgA and hormonal responses to an acute bout of strenuous endurance exercise	Michael Kakanis		206
		Contribution of autonomic dysfunction to abnormal exercise blood pressure in patients with type 2 diabetes mellitus	Kassia Weston		207
		Sex differences in the changes in muscle damage markers following eccentric exercise of the elbow flexors	Luis Penailillo		208
		Blood rheology may facilitate changes in cardiovascular dynamics at the onset of submaximal cycling	Michael Simmonds		209
0930 – 1030	Free papers: Physical activity – adults epidemiology			Rottneest Room	
		Physical activity and all-cause mortality in older women and men	Wendy Brown		210
		Australians do not exercise at sufficient levels to promote good health	Brendan Humphries		211
		An examination of the physical activity and physical function relationship in older adults: The 45 and Up Study	Gregory Kolt		212
		Associations between vigorous exercise and moderate activity patterns with disease prevalence in Central Queensland	Michael Kingsley		213
		Physical activity, sitting and weight gain in Australian women	Wendy Brown		214

SATURDAY 22 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1100 – 1230	Multidisciplinary Grand Round	Multidisciplinary Grand Round: Foot, ankle and lower limb		Orion Room	215
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		The development of a clinical management pathway for chest wall pain in elite rowers	Ivan Hooper		216
		Does higher anterior knee joint laxity alter landing biomechanics in pubescent girls? Implications for non-contact ACL ruptures	Catherine Wild		217
		Using a 3D integrated stereoscopic system to investigate the biomechanics of evasive sidestepping: Implications for ACL injuries	Marcus Lee		218
		Does trunk flexion affect knee extensor moments during landing in volleyball players?	Ina Janssen		219
		The relationship between technique and high knee loads related to injury in landing tasks	Alasdair Dempsey		220
		Hamstring tendon autograft does not protect the patellofemoral joint from osteoarthritis after anterior cruciate ligament reconstruction: 7 year follow-up	Hayden Morris		221
		Double-bundle versus single-bundle anterior cruciate ligament reconstruction – Is the double bundle technique really better?	Kate Webster		222
1100 – 1230	Training effects themed poster session			Carnac Room	
		A preliminary analysis of horizontal upper body pushing and pulling strength ratios in elite male athletes	Brendyn Appleby		223
		A novel exercise regime to reduce cardiometabolic risk in overweight sedentary individuals	Shelley Keating		224
		Neuromuscular adaptation following high volume resistance training	Paul Marshall		225
		Effects of 8-week wheelchair Tai Chi training on cardiorespiratory fitness in individuals with spinal cord injury	Busba Thumwaree		226
		Relationship between functional movement screens and physical performance tests in junior basketball athletes	Markus Klusemann		227
		The effects of intensity and type of resistance training on muscle force generation capacity immediately – and 6 hours post training	Kenji Doma		228
		Effects of wheelchair Tai-Chi training on sitting balance of individuals with spinal cord injury	Lucksika Thongsumrit		229
1100 – 1230	Free papers: Exercise and recovery			Garden Room	
		Volitional fatigue occurs with considerable muscle metabolic reserve during intense intermittent forearm exercise	Robert Robergs		230
		Effects of active and passive recovery on intense intermittent forearm exercise	Nicole Vargas		231
		The effect of exercise intensity on sweat rate and sweat sodium loss in well trained athletes	Nicola Holmes		232
		The effect of warm-up on single and intermittent sprint performance	Karen Wallman		233
		An initial prospective exploratory investigation to identify predictors of calf cramping in rugby league players	Katherine Summers		234
		The relationship between measures of cycle intensity and running economy	Jason Bonacci		235
		Effect of immediate and delayed cold water immersion after a high intensity exercise session on subsequent run performance	Ned Brophy-Williams		236

SATURDAY 22 OCTOBER PAPERS AT A GLANCE

Time	Session	Title	Presenter	Room	Paper
1100 – 1230	Symposium	Breast and prostate cancer survivors' experience from treatment through rehabilitation	Eric Martin, Caroline Bulsara, Dennis Taaffe & Paula Magrani do Rosario		237
		The gendered experiences of men and women after diagnosis of and treatment for prostate and breast cancer	Caroline Bulsara		238
		Exercise programming and counselling preferences in men with prostate cancer	Dennis Taaffe		239
		Improving muscular endurance with the MVe Fitness Chair in breast cancer survivors: A feasibility and efficacy study	Eric Martin		240
		The effects of an individual versus a group delivered exercise and counselling intervention on fatigue in breast cancer survivors	Paula Magrani do Rosario		241
		Feasibility and efficacy of a group exercise and counselling program for breast and prostate cancer survivors	Eric Martin		242
		What men and women want: The experiences of men and women in a group exercise and counselling cancer recovery program	Eric Martin		243
1330 – 1430	Keynote	Intrinsic risk factors for patellofemoral pain syndrome: Implications for prevention and treatment	Erik Witvrouw	Orion & Pleiades Room	244
1330 – 1430	Workshop	Tips on leading a walk audit	Mark Fenton	Rottnest Room	245
1500 – 1630	Best of the Best			Orion & Pleiades Room	

193 Ultrasound guided injections for tendinopathies: A user's guide

WORKSHOP

J. Saunders^{1*} ■ ¹Sydney University Medical School

1. The research basis for performing these injections in tendinopathy: The current research papers and background for using injections as a therapeutic modality will be discussed.
2. The types of preparations and when to use (Polidocanol, Autologous Blood, PRP, Glucose 50%): This requires some “art” as well as science.
3. Technical requirements: Including ultrasound machine, one operator or two? Choice of syringe and needles
4. Injection techniques: The different choices for aseptic technique. Type of needle and syringe, how to hold etc.
5. Follow up: When to ask your patient to return for review. When should exercise recommence.

194 How to read a wrist MRI: Review of wrist anatomy and common wrist pathologies

WORKSHOP

E. Koh^{1*} ■ ¹Envision Medical Imaging Perth, Western Australia

The workshop will begin with a review of basic MRI terminology for MRI “beginners”. This will be followed by a more detailed review of the MR imaging anatomy of the wrist. Participants should be able to identify the intrinsic ligaments of the wrist and as well as relevant wrist tendon anatomy. An interactive, case-based discussion of wrist pathologies commonly seen, with reference to the relevant imaging anatomy and pathological findings, will follow.

195 Your sports medicine practice Q and A

WORKSHOP

M. Kenihan^{1*} ■ J. Barnesby^{2*} ■ ¹LifeCare Victoria ■ ²Kraft Foods

Need some advice about your practice but don't know who to ask? Legal, HR, marketing etc? This breakfast round table session will be audience driven and consist of a panel of experts with years of corporate and sports medicine management experience to answer the burning questions about establishing, running and improving your practice. This is a must for anyone with an interest in the business of sports medicine.

196 Taping foot and lower limb – the different and difficult

WORKSHOP

R. Naish^{1*} ■ ¹Western Force Rugby Super 15's

Rob is an experienced physiotherapist having worked with Rugby Union for many years both in Perth and overseas. Rob will present a lower limb taping workshops titled “the different and difficult”. This will give participants the opportunity to take away some alternative taping techniques that they can “use tomorrow” in the management of their patients.

197 First Metatarsophalangeal Joint (MTPJ) arthrodesis in the athlete: Does the foot function?

INVITED

Asics Supported Speaker



R. Bouché^{1*} ■ ¹The Sports Medicine Clinic, Seattle, USA

First MTPJ arthrodesis is a joint destructive procedure that is commonly performed for a variety of foot pathologies including failed bunion and hallux varus surgeries and most commonly for advanced stage hallux rigidus. Though the success of this procedure has been well documented in the literature for the general patient population, there are few studies that report on the results of this procedure in an active and athletic patient population. There are few articles that discuss the effects of 1st MTPJ arthrodesis on walking and no articles that have studied the effects of this procedure on running. Because of this situation, there are any many myths and misconceptions that have been propagated related to this procedure. These myths include an inability to wear heeled shoes, inability to walk normally or run, and an inability to play sports. The purpose of this presentation is to review the present status of first MTPJ arthrodesis in an active & athletic patient population. This will include a critical review of the literature, a review of an unpublished Level 4, Grade C retrospective case series of active/athletic patients who underwent this procedure, two case studies including gait video and suggestions for future research.

INVITED

Club Warehouse and Australian Institute of Sport Supported Speaker

E. Witvrouw^{1*} ■ N. Mahieu¹ ■ P. McNair² ■ ¹Ghent University, Belgium ■ ²AUT University

It is generally accepted that increasing the flexibility of a muscle-tendon unit promotes better performances and decreases the number of injuries. Stretching exercises are regularly included in warm-up and cooling-down exercises; however, contradictory findings have been reported in the literature. Several authors have suggested that stretching has a beneficial effect on injury prevention. In contrast, clinical evidence suggesting that stretching before exercise does not prevent injuries has also been reported. Apparently, no scientifically based prescription for stretching exercises exists and no conclusive statements can be made about the relationship of stretching and athletic injuries. Stretching recommendations are clouded by misconceptions and conflicting research reports. We believe that part of these contradictions can be explained by considering the type of sports activity in which an individual is participating. Sports involving bouncing and jumping activities with a high intensity of stretch-shortening cycles (SSCs) [e.g. soccer and football] require a muscle-tendon unit that is compliant enough to store and release the high amount of elastic energy that benefits performance in such sports. If the participants of these sports have an insufficient compliant muscle-tendon unit, the demands in energy absorption and release may rapidly exceed the capacity of the muscle-tendon unit. This may lead to an increased risk for injury of this structure. Consequently, the rationale for injury prevention in these sports is to increase the compliance of the muscle-tendon unit. Recent studies have shown that stretching programmes can significantly influence the viscosity of the tendon and make it significantly more compliant, and when a sport demands SSCs of high intensity, stretching may be important for injury prevention. This conjecture is in agreement with the available scientific clinical evidence from these types of sports activities. In contrast, when the type of 444 *Witvrouw et al.* sports activity contains low-intensity, or limited SSCs (e.g. jogging, cycling and swimming) there is no need for a very compliant muscle-tendon unit since most of its power generation is a consequence of active (contractile) muscle work that needs to be directly transferred (by the tendon) to the articular system to generate motion. Therefore, stretching (and thus making the tendon more compliant) may not be advantageous. This conjecture is supported by the literature, where strong evidence exists that stretching has no beneficial effect on injury prevention in these sports. If this point of view is used when examining research findings concerning stretching and injuries, the reasons for the contrasting findings in the literature are in many instances resolved.

199 The long term impact of hospitalised orthopaedic sport and active recreation injuries on health related quality of life and physical activity levels

N. Andrew^{1*} ■ B. Gabbe^{1,2} ■ R. Wolfe¹ ■ P. Cameron^{1,2}¹Monash University, Department of Epidemiology and Preventive Medicine ■ ²National Trauma Research Institute, Alfred Hospital, Melbourne

Background: Sport and active recreation are important avenues for health enhancing physical activity. These health benefits can be negated by injury with the potential for serious long-term consequences. Despite this, few studies have examined the long-term impact of these injuries on health or physical activity levels. The aims of this research are to establish if patients hospitalised with orthopaedic sport and active recreation injuries had returned to their pre-injury levels of health-related quality of life and physical activity at 12-months post-injury and to identify factors associated with poor outcomes.

Methodology: Adults admitted to hospital with orthopaedic sport and active recreation injuries and captured by the Victorian Orthopaedic Trauma Outcomes Registry, were recruited from two Level 1 trauma centres and one regional hospital, over a 12-month period. There were 324 participants recruited to the study, of which 98% were successfully followed up at 12-months post-injury. Outcome measures were the 36-item Short Form Health Survey (SF-36), which provides a physical component summary (PCS) score and a mental component summary (MCS) score, and the International Physical Activity Questionnaire (IPAQ). Pre and post-injury scores were compared and multivariate linear regression was used to identify demographic, injury, hospital and physical activity variables associated with the outcomes.

Results: At 12-months post-injury participants reported a clinically significant mean 7 point reduction in physical health (95%CI:0.07-0.17, $p<0.001$) and a non-clinically significant mean 2.1 point reduction in mental health (95%CI:0.32-0.47, $p<0.001$) scores. Participants reported large reductions in physical activity levels ($p<0.001$), with median levels reduced by two thirds. In those that reported no disability at 12-months, median IPAQ scores were still reduced by half ($p<0.001$) and vigorous activity was being performed half as frequently. Multivariate analysis identified sporting group ($p=0.001$), an Injury Severity Score >15 ($p=0.007$) and high pre-injury vigorous activity levels ($p=0.04$) as being associated with poorer PCS outcomes. Having a pre-existing medical or mental health condition was associated with poorer MCS scores. No study variables were associated with physical activity outcomes at 12-months.

Conclusions: The study findings show that at 12-month post-injury, most patients injured during sport and active recreation had not returned to their pre-injury health or physical activity status. This information is essential for quantifying the burden of sport and active recreation injuries, prioritising treatment and establishing sport injury prevention as a research priority area. These results highlight the importance of sports injury prevention as a means of promoting population health and physical activity

G. Waddington^{1*} ■ T. Dickson¹ ■ S. Trathen¹ ■ R. Adams² ■ ¹University of Canberra ■ ²University of Sydney

Introduction: It has been suggested that traumatic brain injuries (TBI) in snowsports have been increasing in frequency and that TBI is the leading cause of death and serious impairment in skiing and snowboarding, yet debate continues about the effectiveness of current helmet designs in preventing snowsport injuries, particularly in incidents at speeds higher than 23km/h, the current international standard maximum impact velocity for helmets. The concept that the helmet is potentially a "risk enabler" that encourages behaviours that would not occur if the participant was not wearing a helmet has been proposed i.e. this may include skiing at faster velocities than when not wearing a helmet.

Method: Giro Nine snowsport helmets (Bell Sports, Santa Cruz, CA) were modified to include the Head Impact Telemetry (HIT) System, and GPSports SPI Elite data logging devices that recorded speed, location within resort, time of day and heart rate were also used. Participants were recruited from the Sun Peaks region in Canada and from Australian resorts, during the winters of 2009/2010. Of the 80 'skier days' analysed, the age range was 9 to 80 with a mean of 40.9 years, of which 43% were females. Most were skiers (96%), 28% indicated they were novice-intermediate skill level and 72% were advanced to expert. Only intermediate/advanced participants were included in this analysis to account for variability in skiing velocity, of this sub-group, 64 participants regularly wore helmets and 14 did not. Participants were asked to estimate their maximum speed while skiing and this was compared to their recorded GPS speed.

Results: No significant head impacts were recorded in this group. There was a significant difference in mean participant estimated maximum speed and actual maximum speed recorded between the habitual helmet wearers (estimated at 49Km/h vs. actual 64Km/h) and non wearers (estimated 55Km/h vs. actual 56Km/h) with helmet wearers consistently underestimating their maximum speed by 20%. This data also indicates that all the participants in this study regularly exceeded the maximum speed for helmet impact safety testing (23km/h).

Conclusion: If this sample is indicative of speeds achieved by the broader population of non-elite snowsports participants when wearing helmets, then education of current helmet users to the limits of the level of protection offered by wearing a helmet and advice regarding estimating speed of skiing may be appropriate as well as the development of higher standard testing speeds for approval of helmets as protective devices in snowsports.

C. Ardern^{1*} ■ N. Taylor^{1,2} ■ J. Feller^{1,3} ■ K. Webster¹¹Musculoskeletal Research Centre, La Trobe University ■ ²School of Physiotherapy, La Trobe University ■ ³Orthosport Victoria, Richmond

Background: Returning the athlete to sports participation following injury is typically a major objective of anterior cruciate ligament (ACL) reconstruction surgery. Most people have not returned to their pre-injury level of sports participation at 12 months following surgery. Therefore, twelve months follow up may be too early to assess return to sport outcomes accurately. The purpose of this study was to evaluate the medium-term return to sport outcomes following ACL reconstruction surgery.

Method: A self-report questionnaire was used to collect data at 2 to 7 years following ACL reconstruction surgery regarding pre-injury sports participation, post-operative sports participation and subjective knee function. The main inclusion criteria were participation in regular sports activity prior to surgery and the attendance of routine surgical follow up appointments.

Results: There were 314 participants included, at a mean 39.6 ± 13.8 months following ACL reconstruction surgery. At follow up, 45% were playing sport at their pre-injury level and 29% were playing competitive sport. Ninety three percent of participants had attempted sport at some time following their ACL reconstruction surgery. Those who had not attempted their pre-injury level of sport by 12 months following surgery were just as likely to have returned to pre-injury level by 39 months after surgery as those who had played sport by 12 months (risk ratio, 95% CI = 1.1, 0.76-1.6).

Conclusion: Sports participation rates in the medium-term following ACL reconstruction surgery are increased when compared to levels reported at 12 months after surgery (41% compared to 33% playing competitive sport). However, in the medium-term sports participation is still relatively low, with less than 50% of individuals who were playing regular sport prior to injury having returned to playing sport at their pre-injury level or returned to participating in competitive sport. Return to the pre-injury level of sport at 12 months following surgery was not predictive of participation at the pre-injury level in the medium-term. This suggests that people who return to sport within 12 months may not maintain their sports participation.

X. Liew^{1*} ■ G. Allison¹ ■ W. Gibson¹ ■ ¹Curtin University

Introduction: An external focus of attention may enhance motor performance, yet individuals with low back pain (LBP) may automatically adopt an internal focus. The purpose of this study was to examine the impact of altered attentional focus on spinal proprioceptive performance in individuals with and without a history of LBP.

Methods: A block randomised repeated measures study was conducted with 17 controls and 17 LBP participants. Spinal position sense was assessed using 7 "target – matching" pairs of trials over 1 external (auditory cue), 2 internal (sensory stimulus to the back and leg) focus of attention, and 1 control (self-paced) conditions. Reposition error (accuracy and precision) and postural sway were the dependent variables.

Results: Pooled data did not reveal a main effect of group on repositioning accuracy ($p=.76$) and precision ($p=.56$). Reposition accuracy ($p=.14$) and precision ($p=.70$) was not affected by the focus of attention. Postural sway was significantly smaller during both internal foci conditions compared to the control condition ($p<.05$).

Conclusion: There is a lack of consensus of the presence of proprioceptive deficit in people with LBP. Our results agree with a previous study that people with a history of LBP do not have a general reduction in reposition performance. An internal focus of attention also did not deteriorate spinal reposition performance. However, postural sway was reduced during an internal focus of attention. This suggests that an internal focus of attention had a greater impact on postural sway than spinal reposition performance. A reduced postural sway could be an attempt by the central nervous system (CNS) to bring about postural stability during spinal repositioning. An internal focus of attention has been shown to increase postural instability during

standing. In attempt to maintain postural stability, the CNS could have “de-prioritized” spinal reposition performance. This could have prevented an internal focus from having a deteriorative effect on reposition performance. Our results demonstrate that postural stability may need to be provided during testing, to enable any reposition performance deficits to be revealed. This study provides preliminary evidence that postural control is an integral component of spinal repositioning. Since individuals with LBP may demonstrate greater postural instability, this could have prevented reposition performance deficits from being revealed. Future studies should control postural stability first when selecting spinal repositioning as a test of joint position sense in individuals with LBP.

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Exercise performance and quality of life in patients with atrial fibrillation

G. Brickley^{1*} ■ J. Van Zalen^{1,2} ■ L. Beale¹ ■ S. Podd² ■ P. Raju² ■ G. Lloyd² ■ ¹University of Brighton ■ ²Eastbourne District General Hospital, United Kingdom

Introduction: Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia. AF patients symptoms are fatigue, dyspnoea and a reduced exercise capacity. The impact of these symptoms may have an effect on the quality of life (QoL). From an exercise perspective, it is important to compare AF patients with healthy individuals. **Aim:** The aim of the study was to determine differences in exercise performance and QoL in patients with persistent AF compared to healthy controls in sinus rhythm.

Methods: After seeking ethical approval, ten patients with AF and 9 healthy age matched controls volunteered to take part in the study. On arrival at the hospital, a pre-health screening was carried out followed by a resting echocardiogram. All subjects then exercised to exhaustion on a recumbent cycle, carried out a 6 minute walk test (6MWT) and filled out a QoL questionnaire (SF-36). Peak workload (W), peak oxygen uptake, ventilatory threshold (VT) and total distance walked were determined. Comparisons between groups were determined using t-tests.

Results: A significant lower and 6-MWT distance was found for the AF group compared (424±64m) to the healthy controls (577 ±38m). Whilst there was no difference in resting ejection fraction between groups, stroke volume was greater in the healthy controls. AF did have a significantly lower peak oxygen uptake (14.6±5.9ml.kg⁻¹.min⁻¹) compared to controls (21.0±6.1 ml.kg⁻¹.min⁻¹) The AF group showed lower QoL than the healthy controls.

Discussion: In the present study AF patients had a markedly reduced peak oxygen uptake that was 50% lower than controls. This was related to a lower 6-MWT distance, and a lower QoL compared to the age-matched healthy controls in sinus rhythm. Treatment for AF patients directed towards attaining sinus rhythm should be closely monitored alongside QoL measurements and cardio respiratory fitness.

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Does fear of re-injury impact on sports participation in the medium-term after anterior cruciate ligament reconstruction surgery?

C. Ardern^{1*} ■ N. Taylor^{1,2} ■ J. Feller^{1,3} ■ K. Webster¹

¹Musculoskeletal Research Centre, La Trobe University ■ ²School of Physiotherapy, La Trobe University ■ ³Orthosport Victoria, Richmond

Background: A number of psychological responses have been reported to occur following a serious sports injury such as an anterior cruciate ligament (ACL) rupture, including anxiety, depression, and fear of re-injury. Many studies have reported excellent physical recovery following ACL reconstruction surgery. However, the extent to which psychological responses such as fear of re-injury impact on return to sport outcomes has not been well investigated. Therefore the purpose of this study was to examine fear of re-injury in people who had returned to regular sports participation following ACL reconstruction surgery.

Method: A self-report questionnaire was used to collect data from a group at two to seven years following ACL reconstruction surgery. Questions were based on Johnston and Carroll's model of the behavioural manifestations of fear of re-injury. Data were also collected regarding subjective knee function and symptoms. Key inclusion criteria were regular participation in sport prior to injury and participation in sport at the time of the study.

Results: Two hundred and nine individuals (88 females, 121 males) participated. Overall, participants did not express specific concern or fear for their knee scoring greater than 7/10 on all questions. Individuals who had returned to their pre-injury sports level had significantly less fear of re-injury than those who had not returned to their pre-injury level, while females had significantly more concern about the environmental conditions experienced whilst playing (mean 7.0 compared to 8.4), and felt significantly less able to go “full out” (mean 8.2 compared to 9.0) when compared to males.

Conclusion: Individuals who are participating in recreational or competitive level sport in the medium-term following their ACL reconstruction generally appear to do so without fear of re-injury. Whilst individuals who had returned to their pre-injury level demonstrated significantly less fear of re-injury compared to those who had returned to a lower level of sports participation, both groups reported a more positive, rather than negative emotional response (> 6/10) for all fear of re-injury questions. The gender differences observed in this study may reflect differences in the types of sports played or the main motivations for sports participation between males and females.

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Debating SMA's position on drugs in sport: Policy and paradigm alternatives in the management of drugs in sport

SYMPOSIUM

J. Mazanov^{1*} ■ ¹School of Business, UNSW@ADFA

Sports Medicine Australia (SMA) members have a very important role implementing the policies that govern the role of performance enhancing drugs (doping), illicit drugs (e.g. marijuana) and licit drugs (alcohol), but have had very little input to those policies. The dominant paradigm for managing drugs in sport comes from the World Anti-Doping Code, which prioritises compliance with the rules through a legalistic approach. Harm minimisation represents an alternative paradigm that is prioritises athlete health and welfare through management of drug use. This symposium presents members of the sports medicine community the opportunity to hear the arguments for and against these paradigms towards establishing a position statement that best reflects the mission and vision of SMA. This includes an articulation of why SMA should support the current legalistic approach, followed by the arguments around why SMA should support a change to the harm minimisation approach. A range of speakers are invited to give their views from different points of view within the sports medicine community (e.g. practitioners, trainers and administrators) before the floor opens for general discussion. The symposium is then summarised towards informing the development of SMA's position statement on how members want drugs in sport to be managed.

M. Kakanis^{1,2,4*} ■ J. Peake^{3,4} ■ E. Brenu^{1,2} ■ S. Hooper⁴ ■ B. Gray¹ ■ S. Marshall-Gradisnik^{1,2}

¹Faculty of Health Science and Medicine, Population Health and Neuroimmunology Unit, Bond University ■ ²Faculty of Health Science and Medicine, Bond University

³School of Human Movement Studies, University of Queensland ■ ⁴Centre of Excellence for Applied Sport Science Research, Queensland Academy of Sport

Introduction: Strenuous endurance exercise suppresses some immune variables such as T helper (Th) cell activities during the post-exercise recovery period. Changes in the Th1/Th2 response to exercise have been reported previously; however, earlier reports have not investigated cytokine production by phytohemagglutinin (PHA)-stimulated Th cells following strenuous endurance exercise. Changes in plasma cortisol and salivary IgA concentrations have been linked to the exercise-induced immunosuppression explained by the 'open window' theory. This study measured the production of cytokines by Th1/Th2/Th17 cells, salivary IgA concentration and plasma cortisol concentration for 8 h following an acute bout of strenuous endurance exercise. **Methodology:** Ten male 'A' grade cyclists (age 24.2 years, range 18–34; body mass 73.8 ± 6.5 kg; $\dot{V}O_{2peak}$ 65.9 ± 7.1 mL.kg⁻¹.min⁻¹) exercised for 2 h at 90% of their second ventilatory threshold. Blood and saliva samples were collected before, immediately after, and 2, 4, 6, 8, and 24 h after exercise. The immune variables examined were the concentrations of cytokines released by PHA-stimulated Th1/Th2/Th17 cells and salivary IgA and plasma cortisol concentrations. Data at each time were compared using one-way repeated-measures ANOVA with Bonferroni correction. Non-parametric data were analysed using Friedman's ANOVA.

Results: Plasma cortisol concentration decreased significantly 4 h after exercise ($p < 0.001$) and remained lower than the pre-exercise level 6 h ($p < 0.01$), 8 h ($p < 0.001$), and 24 h after exercise ($p < 0.01$). IL-6 release from stimulated T helper cells increased significantly ($p < 0.05$) from 2 h to 8 h after exercise. Despite wide inter-individual variations in cytokine responses, the release of other cytokines and salivary IgA concentration did not change significantly after exercise.

Conclusion: This is the first study to analyse the Th1/Th2/Th17 cytokine response to PHA stimulation and changes in salivary IgA and plasma cortisol concentrations from immediately to 8 h after endurance exercise. The present results do not support the concept that low salivary IgA and elevated cortisol concentrations may reduce immune function after intense exercise. Further work using a larger sample size is warranted to clarify the effects of exercise on Th1/Th2/Th17 cytokine responses.

K. Weston^{1*} ■ J. Sacre¹ ■ J. Coombes¹ ■ ¹University of Queensland

Background: An exaggerated blood pressure response to exercise predicts cardiovascular and all-cause mortality and is common in uncomplicated patients with type 2 diabetes mellitus. A potential mechanism may be related to the autonomic nervous system, which is important in the regulation of exercise haemodynamics.

Aim: To compare the presence and severity of autonomic dysfunction in type 2 diabetes mellitus patients with and without exaggerated blood pressure (BP) responses to exercise. As preclinical autonomic dysfunction may be difficult to detect at rest, we sought associations of resting and post-exercise heart rate variability (HRV) measurements with peak exercise BP.

Methods: HRV was measured at rest and 20 minutes post-exercise in T2DM patients with either exaggerated exercise BP or normal exercise BP. An exaggerated BP response to exercise was identified by peak (final minute) BP ≥ 190/105 mm Hg (women) or ≥ 210/105 mm Hg (men). Each group consisted of 48 type 2 diabetes mellitus patients (aged 59 ± 9). BP at rest and peak exercise was recorded using a mercury sphygmomanometer. **Results:** At rest there were no significant differences between groups for all time and frequency domains of the HRV parameters. Post-exercise, in patients with an exaggerated BP response, there was a significant ($p < 0.05$) reduction in the standard deviation of RR intervals (SDNN), root-mean-square of successive RR interval differences (RMSSD) and total power (TP). There were no post exercise group differences in high frequency (HF), low frequency (LF) and very low frequency (VLF) domains. In a linear regression model independent correlates of exercise systolic blood pressure (SBP) included post-exercise TP ($\beta = -0.28$, $p = 0.01$; adj. $R^2 = 0.32$, $p < 0.001$).

Conclusions: Type 2 diabetic patients with an exaggerated exercise BP response have reduced post-exercise HRV that is not detected at rest. These HRV changes suggest preclinical autonomic dysfunction from decreased vagal tone and a relative sympathetic dominance.

L. Penailillo^{1,2*} ■ A. Gurovich² ■ P. Plaza² ■ K. Nosaka¹

¹Edith Cowan University, School of Exercise, Biomedical and Health Sciences ■ ²Pontificia Universidad Católica de Valparaíso, Chile

Controversy exists concerning sex differences in exercise-induced muscle damage (EIMD). Animal studies have shown that females are less susceptible to EIMD than males; however, this is more equivocal in human studies. Previous studies showed higher increase in creatine kinase (CK) activity in the blood for men than women following eccentric exercise, but no significant sex differences in strength loss and muscle soreness (SOR) have been reported. It appears that sex differences are dependent on muscle damage markers, but no previous studies have systematically compared changes in several muscle damage markers between men and women. Thus, this study compared the changes in several indirect markers following eccentric exercise of the elbow flexors between men and women.

Methods: Ten men (23.6 ± 1.5 y; 176.2 ± 8.1 cm; 73.5 ± 11.6 kg) and 10 women (23.5 ± 1.8 y; 167.1 ± 6.7 cm; 61.5 ± 6.6 kg) who were sedentary and had no history of resistance training in the previous 6 months were recruited. All subjects performed 3 sets of 15 eccentric contractions of the elbow flexors of the non-dominant arm using a dumbbell set at 80% of the maximal isometric voluntary contraction strength at 90° (MIVC) from 115° to 0° of elbow flexion. MIVC, elbow range of motion (ROM), upper arm circumference (CIR), SOR using a visual analogue scale, and serum CK activity were measured 72 h before, immediately after, and 1-4 and 7 days after exercise. A two-way repeated measures ANOVA was used to compare between sexes, and a Bonferroni post-hoc test was used when significant effect was found.

Results: All markers showed significant changes over time for both men and women. A significant sex difference was evident for ROM, CIR, and CK showing greater changes for men than women; however, MIVC and SOR showed no significant sex difference.

Discussion: Three out of five damage markers showed greater changes for men than women, but other two markers did not show any sex differences. When the dumbbell weight relative to the body weight was compared between sexes, men used 7% heavier weight than women. Thus, it seems reasonable to assume that mechanical stress to the muscles was greater for men than women. This could explain the greater changes in ROM, CIR and CK for men; however, this was not reflected in MVIC and SOR. It is concluded that sex difference in EIMD depends on which marker is used to determine EIMD.

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Blood rheology may facilitate changes in cardiovascular dynamics at the onset of submaximal cycling

M. Simmonds^{1*} ■ J. Tripette^{2,3,4} ■ S. Sabapathy⁵ ■ S. Marshall-Gradisnik¹ ■ P. Connes^{2,3} ■ ¹Faculty of Health Sciences and Medicine, Bond University
²UPRES EA 3596 (ACTES), Université Des Antilles Et De La Guyane, Campus De Fouillol, Guadeloupe ■ ³UMR Inserm 763, CHU De Pointe À Pitre, Guadeloupe
⁴Laboratory of Biorheology and Medical Ultrasonics, University of Montreal Hospital, Canada ■ ⁵School of Physiotherapy and Exercise Science, Griffith University

Introduction: Given that oxygen supply is dependent on the flow and distribution of blood, it is surprising that little is known regarding the influence of blood rheology on the dynamic responses of the cardiovascular system at the onset of exercise. The aim of this study was to determine whether important parameters of blood rheology were related to the time-course changes in oxygen uptake ($\dot{V}O_2$), cardiac output (Q), and/or arteriovenous oxygen difference (a- $\dot{V}O_2D$) at the onset of submaximal cycling.

Methods: Ten healthy subjects (age: 21.7 ± 1.3 yr; body mass index: 22.7 ± 2.0 kg·m⁻²) performed submaximal cycling at an intensity reflecting 105% of the first ventilatory threshold. Whole blood was collected at rest before exercise for assessment of red blood cell (RBC) deformability, RBC aggregation, and blood viscosity. During exercise, $\dot{V}O_2$ was measured breath-by-breath (ZAN 600 USB, Oberthulba, Germany) and Q was measured beat-by-beat (Physioflow, Manatec type PF05L1, Paris, France). The a- $\dot{V}O_2D$ was subsequently determined using the Fick principle. A monoexponential equation was used to describe the time course of the $\dot{V}O_2$, Q, and a- $\dot{V}O_2D$ responses to exercise.

Results: RBC aggregation was negatively correlated with steady-state $\dot{V}O_2$ during exercise and the a- $\dot{V}O_2D$ at rest ($r = -0.73$, $p < 0.05$), and RBC aggregation was positively correlated to Q at rest ($r = 0.71$, $p < 0.05$). Blood viscosity at various shear rates was negatively correlated with the time constant of on-transient kinetics for $\dot{V}O_2$ (all $p < 0.01$) and a- $\dot{V}O_2D$ (all $p < 0.05$), and RBC deformability at various shear stress was positively correlated to the time constant of on-transient kinetics for $\dot{V}O_2$ (all $p < 0.05$) and a- $\dot{V}O_2D$ (all $p < 0.05$).

Conclusions: While our finding that faster a- $\dot{V}O_2D$ and $\dot{V}O_2$ kinetics was related to increased blood viscosity and decreased RBC deformability initially seems counterintuitive, accumulating evidence suggests that mildly elevated blood viscosity may facilitate peripheral blood flow due to increased nitric oxide production, secondary to the increased shear stress applied to the endothelium. Moreover, slightly decreased RBC deformability could paradoxically improve tissue extraction of oxygen from blood due to i. an increased transit time for RBC to pass through capillary networks, and; ii. reduced distance between the RBC and vessel wall. The results of the present study support that the rheological properties of blood may modulate, at least in part, the rate of change in the uptake and extraction of oxygen at the onset of exercise.

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Physical activity and all-cause mortality in older women and men

W. Brown^{1*} ■ D. McLaughlin² ■ J. Leung² ■ L. Flicker³ ■ O. Almeida³ ■ G. Hankey³ ■ D. Lopez³ ■ K. McCaul³ ■ A. Dobson²

¹School of Human Movement Studies, University of Queensland ■ ²School of Population Health, University of Queensland ■ ³University of Western Australia

Background: There is strong epidemiological evidence that physical activity in young-middle adulthood is associated with lower all-cause mortality in both women and men. The aim of this study was to examine the relationship between physical activity and mortality in older people.

Methods: Data from two Australian cohorts [the Australian Longitudinal Study on Women's Health (N=10,430) and the Health in Men Study (N=12,203)] aged 65 years or more were analysed to assess the relationship between physical activity and all-cause mortality over a median follow-up of 10.4 years for women and 11.5 years for men.

Results: After adjustment for other behavioural risk factors and demographic variables, there was an inverse dose-response relationship between physical activity and all-cause mortality, with lower hazard ratios for mortality in women than men at all levels of physical activity. The hazard ratios for all-cause mortality in the 'low' physical activity category (40-600 MET.min/week) were 0.58 (0.52-0.65) for women and 0.91 (95% CI 0.84-0.99) for men; and in the 'moderate' physical activity category (600-<1200 MET.min/week) were 0.79 (95% CI: 0.73, 0.86) in men and 0.52 (95% CI: 0.45, 0.60) in women, compared with the lowest physical activity group (< 40 MET.min/week).

Conclusions: For people aged over 70 years, levels of physical activity lower than those recommended in current guidelines were associated with significant reductions in all-cause mortality. For those who met the guidelines, the risk reduction was greater in these older people than in most studies of younger adults, and the relative risk reduction was greater in women than in men.

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Australians do not exercise at sufficient levels to promote good health

B. Humphries^{1*} ■ M. Kingsley¹ ■ V. Dalbo¹ ■ M. Duncan¹ ■ F. Coulson¹ ■ ¹CQUniversity

Introduction: Decades of research into muscle strengthening activities has shown a multiplicity of health benefits for both healthy and elevated risk populations. Physical activity guidelines for older adults in several countries explicitly state that older adults should initiate and maintain engagement in muscle strengthening activities in conjunction with aerobic, flexibility and balance based activities to continue to lead healthy lifestyles. National health authorities have widely promoted physical activity in the form of aerobic exercise to the public, although the promotion of muscle strengthening activities has received far less attention. The primary objective of this research was to highlight the lack of prevalence of muscle strengthening activities across a six year period in an Australian population whilst examining gender and age trends.

Methodology: A Computer -Assisted -Telephone-Interview (CATI) survey conducted by Population Research Laboratory at CQUniversity performed a survey of Central Queensland adults in October-November 2006 (n=1236; male=620, female=616), 2008 (n=1237 male=619, female=618) and 2010 (n=1289; male=635, female=654). Respondents were asked to report on their strength training knowledge, sources of strength training knowledge, participation levels, duration, frequency and intensity of training, and barriers and constraints to engaging in strength training.

Participants: Respondents were 18 years of age or older that could be contacted by direct-dialed, land-based telephone service. A telephone database using a computer program to select, with replacement, a simple random sample of phone numbers selected respondents.

Results: Across the six year time period almost 85% of the population sampled did not perform strength training activities with only 13.7% in 2006, 16.9% in 2008 and 13.2% in 2010 responding to participating in strength training activities. Males (2006 12.5%, 2008 22.4%, 2010 13.2%) were consistently more likely to perform muscle strengthening activities than females (2006 14.8%, 2008 17.7%, 2010 11.2%). Significantly more males performed strength training and at sufficient physical activity levels than females ($p < 0.05$). Respondents over 65 years were less likely to participate in strength training and less likely to train at sufficient levels than younger cohorts ($p < 0.01$).

Conclusions: The present data suggests that the prevalence of Australian's participating in regular muscle strengthening activity programs is very low and unlikely to provide health benefits to stave off age associated muscle decline and health risks. The findings also underscore the need to increase overall education on the benefits of regular strength training with an emphasis among targeted adult populations to increase participation in strength training programs.

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An examination of the physical activity and physical function relationship in older adults: The 45 and Up Study

G. Kolt^{1*} ■ L. Yorston¹ ■ R. Rosenkranz¹ ■ ¹School of Biomedical and Health Sciences, University of Western Sydney

Introduction: Reduced participation in physical activity has been associated with functional decline in older adults. The growing population of older adults is placing unprecedented pressure on health and welfare systems due, in part, to increasing inability of these older adults to perform functional tasks essential for independent living. Further, the increasing rates of non-communicable chronic disease add to functional limitations in this population group. Understanding how physical activity can impact on physical function in older adults is therefore important. The purpose of this study was to investigate the relationship between physical activity levels and physical function in older adults.

Methods: Participants were 62,290 older adults aged 65 years and older (mean age 73.8 ± 6.6 years) drawn from the 45 and Up Study, a longitudinal cohort study of 266,848 people (45 years and older) from across New South Wales, Australia. Baseline data on physical activity (Active Australia Survey) and physical function (Medical Outcomes Study Physical Functioning Scale), as well as data on body mass index, psychological distress (Kessler-10), smoking history, age, gender, and educational attainment were used for cross-sectional analysis.

Results: In bivariate and fully adjusted logistic regression models, higher levels of physical activity were associated with higher physical function in older adults ($p < 0.001$). The factors most likely to influence this relationship were psychological distress ($p < 0.001$) and advancing age ($p < 0.001$). Compared to those in the lowest tertile of physical activity, those reporting higher levels of physical activity had progressively lower odds of functional limitation (middle tertile of physical activity - AOR = 0.48, 95% CI = 0.46, 0.50; highest tertile - AOR = 0.36, 95% CI = 0.34, 0.37). Older adults with the highest odds of functional limitation were those aged 85 years and over (AOR = 7.76, 95% CI = 7.11, 8.46) and those reporting any level of psychological stress (mild psychological distress - AOR = 3.92, 95% CI = 3.57, 4.30; moderate - AOR = 5.64, 95% CI = 4.78, 6.65; severe - AOR = 4.19, 95% CI = 3.55, 4.94).

Conclusion: These findings demonstrate an association between physical activity and physical function in older adults, and should be used to inform interventions for this population group. Such interventions would need to take into account other factors such as age of participants and psychological distress.

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Associations between vigorous exercise and moderate activity patterns with disease prevalence in Central Queensland

M. Kingsley^{1,2*} ■ B. Humphries¹ ■ V. Dalbo¹ ■ ¹Institute for Health and Social Science Research, CQUniversity ■ ²Swansea University, United Kingdom

Introduction: In order to gain health benefits, Australian adults are encouraged to accumulate 30 min of physical activity, at moderate or greater intensity, on most days of the week. Sufficient physical activity has been interpreted in various ways. For example, the ACSM has endorsed the recommendation that all healthy adults should undertake a minimum of 30 min of moderate intensity exercise on at least 5 days of the week or 20 min of vigorous activity on at least 3 days of the week. This study investigated associations between self-reported physical activity patterns and selected diseases in randomly selected adults living in Central Queensland, Australia.

Methods: 1289 participants (male=635, female 654) provided responses to a direct-dial, land-based telephone survey that was conducted using a computer-assisted telephone-interview survey in October-November 2010. Participants were asked to answer questions including age, gender, stature, mass, and health status along with the Active Australia Physical Activity questions. The strength of association between variables was determined using odds ratios and 95% confidence intervals.

Results: 42% of respondents reported that they undertook sufficient physical activity (defined as the completion of 150 min or more of moderate and vigorous activity in the past week, where the time of vigorous activity was doubled) and 23% reported greater than 60 min of vigorous activity. Sufficient physical activity was associated with decreased prevalence of overweight and obesity (OR: 0.59, 0.46-0.75), diabetes (OR: 0.65, 0.44-0.96), arthritis (OR: 0.73, 0.56-0.96), bone disease (OR: 0.62, 0.39-0.97), and depression and anxiety (OR: 0.48, 0.34-0.68). Undertaking 60 min or more vigorous activity was associated with decreased prevalence of overweight and obesity (OR: 0.61, 0.46-0.80), diabetes (OR: 0.48, 0.28-0.83), heart disease (OR: 0.43, 0.25-0.74), abnormal blood pressure (OR: 0.61, 0.45-0.82), elevated cholesterol (OR: 0.58, 0.41-0.82), arthritis (OR: 0.52, 0.37-0.74), bone disease (OR: 0.49, 0.26-0.91), back pain (OR: 0.74, 0.56-0.98), and depression and anxiety (OR: 0.27, 0.16-0.45).

Conclusions: Sufficient physical activity was associated with reduced risk of obesity, depression and anxiety, and selected diseases. Nevertheless, more frequent and stronger associations were evident with health outcomes when respondents accumulated 60 min or more of vigorous exercise. Therefore, vigorous activity patterns might provide additional information when assessing the risk of various hypokinetic diseases and researchers using the Active Australia Physical Activity questions should consider refining the definition of sufficient physical activity to include the accumulation of 60 min of vigorous exercise.

214 Physical activity, sitting and weight gain in Australian women

W. Brown^{1*} ■ R. Hockey² ■ A. Dobson² ■ ¹School of Human Movement Studies, University of Queensland ■ ²School of Population Health, University of Queensland

Introduction: The aim was to determine the relationships between physical activity, sitting time and weight gain over ten years in women who were aged 18-23 in 1996 and 28-33 in 2006.

Methods: Participants in the youngest cohort of the Australian Longitudinal Study of Women's Health (born 1973-1978) completed surveys in 1996, 2000, 2003 and 2006, when they were aged from 18-33. 6458 women provided data on weight, physical activity, sitting time, energy intake, smoking, alcohol, oral contraceptive use and demographic and social characteristics. A random effects model for longitudinal analysis was used to estimate annual percentage weight change associated with each variable.

Results: Overall the women gained weight at a rate of 0.93% per year, which corresponds to 6.1kg over ten years for an average weight woman (65kg). After adjustment for baseline BMI, energy intake, parity, partnership status, smoking, education, hours of paid work and sitting time/physical activity, women who reported doing no physical activity gained an average of 7.9kg in 10 years, while those in the low (40-<600MET.mins/week), moderate (600-<1200) and high (>1200) physical activity categories gained 7.1, 6.6 and 4.3 kg respectively. Women who reported sitting for <6 hours/day gained an average of 5.4 kg and those who reported sitting ≥6 hours/day gained 6.9 kg.

Conclusions: Women in the highest physical activity category (corresponding to about 50 minutes of daily moderate intensity activity) gained (on average) more than 4kg in ten years.

Discussion: These data challenge the belief that high levels of physical activity protect against weight gain at this life stage. Intervention strategies for preventing weight gain in young women should simultaneously consider all the contributing factors, which, in this cohort, include physical activity and sitting time, as well as energy intake, quitting smoking, initial BMI, and changes in partnership and parity status.

215 Multidisciplinary Grand Round: Foot, ankle and lower limb

K. Copeland¹ ■ ¹Alphington Sports Medicine Clinic, Victoria

A highly experienced and interactive multidisciplinary panel will discuss real and complex patient presentations. Real case studies will be presented that lend themselves to the Multidisciplinary treatment model, with differential diagnosis and treatment strategies discussed. This session aims to be both very clinical and interactive between the expert panel members and the audience. The aim of this interactive session is to encourage lively discussion between the expert panel and the audience on processes of Differential diagnosis, required investigations and planned treatment approach.

216 The development of a clinical management pathway for chest wall pain in elite rowers

I. Hooper^{1,2*} ■ P. Blanch¹ ■ J. Sternfeldt¹ ■ ¹Australian Institute of Sport ■ ²National Rowing Centre of Excellence

Introduction: Chest wall pain continues to be a significant problem in elite rowing, generating substantial loss of training time. Typically chest wall pain can originate from bony (i.e. stress fractures) and non bony structures. Non bony causes of chest wall pain include the costo-chondral joints, intercostals, fascia and thoracic referral. Failing to diagnose a bony cause of chest wall pain early may allow an athlete to continue training, potentially making the stress reaction or stress fracture worse. Conversely, late diagnosis of a non-bony pathology may lead to time removed from training that is not necessary.

Methods: Rowing Australia has an injury surveillance system in operation across all SIS/SAS scholarship holders. This system enables the capture of diagnosis, causes and time lost from training for all injuries.

Results: During the 2009 & 2010 domestic and international seasons, amongst elite rowers across Australia, there were 28 cases of chest wall pain that caused a loss of rowing training time. Thirteen of these were confirmed to be bone stress by positive bone scan, while 15 were diagnosed as non bony chest wall pain, with many, but not all confirmed with a negative bone scan. The time cost of a bony injury is 4-5 times greater than non bony. Rib stress reactions generate an average of 47.8 days time lost and rib stress fractures 60.0 days time lost. In comparison with 12.6 days time lost with other chest wall pain. During the same time period, elite rowers presenting with chest wall pain were monitored at each treatment occasion for the presence of a number of subjective and objective markers. The subjective markers were night pain and pain on activities of daily living (e.g. opening a door, carrying a bag). The objective markers were pain response to deep breath, cough, push up and sit up. There are marked differences between the two groups in the onset, severity, number and longevity of these presenting signs that may allow the early differentiation of the two clinical entities.

Conclusion: This information, plus the time frames captured by the injury surveillance system, has been used to generate a clearer picture of chest wall pain in rowers. It has enabled the development of a clinical management pathway to guide treating practitioners.

217 Does higher anterior knee joint laxity alter landing biomechanics in pubescent girls? Implications for non-contact ACL ruptures

C. Wild^{1*} ■ J. Steele¹ ■ B. Munro¹ ■ ¹University of Wollongong

Introduction: From the onset of puberty females are at a greater risk of sustaining a non-contact anterior cruciate ligament (ACL) rupture compared to males. Increased anterior knee laxity (AKL) in females has been proposed as a possible cause of this increased ACL injury risk, due to the associated decrease in dynamic knee joint stability during movements such as landing. Despite this association, there is a dearth of literature investigating the effects of increased AKL on lower limb landing biomechanics in adolescent girls. This study aimed to investigate whether adolescent girls with higher AKL displayed altered landing biomechanics compared to adolescent girls with lower AKL.

Methods: Forty-six healthy girls (10-13 years), confirmed as Tanner stage II-III, were recruited and tested at their time of peak height velocity (PHV; peak growth in height). Passive AKL was quantified and used to classify participants into a higher (peak displacement > 4 mm) and a lower (peak displacement < 3 mm) AKL group (n = 15/group), with the 16 middle participants removed to ensure a significant between-group difference in AKL. Participants then performed a functional, single-limb landing movement, during which three-dimensional lower limb kinematics (100 Hz), ground reaction forces (1,000 Hz) and muscle activation patterns (1,000 Hz) were assessed. Independent samples t-tests were applied to the data to determine any significant ($p \leq 0.05$) differences in lower limb landing biomechanics displayed by the higher AKL group relative to their lower AKL counterparts.

Results and Discussion: Although all testing was performed at the time of PHV, girls with higher AKL displayed significantly ($p = 0.018$) greater height velocity compared to girls with lower AKL (12.3 cm.y⁻¹ vs 9.5 cm.y⁻¹). Girls with higher AKL also demonstrated significantly smaller hip flexion ($p = 0.05$) and abduction angles ($p = 0.023$) at the time the peak vertical ground reaction force was generated, as well as greater peak knee internal rotation moments ($p = 0.032$) and hip abduction moments ($p = 0.011$). Increased internal rotation loads at the knee have been associated with an increased risk of ACL rupture. **Conclusion:** We speculate that the combination of decreased knee joint stability and increased height velocity may contribute to altered knee joint loading at the time of PHV, increasing the risk of ACL injury in girls with higher AKL. Further research is warranted to quantify whether height velocity may affect AKL and, in turn, landing mechanics and knee joint loading, during puberty.

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Using a 3D integrated stereoscopic system to investigate the biomechanics of evasive sidestepping: Implications for ACL injuries

M. Lee^{1*} ■ B. Lay¹ ■ D. Lloyd^{1,3} ■ P. Bourke² ■ J. Alderson¹ ■ ¹School of Sport Science, Exercise and Health, University of Western Australia
²VECC@UWA, University of Western Australia ■ ³Musculoskeletal Research Program, Griffith Health Institute, Griffith University

Purpose: Sidestepping is a context specific perceptual-motor skill commonly performed in team sports to evade opponent(s), but has never been investigated in conditions resembling game situations. This study examined selected trunk and lower body kinematics, kinetics, and muscle activation of high-level (HL) and low-level (LL) soccer players, during sidestepping to evade projected, three-dimensional (3D) stereoscopic defender(s). These comparisons were made with traditionally used two-dimensional planned and unplanned arrow stimuli. Implications for anterior cruciate ligament (ACL) injury prevention were discussed.

Methods: A customised integrated stereoscopic system captured the 3D trunk and lower limb kinematics, and activation of 8 knee muscles, of 15 HL and 15 LL soccer players during the sidestepping tasks. The visual stimuli consisted of a one-defender scenario (1DS), two-defender scenario (2DS), arrow-planned condition (AP), and arrow-unplanned condition (AUNP). Temporal constraints imposed by the stimuli for sidestepping performance increased in the following order: AP, 1DS, 2DS, AUNP. A kinematic model was used in conjunction with force plate data to investigate knee valgus loading. Post-processed electromyography data were grouped into knee flexors and extensors to form co-contraction ratios. Muscles were also grouped into medial or lateral groups to form co-contraction ratios, depending on their ability to counter externally applied varus or valgus moments. Dependent variables were submitted to a 4 x 2 (stimulus x skill) mixed design ANOVA.

Results: Stimuli significantly affected all measurements ($P < 0.05$). Placement of the support step prior to footstrike, peak frontal plane trunk flexion during stance, and peak knee valgus moments increased in accordance with stimuli imposed temporal constraints. At footstrike, push-off foot placement and hip abduction were similar in the 3D defender scenarios, suggesting an overarching influence of stimuli imposed spatial constraints. Muscle activation levels were similar across stimuli conditions. In the 2DS, the shift from a flexor dominant co-contraction strategy in pre-contact toward extensor dominance in weight-acceptance commenced earlier for the HL compared with the LL players. High-level players exhibited decreased hip abduction and knee valgus moments in the 2DS.

Conclusion: Visual cueing affected sidestepping biomechanics. Sidestepping biomechanics of the HL and LL players only differed in the 2DS, due to the presence of visual-perceptual constraints resembling game situations, and the level of stimuli complexity. Using 3D stimuli to investigate sidestepping in a controlled environment addresses both the visual-perceptual and motor components of the manoeuvre. Such an approach has been suggested to improve the efficacy of ACL injury prevention models.

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Does trunk flexion affect knee extensor moments during landing in volleyball players?

I. Janssen^{1,2*} ■ J. Steele¹ ■ B. Munro¹ ■ N. Brown² ■ ¹Biomechanics Research Laboratory, University Of Wollongong ■ ²AIS Movement Science, Australian Institute of Sport

Introduction: Volleyball players suffer a disproportionately high number of overuse knee injuries, particularly when performing blocking movements. Blocking is characterised by numerous jump-land manoeuvres, typically performed with low trunk flexion upon landing due to constraints imposed by the volleyball net. It is possible that these constraints to trunk flexion affect knee extensor moments during landing, whereby excessive knee extensor moments have been associated with overuse knee injuries. The aim of this research was to examine the influence of trunk flexion on knee extensor moments during landing from block jump landings.

Methodology: Fifteen male volleyball players (24.3 ± 5.5 years; 82.80 ± 12.8 kg; 1.87 ± 0.05 m) performed five trials of a slide-step block jump landing moving to the left. Kinematic (250 Hz; VICON) and kinetic (1500 Hz; Kistler force platforms) data were collected and internal knee extensor moments for the lead (left) and trail (right) limbs calculated for each subject. Paired t-tests determined whether there were significant ($p \leq 0.05$) differences in knee extensor moments between the lead or trail limb and a Pearson's correlation was used to determine the relationship between knee extensor moment and trunk flexion during landing.

Results and Discussion: A significantly higher knee extensor moment was generated by the lead limb during landing compared to the trail limb (2.66 Nm/kg vs. 2.26 Nm/kg; $p = 0.007$), suggesting that movement direction affects the knee extensor moments generated during landing. As court position determines movement direction, this result may help identify which volleyball athletes are susceptible to knee injuries, particularly to the lead limb. No significant relationship was found between trunk flexion at the time of the peak knee extensor moment and knee extensor moment ($p = 0.577$ lead limb; $p = 0.249$ trail limb). This suggests that athletes employ a range of trunk flexion angles during landing (range = -14°-34°) and this does not affect knee extensor moments in a systematic way.

Conclusion: In a volleyball-specific movement, trunk flexion was not significantly related to the knee extensor moment during landing. The varying amount of trunk flexion employed by volleyball players may explain this finding with some athletes utilising a trunk extension strategy potentially to avoid touching the net. Further research is required to investigate the effect of trunk rotation and lateral flexion on frontal and transverse plane moments during these landings to provide insight into factors contributing to knee injuries in volleyball players, particularly during blocking.

220 The relationship between technique and high knee loads related to injury in landing tasks

A. Dempsey^{1,2,3*} ■ B. Elliott³ ■ D. Lloyd^{1,2,3} ■ ¹Musculoskeletal Research Program, Griffith Health Institute, Griffith University

²School of Physiotherapy and Exercise Science, Griffith University ■ ³School of Sports Science, Exercise and Health, University of Western Australia

Introduction: Athletes suffering an anterior cruciate ligament (ACL) injury tend to exhibit similar body postures. These body postures have been associated with increased valgus and internal rotation moments at the knee in sidestep cutting. However this relationship between full body postures and knee loads has not been investigated in landing. Catching a ball in different overhead positions during ball marking in Australian football may affect landing postures and the aforementioned knee joint moments. This study investigated these possible relationships. It was expected that some joint postures similar to those observed during actual injuries, would be associated increased knee loads during landing.

Methods: Twenty five healthy male team sports athletes performed four variations of a landing task that mimicked overhead marking of a ball in Australian Football. Full body kinematics were identified at initial contact. Peak flexion, valgus and internal rotation moments at the knee measured during early landing were normalized to mass and height and statistically compared. Intra-participant correlations were performed between all kinematics and each moment. Mean slopes for each correlation were used to identify the existence of relationships between full body kinematics and knee joint moments.

Results: Increased knee valgus moments were correlated with increased knee flexion, hip flexion, torso lean and torso rotation towards the support leg, and foot and knee external rotation. Increase internal rotation moments, which were similar for all tasks, were correlated with reduced hip abduction and external rotation, increased ankle inversion, knee external rotation and torso lean away from the support leg.

Conclusion: Specific body postures were associated with increased knee joint moments related to ACL injuries. The postures linked to injury, specifically a leaning torso and external rotation at the knee, are similar to those observed during ACL injuries. Higher knee moments being associated with increased knee flexion is contrary to what has previously been reported the literature and further investigation is needed into this relationship Training athletes to avoid high loading postures has reduced knee loads in sidestepping, and future work should investigate is similar results can be achieved during landing tasks.

221 Hamstring tendon autograft does not protect the patellofemoral joint from osteoarthritis after anterior cruciate ligament reconstruction: 7 year follow-up

H. Morris^{1*} ■ K. Crossley¹ ■ M. Makdissi¹ ■ C. Lai¹ ■ B. Gabbe¹ ■ ¹University of Melbourne

Introduction: Early tibiofemoral joint (TFJ) osteoarthritis (OA) frequently develops secondary to anterior cruciate ligament reconstruction (ACLR). The few studies that have evaluated patellofemoral joint (PFJ) reported a high prevalence of PFJ OA (~46%) >7 years post surgery. Notably, these studies only followed up people who had a patellar tendon autograft, which is known to be associated with PFJ morbidity. This study aimed to: (i) describe the prevalence of radiographic PFJ and TFJ OA, 7 years after ACLR using a hamstring tendon autograft (HT); (ii) compare OA symptoms, anterior knee pain symptoms, ACLR outcome and activity levels between people with PFJ OA and those who were free of OA; and (iii) compare the range of knee motion and functional performance between people with PFJ OA and those with no OA.

Methodology: 70 people with a HT ACLR from a single surgeon 5-10 years previously were recruited and performed: (i) standard radiographs (postero-anterior (PA) to grade the TFJ, skyline to grade the PFJ) (ii) questionnaires including the Knee Osteoarthritis Outcome Score (KOOS), Anterior Knee Pain Scale (AKPS), Tegner Activity Scale, International Knee Documentation Committee (IKDC) Subjective Knee Form, International Physical Activity Questionnaire; (iii) range of knee movement and functional performance examination.

Results: Of 70 participants, radiographic PFJ OA was evident in 47% (33/70) and radiographic TFJ OA was evident in 33% (23/70). In total, 48% (34/70) exhibited no radiographic evidence of either TFJ or PFJ OA. Of the 36 (51%) people with radiographic OA, isolated PFJ OA was the most common distribution (41%), followed by tri-compartmental distribution (31%), then lateral TFJ and PFJ distribution (13%) combined medial TFJ and PFJ (8%) and isolated TFJ (8%). Between-group comparisons revealed no differences age, height, weight or activity level for people with PFJ OA than those with no radiographic OA. People with radiographic PFJ OA had significantly worse scores on the AKPS, IKDC and most scales of the KOOS than those without OA. There was no difference in the range of knee extension between those with PFJ OA and those with no OA, but participants with PFJ OA performed significantly worse on functional tests than those who were free of OA.

Conclusion: PFJ OA is relatively common ~7 years after HT ACLR and is associated with worse symptoms and reduced functional performance.

222 Double-bundle versus single-bundle anterior cruciate ligament reconstruction – Is the double bundle technique really better?

K. Webster^{1*} ■ T. Whitehead² ■ P. Seccombe¹ ■ ¹La Trobe University ■ ²OrthoSport Victoria

Background: The traditional surgical treatment for ACL rupture is single-bundle reconstruction. Over the past few years there has however been a shift in interest toward double-bundle reconstruction which more closely restores the native ACL anatomy. This study examined the clinical outcomes of single-bundle (SB) and double-bundle (DB) ACL reconstruction procedures.

Methods: One hundred and forty two patients who had undergone SB (n=69) or DB (n=73) primary hamstring ACL reconstruction were evaluated at a minimum 12 months after surgery. Evaluation included IKDC subjective and objective ratings, SF-36, single assessment numerical evaluation, functional hop tests and anterior knee laxity (KT-1000).

Results: Significantly more patients in the DB group had knee effusions and flexion and extension deficits compared to the SB group. Whilst there was no difference in knee laxity between the groups, overall IKDC knee evaluation scores were significantly better for the SB group as were limb symmetry functional hop scores. For patient self report outcomes, both IKDC subjective knee ratings and the single assessment numerical evaluation were significantly better for patients in the SB group. For the SF-36, the SB group also scored significantly higher on a number of subscales including physical function and role physical.

Conclusions: These findings show that single bundle ACL reconstruction performs as well as a double bundle technique. The single bundle technique was associated with a greater range of knee motion, better function and higher quality of life scores.

B. Appleby^{1*} ■ N. Hori² ■ ¹Emirates Western Force, RugbyWA ■ ²Athlete and Coach Services, Western Australian Institute of Sport

Introduction: Balance between opposing muscle groups has long been encouraged to prevent muscle injury (eg. External to internal shoulder rotator cuff, hamstring to quadriceps). The purpose of this investigation was to quantify the opposing horizontal pulling and pushing strength ratios in male athletes from rugby union (RU) and water polo (WP) using common field based tests.

Methods: A 1 repetition maximum (1RM) bench press (BPr), bench pull (BPI) and a concentric-only BPr (CBPr) were used to assess horizontal pulling and pushing strength over three separate testing occasions within a week. Six elite RU players (23.1 ± 3.1 years and 108 ± 9 kg) and seven semi-elite WP players (21.2 ± 4.6 years and 89 ± 16.6 kg) were familiar with the tests. The BPI exercise requires the lifter lie in a prone position on a high bench and pull a bar from the floor to the underside of the bench in a concentric only action. While BPr consists of eccentric and concentric action, there is no eccentric phase in BPI. To make a valid comparison between BPI and BPr, a CBPr was included in the testing. Strength ratios ($BPr/BPI \times 100$ and $CBPr/BPI \times 100$) and correlations were analysed in each sport separately, thus it allows us to discuss specific adaptations to the demands of respective sport.

Results: The 1RM BP, BPI and CBPr for RU were 141.7 ± 10.3 kg, 107.5 ± 7.6 kg and 122.1 ± 5.1 kg and for WP were 94.6 ± 22.2 kg, 84.3 ± 15.3 kg, and 92.1 ± 20.2 kg respectively. The BPr:BPI and CBPr:BPI ratio was $132\% \pm 6\%$ and $114\% \pm 6\%$ for RU and $112\% \pm 11\%$ and $109\% \pm 9\%$ for WP respectively. The correlations between BPr, BPI, and CBPr ranged from $r=0.94$ to 0.98 .

Conclusion: RU player demonstrated far superior absolute 1RM upper body strength compared to WP. However, the WP demonstrated a more balanced push to pull ratio of the upper body. The combative nature of RU requires pushing of opponents and withstanding impact forces during tackling. In WP, the aquatic environment does not permit such application of force. Whilst pushing and pulling strength training tends to be equally prescribed in RU, the injury risk to the shoulder in WP, from throwing and swimming, requires additional prescription of pulling exercises for the posterior muscle groups. This might explain the smaller BPr/BPI and CBPr/BPI ratio of WP players.

S. Keating^{1*} ■ E. Machan¹ ■ K. Rooney¹ ■ H. O'Connor¹ ■ I. Caterson¹ ■ N. Johnson¹ ■ ¹University of Sydney

Introduction: Epidemiological data show that the majority of the adult population fails to meet recommended physical activity levels, which contributes to the global epidemic of overweight/obesity and associated cardiovascular disease risk. Weight loss programs are often difficult to adhere to and poor compliance can be detrimental to the therapeutic effects. The primary reason cited for failure to participate in regular exercise is a perceived lack of time. There is emerging evidence that high intensity interval exercise training (HIIT) is a potent and time-efficient strategy for eliciting improvements in work capacity and body fat levels in young healthy adults. However, there has been no investigation of the efficacy of supra-maximal HIIT in an overweight sedentary adult population.

Methods: We have initiated a randomized placebo controlled trial to examine the effect of 12 weeks of HIIT versus continuous-type training on work capacity and body fatness. Sedentary and overweight (BMI 25-29.9 kgm⁻²) adult (18-55yrs) volunteers were randomised to receive three sessions/week of regular HIIT, continuous moderate intensity exercise (CONT), or placebo exercise intervention (PLA). Work capacity, measured by graded exercise test, and body fatness/fat partitioning measured by Dual-energy X-ray absorptiometry were assessed. Values are reported as means \pm SE pre- and post-intervention.

Results and Conclusions: To date, seven participants have completed the intervention and preliminary results suggest that work capacity was improved to a greater extent in HIIT ($n=2$) and CONT ($n=2$) (136.4 ± 26.4 W to 163.9 ± 40.4 W; 124.1 ± 29.9 W to 144.5 ± 33.2 , respectively) than in PLA ($n=3$; 146.7 ± 47.6 W to 157.7 ± 45.4 W). There was a tendency for total body fat to reduce in HIIT (39.1 ± 9.4 kg to 37.6 ± 9.5 kg) and CONT (30.7 ± 0.2 kg to 29.1 ± 0.3 kg) but not in PLA (37.3 ± 5.0 kg to 37.2 ± 4.7 kg). These effects reflected a reduction in gynoid fat distribution in HIIT ($48.3 \pm 10.3\%$ to $46.1 \pm 9.4\%$) and CONT ($48.5 \pm 0.7\%$ to $46.6 \pm 1.2\%$) but not PLA ($47.1 \pm 4.9\%$ to $47.2 \pm 4.1\%$) and android fat distribution in HIIT ($54.0 \pm 3.3\%$ to $52.4 \pm 2.1\%$) and CONT ($51.3 \pm 0.0\%$ to $49.4 \pm 2.0\%$) but not PLA ($49.8 \pm 4.3\%$ to $50.4 \pm 5.4\%$). The limited initial data suggest that both continuous-type exercise and HIIT are useful in improving work capacity, reducing body fat and reducing the distribution of android and gynoid fatness in overweight, previously sedentary adults.

P. Marshall^{1*} ■ ¹University of Western Sydney

There is an absence of literature investigating neuromuscular adaptation following different volumes of resistance exercise in trained individuals. Common measures include the maximal electromyography (EMG) signal, the EMG-torque relationship, and neuromuscular efficiency (force/EMG). Thirty-two resistance trained males were randomly assigned to a 6-week training period consisting of 1, 4, or 8 sets of squat exercise prescribed at 80% of a 1-repetition maximum. Subsequently, the same 4-week peaking program was prescribed to all participants. Maximal strength and neural measures were made throughout the training program. 1-RM squat strength significantly increased in all groups ($p<0.05$), but was greater for the 8-set compared to the 1-set group ($p<0.05$). Maximal EMG and the slope of the EMG-torque curve did not change following training in any group. Sub-maximal neuromuscular efficiency was significantly increased in the 8-set group only ($p<0.05$). The results of this study support high volume prescription, in excess of 4-sets, for optimal strength gains in resistance trained males. Furthermore, underlying neural adaptation was observed in the 8-set group suggesting improved contraction efficiency, which is related to research findings suggesting that resistance training increases corticospinal gain.

B. Thumwaree^{1*} ■ A. Nana¹ ■ W. Limroongreungrat¹ ■ W. Laksanakorn²¹College of Sports Science and Technology, Mahidol University, Thailand ■ ²Golden Jubilee Medical Center, Mahidol University, Thailand

Introduction: Physical inactivity is one of the factors that increase the risk of diseases of people with spinal cord injury (SCI). Improvements in cardiorespiratory fitness not only reduce incidence of diseases but can also improve quality of life. Wheelchair tai chi (WTC) is an alternative exercise for people who are confined to wheelchair. However, the effect of WTC on cardiorespiratory fitness has yet to be determined.

Purpose: The purpose of this study is to examine the effects of 8-week WTC training program on cardiorespiratory in individuals with SCI.

Methods: Thirty individuals with paraplegia with an ASIA scale of A-C volunteered in the study. The subjects were randomly assigned into either the WTC group (meanage 27.6 +/- 3.8, meanwt 55.6 +/- 8.4 Kg, meanht 167.7 +/- 10.0 cm) or Control group (CON)(meanage 27.2 +/- 4.9, meanwt 58.3 +/- 13.1 Kg, meanht 166.4 +/- 13.8 cm). Blood pressure (BP), heart rate (HR), and VO₂ peak were measured at the baseline (pre-test) and after 8 weeks (post-test). The WTC group received the training one hour a day, 3 days a week.

Results and Discussions: Independent t-test did not reveal any statistical significant differences of characteristics as well as BP and VO₂ peak between the two groups during the pre-test. For the post-test, although no statistical significant differences of BP, HR and VO₂ peak were found, WTC had greater VO₂ peak but lower resting HR than CON. When compared within group, WTC found significantly increased VO₂ peak ($p=0.001$) and decreased resting HR ($p=0.002$). However, no significant changes of blood pressure when compared both between groups and within group. It seems that WTC may help improve some cardiorespiratory fitness. Thus, it could be an alternative choice of exercises for SCI people. Nevertheless, further investigation with larger sample size and longer training time are warrant.

M. Klusemann^{1*} ■ T. Fay² ■ D. Pyne¹ ■ E. Drinkwater³ ■ ¹Australian Institute of Sport ■ ²University of Jyväskylä, Finland ■ ³Charles Sturt University

Deficiencies in physical performance may be attributed to poor basic movement fundamentals. **Purpose:** We examined correlations between Functional Movement Screen (FMS) scores and fitness test results in male and female junior basketball players.

Methods: Thirty nine male and female players (age 14-17 y) undertook a battery of fitness tests including the 20m-sprint, step-in vertical jump, agility, sit and reach, line drill test and the Yo-Yo intermittent recovery level 1 test. Five d later, the seven standard FMS tests (squat, hurdle step, in-line lunge, shoulder mobility, straight-leg raise, push up, and rotary stability) were performed involving one demonstration then two formal trials. The 'best' trial was scored on a scale of 0-3 with a maximum total of 21. Strength and power testing included a countermovement jump (CMJ), a 15 s push up and pull up test. The total FMS score (FMSsum7) was determined with a single score for each test where the worst score was used with those screens that involved a right and left side component. Correlations were determined between single and total FMS score and each physical performance test for both genders combined and then separately. The magnitude of correlation was interpreted as: 0-0.1 trivial, 0.1-0.3 small, 0.3-0.5 moderate, and >0.5 large.

Results: No substantial correlations were found between FMSsum7 and performance tests for both genders combined. For females, moderate correlations were observed between the FMSsum7 and Yo-Yo test ($r=0.39 \pm 0.34$; correlation coefficient $\pm 90\%$ confidence limits), and the agility test ($r=-0.41 \pm 0.32$). Small to moderate relationships were present between the FMSsum7 and the push up, yo-yo and CMJ tests in the male subjects, but correlations were unclear given large variability. Both the push up strength test and the FMS push up screen ($r=0.30 \pm 0.26$) and the sit and reach test and the straight-leg raise screen ($r=0.43 \pm 0.23$) had a moderate correlation in both genders combined. The sit and reach test had a large relationship with the straight-leg raise screen in male subjects ($r=0.50 \pm 0.32$).

Conclusion: FMS scores are moderately correlated with endurance and agility in females, and lower body flexibility in males. Deficiencies in some basic movement patterns may reveal potential areas of improvement for physical performance and assist coaches and support staff in training prescription.

K. Doma^{1*} ■ G. Deakin¹ ■ ¹James Cook University

Introduction: The assessment of muscle force generation capacity (MFGC) is effective in determining muscular fatigability following resistance training and its association to prevalence with injuries. Subsequently, the purpose of the current study was to examine the intensity and type of resistance exercises on MFGC immediately- and 6 hours post training.

Methodology: Male participants ($n=12$) performed high intensity whole body (HW), low intensity whole body (LW) and high intensity lower body only (HL) sessions in random order across three sessions. Exercises for HW and LW sessions were performed in the order of inclined leg-press, bench press and flat bench rows whereas the HL session solely consisted of inclined leg-press. The upper body and lower body exercises were performed with 4 and 6 sets, respectively. Exercises for HW and HL sessions were performed with 6 reps and 3 minutes rest between each set whereas exercises for the LW session were performed with 20 reps with 1.5 minutes rest between each set. MFGC of the right knee extensors were assessed prior to, immediately- and 6 hours following each of the resistance training session with an isometric dynamometer. A two-way (session x time) Friedman test was used to determine differences in MFGC.

Results: Peak and average forces were significantly greater during pre- compared to immediately post LW session ($P < 0.05$) and average force was significantly greater during pre- compared to immediately post HL session ($P < 0.05$). No significant differences in peak and average forces were found between pre- and 6 hours following LW and HL ($P > 0.05$), between pre-, immediately- and 6 hours following HW ($P > 0.05$) and between LW, HL and HW for immediately- and 6 hours following training ($P > 0.05$).

Discussion and Conclusion: A significant reduction in MFGC immediately following LW session indicates that a systemic effect was induced, exemplifying greater muscular fatigue compared to post HW session. Similarly, a significant reduction in MFGC following HL session was found despite comparable MFGC between pre- and immediately post HW session. These discrepancies in results may be because upper-body exercises were performed after leg-press causing a 30-minute window between the leg-press and the MFGC assessment for HW session. Subsequently, such findings indicate that physical activity may be performed immediately following high intensity- and 6 hours following high volume low intensity resistance training sessions constructed specifically for the current study with minimal risks of injuries.

L. Thongsomrit^{1*} ■ A. Nana¹ ■ W. Limroongreungrat¹ ■ W. Laksanakorn²

¹College of Sports Science and Technology, Mahidol University, Thailand ■ ²Golden Jubilee Medical Center, Mahidol University, Thailand

Introduction: After spinal cord injury (SCI), many people are confined to wheelchairs. Sitting balance is of importance for these individuals in order to perform several functional daily activities. Wheelchair tai chi (WTC) is an exercise which is primarily focused on shifting center of mass during seated position. Therefore, it may help to improve sitting balance in individuals with SCI. **Purpose:** The purpose of this study is to examine the effect 8-week WTC training on both static and dynamic sitting balance of individuals with SCI.

Methods: Thirty individuals with level of SCI below T1 were randomly assigned to either the WTC group (meanage 27.6 SD 3.8, meanwt 55.6 SD 8.4 Kg, meanht 167.6 SD 10.0 cm) or Control group (CON)(meanage 27.2 SD 4.9, meanwt 58.3 SD 13.1 Kg, meanht 166.4 SD 13.8 cm). The WTC received the training for 8 weeks. Center of pressures (COP) excursion and velocities in both antero-posterior (AP) and mediolateral (ML) directions were assessed to determine static and dynamic balance during a baseline (pre-test) and after eight weeks (post-test). Functional reach test (FRT) was also examined.

Results and Discussions: No significant differences of subjects' characteristics and balance variables between the two groups at the pre-test. At the post-test, FRT of WTC statistically significant increased as compared to CON ($p < 0.01$). Moreover, COP velocities during static testing were significant difference between the 2 groups in both directions ($p < 0.05$). For within comparison, only COP velocity of WTC showed the difference in the AP direction. On the contrary, no differences of all parameters were found in the CON as compared between the pre- and post-test. Wheelchair Tai Chi appears to show an improvement of static sitting balance in individuals with SCI. Nevertheless, a large sample size and different subjects groups are required for future investigations.

R. Robergs^{1,2*} ■ N. Vargas^{1,2} ■ S. Altobelli³ ■ L. McNaughton⁴ ■ J. Siegler⁵ ■ A. Hillman⁶ ■ J. Franssen²

¹Charles Sturt University ■ ²University of New Mexico ■ ³New Mexico Resonance ■ ⁴Bond University ■ ⁵University of Western Sydney ■ ⁶Hull University

Introduction: This study was completed to investigate the extent of phosphagen system depletion, intramuscular acidosis and their recovery during and between 3 bouts of high intensity forearm wrist flexion exercise.

Methods: Exercise was performed within a 1.9 Tesla 30 cm bore superconducting magnet. Eight subjects completed forearm incremental exercise to failure (0.5 or 1 kg/min) (Ex1), followed by 5 min recovery (Rec1), 2 min of intense exercise (Ex2), 5 min of recovery (Rec2), and 2 more min of intense exercise (Ex3). Muscle contractions occurred at a rate of 5.4 s per contraction cycle, and free induction decays (FIDs) were acquired at 4.5 s of each contraction cycle after a 45 ms excitation pulse. During exercise and recovery bouts, data of muscle phosphagen system metabolites were acquired using phosphorous magnetic resonance spectroscopy (31P MRS). Metabolite concentrations were normalized to the resting muscle ATP signal, which was assumed to equal 8.4 mmol/kg wet wt.

Results: Muscle pH significantly decreased from baseline rest (7.05 ± 0.31) and remained similar at Rec1, Ex2, Rec2, and Ex2 (6.61 ± 0.29 , 6.30 ± 0.30 , 6.75 ± 0.33 , and 6.39 ± 0.34 respectively). End-exercise CrP (15.6 ± 9.1 , 16.4 ± 10.9 , 14.8 ± 8.2 mmol/kg wet wt) and Pi (29.1 ± 10.7 , 26.7 ± 10.8 , 26.6 ± 13.1 mmol/kg wet wt) were similar across the three bouts, respectively. Despite subjects exercising to volitional fatigue in each bout, revealing appreciable metabolic strain as evidenced by pH, the phosphagen system was only utilized to 55 to 60% of capacity. Only 1 subject of 8 showed near complete CrP depletion. As exercise bouts 2 and 3 were similar to bout 1, muscle acidosis does not appear to influence phosphagen system energy contribution. Voluntary repeated human forearm exercise occurs to volitional fatigue in most subjects with considerable reserve remaining in muscle CrP. These findings differ to animal research, or human research involving artificial stimulation, and raise the question of why and how volitional exercise is constrained to prevent more extreme metabolic strain.

N. Vargas^{1,2*} ■ R. Robergs^{1,2} ■ L. McNaughton³ ■ J. Siegler⁴ ■ S. Altobelli⁵ ■ A. Hillman⁶ ■ J. Franssen²

¹Charles Sturt University ■ ²University of New Mexico ■ ³Bond University ■ ⁴University of Western Sydney ■ ⁵New Mexico Resonance ■ ⁶University of Hull

Introduction: The purpose of this study was to compare the effects of active (AR) vs. passive (PR) recovery during intense intermittent exercise of the forearm on changes in intramuscular creatine phosphate (CrP), inorganic phosphate (Pi) and pH using phosphorous magnetic resonance spectroscopy (31P MRS).

Methods: Exercise was performed within a 1.9 Tesla 30 cm bore superconducting magnet. Eight subjects completed forearm incremental exercise to failure (0.5 or 1 kg/min) (Ex1), followed by 5 min recovery (Rec1), 2 min of intense exercise (Ex2), 5 min of recovery (Rec2), 2 min of intense exercise (Ex3) and finally 20 min of recovery (Rec3). Muscle contractions occurred at a rate of 5.4 s per contraction cycle, and free induction decays (FIDs) were acquired at 4.5 s of each contraction cycle after a 45 ms excitation pulse. Metabolite concentrations were normalized to the resting muscle ATP signal, which was assumed to equal 8.4 mmol/kg wet wt. Subjects performed two trials involving PR and AR (0.5 kg load) at least 7 days apart.

Results: There were no differences between active and passive trials for any exercise or recovery data for CrP, Pi and pH. For main effect data, end exercise and end recovery data for each bout were all significantly different. For example, CrP decreased 58.9% from 34.8 ± 8.2 to 14.3 ± 8.1 mmol/kg from baseline to Ex1. After Rec1, Rec2 and Rec3, CrP was 31.0 ± 8.4 , 29.8 ± 9.5 , and 33.9 ± 8.8 mmol/kg wet weight, respectively. Similar yet inverse trends existed for changes in muscle Pi. Muscle pH decreased from 7.01 ± 0.23 at baseline to 6.33 ± 0.41 at Ex1. Muscle pH remained no different from Ex1 through each Ex and Rec interval, and at Rec3 attained values no different to rest (7.06 ± 0.14).

Conclusions: When performing high intensity intermittent exercise of the forearm, muscle phosphate metabolites can recover 75-90% of resting values within 5 min using active or passive recovery, and muscle pH can return to normal after 20 min recovery. There is no difference in metabolite recovery, short or long term, between a passive and low intensity active recovery.

232 The effect of exercise intensity on sweat rate and sweat sodium loss in well trained athletes

N. Holmes^{1*} ■ V. Miller¹ ■ G. Bates¹ ■ Y. Zheo¹ ■ ¹Curtin University of Technology

Introduction: Endurance athletes often train and compete in harsh environmental conditions prompting high sweat losses. The need to replace fluid lost during exercise is well documented however the replacement of sweat sodium losses has had far less focus. Symptoms of sodium depletion include fatigue, muscular weakness, muscle cramps and in severe cases may lead to circulatory failure. This study was designed to better understand the sweat rate and sweat sodium losses that occur during exercise of varying intensities in order to be able to more accurately determine sodium intake requirements in athletes.

Methodology: Eighteen male endurance athletes (age 38.6 ± 9.9 years, Weight 83.2 ± 13.6 kg, $\text{VO}_{2\text{max}}$ 57.4 ± 9.7 ml/kg.min) volunteered to be part of the study. Subjects were randomised into one of three groups for the experimental trials. Group 1 (L) began with the low intensity trial ($40\%\text{VO}_{2\text{max}}$), group 2 (M) with the moderate intensity trial ($70\%\text{VO}_{2\text{max}}$) and group 3 (H) with the high intensity trial (time trial). All subjects performed each of the three trials one week apart. Each trial consisted of 15 mins warm up followed by 15 mins at the various intensities where sweat was collected from the arms and legs.

Results: There was a significant ($p < 0.05$) increase in sweat rate with increasing exercise intensity in all 18 subjects ($L = 1.0\text{L/hr} \pm 0.3$, $M = 1.5\text{L/hr} \pm 0.4$, $H = 1.9\text{L/hr} \pm 0.3$). There was also a significant increase ($p < 0.05$) in sweat sodium concentration between the Low and the High exercise trials ($L = 30.0\text{mmol/L} \pm 2.5$, $H = 49.4\text{mmol/L} \pm 5.3$). Estimated average sodium loss (mg/hr) based on an individual's sweat rate ranged from 700mg/hr in the low intensity trial to 1350mg/hr in the moderate trial and 2200mg/hr in the high intensity trial.

Conclusion: There is considerable individual variation in sweat rate and sodium loss in athletes. This further highlights the need for fluid and sodium recommendations to be specific to the individual athlete based on their sweat rate, the environmental conditions as well as the type, intensity and duration of exercise. Based on these results the predicted sweat sodium loss in a high salt sweater training 4 hours per day could potentially be as high as 7-10g sodium (Na) or 17.5 – 25g salt (NaCl). Emphasis on the replacement of both fluid and electrolyte losses accompanying prolonged exercise in the heat is important in order to avert potential heat related illness and maintain performance.

233 The effect of warm-up on single and intermittent sprint performance

K. Wallman^{1*} ■ D. Bishop² ■ A. Morton¹ ■ P. Yaicharoen¹ ■ ¹University of Western Australia ■ ²Victoria University

Purpose: The effect of warm-up (WUP) on subsequent exercise performance has been equivocal. This may be due to the use of WUP intensities that were self-selected or based on a percentage of maximal oxygen uptake, where participants in a cohort were not working at the same metabolic load. Furthermore, the effect of WUP on repeated sprints that simulate those performed in team sports has not been well studied. Therefore the purpose of this study was to investigate the effects of WUP, versus no WUP, on 4 s single-sprint performance and prolonged intermittent-sprint performance (ISP; 80 min) where sprints simulated those performed in team sports. The first sprint of ISP (WUP and no WUP) was also compared to single sprint performance (WUP and no WUP).

Methods: Twelve male, athletes performed four trials on a cycle ergometer consisting of either prolonged ISP or single sprint performance, following either a WUP or no WUP. WUP intensity was performed midway between the lactate and anaerobic thresholds.

Results: There were no significant interaction effects between trials for prolonged ISP for total work (J·kg⁻¹), work decrement and power decrement ($P = 0.59$, $P = 0.50$, and $P = 0.37$, respectively). Work for the first sprint of ISP (no WUP) was significantly less ($P < 0.001$) compared to the first sprint of ISP (WUP) and to both single sprint performance trials (WUP and no WUP). Peak power output (W·kg⁻¹) for single sprint performance (WUP) was significantly higher ($P < 0.05$) compared to the no WUP trial, and to the first sprint of both ISP trials (WUP and no WUP).

Conclusion: WUP improved single sprint performance and the first sprint of prolonged ISP. Use of a pacing strategy during prolonged ISP may explain improved single sprint performance compared to the first sprint of prolonged ISP, as well as similar prolonged ISP between the WUP and no WUP trials.

234 An initial prospective exploratory investigation to identify predictors of calf cramping in rugby league players

K. Summers^{1*} ■ S. Snodgrass² ■ R. Callister² ■ M. Drew³ ■ ¹Therapy at Home ■ ²University of Newcastle ■ ³Newcastle Knights

Introduction: Exercise-Associated Muscle Cramps (EAMC) in the calf are common in the last 10 minutes of a rugby league game. This period is usually when a game is won or lost, therefore it is important a player's performance is not inhibited by calf cramps. To date there are no published studies on calf cramps in team sports that fluctuate in intensity. The study's aim was to identify predictors of calf cramping in rugby league players.

Methods: Male rugby league players ($n = 103$; mean age 18.8 years, range 15-34) were classified as either EAMC (experienced at least one occurrence of calf cramps throughout the season) or non-EAMC (no calf cramps). The following were considered as possible predictors of EAMC using logistic regression modelling: competition level, age, ethnicity, playing position, history of cramping, pre-cramping or low back pain, orthotic usage, foot posture and strike, muscle length and bulk, hydration, and number of games played. Players were categorised as either junior ($n = 44$; mean age 15.8 years, range 15-17) or senior (59; 21.1, 17-34) by the highest competition level played.

Results: Half of players, $n = 52$, experienced at least one incidence of calf cramping throughout the season with 21% of the EAMC group suffering four or more incidences of calf cramping. Experiencing EAMC in the previous season was found to be a strong predictor of EAMC (OR 10.85; 95% CI 2.16, 54.44; $p = 0.01$), and playing in a senior competition level was also associated with EAMC (OR 0.21; 95% CI 0.06, 0.75; $p = 0.02$).

A novel finding was the relationship between low back pain resulting in missed field minutes and EAMC (OR 4.50, 95% CI 1.37, 14.79; $p = 0.01$).

Discussion: Three hypotheses are proposed for the relationship between playing in a senior competition level and EAMC: (1) senior games are ten minutes longer than junior games, (2) seniors play 15 more competition rounds than juniors; and (3) senior player's mean age was six years older than junior players. For lower back pain, a hypothesis of altered neural transmission in the nerves supplying the lower limb is proposed, though potential sources of low back pain were not identified in the current study.

Conclusion: As this study suggests that there is a high incidence of calf cramping in rugby league, especially at senior competition levels it is recommended pre-season screening is undertaken in senior players to identify those at risk of calf cramping and develop possible preventative strategies.

J. Bonacci^{1,2*} ■ P. Blanch² ■ P. Saunders² ■ D. Green² ■ B. Vicenzino³ ■ ¹Deakin University ■ ²Australian Institute of Sport ■ ³University of Queensland

Introduction: Triathlon success depends primarily on a triathlete's ability to run efficiently after cycling. Running economy is influenced by the preceding cycle and previous investigations have reported variable changes in running economy after cycling in triathletes. However, there is little information on what measures of cycle intensity are related to subsequent running economy.

Purpose: To determine which commonly measured variables of cycling intensity are related to subsequent running economy.

Methods: Running economy was compared between a control run (no preceding cycle) and a run performed after a 45 min high intensity cycle in eighteen triathletes. Cycling intensity was monitored throughout the cycle using power output, heart rate, rating of perceived exertion (RPE) and blood lactate concentration. The relationship between these measures of cycle intensity and the change in running economy was evaluated using Pearson's correlation. Changes in running economy were also interpreted using the smallest worthwhile change (> 2.4%) and grouped accordingly (i.e. impaired, no change or improved running economy). The differences in cycle intensity between groups were evaluated using a one-way analysis of variance and Tukey's post hoc test.

Results: Triathletes' RPE at the end of the cycling bout was significantly associated with the change in running economy after cycling ($r = 0.57$, $p = 0.01$). Average RPE of the cycling bout and RPE at the end of the cycling bout were also significantly different between groups ($p = 0.04$ and 0.02 respectively). Post hoc tests revealed that average RPE and RPE at the end of the cycling bout were significantly different between the impaired and improved running economy groups, with increases in RPE scores being related to impairments in running economy ($p = 0.04$, standardized mean difference = 2.5 and $p = 0.02$, standardized mean difference = 2.8, respectively). None of the other variables of cycle intensity were associated with the change in running economy after cycling.

Conclusions: RPE during cycling is associated with subsequent running economy in triathletes. RPE is a simple, cost-effective measure that triathletes and their coaches can use in competition and training to control cycling intensity without the need for specialised equipment such as crank systems or blood analyzers.

N. Brophy-Williams^{1*} ■ G. Landers¹ ■ K. Wallman¹ ■ ¹School of Sports Science, Exercise and Health, University of Western Australia

Introduction: Cold water immersion (CWI) is a widely-used exercise recovery technique, however there has been little research into the specifics of its practice. This investigation aimed to determine the effects of CWI performed immediately or 3 hr after a high intensity interval exercise session (HIIS) on next-day exercise performance. **Design:** Cross-over design.

Methods: Eight male athletes performed three HIIS at 90% $\dot{V}O_{2\max}$ velocity followed by either a passive recovery (CON), CWI performed immediately post-exercise (CWI(0)) or CWI performed 3 hr post-exercise (CWI(3)). Participants then performed a Yoyo Intermittent Recovery Test [level 1] (YRT) 24 hr post the HIIS. Prior to the YRT, participants completed a muscle soreness and a totally quality recovery perception (TQRP) questionnaire.

Results: Significantly more shuttles were performed during the YRT following CWI(0) compared to the CON trial ($p = 0.017$, $ES = 0.8$), while differences between the CWI(3) and the CON trials approached significance ($p = 0.058$, $ES = 0.5$). YRT performance between the CWI(0) and CWI(3) trials were similar ($p = 0.147$, $ES = 0.3$). Qualitative analyses demonstrated a 98% and 92% likely beneficial effect of CWI(0) and CWI(3) on next day performance, compared to CON, respectively, while CWI(0) resulted in a 79% likely benefit when compared to CWI(3). Muscle soreness scores were similar between trials ($p = 1.10$), while TQRP scores were significantly lower for CON compared to CWI(0) ($p = 0.002$) and CWI(3) ($p = 0.024$).

Conclusions: Both CWI trials resulted in superior next-day performance compared to CON, while qualitative analyses suggested that CWI(0) resulted in better performance than CWI(3). These results are important for athletes who do not have immediate access to CWI following exercise.

SYMPOSIUM

E. Martin^{1*} ■ C. Bulsara^{2*} ■ P. Magrani do Rosario^{1*} ■ F. Naumann³ ■ M. Philpott¹ ■ C. Smith⁴ ■ C. Battaglini⁵ ■ D. Groff⁶ ■ ¹University of Notre Dame Australia ■ ²University of Western Australia ■ ³University of New South Wales ■ ⁴Breast Cancer Care Western Australia ■ ⁵University of North Carolina at Chapel Hill, USA

Recent reviews and meta-analysis have stated that intervention characteristics need comparing to determine the optimal mode of rehabilitation for cancer survivors. The guidelines for these characteristics need to come not only from empirical evidence but also from patient preference and feedback. The aim of this symposium is to present quantitative and qualitative results from different projects within the Get REAL & HEEL Breast Cancer Rehabilitation Program in the USA, its sister Cancer Survivorship Program in Australia, and research conducted at the University of Newcastle. This symposium will present on the needs of breast and prostate cancer survivors and the results of studies that have tried to meet those needs. Paper one qualitatively describes the experiences of men and women after receiving their cancer diagnosis and how they coped on their own. Second, Dr. Taaffe will present on how prostate cancer survivors perceive a program needs to be delivered to be valuable, professional, and conducive to their preferences. The third paper describes the use of the MVe Fitness Chair for rehabilitation in this breast cancer survivors. Paper four compares individual and group formats for an exercise and counselling program, focusing on fatigue outcomes. Paper five presents the feasibility and efficacy of the group exercise and counselling program from a quantitative perspective, while paper six delves deeper into the group program to assess it from a qualitative perspective. To conclude, Martin will discuss how these results inform what a rehabilitation program should and could be from both a researcher's perspective and from a participant's perspective.

Paper Title 1: The gendered experiences of men and women after diagnosis of and treatment for prostate and breast cancer

Paper Title 2: Exercise programming and counselling preferences in men with prostate cancer

Paper Title 3: Improving muscular endurance with the MVe Fitness Chair in breast cancer survivors: A feasibility and efficacy study

Paper Title 4: The effects of an individual versus a group delivered exercise and counselling intervention on fatigue in breast cancer survivors

Paper Title 5: Feasibility and efficacy of a group exercise and counselling program for breast and prostate cancer survivors

Paper Title 6: What men and women want: The experiences of men and women in a group exercise and counselling cancer recovery program

C. Bulsara^{1*} ■ E. Martin² ■ F. Naumann³ ■ C. Smith⁴ ■ M. Philpott²

¹University of Western Australia ■ ²University of Notre Dame Australia ■ ³University of New South Wales ■ ⁴Breast Cancer Care Western Australia

Introduction: Both exercise and counselling have been shown to be effective modes of improving quality of life (QOL) in cancer survivors post treatment. While many exercise or counseling interventions have been delivered to cancer survivors, few studies have combined the two modalities to assess if a more comprehensive rehabilitation can be achieved. This study provided a comprehensive group counselling and exercise program for breast and prostate cancer survivors.

Methodology: A series of in-depth semi structured interviews were conducted with 28 participants (11 male, 17 female). Thematic analysis was completed using QSR NVivo and a number of key themes emerged around the topic of program experience. This paper will focus on the results as they pertain to patient preference and needs for a program and the narrative impacts of the program.

Results and Discussion: The thematic analysis identified significant needs that patients identified with the program. These main needs were dealing with longer term psychological issues around surviving cancer, successfully changing fitness behaviors, and regaining control in their life. Another major theme was that the patients recognized the need to make a personal commitment to themselves to participate in this program despite how it may conflict with their normal schedule. Participants identified the major components of the exercise and counseling experiences and why each was important to them. They also discussed how the two modes had to coexist in order to serve their needs. The overarching theme amongst participants was that the group cohesion became the focus of the program, and that it became the main facilitator of the program. Both exercise and counselling facilitated group bonding, and the group cohesion reciprocated in making the interventions more effective. The final benefits from the program include increasing personal control and energy, affirming self identity, adopting a healthier lifestyle, and increasing their social support network. The main lingering question at the end of the intervention was how each individual could maintain their new and healthier life, and how the groups could continue their existence.

Conclusion: The feedback from these participants can help create a model by which practitioners can optimize rehabilitation program design. It also identifies the need for long term follow up with patients to help them maintain changes adopted during an intensive short term program.

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O. Close¹ ■ K. Bolam¹ ■ D. Galvao² ■ N. Spry³ ■ R. Newton² ■ D. Taaffe^{4*}

¹University of Queensland ■ ²Edith Cowan University ■ ³Sir Charles Gairdner Hospital ■ ⁴University of Newcastle

Introduction: Men with prostate cancer may be less likely to participate in regular physical activity making them particularly vulnerable to developing cardiovascular disease and osteoporosis, which is compounded by treatments such as androgen deprivation therapy. Understanding exercise programming and counselling preferences may represent an effective method for enhancing exercise participation and adherence in these men. The purpose of the study was to investigate the exercise programming and counselling preferences for men with prostate cancer.

Methods: Ninety men aged 48-84 years from South East Queensland prostate cancer support groups completed a questionnaire that included questions related to exercise history, motivation and beliefs, exercise programming preferences, and exercise counselling history and preferences.

Results: The majority of the men had localised disease (85%) with a Gleason score of 6-9, and 39% had undertaken hormone therapy. Exercise counselling had been received by 40% of the participants primarily from their urologist, general practitioner, or physiotherapist. The majority of respondents viewed exercise as necessary (86%) and were motivated to exercise for health improvement (66%). In general, participants were interested (61%) and physically able (76%) to participate in an exercise program, with most preferring the program to comprise walking (55%) and resistance exercise (25%) performed at a moderate intensity (57%), 3-4 times per week (44%), and held in the early morning (42%). Most of the respondents preferred to be counselled by an exercise physiologist/specialist (48%), face to face (82%), and at a medical centre (35%). Exercise counselling and programming were preferred by the majority to be undertaken before cancer treatment (67% and 62%, respectively). The main barriers to exercise were poor health (25%), lack of interest (22%), and lack of time (21%).

Conclusions: We observed that most men with prostate cancer were interested in an exercise program and had clear preferences with regards to exercise counselling and programming which were, in general, consistent with previous research into other cancer populations. These findings highlight the opportunity for exercise physiologists to become more involved in oncological health care and provides valuable information for improving exercise programming and counselling in men with prostate cancer.

E. Martin^{1*} ■ C. Battaglini² ■ D. Groff² ■ F. Naumann³ ■ ¹University of Notre Dame ■ ²University of North Carolina at Chapel Hill, USA ■ ³University of New South Wales

The American College of Sports Medicine Roundtable on Exercise Guidelines for Cancer Survivors highlighted a need to expand our exercise programming knowledge, specifically citing Pilates as a possibly safe and effective mode for use in breast cancer survivors. The purpose of this study was to assess the feasibility and efficacy of using the MVe Fitness Chair to program and deliver Pilates exercises to breast cancer survivors. The study compared the MVe Fitness Chair (MFC) to traditional weight lifting (TWL). Twenty six female breast cancer survivors were randomized the MFC (n=8), TWL (n=8), or a control group (CO) (n=10). The MFC and TWL groups completed 8 weeks of training, while the CO was asked to not exercise between pre and post test. All possible attempts were made to match the MFC and TWL training protocols, specifically through sequence of exercise, volume of training, and intensity of training as measured through rating of perceived exertion. Muscular endurance was assessed pre-test and post-test for comparisons within and between groups. Statistically significant improvements in muscular endurance were observed in the MFC (p < 0.00) and TWL groups (p < 0.00) from pretest to posttest, while the CO had virtually no change (p < 0.96), making the MFC and TWL significantly different from the CO (p < 0.00 and p < 0.00 respectively). The between the MFC and TWL groups was not statistically significant (p < 0.71) indicating that Pilates and weight training may be equally effective at improving muscular endurance. Both interventions also provided clinically significant gains (a previous study identified greater than 48% improvement as clinically significant) in muscular endurance, with the MFC improving 57% and the TWL improving 71%. One explanation for the difference is that the protocol used to assess muscular endurance and the exercises used for the TWL intervention were similar, thus the specificity of training may have allowed for better assessment performance in the TWL group when compared with the MFC group. The results suggest that for an 8 week training program, the MFC appears to promote similar changes in muscular endurance when compared to TWL and could be promoted as a valuable alternative to traditional weight lifting. The findings also expand the possible modes of exercise for cancer survivors, enabling exercise programming to be designed around patient preference.

P. Magrani do Rosario^{1*} ■ F. Naumann² ■ E. Martin¹ ■ ¹University of Notre Dame Australia ■ ²University of New South Wales

Introduction: Fatigue has been considered a common and distressing symptom experienced by cancer patients, which may persist for years after treatment. Recent studies indicate combining physical and psychological interventions may provide an efficient method to manage the cancer-related side-effects, specifically fatigue. The aim of this study was to compare the effectiveness of a group-based (GEXC) versus individual-based (IEXC) combined exercise and counselling intervention on fatigue in breast cancer survivors.

Methods: Twenty-eight women (53 years, 164.6 cm, 75.3 kg) post-treatment for breast cancer (7 months) were eligible and completed the study. They were allocated into GEXC (n=10), IEXC (n=10) or usual care (USC, n=8) groups. Fatigue was assessed by the Piper Fatigue Scale (PFS) before and after the 9-week intervention. Participants from IEXC performed one-on-one sessions involving flexibility, resistance and aerobic training. Participants from GEXC performed classes such as Pilates, hydrotherapy, boxing, outdoor walking and circuit classes. Both interventions consisted of three supervised exercise sessions per week and a weekly counselling session. Counselling session topics included stress management, searching for the positive, concerns with family and friends and dealing with issues of the past. Logbooks were recorded for each participant. Change scores from pre to post-intervention, between treatment groups were compared by using one way ANOVA. Statistical significance was at p ≤ 0.05 and a change of one unit on the PFS was considered clinically significant.

Results: There was a clinical and statistical significant reduction in total fatigue for both IEXC (5.7 to 3.1, $p < 0.01$) and GEXC (5.2 to 3.3, $p < 0.01$) across time when compared to USC (3.9 to 4.3). There was also a clinical and statistical significant reduction in all fatigue subscales for both IEXC and GEXC when compared to USC, except for affective fatigue in GEXC that did not reach statistical significance (4.9 to 3.4, $p < 0.15$). The results revealed no significant difference between individual versus group delivery in any of the PFS scores. Individuals from GEXC attended 85% of the sessions and from IEXC, 79% of the sessions. There was no difference in relation to adherence between the groups ($p < 0.75$).

Conclusions: Both intervention groups were shown to be superior in reducing fatigue when compared to USC. There was no statistical difference between individual versus group delivery for change in fatigue, thus both interventions might be suitable and effective to reduce fatigue in breast cancer survivors.

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Feasibility and efficacy of a group exercise and counselling program for breast and prostate cancer survivors

E. Martin^{1*} ■ F. Naumann² ■ P. Magrani do Rosario¹ ■ C. Smith³ ■ ¹University of Notre Dame Australia ■ ²University of New South Wales ■ ³Breast Cancer Care Western Australia

Introduction: The purpose of this study was to test the feasibility and efficacy of a group exercise and counselling program for breast and prostate cancer survivors.

Methods: Subjects were recruited by flyers distributed to oncologists, nurses, and doctors in the Perth area. Eligibility criteria were: men and women diagnosed with early stage (I, II, or III) prostate or breast cancer, respectively; within 5 years of completing all acute treatments; and not currently in a structured exercise or counselling program. Participants underwent baseline physiological and psychological assessments, participated in a group exercise (3x/week) and counselling (1x/week) program for 8 weeks, and then had a post test assessment. Assessments were compared from pre-test to post-test with a repeated measures ANOVA.

Results: Of 67 possible participants, only 46% ($n = 31$) enrolled in the study, and 90% of those completed the whole program ($n = 17$ women, 11 men). The two most common reasons for not enrolling were schedule conflicts or travel distance to program site. Dropouts were due to non-related sickness or injury or lack of motivation. Adherence to the program was 85% for the women for both parts. Men attended 80% of counselling sessions and 87% of exercise sessions. The men significantly improved static balance ($p < 0.05$), dynamic balance ($p < 0.01$), and lower body strength ($p < 0.01$). The women significantly decreased body fat % ($p < 0.05$) and improved static and dynamic balance ($p < 0.05$), aerobic capacity ($p < 0.01$), lower back and hamstring flexibility ($p < 0.05$) and quality of life ($p < 0.01$).

Discussion: Based upon retention and adherence rates, this program design works very well for those who can commit to 4.5 hours per week. However, the poor recruitment rate shows that such a program is not feasible for all. Some people may need home visits or telephone and internet based interventions to supplement assessment and orientation sessions with an exercise physiologist. However, telephone, internet, or book based interventions without the exercise physiologist contact may not work as patients would not be motivated to complete them on their own. The current program showed almost across the board gains in the women, but not in the men. Most of the men who enrolled in this program happened to be fit already, and therefore had less room to improve. The women were mostly sedentary, with little experience exercising, and had a greater potential to adapt to the stimuli.

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What men and women want: The experiences of men and women in a group exercise and counselling cancer recovery program

E. Martin^{1*} ■ C. Bulsara² ■ F. Naumann³ ■ P. Magrani do Rosario¹ ■ C. Smith⁴ ■ M. Philpott¹

¹University of Notre Dame Australia ■ ²University of Western Australia ■ ³University of New South Wales ■ ⁴Breast Cancer Care Western Australia

Introduction: While the medical science of diagnosing and treating breast and prostate cancer has dramatically improved in the last decade, patients still find the experience traumatizing. By better understanding the patient experience, health care practitioners can better meet their needs and improve their quality of life (QOL).

Methodology: This study compared the experiences of men and women who had completed treatment for prostate or breast cancer and who were attending a combined group exercise and counselling program. A series of in-depth semi structured interviews were conducted with 28 participants (11 male, 17 female) in groups of 4-6. Thematic analysis was completed using QSR NVivo.

Results and Discussion: Analysis of the results identified seven major themes around treatment experience and impact on QOL. While the themes were similar between men and women, there were some perceived differences depending on the gender of participants. Both sexes expressed dissatisfaction with their treatment and follow up, but had different views on what they needed. In general, the men seemed to have worse experiences, partly due to the lack of focus on men's needs while there is an abundance of attention given to breast cancer. Both the men and women identified family as the most important part of their QOL, though their views of their role within the family were very different. With self identify, sexuality, and fear and anxiety, most of the issues were the same, such as a dislike of being labeled a survivor or a reciprocal link and decrease in self identify and sexuality. Some of the specifics of each were due to differences in treatment and side effects.

Conclusion: Overall, while the men and women had some similar experiences, their interpretations of the experiences were different in the details and meanings. A major contributor to this is likely to be social expectations of gender standards. The stereotype of men as the strong, silent, self-reliant type who don't talk about their feelings has led to a culture of poor care amongst prostate cancer survivors. While improvements are needed for breast cancer survivor care as well, one main target of health care providers should be to bring the care for prostate cancer survivors up to par. Another goal should be the provision of holistic care that takes into account not only physical and medical outcomes, but psychological and QOL outcomes.

KEYNOTE

Club Warehouse and Australian Institute of Sport Supported Speaker

E. Witvrouw^{1*} ■ D. Van Tiggelen¹ ■ Y. Thijs¹ ■ ¹Ghent University, Belgium



Introduction: Despite the high number of scientific publications about patellofemoral pain syndrome (PFPS), there are rather few studies investigating risk factors for PFPS. The identification of risk factors is important concerning a better understanding of the etiology of PFPS. To improve our insight we have in our research centre set up several prospective studies over the last decade.

Methods: We have set up a prospective study in students Physical education and examined several antropometrical, physical and psychological parameters. To improve the methodology used in this first prospective study we set up a new prospective study in which we focussed on dynamic foot malalignment, and neuromuscular dysfunctions as risk factors for the development of PFPS in a military population. In addition we set up a prospective study in novice runners to evaluate if abnormalities in hip muscle strength can be considered as risk factors for PFPS. In order to evaluate the hypothesis that hip muscle abnormalities will lead to malalignment of the knee joint, an additional study was set up to correlate the hip muscle strength with frontal plane movement of the knee. Binary logistic regression analysis was used to identify possible risk factors of PFPS. The data from these studies were analyzed by SPSS software.

Results: The results of our first prospective study identified only four parameters as intrinsic risk factors for the development of PFPS. These parameters are: decreased flexibility of the Quadriceps; decreased explosive strength of the Quadriceps; altered neuromuscular coordination between VMO and VL; and a hypermobility of the patella. Striking was that we did could not identify a malalignment parameter as a risk factor for the development of PFPS.

Our second prospective study however identified a more lateral directed pressure distribution at initial contact during walking and a more laterally directed rollover as risk factors for the development of PFPS. In this prospective study we also observed (again) that a delayed activation of the VMO compared to the VL was identified as a risk factor for PFPS. In our third prospective study we were unable to identify hip muscle strength as a risk factor for the development of PFPS. We were also unable to find a significant correlation between between hip strength and frontal plane movement of the knee.

Discussion: The results of our first prospective study identified four risk factors of PFPS: decreased flexibility of the Quadriceps; decreased explosive strength of the Quadriceps; altered neuromuscular coordination between VMO and VL; and a hypermobility of the patella. This implies that as well in the treatment, as in the prevention of PFPS therapists need to focus their examination and treatment protocol on these four important parameters.

The findings of our second prospective study show that a disturbance of the "normal dynamic foot alignment" significantly increases the risk for the development of PFPS. Therefore, this parameter needs also to be carefully examined and treated in the prevention and treatment of PFPS. The results of our last prospective study show us, in contrast to our hypothesis, that hip strength can not be considered as an intrinsic risk factor of PFPS. In addition, we could not find a significant correlation between the muscle strength and the movement of the knee in the frontal plane (knee valgus/varus). Further investigations need to be carried out to clarify the exact importance of the hip muscle strength in the etiology of PFPS. Without a doubt however is strengthening and a focus on the hip muscles an important aspect of the treatment of PFPS if the therapists clearly finds dysfunctions of these muscles. Important to remember is the fact that PFPS is a multifactorial pathology. Today's scientific insight in this pathology tends to show us that not every individual PFPS patient has the same "abnormalities". Therefore, a standard treatment for PFPS does not exist, and a tailor made approach is preferred.

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WORKSHOP

be active wa Physical Activity Taskforce Supported Speaker

M. Fenton^{1*} ■ ¹Tufts University, Boston MA



Walk audits (or walkabouts) are facilitated walks for an interdisciplinary group of community stakeholders, often led by design expert, with some or all of the following goals:

- Education. Teaches people to actually experience and assess the "friendliness" of an area to physical activity and healthy eating, not just to look at it theoretically.
- Inspiration. Helps leaders and policy makers to imagine what could be possible.
- Practical planning. An outstanding way to get everyone--professionals and others--actively involved in project or policy development, valuing each person's input.

It is recommended to invite anyone who can influence or is affected by the built environment: Planners, public works, engineers, architects and landscape architects, public health and safety, school officials; elected and appointed officials (city or regional council, planning commission, school board); parents, children, elderly, people with disabilities, community health and environmental advocates. A walk is typically 0.5 to 2.0 miles to create a 30 to 90 minute walk, allowing time to stop for observation and discussion. For example, a one-hour walk of roughly 1.5 miles can work very well. The route should be determined ahead of time and pre-scouted by the facilitator. Ideally it should include a mix of supportive and challenging settings for healthy eating and active living, with safe (e.g. out of traffic) places for the group to stop and talk.

Favourable attributes include parks, multi-use trails, pedestrian oriented downtowns, traffic calming (e.g. curb extensions, islands, raised crossings); plentiful bicycle-parking; a community garden or farmer's market. Challenging features include wide roads lacking crosswalks, and speeding traffic; automobile-oriented malls and sprawling subdivisions; giant parking lots; fast food strip development. Also seek out surprises such as goat trails (worn pathways); bikes parked at trees or parking meters (or other evidence of un-met demand); overlooked gems such as a small neighbourhood park or green grocer.

The four major elements of the walk include brief introductions to connect the group, a brief educational set-up (such as a PowerPoint presentation on elements of healthy community design); the walk itself; and a debrief discussion following the walk to consider collective steps the group can take to improve community well-being. During the educational session and walk, the following are community attributes to assess:

- A varied mix of land uses (live, work, shop, play, learn, pray in close together).
- Good connections for pedestrian, bicycle, and transit use (sidewalks, trails, etc.)
- Functional, inviting site designs (buildings at the sidewalks, trees, benches, etc.)
- Safety and access for users of all ages, abilities, incomes (lights, traffic calming)
- Accessible, appealing, and affordable healthy food options.

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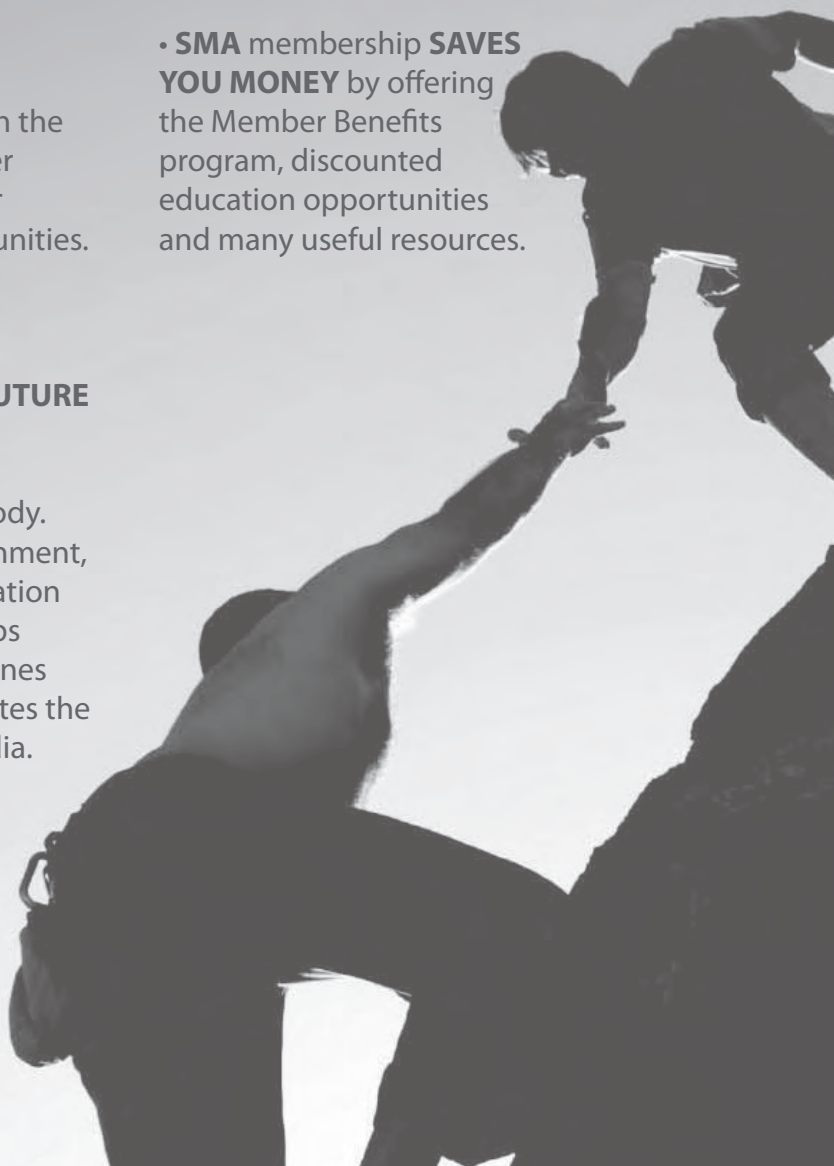
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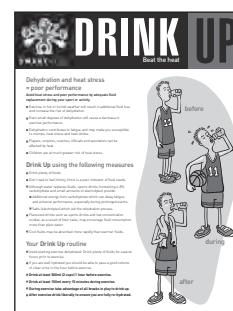


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- * Gear up
- * Fix up

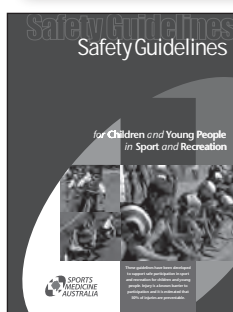


Sport Health

Quarterly magazine for members and the general public, covering topical issues in various disciplines

Sporting and injury fact sheets

- 18 sport specific fact sheets on injury prevention
- 12 injury specific fact sheets on injury prevention and management



Policy and guidelines

- * Safety guidelines for children and young people in sport and recreation
- * Beat the heat
- * Blood rules OK - Infectious diseases policy

Women in sport fact sheets

- * Exercise and osteoporosis
- * Exercise in pregnancy
- * Nutrition for active women
- * Contraception for active women
- * Teenage girls staying active



Resources can be found online at <http://sma.org.au>

For more information on subscription to SMA's publications email smanat@sma.org.au

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4th International Congress on
**PHYSICAL ACTIVITY
AND PUBLIC HEALTH**

OCT 31 – NOV 3 2012 SYDNEY AUSTRALIA

4TH INTERNATIONAL CONGRESS ON

PHYSICAL ACTIVITY AND PUBLIC HEALTH

OCT 31 – NOV 3 2012 SYDNEY CONVENTION & EXHIBITION CENTRE

The 4th International Congress on Physical Activity and Public Health will be held at the Sydney Convention and Exhibition Centre, New South Wales, Australia from 31st October to 3rd November 2012.

The Congress will incorporate the Australian Conference of Science and Medicine in Sport, the Australian Physical Activity Conference and the Australian Sports Injury Prevention Conference, under the banner of "be active 2012"

We are delighted to be hosting the 2012 International Congress on Physical Activity and Public Health (ICPAPH 2012) in Sydney, Australia. ICPAPH 2012 will provide a scientific forum for professionals from many fields and disciplines to share in the latest research, practice and policies relating to safe participation in physical activity.

ICPAPH 2012 will build on the success of the previous Congresses in Atlanta 2006, Amsterdam 2008 and Toronto 2010 in highlighting the importance of, and opportunities for health and exercise professionals, scientists, educators, planners, policy makers and many others to promote physical activity across the lifespan and throughout our wide and varied populations. The Congress will focus on understanding and measuring physical activity and its relationships with public health, on safe participation and on the individual, social, environmental and policy interventions that make a difference.

We look forward to welcoming you to Sydney, Australia in 2012.

WWW.ICPAPH2012.ORG

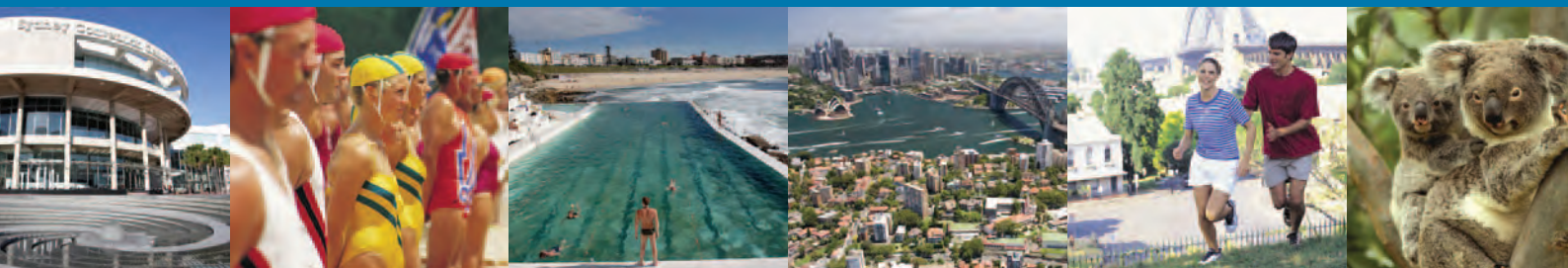


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For further information please contact:

Sports Medicine Australia

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