Bond University Doctor of Physiotherapy Mini Congress: Book of Abstracts 2019

Furness, James; Orr, Rob Marc; Gough, Suzanne; Zischke, Cherie

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BOND UNIVERSITY
FACULTY OF HEALTH SCIENCES & MEDICINE

BOND UNIVERSITY
DOCTOR OF PHYSIOTHERAPY PROGRAM

MINI CONGRESS Book of Abstracts 2019

Editor:

Assistant Professor James Furness

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Associate Professor Rob Orr, Associate Professor Suzanne Gough & Assistant Professor Cherie Zischke

April 30th and May 1st 2019
Gold Coast, Australia

Bond University Doctor of Physiotherapy Mini Congress

Editing Panel:

Assistant Professor James Furness, Associate Professor Rob Orr, Associate Professor Suzanne Gough & Assistant Professor Cherie Zischke

Research Project Supervisors:

Professor Wayne Hing, Assistant Professor Elisa Canetti, Assistant Professor Ben Schram, Assistant Professor James Furness, Associate Professor Suzanne Gough, Associate Professor Rob Orr, Assistant Professor Nikki Milne, Jessica Farley (PhDc), Vini Simas (MD), Associate Professor Justin Keogh, Dr Jaimon Kelly, Dr Daniel Harvey, Associate Professor Mike Climstein

Key note Speakers:

Associate Professor Gavin Williams will be presenting on "The rehabilitation of gait disorders, current evidence, the past mismatch between the muscle requirements for walking and the exercises prescribed, and future directions".

Gavin is an Associate Professor of Physiotherapy Rehabilitation and works clinically in a neurological rehabilitation unit as well as having a research role. He has previously developed a program to teach advanced gait and running skills to people with neurological injuries and within his Post-doctoral Research Fellowship focusing on the assessment, classification and treatment of mobility limitations following traumatic brain injury.

Professor Gwendolen Jull will be presenting on "Clinician and Researcher Linkage". This presentation will focus on the translation of relevant evidence into Physiotherapy practice and highlight the good, the bad and the evil when implementing research into practice.

Gwen Jull is a Professor Emeriti in Physiotherapy at The University of Queensland. Her clinical and research interests are in cervical spine disorders including headache, mechanical neck pain and whiplash. Her research focussed on quantifying the dysfunction in the cervical motor and sensorimotor systems as a basis for therapeutic exercise.

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Contents

Preface:

On behalf of the Faculty of Health Sciences and Medicine, it gives me great pleasure to welcome you to the Bond University Doctor of Physiotherapy Mini Congress for 2019.

The purpose of this congress is to showcase the wealth and diversity of research conducted by the Bond Physiotherapy postgraduate students. As such they are amongst my favourite types of meetings to attend, given their student-led focus.

Each abstract published represents original research carried out by our 49 Doctor of Physiotherapy students, highlighting the following major domains of research:

- Water Based Research
- Physiotherapy Research Specific to the Clinical Setting
- Sports Physiotherapy and Decision-Making Processes
- Musculoskeletal Physiotherapy
- Tactical Research

But a successful conference involves more than just presentations. It is also a meeting place, where ideas are vehemently discussed and debated, in addition to new research projects and collaborations beginning to form. I specifically hope that all our new researchers come away with a sense of achievement and a passion for impactful research that they will continue to pursue throughout their professional careers.

Thank you to all the authors who submitted an abstract to be included in this booklet, and the reviewers who supported the editorial process. Finally, a huge thank you to our keynote speakers for further enriching the program and our sponsors for financial support.

In closing, I hope you enjoy the interesting array of presentations and help to contribute to a feeling that this was a stimulating and rewarding meeting, one you were glad to have attended.

Associate Professor Kevin Ashton
Associate Dean of Research
Faculty of Health Sciences and Medicine

Abstracts

Water Based Research

A comparison of two commercial surfing ergometers on determining maximal aerobic capacity and its correlation to a 400m paddle test

Linley Bertacchini[1], Lisa Hicklen[1], Dane Monaghan[1], Elisa Canetti[1], Mike Climstein [2,3] & James Furness [1,2]

[1.] Faculty of Health Sciences and Medicine, Bond Institute of Health and Sport, Bond University, Robina, QLD, Australia
[2.] Bond University Water Based Research Unit
[3.] Clinical Exercise Physiology, School of Health and Human Sciences, Southern Cross University

PURPOSE: The recent addition of surfing to the Olympic Games - Tokyo 2020 has fuelled a surge in commercial and research interest in understanding the physiological demands of the sport. However, studies specific to maximal aerobic testing of surfers are scarce. Therefore, the primary aim of this study was to compare two laboratory-based, commercially available, swim bench (SWB) ergometers in the determination of maximal aerobic capacity in recreational and competitive surfers. A secondary aim was to correlate (independent of one another) the two ergometer findings to the time taken to complete a water-based 400m paddle test. **METHODS:** This cross-sectional study consisted of 18 surfers (14 recreational, 4 competitive) aged between 18-58 years. Participants were randomised to either the SwimFast ergometer or VASA ergometer and tested for maximal aerobic capacity, followed by a 400m surfboard paddle test. **RESULTS:** There was no significant differences between the two SWB ergometers in the determination of relative VO_2peak (mean difference 0.33 mL/kg/min; 95% CI -1.24-1.90; p = 0.66). Figure 1 presents the agreement between the two ergometers and the associated limits of agreement. Correlations between VO_2peak obtained from maximal paddling effort on the SwimFast and the VASA and the 400m paddle test (total time (s)) showed a negative significant correlation r = -.819, p = 0.24; r = -.818, p = 0.24 respectively. **RELEVANCE TO CLINICAL PRACTICE:** Results suggest that either ergometer (VASA or SwimFast) can be used to determine peak aerobic capacity within a surfing cohort. The significant correlation of the two SWB ergometers and 400m paddle test, suggest that the 400m paddle test may be a suitable field-based method of predicting maximal aerobic capacity, however further research is needed with a larger sample size. Collectively, these findings benefit athletes, coaches, and exercise scientists in identifying equipment that may be used when measuring maximal aerobic capacity for both baseline testing and quantifying effectiveness of aerobic training programs specific to a surfing population.

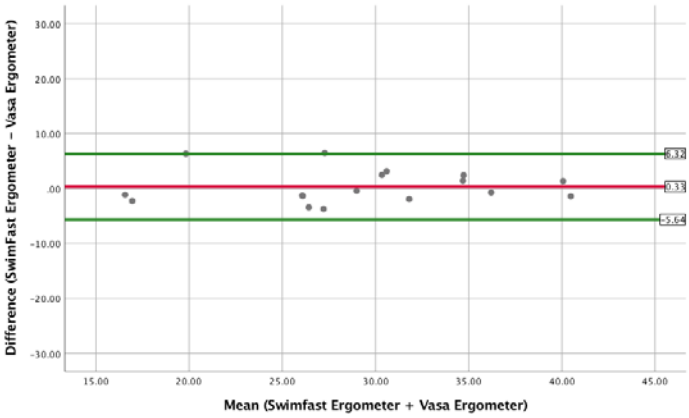

Figure 1. *Bland–Altman Plot displaying mean difference between two ergometers with the associated 95% limits of Agreement*

Assessing shoulder strength and endurance in a surfing population

Georgia McIntosh[1], Mia Pinchin[1], James Duke[1], Mike Climstein[2,3] & James Furness[1,2]

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PURPOSE: To develop a shoulder strength and endurance profile of internal and external rotator muscles using isokinetic measurements. **METHODS:** A cross-sectional study design within a laboratory setting was used. A total of 25 male recreational and competitive surfers were recruited. Absolute peak torque for shoulder internal (IR) and external Rotation (ER) was measured using an isokinetic dynamometer (Biodex). ER to IR ratios were expressed as percentages (ER divided by IR multiplied by 100). A paired sampled t-test was used to compare peak torque of internal and external rotation and peak torque between the dominant and non-dominant limb. A one-way ANOVA was used to determine differences in relative peak torque between surfers with and without pain. **RESULTS:** There were no significant differences in peak torque between hand dominance apart from absolute PT for IR at 60°/s, PT on the NDL (M = 93.0 ± 18.1) was significantly higher (p=0.03) than PT on the DL (M = 88.7 ± 19.2), however the difference was trivial (d = 0.11). Internal rotation strength and endurance was significantly ($p < 0.001$) higher than external rotation and the magnitude of difference was large (see Table 1). ER to IR strength ratios (expressed as percentages) were 78.5 ± 11.5 and 75.2 ± 8.68 for the DL and NDL respectively. ER to IR endurance ratios were 80.1 ± 11.8 and 81.3 ± 12.9 for the DL and NDL respectively. Surfers with should pain generated less peak torque relative to body weight than surfers without pain, however results were not statistically significant. **RELEVANCE TO CLINICAL PRACTICE:** The information gathered can be used by coaches and clinicians to guide shoulder rehabilitation programs. Weaknesses and asymmetries identified in a surfer's internal and external shoulder strength and endurance can be targeted with the prescription of specific exercises. In the case of this study, strengthening exercises should target the external rotators of the shoulder to promote an ER:IR ratio closer to 1, as a lower ER:IR ratio has been identified as a risk factor for future shoulder injury.

Table 1. Mean difference between of IR and ER absolute PT values with associated effect sizes (n=25)

Hand dominance	AV (°/s)	Mean difference	P value	Effect size (d)	Magnitude of effect
DL	60	20.2	<0.001	1.25	Large
	180	16.1	<0.001	1.22	Large
NDL	60	20.2	<0.001	1.58	Large
	180	16.0	<0.001	1.07	Large

ER refers to external rotation; IR refers to internal rotation; ER:IR refers to external rotation to internal rotation ratio; DL refers to dominant limb; NDL refers to non-dominant limb; AV refers to angular velocity; effect size is deemed large when greater than .80

Epidemiology of traumatic surfing injuries in New Zealand

Katherine McArthur[1], Darcy Jorgensen[1], Mike Climstein[2,4,5], Debbie Remnant[3], Catherine Bacon[3,4], Robert Moran[3], Wayne Hing[1,2] & James Furness[1,2]

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PURPOSE: Approximately 1 in 27 people participate in surfing in New Zealand (NZ). One study has investigated injury epidemiology of surfers in NZ, however the study was restricted to injuries treated at the beach. The purpose of this study was to examine surfing injury epidemiology in NZ using an online-based survey. **METHODS:** A sample of self-identified surfers aged ≥8 y and currently living in NZ completed an online retrospective cross-sectional survey between December 2015 and July 2016. Information on participant demographics, NZ residency, competitive level, time spent surfing per season (winter/summer), stance, board type, and surf location was collected. Surfing injury data included injury onset (traumatic or gradual), season the injury occurred, injury type, body region, mechanism, wave size, time off work/surfing, and treatment. Only traumatic injuries were examined in this study. **RESULTS:** The survey yielded 1,473 respondents (18.3% female) mainly of NZ European (75.9%) ethnicity primarily surfing in Auckland Region (40.0%). Hours of exposure were greatest during the summer (avg. 7.9 h/week). A total of 502 surfers reported 702 major injuries (requiring treatment from a health professional or at least 1 day off work or surfing). The Incidence Rate was 1.98 (95% CI, 2.23-2.23) injuries per 1000 hours and Incidence Proportion was 0.34 (0.32-0.37). Injuries to the head and face were most common (23.6%), with recreational surfers sustaining more injuries than competitive surfers (26.8% vs 19.9%, $p = .046$). Competitive surfers had a higher incidence of lower back injuries ($p = .037$, 12.4% vs 8.2%), and surfers who performed aerial manoeuvres more frequently reported knee injuries ($p = .045$). Key risk factors for traumatic injury included: recreational compared to competitive status (41.0% vs. 30.1%, Risk Ratio (RR) 1.36, P <.001), ability to perform aerial manoeuvres (31.8% vs 48.1%, RR 1.51, $p < 0.001$) and riding a short board (30.9% vs 36%, RR 1.17 $p < 0.043$). **RELEVANCE TO CLINICAL PRACTICE:** Recreational surfers are more prone to head and face injuries versus competitive surfers and aerialists are more prone to lower back and knee injuries. Competitive status, riding a short board and performing aerials increase the risk of sustaining a traumatic injury. This information provides rationale for injury reduction strategies, such as the use of protective equipment in recreational surfers to minimise head and face injuries and use sport-specific strength training in competitive and aerialist surfers to minimise the incidence of lower back and knee injuries.

Physiotherapy research specific to the clinical setting

Current management of acute ankle sprains across Gold Coast Hospital Health Service Emergency Departments: A retrospective audit

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PURPOSE: Clinical guidelines specific to acute ankle injury assessment and treatment support a detailed history, a thorough physical examination including the Ottawa Ankle Rules (OAR), the use of functional support, exercise therapy and the importance of referral. It is not clear as to whether these standards are being met across facilities and practitioners within the emergency department (ED) settings. The aims of this study are: 1) Outline current management for acute ankle sprains and quality indicators including National Emergency Access Target (NEAT), length of stay (LOS), time to be seen (TTS) and representation rate between Doctors, Physiotherapists (PT) and Nurse Practitioners (NP) in Robina Hospital and Gold Coast University Hospital (GCUH) ED. 2) Benchmark the current management by Practitioners in the ED for acute ankle sprains against the Clinical Guidelines[1-3.] **METHODS:** A Retrospective cross-sectional study was performed across Gold Coast Hospital and Health Service (GCHHS) ED; where-by 400 charts diagnosed as ankle sprain/strain from October to December 2018 were assessed against the aforementioned aims of the study. Data was collected from two electronic sources (Health Analytics and Electronic Medical Records) within the GCHHS. **RESULTS:** Differences between facilities revealed small effect sizes for Age, LOS, TTS, NEAT, OAR, Physical Assessment, Treatment, Referral Rate and Representation Rate. Robina provided significantly more load education compared with GCUH (p = 0.001, medium effect size 2.35; 24% vs. 7%, respectively). PTs had higher frequencies in providing Load Education (see figure 1 below) and Referral to Follow-up (64% vs. 24% and 13.2% for Doctors and Nurses respectively). PTs showed the shortest LOS (96 minutes vs. 160 and 109 minutes for Doctors and Nurses respectively). **RELEVANCE TO CLINICAL PRACTICE:** Once fracture is ruled out, further emphasis should be placed on exercise prescription specific to progressive loading and referral to follow-up for re-assessment and progression of rehabilitation.

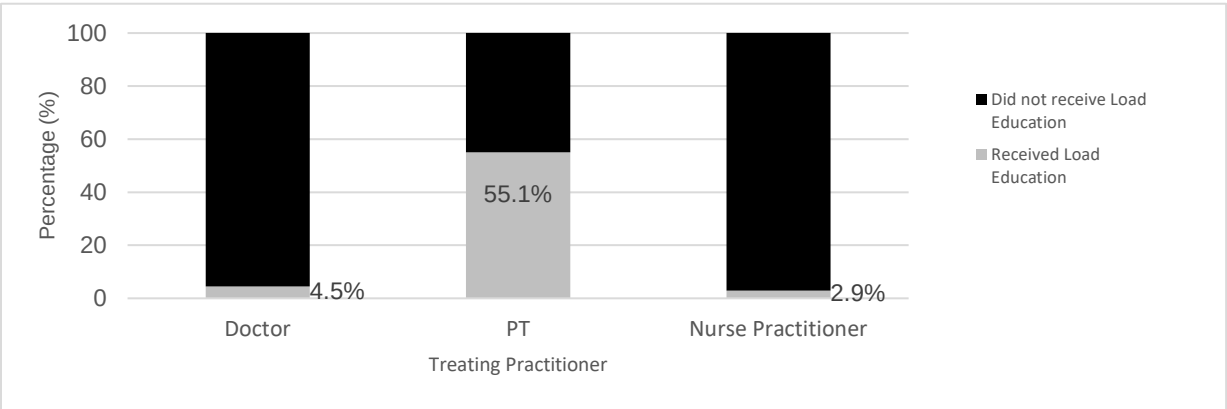

Figure 1: Bar Graph presenting the percentage of patients who receive Load Education between practitioners

A retrospective audit of service delivery to people with Parkinson's disease on the Gold Coast

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PURPOSE: To carry out a retrospective audit of current service delivery to people with Parkinson's Disease (PD) by the Gold Coast Hospital and Health Service (GCHHS). The secondary objective is to compare the current service delivery with the 2017 National Institute for Health and Care Excellence (NICE) guidelines for PD. **METHODS:** A retrospective audit was conducted of inpatient admissions presenting to the GCHHS, over a five-year period, with a diagnosis of or relating to PD. Two authors used Microsoft Excel to manually code and filter the data. IBM SPSS Statistics 25 software was used to undertake statistical analysis of the data. **RESULTS:** A total of 3076 inpatient admissions were recorded, with 3874 overall encounters. The median age of the patients admitted was 78 years. The median length of stay (LOS) of the admissions was 2.3 days. 40.4% of encounters received input from at least one of Physiotherapy, Occupational Therapy, Speech Therapy, or Dietetics. **RELEVANCE TO CLINICAL PRACTICE:** The results obtained from this audit may be used by the GCHHS for future planning of service delivery and can lead to future research that allows for a better understanding of current management of PD on the Gold Coast.

The influence of motor imagery and action observation on mobility and balance in apparently healthy older adults: A systematic review and meta-analysis

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[2]Faculty of Health Sciences, School of Allied Health, Australian Catholic University, Brisbane, QLD

PURPOSE: To determine if Motor Imagery (MI) and Action Observation (AO) have an effect on functional ability and balance in apparently healthy older adults, including those with musculoskeletal conditions or who have undergone orthopaedic surgery? **METHODS:** Systematic review with meta-analysis of randomised trials design was used. Participants were apparently healthy older adults, including those who have undergone orthopaedic surgery and above the age of 60 years old. The intervention of interest was MI alone or MI with AO. Outcome Measures assessed included; Mobility, measured in gait speed (m/s), Timed Up and Go (sec) and performances of an obstacle course. Balance was measured in Postural Sway, Equilibrium Reactions during an obstacle course and by Four Square Step Test. **Results:** Thirteen studies were included in the review with eight studies included in the meta-analysis. MI had a statistically significant effect on mobility (SMD = 0.43, 95% CI 0.19 – 0.67) and balance (SMD = 1.16, 95% CI 0.24 – 2.07) see Figure 1. **RELAVANCE TO CLINICAL PRACTICE:** The evidence suggests that MI and AO significantly improve mobility and balance in the apparently healthy older population, including post orthopaedic surgery. It could therefore be used to improve mobility and balance in the older population, especially in those who are unable or unwilling to perform traditional therapy.

Study or Subgroup	Motor imagery Mean	Motor imagery SD	Motor imagery Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Batson 2007	-13.56	1.51	3	-12.91	2.16	3	2.1%	-0.28 [-1.90, 1.34]
Goudarzian et al 2017	-5.76	0.72	12	-5.82	0.9	9	6.5%	0.07 [-0.79, 0.94]
Goudarzian et al 2017	0.63	0.18	12	0.5	0.12	9	6.1%	0.79 [-0.11, 1.70]
Jacobson et al 2016	-7.4	2.2	29	-8.5	2.3	29	13.7%	0.48 [-0.04, 1.00]
Kim et al 2012	-11.6	3.3	46	-13.6	3.2	45	17.6%	0.61 [0.19, 1.03]
Marusic et al 2018	-6.23	1.56	10	-8.3	2.39	11	5.9%	0.97 [0.06, 1.89]
Marusic et al 2018	1.19	0.17	10	1.09	0.25	11	6.5%	0.44 [-0.42, 1.31]
Marusic et al 2018	1.59	0.11	10	1.13	0.29	11	4.5%	1.97 [0.89, 3.06]
Moshref-Razavi et al 2017	-11.05	2.97	8	-12.38	2.76	8	5.2%	0.44 [-0.56, 1.43]
Moukarzel 2017	-12.7	2.76	10	-13.32	2.66	10	6.4%	0.22 [-0.66, 1.10]
Nicholson et al 2018	-30.58	8.52	10	-29.79	6.93	10	6.4%	-0.10 [-0.97, 0.78]
Nicholson et al 2018	1.66	0.36	10	1.72	0.33	10	6.4%	-0.17 [-1.04, 0.71]
Nicholson et al 2018	-7.63	1.87	10	-7.74	1.63	10	6.4%	0.06 [-0.82, 0.94]
Nicholson et al 2018	1.35	0.25	10	1.3	0.25	10	6.4%	0.19 [-0.69, 1.07]
Total (95% CI)			**190**			**186**	**100.0%**	**0.43 [0.19, 0.67]**

Heterogeneity: Tau² = 0.04; Chi² = 16.25, df = 13 (P = 0.24); I² = 20%
Test for overall effect: Z = 3.47 (P = 0.0005)

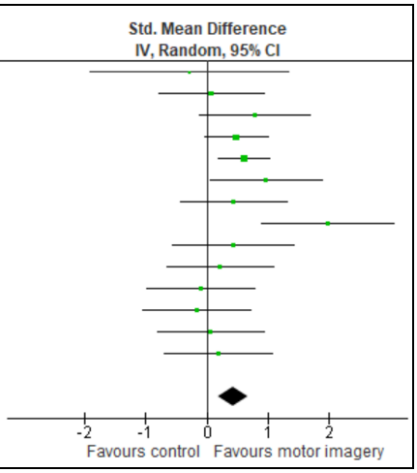

Figure 1: Forest Plot representing mobility score change following MI compared to control

Nutrition interventions to decrease inflammatory markers in people with chronic pain: A systematic review

Kurt Drinkwater[1], Mark Thompson[1], Katherine Brain[4], D. Harvie[3], Vinicius Simas[1] & Jaimon Kelly[2]

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[2]School of Public Health, The University of Queensland, Brisbane, QLD
[3]Griffith University, Gold Coast, QLD
[4]School of Health Science, University of Newcastle, Newcastle, NSW

PURPOSE: The aim of this study was to review evidence linking nutritional interventions to changes in inflammatory biomarkers in people with persistent pain. **METHODS:** A systematic search was conducted on MEDINE, EMBASE, CINAHL and PsychINFO to identify randomised controlled trials (RCTs) evaluating nutritional interventions (diet or supplement based) in adults with persistent non-cancer pain. Only RCTs containing measures of inflammatory biomarkers were included. Studies were grouped according to biomarker of interest for meta-analysis. **RESULTS:** A total of 11 studies were included involving 513 participants investigating osteoarthritis (n=3) and rheumatoid arthritis (n=8). Studies used a range of nutritional interventions, with no studies utilising a similar nutrition intervention. Dietary interventions included quercetin and vitamin C or a-lipoic acid, a liquid diet added with methionine, supplement containing GS hydrochloride, methylsulfonylmethane, type II collagen, collagen peptide, olive extract and concentrated bovine protein, fasting for 1 year followed by a vegetarian diet, undenatured type II collagen or glucosamine hydrochloride plus chondroitin sulfate, uncooked extreme lactobacilli-rich vegan diet, polyunsaturated fatty acids, chamomile tea, tart cherry juice blend, fasting followed by lactovegetarian diet, and fish oil polyunsaturated fatty acids. Eligible biomarkers of inflammatory pain included C-reactive protein (CRP; n=8), Erythrocyte Sedimentation Rate (ESR; n=6), and Interleukin-6 (IL-6; n=3). Overall, evidence suggested nutritional interventions lowered CRP [mean difference (MD): -1.22 mg/L (95% CI: -2.38, -0.07), I^2= 0%], but not ESR or IL-6 [MD: -1.20 (95% CI: -4.02, 1.62), I^2 = 12%] and [MD: -0.36 pg/mL (95% CI: -0.90, 0.19 pg/mL), p = 0.74, I^2 =0% respectively]. **RELEVANCE OF CLINICAL PRACTICE:** Current evidence suggests that nutritional interventions may reduce specific inflammatory markers (i.e. CRP) in adults with RA or OA, but not others (i.e. ESR or IL-6). Differences between nutritional interventions and future directions are discussed.

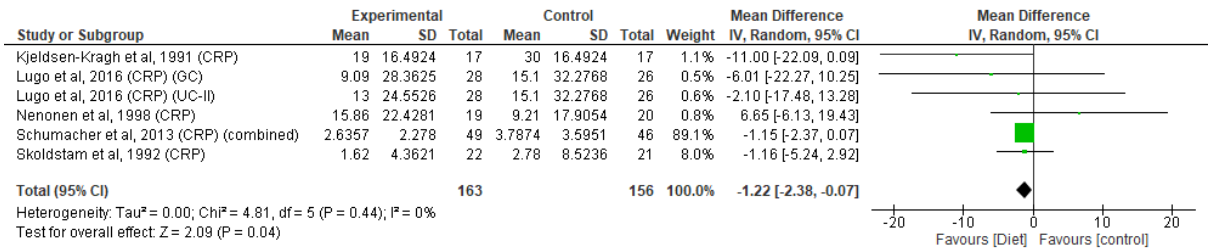

Figure 1: Forest Plot representing CRP mean score change following dietary interventions compared to control

Sports physiotherapy and decision-making processes

Appearance or health. What motivates you to exercise?

Melissa Saken[1], Jayde Williams[1], Wayne Hing[1] & Suzanne Gough[1]

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PURPOSE: Physical activity has numerous benefits but only 25% of Australian adults meet the national physical activity guidelines. Altering how a message is framed has been shown to influence a person's behaviour response. The purpose of this study was to a) explore the factors which may influence physical activity participation and b) whether message framing may influence motivation to participate in physical activity. **METHODS:** A self-administered 28-item electronic survey was purposely designed. The questionnaire featured The Godin Leisure Time Exercise Questionnaire (GLTEQ) to measure exercise participation in the week preceding participation. Open and closed questions were used to explore physical activity motivation and perceptions of four message framing options (Table 1). A manipulation check was used to determine if the participants correctly interpreted each message option. Content analysis was used to generate themes from open questions. Ethical approval was obtained from Bond University. **RESULTS:** 273 respondents commenced the online questionnaire however; 60 participants failed to finish and were excluded from analysis. The final sample of 213 participants consisted of 51 (23.9%) males and 161 (75.6%) females between the ages of 19 and 76 years old (median = 36.0yrs; mean = 38.8yrs). Most respondents were classified as sufficiently active (85.4%) as opposed to insufficiently active (14.6%), the week prior to study participation. Physical activity participation was reportedly influenced by extrinsic (injury, soreness/fatigue, health and age), intrinsic (motivation, laziness, enjoyment and knowledge) and environmental factors (time, weather, accessibility, cost and family). The extent to which the four message framing options may influence motivation to participate in physical activity is presented in Table 1. The manipulation checks revealed most respondents correctly identified the message framing option as health/appearance and positive/negative biased for options 1 to 4 (98.6%, 91.1%, 94.8%, 90.1% respectively). **RELEVANCE TO CLINICAL PRACTICE:** This study highlights the importance of message framing to influence motivation to participate in physical activity. A positively health-based message was deemed most likely to motivate physical activity participation, whilst negatively framed appearance-based messages were the least likely to motivate. Additionally, positively framed messages were found to be more motivating than negatively framed messages regardless of appearance or health used in combination with positive framing.

Table 1. Message framing options and perceived level of motivation

Motivation level	**Agreement**			**Neither**	**Disagreement**		
	Number (%)						
Message Framing	SA	A	SWA	NA/ND	SWD	D	SD
Option 1	69 (32.4)	**94 (44.1)**	34 (16.0)	10 (4.7)	1 (0.5)	2 (2.9)	3 (1.4)
Positive health		**197 (92.5)**			6 (2.9)		
Option 2	53 (24.9)	**72 (33.8)**	49 (23.0)	24 (11.3)	4 (1.9)	8 (3.8)	3 (1.4)
Positive appearance		**174 (81.7)**			15 (7.0)		
Option 3	28 (13.1)	**55 (25.8)**	41 (19.2)	28 (13.1)	20 (9.4)	27 (12.7)	14(6.6)
Negative health		**124 (58.2)**			61 (28.6)		
Option 4	14 (6.6)	33 (15.5)	**42 (19.7)**	34 (16.0)	29(13.6)	**37 (17.4)**	24(11.3
Negative appearance		89 (41.8)			**90 (42.3)**		

Key: SA: Strongly Agree; A: Agree; SWA: Somewhat Agree; NA/ND: Neither Agree or Disagree; SWD: Somewhat Disagree; D: Disagree; SD: Strongly Disagree

Why risk it? A pilot study on athletes return to sport decisions following concussion injuries and the influence of education

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PURPOSE: Risk associated with return to sport post-concussion injury has been mostly looked at from a medical professional point of view, with health risks perceived by medical professionals and not the athletes. There have been limited known studies that assess the athletes and how they view risk when returning to sport post-concussion injury. The purpose of this study was to explore the influence of education and other factors on an athletes' decision to return to sport (RTS) post-concussion injury, and whether general risk-taking tendencies are related to RTS post-concussion decisions in athletes. **METHODS:** A self-administered electronic survey was purposely designed to examine their decision-making process when faced with scenario-based questions regarding returning to sport post-concussion injury. Students from the Health Sciences and Medicine Faculty at Bond University were invited to participate. Participants were randomly allocated to a concussion education or non-education group prior to commencement of questionnaire via the random generator on Qualtrics software function. The risk propensity scale was used to assess the risk aversion of each participant. **RESULTS:** Sixteen respondents were included within the current study, eight in both the education and non-education groups respectively. Seven (43.8%) had previously received concussion education training prior to completing the questionnaire. Influential factors that would influence a decision to RTS included: game importance, concussion severity and symptoms, internal and external factors. RTS also varied factors depending on season and game type (Table 1). There was a divergence in results from the risk propensity scale when deciding to return to sport and general risk-taking propensities. **RELEVANCE TO CLINICAL PRACTICE:** This was the first study to determine the influences that affect RTS post-concussion injury decisions, the role that concussion education plays with these decisions, and the relationship between the general risk-taking capabilities and athletes' decisions to RTS. Despite providing concussion education, there were still differences in decisions relating to the hypothetical scenario of RTS following a concussion. Lastly, there is a perceived discrepancy when athletes choose to take risks in sport compared to everyday life.

Table 1. Concussion Education, Scenario based Questions and Risk Propensity Scale

	Reason for RTS							
	Preseason	**Mid-season, guaranteed playoff**	**Mid-season, no playoffs**	**Playoffs, first game winning**	**Playoffs, first game losing**	**Championship game, winning**	**Championship game, losing**	**Championship game, tied**
Yes	n = 0 (0%)	n = 0 (0%)	n = 0 (0%)	n= 1 (6.3%)	n = 3 (18.8%)	n = 3 (18.8%)	n = 6 (37.5%)	n = 6 (37.5%)
No	n = 16 (100%)	n = 16 (100%)	n = 16 (100%)	n = 15 (93.8%)	n = 13 (81.3%)	n = 13 (81.3%)	n = 10 (62.5%)	n = 10 (62.5%)
Risk Propensity Scale	**Safety First***	**I do not take risks with my health***	**I prefer to avoid risks***	**I take risks regularly***	**I really dislike not knowing what is going to happen***		**I usually view risks as a challenge***	**I view myself as a…+**
Mean	7.88	6.94	6.50	4.31	6.69		4.63	4.31
SD	± .258	± 1.914	± 1.862	± 1.740	±1.662		±1.708	± 1.352

Key: *- scale 1 (totally disagree) to 9 (totally agree); +- scale 1 (risk seeker) to 9 (risk avoider)

Profiling athletic injuries in competitive gymnastics in the new millennia: A systematic review and meta-analysis

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PURPOSE: To identify and critically appraise the available literature since the year 2000 to profile injuries, including incidence rates, location, types, and common mechanism of injuries, within competitive gymnastics. **METHODS:** Seven databases (PubMed, CINAHL, SPORTDiscus, EMBASE, Science Direct, Trip, and Web of Science) were searched from the year 2000 through August 2018 using the search terms: *Gymnast* OR Trampolin* OR cheerlead* OR Acrobat* AND Injur* OR traumatic OR fracture OR bone OR contusion OR sprain OR strain OR concussion OR tendon* OR tendin* OR teno* OR neuro* OR spinal* OR psycholog**. Peer-reviewed studies printed in English language that reported injury data in male and female competitive gymnasts were included. Studies of fair to good methodological quality which reported overall injury rates (or sufficient data for this to be calculated) and defined injuries as resulting in time-loss from competition or training, or resulted in training modification, were included in the meta-analysis. The calculated pooled overall injury incidence rate was estimated using a random-effect model. Proportions and percentages were also calculated to report the most common injury types, locations, and mechanisms of injury in modern-day gymnasts. **RESULTS:** Eighty-one studies were included in the meta-synthesis, with eight studies eligible for meta-analysis. The overall injury incidence rate in gymnasts is 1.43/1000h (95% CI, 0.88-2.32). The most common type of injuries in competitive, modern-day gymnastics were muscle strains (9.7%, 308/3169 total injuries). Injuries to the ankle/foot/toes were most frequent (21.6%, 351/1625 total injuries) with the most common mechanism of injury of all injuries reported due to landing (36.4%, 152/418 total injuries). **RELEVANCE TO CLINICAL PRACTICE:** This systematic review estimated an overall injury incidence rate and profiled injury types, locations, and mechanisms of injury from literature reporting on competitive gymnastics injuries since year 2000 in order to influence further investigations in research, policy and guidelines, and modern equipment modifications to prevent injury in modern-day gymnastics. Additionally, this information can be useful when developing new and innovative injury prevention programs and strategies for gymnasts, particularly targeting minimizing muscular strains and injuries to the lower limb, as well as directing preventative measures highlighting landing mechanisms

Linking the essential core competencies in entry-level pediatric physical therapy education to an Australian entry-level extended masters physical therapy curriculum: A case report

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PURPOSE: The objectives of this case report were to use a linking-rules mapping approach to determine the extent to which an Australian entry-level extended masters physical therapy education program i) aligns to the Academy of Pediatric Physical Therapy (APPT) pediatric essential core competencies (ECCs), ii) meets the International Organization of Physical Therapists in Pediatrics content areas (IOPTP CAs) as a minimum international standard for pediatric content, and iii) utilizes pediatric curriculum to contribute towards meeting the Physiotherapy Practice Thresholds in Australia and Aotearoa New Zealand (PPTAANZ). **METHODS:** This case study examined an Australian entry-level extended master's physical therapy program curriculum to identify pediatric related content. Two independent reviewers mapped the pediatric subject learning outcomes (SLOs) and meaningful pediatric concepts (MCs) in the curriculum to the ECCs, IOPTP CAs, and PPTAANZ. Mapping consensus was achieved by two secondary physiotherapist reviewers. Descriptive statistics were used to derive percentages and frequencies of 1) the pediatric SLOs and MCs relative to the program's physical therapy curriculum and 2) the pediatric SLOs and MCs mapped to the ECCs, IOPTP CAs, and PPTAANZ to demonstrate the extent of pediatric physical therapy education content addressed in the curriculum. Evaluation of the program's physical therapy curriculum was rated on a scale from poor to excellent based on the number of ECCs and IOPTP CAs that were covered during the mapping process. **RESULTS:** Findings revealed excellent representation of the ECCs and IOPTP CAs, suggesting that the entry-level program explored was meeting minimum pediatric content area standards. Nine (47%) subjects incorporated pediatric-related concepts within the entry-level physical therapy program. Out of a total of 205 subject learning outcomes (SLOs), 39 (19%) were identified as pediatric-related objectives. A total of 392 (21%) meaningful pediatric concepts (MCs) were revealed across the program and these were mapped to the ECCs, IOPTP CAs and the PPTAANZ using a modified linking rules approach. All ECCs and IOPTP CAs were represented within the entry-level physical therapy education curriculum. All but one sub-criteria (7.1) of the PPTAANZ were represented through pediatric content within the course curriculum. **RELEVANCE TO CLINICAL PRACTICE:** The mapping process highlighted the importance of accurate reporting to improve curriculum, identified potential gaps in the pediatric content, and illustrated evidence of important key elements in the curriculum. Future utilization of this linking-rules approach to map the entry-level physical therapy curriculum to the ECCs, IOPTP CAs, and PPTAANZ is recommended to establish evidence that programs are meeting a national and international baseline standard for inclusion of pediatric content within Australian and New Zealand physical therapy education programs, which is an important component of developing graduates who can safely and effectively manage children, infants and their families.

Musculoskeletal Physiotherapy

The effect of traction straight leg raise on hamstring flexibility in asymptomatic populations: A randomised controlled trial

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PURPOSE: The aim of this study was to compare the immediate effects of a Mulligan Traction Straight Leg Raise (TSLR) compared to a static stretching (SS) and control group (CG) on hamstring flexibility. We hypothesise that a TSLR will improve hamstring flexibility significantly in comparison to both SS and CG. **METHODS**: Sixty-three individuals (age 18-47 years) volunteered to participate in this study. For inclusion, participants were required to be between the ages of 18 and 55 years of age and have good overall general health. Subjects were excluded from the study if they had a previous history of lower-extremity pathology, which may negatively influence hamstring flexibility or power. The subjects were randomly assigned to each intervention group (I) TSLR, (II) SS, or (III) CG. There was no blinding of the investigators to subject assignment throughout the trials. Outcome measures used to assess hamstring flexibility were passive straight leg raise (SLR) and passive knee extension angle (PKEA) utilising an inclinometer strapped to each subject's right tibia. **RESULTS**: For PKEA, A Welch's ANOVA was statistically significant indicating that differences in mean PKEA exist between TSLR, static stretching, and control groups, df (2,38) = 7.21, $p = 0.002$. Post hoc analyses using Games-Howell (with a significance level of 0.05) revealed that TSLR group had significantly ($p= 0.024$) higher improvements in mean PKEA (Mean 6.73 $\pm$ 2.58 SD) compared to control group (3.02 $\pm$ 5.53). There were significant ($p = 0.005$) differences between TSLR group and static stretching group (4 $\pm$ 2.75 SD). No significant ($p = 0.747$) differences were noted between static stretching group and control group. For SLR ROM, There was statistically significant ($p < 0.001$) differences between TSLR group (*Mean Rank* = 44.57), static stretching group (*Mean Rank* = 33.21), and control group (*Mean Rank* = 18.21), H (corrected for ties) = 21.896, df = 2, $p < 0.001$, Cohen's ƒ = 0.739. Significant ($p = 0.01$) improvements were found when TSLR group (7.22 $\pm$ 2.40) was compared to static stretching (5.38 $\pm$ 2.47). There was a significant ($p < 0.001$) improvement between the TSLR and control group (2.13 $\pm$ 3.80). A significant ($p = 0.001$) difference was also noted between static stretching and control group. **RELEVANCE TO CLINICAL PRACTICE**: TSLR is indicated when treatment aims to obtain immediate increases in PSLR ROM and PKEA, as this study demonstrated it to be a superior technique when compared to static stretching. Static stretching still has a valuable therapeutic indication, particularly as a home exercise prescription, as it, contrary to TSLR, can be performed independently.

A comparison of the effects of Mulligan's bent leg raise-technique and static stretching on hamstring flexibility: A randomized controlled trial

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PURPOSE: The Mulligan bent leg raise-technique (BLR) was initially developed to improve limited or painful SLR in subjects with lower back pain (LBP). More recently, the BLR has been suggested as an alternative technique to increase hamstring flexibility in the general population. A limited number of studies have investigated the effect of static stretching on hamstring flexibility and compared it to the BLR for periods greater than 24 hours. The present study aimed to investigate the effect of the BLR immediately and 1-week post-intervention when compared to static stretching on range of motion (ROM). **METHODS:** This randomized controlled trial compared the effect of a control (Group 1), static stretch (Group 2), BLR (Group 3) and BLR + home exercise program (HEP) (Group 4) on hamstring flexibility, both immediately post and 1- week post-intervention. Sixty participants (23 females, 37 males) volunteered to be involved in this study, participants were between 18 – 65 years. Presence of a current lower limb musculoskeletal injury or pain was grounds for exclusion. Hamstring flexibility was measured using the SLR and KEA. **RESULTS:** Subjects in Groups 2, 3 & 4 demonstrated mean improvements from baseline to post-intervention that were significant ($p < 0.01$). No significant interaction in ROM was observed from post-intervention to 1-week post-intervention. From baseline, significant improvement ($p < 0.01$) was also demonstrated 1-week post-intervention in both outcome measures. **RELEVANCE TO CLINICAL PRACTICE:** This study provides evidence to support that the BLR is equally as effective as a static stretch in immediately improving hamstring flexibility. It also demonstrates that the inclusion of a HEP may maintain improvements in hamstring flexibility 1-week post-intervention.

The efficacy of Mulligan's MWM on ROM and pain: A systematic review and meta-analysis.

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PURPOSE: The aims of this study were two-fold. Firstly, the study aimed to, through a scoping review, create an understanding of the available literature on Mulligan's mobilisation with movement (MWM) technique, and be able to compare the quality and clinical utility of indexed vs non-indexed randomized controlled or clinical trials (RCTs). Secondly, to establish and quantify the efficacy of MWMs on the treatment of pain and range of motion (ROM) in peripheral joints through a systematic review and meta-analysis. **METHODS:** As part of the scoping review, four indexed databases (Pubmed, SportsDiscus via EBSCO, Cinahl via EBSCO, Cochrane) and one non-indexed database (Google Scholar) were scoured and systematically delineated into levels of evidence using the Oxford Centre of Evidence Based Medicine guidelines (OCEBM). Studies retrieved from the indexed databases were then extracted and a systematic review and meta-analysis was performed. The Physiotherapy Evidence Database tool (PEDro) was used for critical appraisal and scoring of all RCTs. **RESULTS:** 59 studies were retrieved from indexed (19 RCTs) and non-indexed (40 RCTs) and were scored; indexed databases showed three excellent, five good, five fair and six poor studies; non-indexed databases demonstrated seven good, eight fair and 25 poor studies. Of the 19 indexed studies, eight reported on shoulder, six on ankle, three on knees and two on hips. The distribution of females to males were 58% and 39% respectively. 12 studies explored pain, 17 studies examined ROM and 10 studies investigated both pain and ROM. Meta-analysis of pain using VAS or NPRS scoring demonstrated statistically significant effect that favoured MWM vs taping (MD = -1.07; CI = -1.49 to -0.65; p = < 0.001), control (MD = -2.20; CI = -2.51 to -1.90; p < 0.001) and placebo (MD = -1.11; CI = -1.56 to -0.66; p < 0.001). There were also statistically significant effects for all measures of ROM, as shown in table 1. **RELEVANCE TO CLINICAL PRACTICE:** This systematic review with meta-analysis provides clinicians with evidence-based guidelines to justify the use of MWMs in clinical practice. Furthermore, evidence retrieved from indexed databases generally provides greater quality and therefore, relevancy to clinical practice.

Table 1: Mean differences between MWM and other groups with changes in ROM

Outcome Measures		Mean Difference	Confidence Interval	Number of studies
AROM Sh	F	-10.83	-13.58 to -8.09	3
	ABD	-22.33	-28.40 to -16.27	2
	ER	-9.22	-12.38 to -6.05	2
	IR	-20.30	-23.46 to -17.14	2
PROM Sh	F	-8.49	-11.07 to -5.92	2
	ABD	-20.11	-24.25 to -15.96	3
	ER	-11.49	-14.40 to -8.57	3
	IR	-11.52	-13.10 to -9.93	3
Pain-Free Sh	F	-46.73	-56.47 to -36.98	2
	ABD	-44.24	-53.53 to -34.95	2
ROM Ankle	DF	-0.86 (SMD)	-1.18 to -0.53	5

Key: AROM = Active range of motion; PROM = Passive range of motion; ROM = Range of motion; Sh = Shoulder; DF = Dorsiflexion; F = Flexion; Abd = Abduction; ER = External rotation; IR = Internal rotation; SMD = Standardized mean difference

The effect of Mulligan concept techniques on pain and range of motion of the spine: A systematic review and meta-analysis

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PURPOSE: Mulligan's concept techniques have been well documented in research, specifically mobilisations with movement (MWMs). The effect of MWM's have been established to treat joint dysfunction in the presence of various pathologies. To our knowledge, only one systematic review has been published with regards to the efficacy of Mulligan concept techniques on the lumbar spine. No systematic reviews have examined the effects of the technique on the entire spine. The primary purpose of this systematic review and meta-analysis was to critically evaluate the literature around the efficacy of MWMs on the spine, with respect to pain and range of motion (ROM). Secondly, to provide a global scoping review of the current literature. **METHODS:** The key terms; "Mobilis(z)ation(s) with movement" were used to search the following electronic databases: PubMed, SportsDiscus via EBSCO, PEDRO, Cinahl via EBSCO, Cochrane and Google Scholar from gestation origin to August 2018. Findings were categorised into levels of evidence using the Oxford Centre of Evidence Based Medicine guidelines (OCEBM), then two researchers independently reviewed all papers with cross referencing. Methodological quality was assessed using a Physiotherapy Evidence Database tool (PEDro) and tables were developed to highlight study characteristics and quality scoring. For articles that met inclusion criteria for the meta-analysis, forest plots were compiled via REVMAN. **RESULTS:** 31 randomised controlled trials (RCTs) were used in this review and upon critical appraisal 54% of these studies were classified as having good to excellent methodological quality. Of the 31 studies, 8 were of the upper cervical spine (C1-2), 11 on the lower cervical (C3-7) and 12 studies analysed the lumbar spine. A meta-analysis was performed on 13 RCTs, 9 of which were cervical studies and 3 lumbar. An overall statistically significant effect was found in favour of the control groups on cervical pain (MD = 0.36; CI = 0.14 to 0.58; $p < 0.001$; I2 = 95%). At the lumbar spine level, the data shows an overall statistically significant effect on pain reduction favouring MWMs over traditional physiotherapy and a placebo intervention (SMD = -0.44; CI = -0.86 to -0.03; $p = 0.02$; I2 = 80%). Cervical ROM results were statistically significant supporting MWMs ability to improve range over all other alternative therapies in each direction of movement. Lumbar flexion ROM showed a non-significant improvement for the MWM groups over the placebos (SMD = 0.22; CI = -0.17 to 0.61; $p = 0.63$; I2 = 0%). **RELEVANCE TO CLINICAL PRACTICE:** This review highlights the need for more high-quality evidence for MWMs effect on pain and ROM for both the thoracic and lumbar spine. Practitioners are now able to easily locate quality evidence which supports the use of MWMs as a treatment technique for pain and ROM of the cervical and lumbar spine.

Tactical Research

Predicting load carriage performance in recreational hikers and specialist police

Study 1: Load carriage and predicting performance and injury in tactical populations

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PURPOSE: Tactical personnel are required to carry external loads as part of their everyday occupation. This load carriage can come with increased risk of injury or degradation of individual performance. To ensure these risks are minimized tactical personnel are routinely required to meet strict aerobic and anaerobic requirements. The aim of this study was to investigate the predictive relationship between a variety of fitness parameters and load carriage performance utilizing a modified predictive equation. **METHODS:** Retrospective data were collected from 18 specialist tactical police officer candidates serving within an Australian law enforcement agency (mean body weight=89.4 ± 8.5 kg). Baseline data were provided for 20-meter Multi-Stage Fitness Test (20m-MSFT) level which were converted to VO2 max, time to complete a 10 km pack march carrying load of 25 kg, average heart rate and speed during the 10 km pack march and pass or fail of a specialist tactical police selection course. Baseline data were then entered into a modified load carriage energy cost equation to determine the % of VO_{2max} work effort ($M = 1.5\ W + 2.0\ (W + L)(L/W)^2 + \eta(W + L)[1.5\ V^2 + 0.35\ VG] + V^2(0.015LH^2 + 0.064LF^2)$) and scored on a risk matrix for load carriage. **RESULTS:** Seven out of the eighteen participants failed the selection course with one participant self-withdrawing from the selection course (Figure 1). Seven participant's work efforts exceeded a predicted work effort of 60% VO_{2max} and of these seven, five failed the selection course. Likewise, 71% of those who were considered to be at moderate risk or higher were injured. **RELEVANCE TO CLINICAL PRACTICE:** Modified load carriage equations appear to accurately predict success in a specialist police selection course and injury risk. The ability to accurately predict selection success or failure within tactical populations may assist in the identification of deficits in physical capabilities in candidates and may serve to decrease injury risk. Within a broader scope these findings are also transferrable across various applications, occupations and populations from recreations hikers, porters, tactical personnel both locally and serving overseas as well as within a school and sporting environment where load carriage may be undertaken.

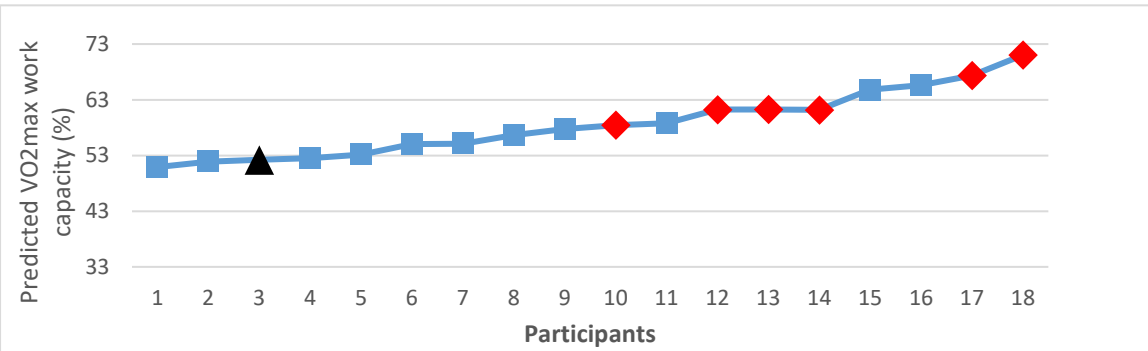

Figure 1: Candidate predicted VO_{2max} work effort based on the modified equation and selection success Diamond (red) markers indicate selection course failure: Triangle (black) marker indicates self-withdrawal

Study 2: Predicting load carriage performance in recreational hikers

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PURPOSE: Despite dedicated research investigating the energy cost of load carriage in tactical personnel, minimal research has been done from a recreational hiking perspective. Hikers, like tactical personnel, carry loads up to 29% of their body weight, and are subsequently thought to be prone to similar injury risks as tactical personnel. The purpose of this study is to investigate if a predictive equation, which is used on military personal, can be used to predict load carriage performance or injuries in recreational hikers and hiking guides. **METHODS:** Participants for this study were found through purposive sampling from the Tasmania Walking Company. Prior to and after a multiple day hike, a survey was administered to participants which investigated current fitness levels, loads carried and body weight which informed the injury risk calculations. Baseline data were then entered into a modified load carriage energy cost equation to determine the % of VO_{2max} work effort ($M = 1.5 W + 2.0 (W + L)(L/W)^2 + \eta(W + L)[1.5 V^2 + 0.35 VG] + V^2(0.015LH^2 + 0.064LF^2)$) with previous captured hiking data and surveys used to inform the equation. Final scores were graded using the international Risk Management Framework, risk matrix to grade injury risk (very low, low, medium, high or very high risk). **RESULTS:** Mean predicted work effort was 40.9 (±6.5) $\%VO_2$ max). A total of 31 participants were stratified for risk with seven being classified as 'low risk' and the remaining 24 being 'medium risk'. None of the participants deemed to be 'low risk' suffered an injury, while five of the 24 (20.8%) of the 'medium risk' group suffered an injury. **RELEVANCE TO CLINICAL PRACTICE:** The results of this study suggest that a modified load carriage equation, could successfully predict successful completion of a recreation hike but with limited sensitivity. Equations, such as these could be in recreational hiking populations to screen for injury risk prior to embarking on hikes.

Application of a physical appraisal test and the physical competency test in a police recruit population

Study 1: The use of the physical appraisal test to predict recruit performance on the physical competency test: Retrospective study

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PURPOSE: Police officers are required to perform physically demanding occupational tasks. The aim of this study was to investigate the association between the Physical Appraisal Test (PAT) and the Physical Competency Test (PCT), a police occupational task assessment, to identify the usability of PAT to predict PCT performance. **METHODS:** Retrospective data for 208 male recruits (mean age: 26.60 ± 5.66 years; mean height: 179.22 ± 10.49 cm; mean body mass 83.97 ± 14.02 kg; mean Body Mass Index(BMI) : 25.85 ± 3.92) and 99 female recruits (mean age: 26.87 ± 6.62 years; mean height: 168.13 ± 6.46 cm; mean body mass 65.42 ± 8.60 kg; BMI: 23.61 ± 2.52) who completed the PAT and the PCT were provided. The PAT comprised of a 2.4 km run, vertical jump height, press-ups, and grip strength measures. The PCT consisted of ten occupational specific tasks within 400m obstacle course. Pearson correlations were used to identify the relationship between the PAT and the PCT with linear regression analyses performed to determine the relationship between the two assessments. **RESULTS:** All PAT measures were significantly correlated to PCT performance with the strength of the correlations ranging from strong (2.4km run time; r =.639, p < 0.01) to moderate (vertical jump height; r = -.420, p < 0.01). The highest predictive relationship was seen with 2.4km (r^2 = .409) and the lowest predictive relationship was seen with standing vertical jump (r^2 = .177). **RELEVANCE TO CLINICAL PRACTICE:** The results of this study highlight the importance of aerobic endurance, lower body muscle power, and upper body grip strength and muscle endurance in performing the PCT (an assessment designed to mimic police task requirements). These physical attributes need to be developed in new recruits and form part of any return-to-work reconditioning frameworks for police recruits and officers.

Study 2: Profiling the physical competency test in a police recruit population

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PURPOSE: Police officers often require a significant amount of fitness in order to perform physically demanding occupational tasks. As such, recruits are required to undergo training in order to assess their ability to perform such tasks. The physical competency test (PCT) is a 400m obstacle course used to evaluate and assess a recruit's ability to perform occupation specific tasks that a police officer is expected to perform whilst on duty. The purpose of this study was to profile the PCT in a police recruit population. **METHODS:** Retrospective data for 813 male (mean age = 27.41 ± 5.92 years, mean weight = 83.98 ± 14.03kg, mean height = 179.23 ± 10.50cm and mean BMI = 25.85 ± 3.92) and 372 female (mean age = 27.01 ± 6.45 years, mean weight = 67.14 ± 8.60kg, mean height = 168.14 ± 6.46cm and mean BMI = 23.61 ± 2.52) recruit police officers from the NZ Police Constabulary Recruitment database were provided for analysis. Anthropometric data including height, weight and BMI were provided as well as participant PCT time. **RESULTS:** Significant differences were observed between sexes for all anthropometric measures and PCT time. Generally, in both the male and female groups, younger recruits tended to perform better than the older recruits with results between under 20 age group and 35-39 year-old-age group reaching significance. Interestingly however, no significant differences existed in the 40-44-year-old and 45-49-year-old age groups in females. **RELEVANCE TO CLINICAL PRACTICE:** The data provided in this study provides a benchmark for performance of male and female recruits of various ages on the PCT in preparation for entry, or re-entry following injury, into the NZ Police force.

Table 1: Profile of PCT results by gender in 5-year age bins

Age Group (yrs)	PCT Time (mins:sec)	
	Females	Males
Under 20 n=29 (♀=11: ♂=18)	2.26±0.05†	1.78±0.26*†
20-24 n=188 (♀=69: ♂=119)	2.29±0.19†	1.83±0.27*†‡
25-29 n=159 (♀=40: ♂=119)	2.34±0.17†	1.93±0.27*
30-34 n=78 (♀=19: ♂=59)	2.24±0.16	1.92±0.26*
35-39 n=39 (♀=10: ♂=29)	2.69±0.37	2.06±0.15*
40-44 n=25 (♀=10: ♂=15)	2.51±0.36	2.07±0.17*
45-49 n=3 (♀=3: ♂=0)	2.46±0.14	-

*=Significantly faster than the female PCT time of that age group (p<0.001). †= Significantly faster than the 35-39 Age Group of that gender (p<0.01). ‡= Significantly faster than the 40-44 age group of that gender (p<0.001).

Study 3: Profiling the fitness of New Zealand police officer recruits versus the general population

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PURPOSE: Police officers must have adequate fitness to sprint short distances, pull/push objects, drag victims, lift and carry objects, jump, and climb stairs. However, inadequate fitness can lead to task failure, injury and potential adverse health outcomes with research suggesting police officers lose fitness once leaving their training academy. The aims of this study were to evaluate fitness levels in a cohort of New Zealand police officer recruits and compare these results to the general population. **METHODS:** Deidentified, retrospective data for 426 Police Officer recruits (274 males, 26.46±6.55yrs, 179.64±9.81cm; 152 females 27.02±7.09yrs, 167.71±6.24cm) were supplied from a New Zealand Recruitment data base. Measures included height, weight and the results of a Physical Appraisal Test (PAT; 2.4km run, vertical jump, press-ups and grip strength) which was assessed twice separated by a period of approximately 12 weeks. **RESULTS:** On initial measurement, males were significantly quicker in the run ($p < 0.001$), jumped significantly higher ($p < 0.001$), completed significantly more pushups ($p < 0.001$) and had significantly greater grip strength of both hands ($p < 0.001$) when compared to females (Table 1). A total of 341 recruits completed a second assessment on the PAT where there were no longer significant differences between genders in the 2.4km run, in vertical jump, push ups or in grip strength. In comparison to normative data, the results of the final PAT score males in the 70th percentile for their run times, in the 90th percentile for their vertical jump, 'very good' for their push up score and 'good' for both left and right handed grip strength. Female recruits were on average in the 90th percentile for their run times and vertical jump and classified as being 'excellent' for push ups and both left and right handed grip strength. **RELEVANCE TO CLINICAL PRACTICE:** At this stage of their career, police recruits appear to have fitness levels comparable to, if not above, population norms. Efforts should be made to ensure maintenance, or improvement of these levels over the course of a police officer's career, to minimize cardiovascular risk amongst this population.

Table 1: Results of the Physical Appraisal Test (PAT) by gender.

	Initial PAT	Final PAT	*p value*
MALES			
2.4km Run (min:sec)	10:44±1:11*	10:57±1:01	0.001
Vertical Jump (cm)	106.36±21.89*	95.17±23.48	0.000
Pushups (reps)	35.59±7.32*	32.23±9.06	0.000
(L) Grip Strength (kg)	58.78±8.70*	53.65±28.21	0.000
(R) Grip Strength (kg)	61.18±8.33*	53.62±12.60	0.000
FEMALES			
2.4km Run (min:sec)	12:14±1:14	10:53±0:54	0.000
Vertical Jump (cm)	83.06±15.35	98.77±26.57	0.000
Pushups (reps)	20.36±6.06	32.69±8.17	0.000
(L) Grip Strength (kg)	38.64±5.14	54.10±12.86	0.000
(R) Grip Strength (kg)	40.78±5.57	56.10±13.27	0.000

*= Significant difference to female initial scores (p<0.001).

Profiling and predicting injuries in a police recruit population

Study 1: Profiling the injuries sustained by recruits during the New Zealand Police Force recruit training: A retrospective study

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PURPOSE: The tasks performed by police officers are unique, varied and can be performed in unexpected situations. The physicality associated with law enforcement tasks and duties is thought to increase the injury risk in this population. Recruit training is known to be a time when police officers are at an elevated risk of injury, due to the increase in physical demands compared to civilian life. The aim of this study was to profile the injuries occurring within the New Zealand Police Force during initial training to inform injury prevention strategies.
METHODS: Using a retrospective cohort design, injury data previously collected by a New Zealand Police College following organisation reporting protocols were provided. The data included injury body site, nature, mechanism and the activity being performed when the injury was suffered. **RESULTS:** A total of 564 injuries were recorded over the 22-month period, with the mean age of recruits reporting an injury being 28.83 ($\pm$ 6.9) years. The shoulder was the most commonly injured site (n=113, 20% of injuries), with sprains and strains being the most common nature of injury (n=287, 51% of injuries). Muscular stress with physical exercise was the most common mechanism of injury (n=175, 31% of injuries) with the activity responsibly for the majority of injuries being 'unknown' (n=256, 25% of injuries). **RELEVANCE TO CLINICAL PRACTICE:** Injury minimization programs should target the shoulder as the most commonly injured site during recruit training in police. Injuries appear to be joint related and cumulative in nature, without a specific activity causing them. Pre-screening protocols may be of benefit and efforts should be made to recruit and train physically resilient recruits and ensure any injuries, be they pre-enlistment or during training, are fully rehabilitated prior to their commencement as a qualified officer.

Study 2: Use of fitness testing results to predict injury in police recruits

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PURPOSE: In the conduct of their daily duties, law enforcement officers (LEO) are often required to perform dynamic, physically demanding tasks with little or no notice, sometimes at maximal levels of exertion. Given these requirements, training for prospective LEOs must be rigorous enough to ensure that when trainees graduate, they are competent in their response to crisis and resilient enough to do so for the span of their career. Therefore, based on previously reported effectiveness of fitness testing in predicting injury in predominantly military settings, the aim of this study was to investigate relationships between a physical ability test (PAT) and risk of injury during police recruit training. **METHODS:** Retrospective data pertaining to the results of a 2.4km run, vertical jump, pushups, and left- and right-hand grip assessments were obtained from a New Zealand Police Department. Records of injuries were also provided to determine the relationship between fitness measures and injury (and by injury location) using Mann-Whitney U tests to compare between those who were or were not injured. **RESULTS:** Significant differences in PAT performance between injured and non-injured groups existed for the pushups (p = 0.010) and right sided grip strength (p = 0.042) regardless of injury location. Vertical jump height demonstrated a significant relationship with lower limb injury (p = 0.032) while all measures of grip strength was significantly related to trunk injury (right grip p = 0.008; left grip p = 0.011; combined grip p = 0.007). **RELEVANCE TO CLINICAL PRACTICE:** Results suggest a clinically relevant relationship between some PAT events and injury risk during police recruit training. Higher levels of these physical attributes during recruitment, the development of these physical attributes during training and the reconditioning of these attributes following injury, may reduce recruit injury risk.

Redundancy in fitness tests for police officers

Study 1: Relationships between upper-body and trunk fitness assessments in law enforcement officers

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PURPOSE: Law enforcement officers are expected to perform physically demanding tasks due to the unpredictable events that occur during policing. For this reason, police officer recruits often undergo several aerobic, anaerobic and muscular strength fitness tests to ensure they are prepared for the exertional and physical nature of their training academies and subsequent occupation. The aim of this study was to investigate the correlations between several trunk and upper body fitness assessments used in two law enforcement agencies (LEAs) and identify potential redundancies. **METHODS:** Retrospective data were collected from two LEAs (LEA1 n=165; LEA2 n=633). The data of LEA1 included: age, weight, 1-minute push-up (1PU) and sit-up (1SU) repetitions, 1-repetition maximum bench press (1RM Bench) and bench press ratio (BPR). LEA2 included age, weight, 1PU, 1SU, grip dynameter (GRIP) and prone plank (PLANK). A Pearson's correlation was used to calculate relationships between each of the fitness measures. **RESULTS:** 1PU were strongly correlated to 1SU (LEA1 r=0.660; LEA2 r=0.590) and BPR (LEA1 r=0.762), moderately to 1RM Bench (LEA1 r=0.652); and weakly to GRIP (LEA2 r=0.138). 1SU were moderately correlated to BPR (LEA1 r=0.572) and PLANK (LEA2 r= .578) and weakly to 1RM Bench (LEA1 p = 0.394). **RELEVANCE TO CLINICAL PRACTICE:** While there are a few correlations between the upper-body and trunk fitness assessments, the tests results were not strong enough to warrant replacing one measure with another. Given the diverse fitness requirements of police officers, the conditioning and reconditioning of a diverse range of physical fitness qualities must be developed and assessed using a variety of assessment measures.

Study 2: Relationships between lower body fitness measures in police fitness testing: Are there redundancies?

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PURPOSE: Physical fitness is an important attribute of a police officer, with poor fitness linked to an increased injury risk and poor occupational task performance. Consequently, fitness is determined via a wide variety of assessments (e.g. strength, jump and running assessments). It is unclear, however, whether the vast array of assessments are all required within this population. The aim of this research was to compare fitness measures commonly used with police officers to identify whether any redundancies in fitness testing measures existed. **METHODS:** Retrospective data from two law enforcement agencies (LEA) were provided (LEA1: 33.72±8.86yrs, 82.35±14.01kg; LEA 2: 39.36±8.15yrs, 92.61±16.2 kg) and included: vertical jump height (VJ; measured in cm), 300m sprint time (S300m; measured in sec), 2.4km run time (RUN; measured in min:sec), isometric leg / back dynamometer (LBD; measured in kg) and progressive shuttle run test scores (PSRT; measured in shuttles). Pearson's correlations were used to calculate relationships between the fitness assessments for both agencies (p <0.05). **RESULTS:** In LEA1, there was a strong correlation between the S300m and the RUN (r =.706, p =.02). There was no significant correlation between the VJ and S300 (r=.03). In LEA2, there were significant weak-to-moderate correlations between VJ and LBD (r=.380, p=.02), and between VJ and PSRT (r = .506, p =.02). **RELEVANCE TO CLINICAL PRACTICE:** Although there were some significant correlations between measures, the strength of these correlations suggests that for the tests provided, no single test could replace another to measure a similar value. However, the short distance nature of the S300 may make it a useful tool as part of a return-to-run program in lieu of longer (i.e. 2.4km run) assessments.

The relationship between fitness, heart rate and three different marksmanship tasks

Study 1: The relationship between fitness and marksmanship in police officers

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PURPOSE: Police officers can be required to rapidly transition from sedentary work to a physically challenging, and potentially dangerous, field-based task. During these tasks, an officer may also be required to accurately aim and fire a weapon while under duress. The purpose of this study was to investigate the relationship between fitness and marksmanship to facilitate future strategies to improve occupational skills. **METHODS:** Retrospective data were provided for thirty-four police officers (n=33: mean age = 40.48 ± 6.66 years: mean weight = 100.60 ± 19.82 kg: mean height = 180.42 ± 6.87 cm: mean BMI of 30.76 ± 4.88 kg/m2) from a US based law enforcement agency in regards to scores of different fitness measures (vertical jump, leg-back dynamometer, grip strength and 20m Shuttle Run) and different shooting scenarios (static shoot scenario, dynamic movement scenario and a decisional shooting scenario). Relevant data were extracted and analyzed for significant correlations. **RESULTS:** No single fitness measure consistently demonstrated a relationship to the officers shooting scores between the marksmanship tasks. There was a moderate and significant correlation between the 20m Shuttle Run scores and the static shooting scenario scores ($r = 0.528$, $p = 0.002$). There was also a weak but significant relationship between the dynamic movement scenario and grip strength ($r = -0.367$, $p = 0.035$) and between the decisional shooting scenario and leg dynamometer strength ($r = 0.344$, $p = 0.050$). There were no significant correlations between any of the three shooting scenarios. **RELEVANCE TO CLINICAL PRACTICE:** This study demonstrated that relationships between fitness measures varied between different shooting scenarios. Furthermore, with no correlation between different shooting scenarios, marksmanship performance on one task was not indicative of performance on other marksmanship tasks. These results may explain the high variability in previous research investigating fitness and marksmanship. Injuries to police officers, though potentially reducing elements of fitness, may have varying impacts on police officer marksmanship as such a high variety of fitness reconditioning must inform their return-to-work practices.

Study 2: The impact of heart rate on marksmanship in police officers

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PURPOSE: The purpose of this study was to examine the relationship between heart rate (HR) and marksmanship performance in police officers. **METHODS:** All subjects (n=33 males: n=1 female) were officers of a US State police force. Data results for a Queen College Step Test (used to determine maximum HR) and results from three shooting scenarios (static shooting, dynamic shooting, and a decisional shooting scenario) were provided. Shooting scores were awarded based on accuracy measured by proximity to a target. HR were captured using Polar Team 2 monitors during with average and peak HR provided. The level of significance was set at ($p < .05$). **RESULTS:** A significant negative correlation was identified between peak HR value and marksmanship score during the dynamic shooting scenario (r=-.547, $p < .001$) (see Table 1), with higher peak HR values being associated with lower scores. There were significant differences between the average HR of the static shooting scenario compared to the other two shooting scenarios, and significant differences between peak HR for all shooting scenarios. **RELEVANCE TO CLINICAL PRACTICE:** Average and peak HR differ between shooting scenarios with dynamic shooting (which elicits the highest peak HR) most significantly associated with marksmanship. Cardiovascular conditioning the includes peak HR training is of importance to police officer marksmanship, especially when moving and shooting as may be the case in an active shooter scenario.

Table 1. HR results during the three marksmanship scenarios (mean ± SD)

	Average Heart Rate (bpm)	Peak Heart Rate (bpm)	Average Heart Rate (%)	Peak Heart Rate (%)
Static Shooting	103.60 ± 12.72	127.87 ± 21.73‡	58.07% ± 8.90%	71.80% ± 12.68%
Moving and Shooting	150.00 ± 12.27§	175.91 ± 10.02*‡	77.19% ± 20.61%†	90.57% ± 23.52%
Decisional Shooting	153.13 ± 14.19§	159.88 ± 12.56‡	78.69% ± 21.19%	82.15% ± 21.71%

*= Strong negative correlation with mean moving and shooting score: r=-.547, $p < .001$
†= Significantly differently from static shooting Avg HR %: $p = .04$
‡= Significantly different between all 3 values for peak HR: $p < .001$
§= Significantly different from static shooting Avg HR: $p < .001$

Study 1: Differences between novice and expert performance in defensive tactics employed by police officers

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PURPOSE: Tactical skills are important in law enforcement and if not performed at an adequate standard, may increase injury risk or task failure. Minimal research exists comparing experts and novices in defensive tactics. The aim of this study was to compare experts and novice law enforcement officers in defensive skill execution, using the Defensive Tactics and Arrest Control (DETAC) gauntlet to inform training protocols.
METHODS: Fifteen police DEFTAC instructors and 36 general duties officers completed the DEFTAC training. Four DEFTAC subject matter experts (SMEs) evaluated Police officers' ability to execute the techniques as trained, and their physical ability to perform each defensive skill. Defensive skills included edged weapon disarm, holstered gun retention, blunt object defence, gun disarm and prone handcuffing. **RESULTS:** Instructors outperformed general officers with significant difference in technique as trained in; Edged weapon disarm ($p < 0.001$), holstered gun retention ($p < 0.001$), blunt object defence ($p < 0.001$), gun disarm ($p < 0.001$) and prone handcuffing ($p < .001$). Physical ability to perform the DEFTAC skills efficiently, showed significant differences for instructors outperforming general officers in; edge weapon disarm ($p < 0.001$) and holstered gun retention ($p < 0.001$). Gun disarm had a mild difference when comparing groups to physical ability to perform efficiently ($p < 0.05$).
RELEVANCE TO CLINICAL PRACTICE: With physical assault being a leading cause of police officer injury, investment in the development and maintenance of instructor-level DEFTAC skill, especially where physical capability is required, may lead to an increase in general duties officer effectiveness in DEFTAC performance and decrease their risk of physical injury (both intrinsic and extrinsic) when restraining an offender.

Study 2: Differences in heart rates between general officers and instructors employing defensive tactics skills

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PURPOSE: Defensive tactic skills are often performed when a police officer is under threat from potential physical stress. Little research has measured the actual stress experienced by officers in these types of scenarios. The aim of this study was to compare heart rates between expert and novice police officers performing defensive tactic skills during a Defensive Tactics and Arrest Control (DETAC) gauntlet. **METHODS:** Data from 61 police personnel including both defensive tactics instructors (n=24, mean age = 32.13 ± 6.72 yrs, mean height = 178.30 ± 60 cm, mean body mass = 92.40 ± 16.30 kg) and general duties officers (n=37, mean age = 39.20 ± 8.40 years, 179.50 ± 7.70 cm, mean body mass = 89.70 ± 14.10 kg) who participated in a DEFTAC gauntlet drill were provided. Measures of height, weight, and duty weight were recorded prior to the drill with heart rates taken throughout (Polar FT7 Polar heart rate monitoring device) the drill. Additionally, a final score for the DEFTAC drill was provided by assessors after the drill. An independent-samples T-test was performed to investigate differences in heart rate measures (peak heart rate, mean heart rate and peak percentage heart rate) between instructors and general duties officers with a one-way analysis of variance to determine if any differences existed between the instructors and the general duties officers who passed and those who failed. **RESULTS:** There were no significant differences in peak heart rate, mean heart rate and peak percentage heart rate between the instructors, and the general duties police officers who both passed or failed the DEFTAC drill. Nonetheless, the officers who failed DEFTAC were working at the highest percentage of peak HR (Figure 1). **RELEVANCE TO CLINICAL PRACTICE:** All police officers place their hearts under significant stress when performing defensive tactics skills, regardless of skill level. However, general duties officers with poorer skills may place their hearts under greater strain. With cardiovascular disease risk higher in police officers than the general population, heart health optimisation strategies (including general health, fitness and stress management) are of importance for all officers.

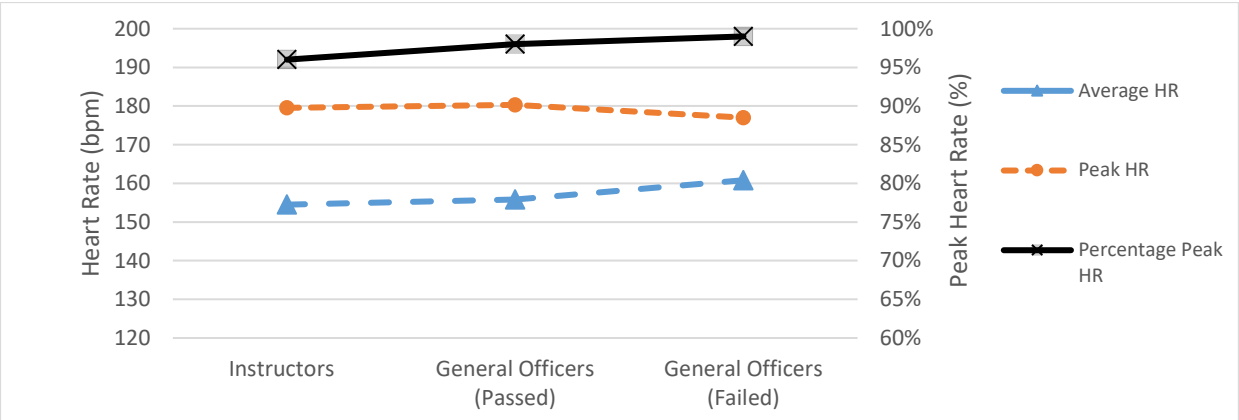

Figure 1: Mean average heart rate, mean peak heart rate and percentage peak heart rate of instructors, general officers that passed and general officers that failed during the DEFTAC gauntlet.

The use of a specialist occupational fitness test in specialist police

Study 1: Predicting Specialist Tactical Response Police Unit selection success using the urban rush, 2.4 km and 10km loaded carriage events

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PURPOSE: Officers serving in specialist tactical response police teams are highly-trained personnel who operate in dangerous and unpredictable environments. The aim of this study was to determine whether performance on a loaded explosive occupational task (Urban Rush), or distance-based load carriage tasks (2.4 km or 10 km) were indicative of officer success on a specialist selection course (SSC). **METHODS:** Eighteen male police officers (mean age = 32.1±5.04 yrs; mean height = 183.72±5.79 cm; mean weight = 89.44±8.56 kg; mean Body Mass Index (BMI) = 26.45±1.58 kg/m^2) participated in the SSC over 5 consecutive days. Data were categorised into: Group 1 (successful specialist selection applicants) and Group 2 (unsuccessful applicants). Independent sample t-tests, Pearson's correlations and a linear regression determined the differences and relationship between anthropometric and event performance data with alpha levels set at p = 0.05 a priori. **RESULTS:** Height (p = 0.025), body weight (p = 0.007) and 2.4km loaded march event performance (p = 0.013) were significantly different between groups (see Table 1). All three performance measures were significant predictors of success accounting for 44% of the variance in outcomes, however, the 2.4km loaded march was the strongest (r^2= 0.33) and only significant independent (adjusted r^2=0.29) predictor of success. **RELEVANCE TO CLINICAL PRACTICE:** While a loaded 2.4 km event is associated with success, a ceiling effect for an explosive anaerobic task and longer 10 km task may exist whereby increases in performance are not associated with selection success. Police officers preparing for selection, and therapists responsible for returning injured specialist police for duty need to ensure that loaded 2.4 km events are included in candidate's and officer's work hardening practices.

Table 1: Descriptive Statistics for Successful and Unsuccessful Applicants.

Anthropometric Data/ Performance Measure	Successful Applicants Mean ± Standard Deviation	Unsuccessful Applicants Mean ± Standard Deviation
Age (years)	30.64 ± 4.97	34.43 ± 4.54
Height (cm)	181.36 ± 5.35	187.43 ± 4.58*
Body Weight (kg)	85.36 ± 6.65	95.86 ± 7.45**
BMI (kg/m^2)	25.94 ± 1.49	27.27 ± 1.46
Loaded BMI (kg/m^2)	33.33 ± 1.75	34.02 ± 1.38
Urban Rush (mins)	1.87 ± 0.16	1.86 ± 0.15
2.4 km Loaded March (mins)	13.64 ± 0.92	15.29 ± 1.60*
10km Loaded March (mins) ‡	86.03 ± 2.26	87.86 ± 2.34

Significantly difference between applicants at *p>.05 and ** p>.01.

Study 2: Comparing an occupational specific physical assessment to fitness measures in specialist tactical response police candidates: A retrospective cohort study

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PURPOSE: Specialist tactical response police are required to frequently perform physically demanding tasks at high levels, emphasizing the need for optimal physical fitness in this population. This study aimed to investigate the relationships between select measures of physical fitness and performance on an occupational specific physical assessment (OSPA). **METHODS:** A retrospective analysis of data from 18 male specialist police candidates (mean age = 32.1±5.04 yrs; mean height = 183.72±5.79 cm; mean weight = 89.44±8.56 kg; mean Body Mass Index (BMI) = 26.45±1.58 kg/m^2) was conducted. Data comprised of anthropometric measures, fitness measures, and an OSPA (See Table 1). A stepwise linear regression determined the influence of measured fitness parameters on OSPA performance. **RESULTS:** A regression featuring both the 1RM military shoulder press and grip strength of the non-dominant hand was the most significant predicter of performance (adjusted r^2=0.565, p<0.001). A separate model, exclusively using the 1RM military shoulder press additionally predicted OSPA performance (adjusted r^2=0.240, p = 0.023). **RELEVANCE TO CLINICAL PRACTICE:** Given that the upper limbs are the leading site of injury in law enforcement personnel, these results emphasize the importance of optimal upper limb musculoskeletal strength on key occupational tasks in specialist tactical response police candidates and suggest that apart from the re-establishment of a generally high level of fitness, specific attention to strength in the upper limbs must inform any return-to-work practices for this population.

Table 1. Descriptive data for physical fitness and occupational task performance measures in specialist police candidates.

VARIABLE	MIN	MAX	MEAN ± SD
Illinois Agility (sec)	15.44	16.91	15.93 ± 0.52
1RM bench press (kg)	97.5	130	114.31 ± 8.13
1RM back squat (kg)	100	160	132.72 ± 16.01
1RM military shoulder press (kg)	47.5	80	65.64 ± 9.07
1RM hex deadlift (kg)	134	185	166.39 ± 15.91
Grip strength: Dominant (kg)	50.3	72.9	61.95 ± 7.00
Grip strength: Non-dominant (kg)	47.2	66.7	60.17 ± 5.40
Loaded pull-ups + 17 kg plate carrier (reps)	3	10	6.39 ± 2.17
7 stage sit-up (reps)	5	7	6.78 ± 0.55
Push-ups: 60 sec (reps)	49	77	60.28 ± 7.63
Beep test (level)	10.1	13.1	11.48 ± 1.06
1.2 km run (min)	4.01	5.14	4.28 ± 0.26
OSPA (min)	01:36.8	02:07.5	01:51.73 ± 00:09.21
OSPA load weight (kg)	27.45	29.5	28.43 ± 0.54

Key: OSPA = occupational specific physical assessment

Study 3: Performance on an anaerobic specialist tactical police fitness test: Candidates versus specialist tactical response police

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PURPOSE: Specialist tactical response police officers must respond to high threat situations, often resolving these threats in a short explosive event. Candidates wishing to join specialist tactical response police teams are expected to be at a physical level commensurate with their unit's requirements. The aim of this study was to compare differences in performance between candidates and qualified specialist tactical police officers when completing an occupationally-specific explosive anaerobic task. **METHODS:** A retrospective analysis of data from male candidates (n=18) and qualified specialist tactical police officers (n=34) were provided (see Table 1). Data collected included age, body weight, height, worn equipment weight and Urban Rush (UR) time in minutes and seconds. The dummy weight for both groups was 80.00 kg. Following descriptive analyses, independent samples t-tests were performed to determine if there were any significant differences between candidates and specialist tactical police officers. **RESULTS:** There were no significant differences in height or body weight between groups, however candidates were significantly (p = 0.002) younger and carried significantly (p < 0.001) heavier occupational loads when compared to the specialist tactical police officers. The UR times of the specialist tactical police officers were generally faster than those of the candidates, with the result approaching significance (p = 0.087). **RELEVANCE TO CLINICAL PRACTICE:** Given the similar total loads moved and UR task times to completion, the results suggest that candidates attempting selection into a specialist tactical police unit may be at a suitable level of fitness on attending selection and that the differences between successful selection and failure should focus on measures other than fitness. Through reducing excessive physically demanding tasks (for the sake of being physically demanding) and focusing on other specialist tactical police attributes during selection, the potential for loss of effective specialist police due to injury in the selection process may be reduced.

Table 1. Trainee and Qualified Specialist anthropometric characteristics

GROUPS	Candidates; n=18		Qualified Specialist; n =34	
	Mean ± SD	*Min - Max*	*Mean ± SD*	*Min - Max*
Age (yrs)	32.11 ± 4.90	26.00 – 42.00	37.82 ± 6.64*	25.00 – 60.00
Height (cm)	183.72 ± 5.63	173.00–193.00	181.62 ± 6.70	165.00 – 194.00
Weight (kg)	89.44 ± 8.32	71.00 – 110.00	91.54 ± 10.89**	70.50 – 115.00
Kit Weight (kg)	24.02 ± 3.67	16.50 – 31.10	18.97 ± 2.23	14.60 – 24.20
Full Weight (kg)	113.46 ± 8.17	99.00 – 127.60	110.51 ± 11.77	89.00 – 137.00
Urban Rush Time (secs)	111.73 ± 9.21	96.80 – 127.50	105.10 ± 14.61	86.82 – 149.40

NOTE: Significantly different between candidates at *p < 0.05, ** p<.001

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