

# RELATIONSHIP OF ABSOLUTE AND RELATIVE LOWER-BODY STRENGTH TO PREDICTORS OF ATHLETIC PERFORMANCE

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## PURPOSE

Strength is a foundation for many different athletic activities. For example, absolute and relative lower-body strength, measured by a 1RM back squat, strongly correlates with sprint speed among professional male soccer players (Styles et al., 2016). With a strong correlation between that strength and sprint speed, the question remains if these correlations exist in Division II college women's soccer players, and whether this carries over to other actions (e.g. jumping, change-of-direction speed, maximal running performance). The purpose of the study was to investigate the correlations between absolute and relative lower-body strength on multiple predictors of athletic performance among Division II college women's soccer players.

## METHODS

Seventeen (n = 17) Division II college women's soccer players (Age = 19.7±1.2 yrs; Height = 166.4 ± 7.8 cm; Weight = 64.3 ± 7.9 kg) participated in normal pre-season testing protocols including: Vertical Jump (VJ), 1RM Back Squat, 505-Agility (505), Modified T-test (Mod T), 10m and 30m Sprint (10m, 30m), and the Multistage Fitness Test (20m MSFT). Absolute strength (AS) was determined by the 1RM Back Squat test. Relative strength (RS) was calculated for each athlete with the following equation: (kilograms lifted) / (body weight). Pearson's correlation coefficient was used to measure the absolute and relative lower-body strength measures against scores on the performance test.

## RESULTS

Significant correlations were found between AS and 505 (Right:  $r = -0.5$ ,  $p \leq 0.05$ ; Left:  $r = -0.6$ ,  $p \leq 0.05$ ), Mod T ( $r = -0.6$ ,  $p \leq 0.05$ ), and 10m and 30m ( $r = -0.6$ ,  $p \leq 0.05$ ;  $r = -0.5$ ,  $p \leq 0.05$ ). Significant correlations were also found between RS and VJ ( $r = 0.5$ ,  $p \leq 0.05$ ), 505 (Right:  $r = -0.6$ ,  $p \leq 0.05$ ; Left:  $r = -0.7$ ,  $p \leq 0.01$ ), Mod T ( $r = -0.8$ ,  $p \leq 0.01$ ), 10m and 30m ( $r = -0.6$ ,  $p \leq 0.05$ ;  $r = -0.7$ ,  $p \leq 0.01$ ), and 20m MSFT ( $r = 0.6$ ,  $p \leq 0.05$ ). There were no significant correlations found between AS and VJ or the 20m MSFT.

## CONCLUSION

From the results of this investigation, the significance in RS correlated with a better performance on the pre-season tests. Based on these results, it appears that coaches should focus on developing a players RS to improve power, agility, and speed performance.

## REFERENCES

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# The Physiological Impact of Stress on Performance in Tactical Populations: A Critical Review

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**Abstract:** Law enforcement officers (LEOs) are required to perform in high stress situations where they must protect civilians and fellow officers. Due to the impact stress may have on performance, the aim of this review was to critically appraise the available literature on stress and performance in tactical personnel and to synthesize the findings. A systematic search of four selected databases known to report studies in this population and field of research, was conducted. Pre-determined inclusion and exclusion criteria were used to determine which studies qualified for this review. The ten included studies were critically appraised and information relevant to the research topic was extracted and tabulated. The mean critical appraisal score of all articles was 50% and ranged from 21% being of ‘poor’ quality to 64% being of ‘good’ quality. The Cohen’s kappa analysis showed an agreement rating of 43% ( $\kappa=0.429$ ). Eight of the ten studies reported a change in performance between the non-stressful and stressful scenarios while the other two studies reported an increase in dissociative symptoms which led to a change in performance. This critical review concluded that performance in tactical populations can be influenced by stress and LEOs should be made aware of the impact occupational stresses have on their performance as well as the physiological changes their body undergoes in the line of duty.

## Vascular Function is Not Enhanced in Middle-Aged Female Ultra-Endurance Athletes

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Traditional regular aerobic exercise training can prevent or reverse age-related declines in vascular function. However, recent data indicate that long-term, high-volume endurance exercise training may actually negate the normal protective effect of aerobic exercise on cardiac and vascular function. **PURPOSE:** To determine the impact of “ultra-endurance” training on vascular function in middle-aged women. **METHODS:** In 8 female “ultra-endurance” middle-aged athletes (ATH: 52±2 yrs; engaged in high volume training for 18±3 yrs) and 5 healthy recreationally-active controls (CON: 51±3 yrs), we measured brachial artery mean blood velocity and diameter (Doppler ultrasound) at rest and in response to 5 minutes of forearm ischemia. Peak velocity after ischemia was quantified as an index of microvascular function, and flow-mediated vasodilation (FMD), an index of endothelial function, was calculated as the maximal relative change in brachial artery diameter from baseline. Shear rate was calculated as  $8 \cdot (\text{velocity}/\text{diameter})$  from cuff release to peak diameter change and expressed as area under the curve ( $SR_{AUC}$ ) to quantify the stimulus for FMD. To determine central arterial (aortic) stiffness, carotid-femoral pulse wave velocity (cfPWV) was measured using a tonometer probe and an automated, inflatable cuff (SphygmoCor XCEL). **RESULTS:** As expected, ATH demonstrated much greater levels of chronic physical activity (112±5 vs 24±4 MET-hr/week) and  $VO_2$  peak (47.2±3.1 vs 32.5±4.2 ml/kg/min; both  $P < 0.05$ ) vs CON. In contrast, peak velocity (62.3±6.2 vs 60.5±8.2 cm/s), FMD (4.3±1.2 vs 5.6±1.5%), and  $SR_{AUC}$  (21.1±2.9 vs 24.4±4.9  $s^{-1} \cdot 10^3$ ) were not significantly different between groups. Similarly, cfPWV was not different in ATH and CON (6.0 ± 0.2 vs 6.5 ± 0.4  $m \cdot s^{-1}$ ;  $P = 0.12$ ). **CONCLUSION:** Our preliminary data indicate that chronic, high-volume endurance exercise training in middle-aged women is not associated with greater vascular function compared with those that are recreationally-active.

TITLE: Self-reported physical activity and microbiome  $\alpha$ -diversity in healthy adults

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PURPOSE: There are established differences in the gut microbiome diversity indices that have been implicated in chronic diseases such as irritable bowel syndrome, Crohn's, and colorectal cancer. While physical activity (PA) and changes in energy metabolism may also modulate gut microbiome structural composition and function, few studies have been conducted in humans. This study explored associations between self reported PA and  $\alpha$ -diversity of the stool microbiome in healthy adults.

METHODS: Secondary data analysis was completed from a four-week dietary fiber intervention study titled Beans/Bran Enriching Nutritional Eating For Intestinal health Trial (NCT01929122). PA was measured using self-report logs for three days at the beginning and end of the diet intervention. Logs included the specific type (e.g., running, cycling, dancing) and duration of PA. MET values, corrected for height, weight, and age, were assigned to each activity based on the 2011 Compendium of PA. MET values for each activity were multiplied by duration in minutes to compute MET-minutes. Total MET-minutes per day were summed and averaged over each three-day reporting period and the two time points.  $\alpha$ -diversity data was obtained from stool samples and reported as the Inverse Simpson number of species plus distribution. Participants in the intervention group with complete PA and  $\alpha$ -diversity data ( $N=5$ ) were included in analyses. Pearson correlations examined associations between  $\alpha$ -diversity values and MET-min/week.

RESULTS: Participants were female,  $44\pm 13.2$  years old and normal weight,  $M$  BMI =  $22.9\pm 1.68$  kg/m<sup>2</sup>. PA levels were  $M=27.4\pm 13.6$  MET-hours per week. Inverse Simpson values were  $M=21.9\pm 7.90$ . There was a moderate, non significant correlation between PA and  $\alpha$ -diversity ( $r^2= 0.48$ ,  $p=0.19$ ).

CONCLUSION: This study found a positive association between PA and increasing diversity of microbiota, however additional research with a larger sample size is needed. Future studies should examine whether PA modulates microbiome diversity and metabolic function, which may have implications for preventing, or alleviating symptoms of chronic diseases affecting the gastrointestinal tract.

## Substrate Utilization Between Genders at Different Intensities

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Substrate utilization has been defined as the degree to which fuel acts as a primary or secondary source of energy; intensity and duration of physical activity influences these sources. Substrate utilization is measured by determining an individual's respiratory exchange ratio (RER).

**PURPOSE:** To determine the difference between gender's substrate utilization during high and low intensities. **METHODS:** Four subjects were chosen, two males and two females. Each trial consisted a 3-5-minute warm up on a treadmill at 25% of the subject's  $VO_2$  max. The subjects performed a randomly selected exercise bout of either high or low intensity with a four percent incline for each intensity. The speeds for the high and low intensities were calculated by using the American College of Sports Medicine (ACSM) equation for speed based off their estimated  $VO_2$  maximums from the Rockport walk test. The low intensity exercise trial consisted of a 10-minute trial at 50% of the participants  $VO_2$  max. The high intensity exercise trial consisted of two, four minute intervals at 85% of the participants  $VO_2$  max with a 4-minute break in between each bout where the mask was removed and reattached after 3 minutes, of the 4-minute resting period. RER comparisons at the last minute of each trial were made using a non-parametric two-sample Welch's t-tests. **RESULTS:** At the last minute of the high intensity interval males had a mean score of 1.02 and females of 1.03 yielding a p-value of .5102. For the low intensity males had a mean score of .93 and females of .89 yielding a p-value of .0004. **CONCLUSIONS:** Females showed to have a significantly lower RER for the low intensity ( $p < .05$ ) compared to males. There was no significant difference between genders at the high intensity ( $p > .05$ ).

## Effects Of Upper Limb Circulatory Occlusion On Maximal Oxygen Uptake In Healthy Young Adults

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It is generally accepted that during large muscle mass exercise, such as cycling and running, maximal oxygen uptake ( $\text{VO}_{2\text{max}}$ ) is limited by oxygen delivery. Accordingly, acute interventions that may enhance oxygen delivery in a safe and rule-abiding fashion are of interest to both athletes and coaches alike. In this regard, circulatory occlusion of the upper limbs may have relevance. We have strong preliminary data to suggest that upper limb circulatory occlusion may improve cycle ergometry endurance exercise performance. The influence of upper limb circulatory occlusion on the physiological responses to incremental exercise are currently unknown. **PURPOSE** To determine the influence of upper limb circulatory occlusion on ventilatory threshold ( $T_{\text{vent}}$ ) and  $\text{VO}_{2\text{max}}$  during incremental cycle ergometer exercise to volitional exhaustion. **METHODS** Six healthy adults (5 males, 1 female), aged 21-31 years, participated in this randomized cross-over study. On two different occasions, separated by a minimum of 72 hours,  $T_{\text{vent}}$  and  $\text{VO}_{2\text{max}}$  were determined during incremental stationary cycle ergometer exercise (20-25 W/min). Prior to one trial, participants raised their arms above their head for 60-seconds, and automated blood pressure cuffs were rapidly inflated to 220 mmHg before participants returned their arms to cycling position. Circulatory occlusion was confirmed by the absence of a radial pulse and the inability to measure peripheral oxygen saturation at the fingers. **RESULTS** Neither the  $\text{VO}_2$  at  $T_{\text{vent}}$  ( $1.91 \pm 0.29$  vs.  $1.91 \pm 0.22$  L/min (mean $\pm$ SE);  $P=0.96$ ) nor  $\text{VO}_{2\text{max}}$  ( $3.13 \pm 0.35$  vs.  $3.22 \pm 0.30$  L/min;  $P=0.48$ ) were appreciably influenced by upper limb occlusion. **CONCLUSION** We speculated that upper limb circulatory occlusion would increase central blood volume, and temporarily increase blood and oxygen availability for the lower limbs during incremental cycle ergometer exercise. These exploratory data suggest that upper limb circulatory occlusion does not affect  $T_{\text{vent}}$  or  $\text{VO}_{2\text{max}}$ .

## THE ABILITY OF MOVEMENT SCREENING TOOLS TO PREDICT INJURY IN THE ATHLETIC AND TACTICAL POPULATIONS

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**PURPOSE:** The purpose of this study was to (1) critically review research examining the relationship between movement screens and injury, (2) to synthesize their findings, and (3) to explore any emerging differences in the use of movement screens between tactical and athletic populations on movement screens and their ability to predict injury. **METHODS:** Key databases (CINAHL, OVID, PubMed and SportsDiscus) were searched in September 2017 using variations on the search terms: movement screen(ing), FMS, SFMA and injury\*. An inclusion and exclusion criteria were applied and the remaining studies appraised using the Downs and Blacks tool and Kennelly's grading system. Key data was then extracted from the articles and tabulated. **RESULTS:** This review included 8 tactical (mean age=22.4± 2.7) and 10 athletic (mean age= 21.4±2.3). With a methodological quality ranged from 14.29% to 58.93%. Within the studies the FMS was the most popular screening tool (12 of 18 studies), other studies included: Basketball Mobility Test (BMT), Y balance test, Physical Fitness Test (PFT), Movement Competency Screen (MCS) and Physical Readiness Test (PRT). Combined results showed a mean FMS score of 13.2-16.6 has been reported to predict injury. The FMS was reported to not have enough discriminative power or significance to predict injury in 6 of 18 studies. Components of the PFT, MCS, PRT also found significant relationships to predict injury. **CONCLUSION:** The clinical use of movement screens to predict injury should be used with caution in both tactical and athletic populations. The majority of the studies evaluated were either of poor quality or unable to provide a strong significant finding. Movement screens provide some insight into quality of movement and perhaps future directions for conditioning programs.



**Title:** The Effects of TheraTogs on Postural Muscle Amplitude in Subjects without Sensorimotor Impairments

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### **Abstract**

There has been little research done on the effects of postural muscle amplitude while donned in TheraTogs. TheraTogs is a full body undergarment and strapping system made of elasticized, latex-free, Velcro sensitive fabric that encourages all day passive, postural support. Previous research focused on patients with sensorimotor impairments whereas the current study's subjects had no known impairments. **PURPOSE:** This non-randomized, experimental study aimed to investigate TheraTogs on postural muscle amplitude. To assess the muscles amplitude of four postural muscles, an electromyography (EMG) was used. In the Monfort Human Performance Lab at Colorado Mesa University, four, female subjects, aged  $22.3 \pm 0.9$ , were recruited from the student population. **METHODS:** Data collection was taken for five different cumulative conditions; no garment, TheraTog base, erector spinae strap, rectus abdominis strap, and transverse abdominis strap. During testing, subjects stood for each condition for approximately 25 seconds and data was collected for a total of five seconds. Average EMG activity of middle trapezius, thoracic erector spinae, rectus abdominis, and external oblique muscles was collected. **RESULTS:** Group postural muscle amplitude was the highest for the middles trapezius when the erector spinae strap was applied (+54.9%) compared to no garment. There was little change in the thoracic erector spinae amplitude for each condition, but the rectus abdominis strap caused the highest percent change in that muscle (+22.3%). In the abdominal muscles, all conditions produced less amplitude compared to no garment. Following an ANOVA, there were no significant differences between each condition, although there were qualitative differences. Individual data varied significantly between each subject, which may relate to the individual's muscle recruitment rather than the brace. **CONCLUSION:** TheraTogs induced changes that can be effective for daily postural control.

# Parent Support and Child Enjoyment Mediate the Association between Child Coordination and Physical Activity Participation

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**PURPOSE:** To examine the mediation effects of parent support and child enjoyment on the association between child athletic coordination and physical activity (PA) participation.

**METHODS:** Data were collected from 374 parents of children enrolled in the 2017 Youth Sport Camps at Colorado State University. Parents provided informed consent and completed a survey using Qualtrics. The survey included questions about children's PA and related correlates during three successive school years. The most recent school year (2016-17) was used for these analyses. Outcome variable is PA participation, independent variable is child athletic coordination, and hypothesized mediators are parent support and child enjoyment. Multiple mediator models were tested using hierarchical linear regressions, controlling for child age, sex, and race/ethnicity.

**RESULTS:** As shown in Figure 1, parent support of child PA and child PA enjoyment fully mediated the relationship between child athletic coordination and child PA participation. Child athletic coordination was significantly associated with PA participation before ( $c=0.36$ , 95% CI 0.21, 0.51), but not after ( $c'=0.09$ , 95% CI -0.07, 0.25) including parent support of PA and PA enjoyment. Overall, the mediators accounted for 63% of the observed effect of child coordination on PA participation.

**CONCLUSION:** These findings present a potential casual pathway indicating that child PA participation is associated with child coordination completely via parent support and child PA enjoyment. The illustrated pathway suggests that interventions focused on increasing children's PA participation should target parent support of child PA and child PA enjoyment, along with child athletic coordination.

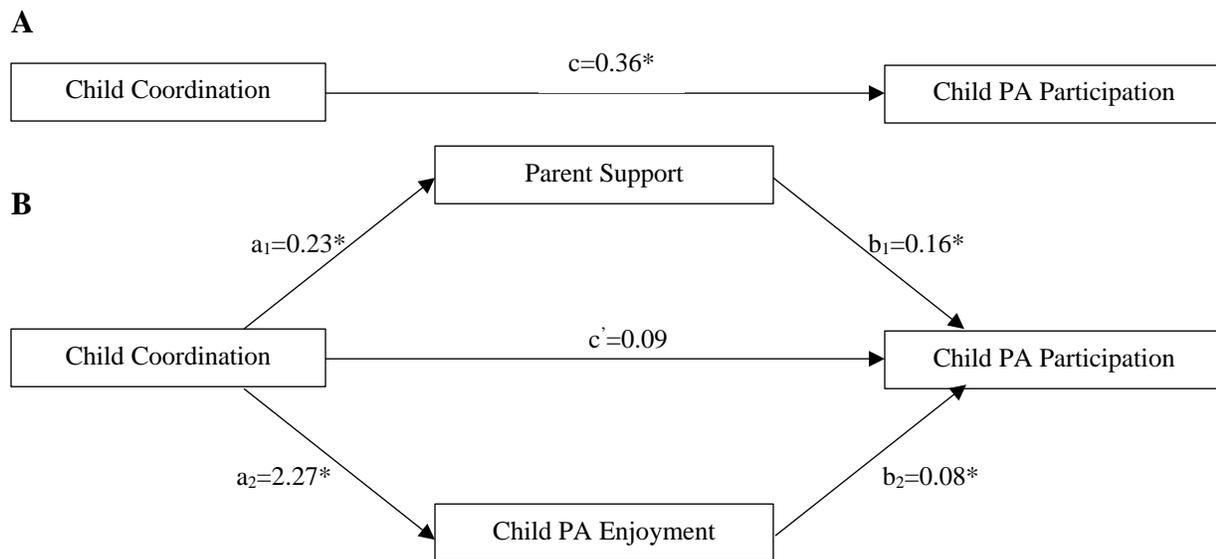


Figure 1. Single-step multiple mediator model: Parent support of child PA and child PA enjoyment fully mediate the relationship between child athletic coordination and child PA participation.

Notes. (A) Illustration of a total effect; (B) Illustration of a mediation effect; Path  $c$ : Total effect; Path  $c'$ : Direct effect; Path  $a_1b_1$ : Indirect effect<sub>1</sub>; Path  $a_2b_2$ : Indirect effect<sub>2</sub>. Total indirect effect:  $a_1b_1 + a_2b_2$ ; \* $p < .05$

## **Group Cohesion in a Community-Based Exercise Program for Cancer Survivors**

**Authors: Covington KR, Pergolotti M, Leach HJ**

**PURPOSE:** Enhancing social support in an exercise group (i.e., group cohesion) has not been tested as a strategy to increase physical activity (PA) in cancer survivors. This study reports the reliability of the Physical Activity Group Environment Questionnaire (PAGE-Q) to measure group cohesion following an 8-week PA program, and associations between group cohesion and post-program PA.

**METHODS:** The 8-week PA program included weekly group-based exercise and three PA behavior change discussion sessions. Strategies which target the group's structure, processes or environment were used to enhance group cohesion (e.g., partner exercises, group PA goal-setting, team name & t-shirt). Group cohesion was measured using the four subscales of the PAGE-Q: attraction to the group-task (ATG-T), and -social (ATG-S), group integration-task (GI-T), and -social (GI-S). Responses used a 9-point Likert scale, from strongly disagree to strongly agree. Subscale items were summed and averaged. Higher scores indicated greater perception of group-cohesion. The International Physical Activity Questionnaire (IPAQ) measured walking, moderate, vigorous and total PA in MET-minutes per week. Chronbach's  $\alpha$  analyzed reliability for each subscale. Pearson correlations examined relationships between PAGE-Q subscales and post-program PA.

**RESULTS:** Participants ( $n=24$ ) were  $M=57.6\pm 8.1$  years old, predominantly female (75%), and diagnosed with breast cancer (62.5%). PAGE-Q subscale scores were ATG-T  $M=7.9\pm 1.6$ , ATG-S  $M=7.1\pm 1.3$ , GI-T  $M=7.1\pm 1.2$ , GI-S  $M=6.1\pm 1.2$ . Reliability was high for ATG-T ( $\alpha=.97$ ) and ATG-S ( $\alpha=.89$ ), acceptable for GI-T ( $\alpha=.78$ ) and low for GI-S ( $\alpha=0.61$ ). Significant associations were found between total PA and GI-T [ $r=0.43$ ,  $p=0.04$ ], and moderate PA and ATG-S [ $r=0.54$ ,  $p=0.01$ ].

**CONCLUSION:** The ATG-T, ATG-S and GI-T subscales were reliable in a sample of mixed cancer survivors, and levels of group cohesion were similar to previous studies in older adults. Higher perceptions of GI-T (i.e. unified beliefs about PA), and ATG-S (i.e. enjoyment of social interactions) were moderately, positively correlated with post-program PA. Future studies should examine specific strategies used to enhance dimensions of cohesion to determine those most effective for enhancing PA adherence and maintenance in cancer survivors.

# DOES BMI NEGATIVELY IMPACT PERFORMANCE IN LOCAL MUSCULAR ENDURANCE, SPRINT PERFORMANCE AND METABOLIC POWER IN POLICE

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**PURPOSE:** Body mass index (BMI) is an anthropometric measure used to assess body mass in relation to height. Studies on police officers (PO) have shown associations between BMI and physical performance, injury rate and health. Thus, the purpose of this study was to investigate if an increased BMI influenced a PO's basic physical abilities, and if so, what the nature of the influence was.

**METHODS:** A cross-sectional study design was used. The sample included 284 participants divided in three groups relative to BMI: Normal – BMI $\leq$ 24.9, Overweight – BMI=25-29.9 and Obese – BMI $\geq$ 30. The main characteristics were: Normal (n=66, age=31.79 $\pm$ 3.35yrs, Body Mass (BM)=71.03 $\pm$ 6.92 kg, Body Height (BH)=174.08 $\pm$ 6.52 cm); Overweight (n=132, age=31.99 $\pm$ 4.13yrs, BM=82.58 $\pm$ 7.45 kg BH=173.77 $\pm$ 6.00 cm); Obese (n=86, age=31.59 $\pm$ 4.13yrs, BM=100.44 $\pm$ 13.27 kg, BH=173.33 $\pm$ 7.24 cm. Sprinting speed, local muscular endurance and metabolic power were tested using a test battery consisting of a 50m sprint (50m), 1-minute Push-ups (PU), and Sit-ups (SU) and an 800m run (800m). Analysis of variance (one-way ANOVA) with Bonferroni post-hoc analysis was used to investigate the differences between the groups in physical abilities, with the significance level set at  $p<0.05$ .

**RESULTS:** Normal and Overweight groups were significantly better than Obese in 50m (-0.99 sec,  $p<0.001$ , and -0.64 sec,  $p<0.001$ , respectively), PU (10.57 reps,  $p<0.001$ , and 7.65 reps,  $p<0.001$ , respectively), SU (8.85 reps,  $p<0.001$ , and 6.52 reps,  $p<0.001$ , respectively), and 800m (-75.99 sec,  $p<0.001$ , and -55.46 sec,  $p<0.001$ , respectively). Although Bonferroni analysis did not show significant differences between Normal and Overweight, the trends of the average changes clearly showed that differences exist between these two groups as well.

**CONCLUSION:** Increased BMI negatively affected running performance and local muscular endurance in PO. The results suggest that BMI standards might be helpful non-invasive, inexpensive, quick screening and follow-up tool for PO's physical performance.

## ACKNOWLEDGEMENT

The paper is a part of the project III47015, funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia – Scientific Projects 2011 – 2018.

## **DOES BMI NEGATIVELY IMPACT PERFORMANCE IN LOCAL MUSCULAR ENDURANCE, SPRINT PERFORMANCE AND METABOLIC POWER IN POLICE**

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# DIFFERENCES IN ANTHROPOMETRIC AND PHYSICAL PERFORMANCE MEASURES IN LAW ENFORCEMENT OFFICERS BASED ON AGE GROUPS

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**PURPOSE:** To identify possible differences in anthropometric and physical performance (PP) measures between different age groups in law enforcement officers (LEO).

**METHODS:** The cross-sectional study included 769 healthy male LEO (mean age=27.43±3.32 yrs; mean body mass (BM) = 78.42±12.38 kg; mean body height (BH) = 173.33±5.71 cm), divided into three age groups: ≤25 yrs (n=255, mean age = 24.02±0.95 yrs; mean BM=76.97±11.98 kg; mean BH=173.89±5.86 cm); 26-30 yrs (n=355, mean age=27.56±1.44 yrs; mean BM=78.82±11.55 kg; mean BH = 173.37±5.42 cm); and 31-35 yrs (n=159, mean age=32.60±1.37 yrs; mean BM=79.87±14.46 kg, mean BH=172.34±5.86 cm). Collected anthropometric variables included: BM, BH, BMI, Waist Circumference (WC) and Waist to Height Ratio (WHtR). Tested PP related to local muscular endurance (1-minute Push-Up test (PU): 1-minute Sit-Up test: (SU)) and aerobic endurance (2.4 km run test (RU)). Data were collected as a part of preselection process for an Abu Dhabi Police LEO postgraduate course. A one-way ANOVA with Bonferroni post-hoc adjustment was used for identifying possible changes between age related groups, with significance set at  $p<0.05$  a priori.

**RESULTS:** When compared to the 26-30 and 31-35 yrs groups, the ≤25 yrs group had a significantly lower BMI (-0.78 kg/m<sup>2</sup>,  $p=0.038$  and -1.38 kg/m<sup>2</sup>,  $p=0.001$ ), WC (-2.43 cm,  $p=0.009$  and -4.87cm,  $p>0.001$ ), and WHtR (-0.016,  $p=0.002$  and -0.032,  $p<0.001$ ) while no difference in BM were observed (-1.84 kg,  $p=0.206$  and -2.90 kg,  $p=0.061$ ). LEO from the 26-30 yrs group differed from the 31-35 yrs group in WC (-2.44 cm,  $p=0.030$ ) and WHtR (0.017,  $p=0.006$ ) but not in BM (- 1.05 kg,  $p=1.00$ ) and BMI (- 0.60 kg/m<sup>2</sup>,  $p=0.303$ ). PP also shown better results in ≤25 yrs group compared to older LEO groups of 26-30 yrs and 31-35 yrs in PU (3.47 reps,  $p<0.001$  and 5.12 reps,  $p<0.001$ ), SU (3.36 reps,  $p<0.001$  and 5.11 reps,  $p<0.001$ ) and RU (-41.69 sec,  $p<0.001$  and -61.47 sec,  $p<0.001$ ). PP scores of the 26-35 yrs group were not significantly different from the oldest group in PU (1.65 reps,  $p=0.349$ ), SU (1.75 reps,  $p=0.088$ ) and RU (-19.78 sec,  $p=0.359$ ), however from the mean differences in PP scores it may still be viable that the trend of reduced performance was existed in relation to the older age group.

**CONCLUSIONS:** This study identified significant differences between age groups with negative impacts of age on anthropometric variables, especially with those related to body weight and which correlate to health status (i.e. BMI, WC and WHtR), and all tested physical abilities.

## **A Comparison of Straight Barbell Deadlift and Hexagonal Barbell Deadlift Muscle Amplitude**

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The deadlift is an exercise used in most strength training programs and is key all athletes looking to enhance performance in physical competition. Due to the effectiveness of this exercise, it has evolved over time and has been modified in numerous ways including changing the shape of the bar. Previous research has been conducted to understand how muscle amplitude may differ when a hexagonal barbell as compared to the traditional straight barbell. **PURPOSE:** To determine the difference in muscle amplitude of four muscles (vastus lateralis, biceps femoris, gluteus maximus, erector spinae) while performing hexagonal barbell and straight barbell deadlifts. **METHODS:** A group analysis was used with eight division II collegiate female track athletes (sprinters) who participated in four separate sets, 10 to 15 seconds in duration, separated by five-minute rest periods. A warm-up consisted of a five-minute stationary bike ride followed by dynamic stretching and two warm-up sets at 40% one repetition maximum (1RM). This was followed by another set of five repetitions at 60% 1RM for each type of deadlift (hexagonal barbell, straight barbell). Next, the athletes completed three sets, of three repetitions at 75% 1RM for each type of deadlift. Muscle amplitude was measured from the start to finish of each set. All data for each muscle group were averaged and normalized to the straight barbell. Statistical comparisons were made using a t-test and ANOVA. **RESULTS:** There was no significant difference between muscle There was no significant difference between muscle amplitude when using the hexagonal and straight barbell during deadlifts in all muscle groups except the bicep femoris ( $p < .05$ ). There was less muscle activation of the biceps femoris when using the hexagonal barbell.

### **Keywords**

Deadlift, Electromyography, Straight barbell, Hexagonal barbell, Track and Field females

## ABSTRACT

### *Effectiveness of the University Of Northern Colorado Cancer Rehabilitation Group Model*

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**PURPOSE:** To evaluate the effects of a Cancer Phase Training Model in a group setting, on cardiorespiratory endurance, muscular strength, and cancer related fatigue in cancer survivors.

**METHODS:** Twelve cancer survivors completed the group model training program. Training frequency was prescribed as two sessions per week for 12 weeks. The duration of each exercise session was 60 minutes with 20 minutes designated for cardiovascular exercise, 30 minutes for resistance exercise, 10 minutes for flexibility training, with balance exercises incorporated throughout the entire session. Changes in peak volume of oxygen consumption ( $VO_{2peak}$ ), muscular strength (MS), and cancer-related fatigue were observed after the 12-week intervention. Percent change in  $VO_{2peak}$ , MS, and fatigue from data collected in the Individual Phase Training Model (IM), which involved one-on-one supervised exercise training, were compared to the data collected in the Group Phase Training Model (GM). **RESULTS:** After completing a 12-week intervention in the GM, significant improvements ( $p < 0.05$ ) were observed in  $VO_{2peak}$ , leg press MS, chest press MS, seated row MS, and shoulder press MS, and fatigue. Although the GM was a pilot study, similar results between GM and the IM Phase Training Model were observed for all variables. Participants completing the IM model showed an average 11% increase in  $VO_{2peak}$ , while the GM resulted an average 9% increase. Leg press increased an average of 9% in the IM compared to an average 10% increase in the GM. Chest press increased by an average of 16% in the IM, in comparison to an average 16% increase in the GM. The mean percent change in fatigue for participants completing the IM was a 21% decrease, while those in the GM experienced a 36% decrease in fatigue. **CONCLUSION:** This pilot study demonstrates that the Phase Training Model protocol can be safely and effectively administrated in a group setting. By offering the Phase Training Program in a group model, healthcare professionals may be able to provide services to more cancer survivors without placing the financial burden on the survivor or the program provider. By demonstrating its diversity, the Phase Training Model should be considered as a standard of care in the clinical cancer rehabilitation setting considering its success in both the group and individual model.

## **Possible Predictors of Physical Activity Program Completion in Workplace Wellness**

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Worksite wellness programs have increased in popularity with employers to help combat the rising costs of healthcare. The University of Colorado Colorado Springs (UCCS) provided voluntary, hands on health and wellness programming as a part of multicomponent worksite wellness program for the City of Colorado Springs Employees. One UCCS program invited employees to enroll in four, free personal training sessions. In efforts to increase program engagement and retention the following question is being investigated.

**Purpose:** To explore resiliency and other psychosocial measures as possible predictors to employee completion of a personal training program consisting of four, free sessions with a UCCS certified personal trainer.

**Methods:** Secondary analysis of de-identified data was performed on 16 employees who voluntarily enrolled in four, free personal training sessions. Data was collected through the administration of three validated measures to employees at the beginning of the program (n=16) and again to those who completed all four sessions (n=5). Measures included the Brief Resilience Scale, PROMIS Global Health and Perceived Stress Scale.

**Results:** A significant, moderate, inverse relationship between resiliency and stress was found ( $R = -.577$ ;  $p = .019$ ). Furthermore, participants who completed all four sessions had higher initial mean/median scores of resiliency and global health while reporting lower stress levels than those who did not complete all four sessions.

**Conclusion:** Employees who are more resilient with higher global health and lower perceived stress are more likely to complete a personalized fitness program offered through an employer. It is speculated that implementation of resiliency and stress management offerings in future worksite wellness programs could increase the number of employees who engage in and complete physical activity programs. These skills, coupled with personal training, may positively influence overall health and wellbeing of employees while reducing healthcare utilization and insurance costs for the company

## Effects of Exercise on the Expansion of Myeloid-Derived Suppressor Cells

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### Abstract

Myeloid-derived suppressor cells (MDSCs) are a heterogeneous population of immune cells that expand in response to cancer and various other pathological conditions. MDSCs are characterized by their suppression of T-cells and their involvement in metastasis. Aerobic exercise protects against tumor growth and metastasis, yet the mechanisms behind this protection are still largely unknown. **PURPOSE:** To examine the effects of exercise on the expansion of MDSCs and suppression of immune function in a murine breast cancer model. **METHODS:** Female mice, 8 weeks of age, were randomly assigned to one of the following groups: exercise tumor (EX+TUM), sedentary tumor (SED+TUM), exercise control (EX) or sedentary control (SED). Animals in both TUM groups were inoculated with  $1 \times 10^4$  4T1 murine mammary carcinoma cells in the mammary fat pad. Both EX groups were given access to running wheels for 4 weeks, beginning on the day of inoculation, and SED groups were restricted to normal cage activity. Following completion of the 4-week training period, blood and spleen samples were collected for analysis via flow cytometry. MDSC expansion was measured as the percentage of CD11b<sup>+</sup>Ly6C<sup>+</sup> and CD11b<sup>+</sup>Ly6G<sup>+</sup> cells in the population. Spleen cytotoxic T-cells were measured as the number of CD8<sup>+</sup> cells and expressed as a percentage of the total population. **RESULTS:** MDSCs in the blood of SED+TUM ( $15.3\% \pm 7.1\%$ ) were significantly higher ( $p < 0.05$ ) than SED ( $0.8\% \pm 0.2\%$ ) indicating tumor-dependent expansion of MDSCs. EX+TUM ( $10.1\% \pm 0.7\%$ ) was not significantly different from EX ( $0.5\% \pm 0.1\%$ ) or SED ( $0.8\% \pm 0.2\%$ ) suggesting MDSC expansion did not occur to the same extent in the blood of exercised animals. The percentage of CD8<sup>+</sup> T-cells in SED+TUM ( $5.6\% \pm 1.7\%$ ) was significantly lower ( $p < 0.05$ ) than EX ( $13.1\% \pm 1.1\%$ ) and SED ( $13.4\% \pm 0.9\%$ ) indicating a tumor-induced suppression of immune function. In contrast, EX+TUM ( $7.7\% \pm 1.0\%$ ) was not significantly different from EX ( $13.1\% \pm 1.1\%$ ) or SED ( $13.4\% \pm 0.9\%$ ). **CONCLUSION:** These data suggest that exercise may have a protective effect against the immunosuppression that results from expansion of MDSCs in tumor bearing animals. MDSCs have been shown to create a premetastatic niche at the site of metastasis and exercise may protect against distant metastases by attenuating increased numbers of MDSCs in the blood.

## Loss of Fitness in Serving Law Enforcement Officers: A Critical Review

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**Purpose:** The purpose of this critical review was to 1) compare fitness levels amongst incumbent police and police recruits, 2) identify whether changes in police fitness levels can be attributed to age or occupational factors, and 3) to map fitness profiles of incumbent police at different points throughout their career. **Methods:** A systematic search of four databases was performed using relevant key search terms. Inclusion and exclusion criteria were applied to each study to determine those included in this review. Downs and Black Critical Appraisal tool was used to assess the quality of evidence. **Results:** The 12 studies included ranged in percentage quality from 57% to 85%, with a mean score of 72.2%. The inter-rater level of agreement was 0.47, using Krippendorff's Alpha. **Conclusion:** A negative effect on fitness measures was found amongst incumbent police, when evaluated throughout their careers. This effect included a decrease in sit-up and push-up repetition and an increase in body fat percentage.

## PERFORMANCE DIFFERENCES WITH STANCE VARIANCE IN WEIGHTLIFTING

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Performance improvements in weightlifting have been examined as the movement of biomechanics research has been gaining steam over the past decades. Throughout all of this research, no studies have examined how stance will affect weightlifting performance, specifically through measuring horizontal displacement and speed of the barbell. **PURPOSE:** The purpose was to determine how stance would affect performance in weightlifting in males and females based on horizontal displacement and speed of the barbell at varying loads. Previous research that has shown that training is optimized for the clean at 80 percent of an individual's one-rep max. An increasing percentage was chosen for the study to determine if a trend could be established across varying loads on the barbell. **METHODS:** Sixteen male and female CrossFit athletes who had a minimum of one year of weightlifting experience completed three stance trials: control, narrow, and wide, at forty, sixty, and eighty percent of one-rep max clean. Control is the participant's normal stance width and narrow and wide were calculated by altering the participant's stance by 66 percent toward a narrower and wider stance respectively. This percentage was taken from previous research which found this percent to be an optimal change without balance alterations. **RESULTS:** There were significant differences ( $p < 0.05$ ) between the control stance and wide stance for all percentages of one-rep max tested when examining horizontal displacement; horizontal displacement was lessened when the participant's stance was widened. There were significant differences found at 40 percent of 1RM between the control stance and wide stance when examining barbell speed; with a wider stance showing an increase in barbell speed. There were no significant differences between a control stance and narrow stance or for control stance and wide stance when examining barbell speed for any other load. There were no significant differences when examining differences between genders at any load between stances. **CONCLUSION:** A weightlifter looking to improve performance by minimizing horizontal displacement without compromising barbell speed should widen stance from normal in order to create a more efficient lift.

## **The Public Health of Mesa County: Finding an American Fitness Index for Smaller Communities**

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The American College of Sports Medicine (ACSM) has developed a tool, the American Fitness Index (AFI), which assists communities in the country to track and measure a conglomerate of health behaviors, community access to healthcare, and preventative health habits. The AFI lists the top 50 metropolitan areas in the country and does not measure the fitness index scores of smaller communities or populations. The MyAFI Toolkit was created for populations not included in the AFI report and allows smaller communities to assess community fitness.

**PURPOSE:** To determine the AFI score for Mesa County and assess the applicability of the MyAFI Toolkit to the population of Grand Junction, Colorado and Mesa County, communities not included in the AFI report. **METHODS:** Using the tools from The MyAFI Toolkit, information and data were obtained on preventative health behaviors, levels of chronic disease conditions, community resources and policies that support physical activity for the community. The information was obtained at the Mesa County Health Department, Colorado Department of Public Health and Environment and the Colorado Health Institute. **RESULTS:** Many of the chronic health disease rates were higher in Mesa County than in Colorado statewide data and most healthy behaviors were significantly lower than the Colorado average. **CONCLUSION:** Obtaining an AFI score for Mesa County using the MyAFI Toolkit is challenging secondary to the dependence on data points that many local health entities do not measure. The information

gathered indicates that the community needs to focus attention on promoting healthy behaviors and policies to decrease chronic disease and improve community wellness.

**Keywords:** American Fitness Index, Public Health, Chronic Disease, Population Characteristics

Ball velocity is an important characteristic for success in competitive tennis. Methods for improving ball speed vary greatly, and controversy exists on which physiological characteristics have the greatest impact on ball speed. **PURPOSE:** To determine if there is a correlation between grip strength and arm length with the velocity produced in a forehand tennis stroke. **METHODS:** Fifteen collegiate tennis players, ages 19-23, were measured for grip strength, body mass and arm length. Grip strength was normalized to body mass and was considered relative strength. After warming up, each subject hit five forehand shots while being recorded with a high-speed camera and distance markers to determine ball velocity. The highest velocity was compared to peak grip strength, arm length, and relative strength; these relationships were then put into a regression plot. **RESULTS:** Analysis showed a strong positive correlation between velocity and arm length of females ( $R=0.7$ ) and a strong negative correlation between velocity and relative strength in males ( $R= -0.77$ ). Between velocity and grip strength and velocity and arm length of all subjects, velocity and grip strength, and velocity and relative strength in females there was a moderate positive correlation ( $R=0.46$ ,  $R=0.58$ ,  $R=0.45$ ,  $R=0.30$ , respectively). There was little to no correlation between velocity and relative strength in all subjects ( $R=-0.20$ ), velocity and grip strength in males ( $R=0.16$ ), and velocity and arm length in males ( $R=0.22$ ). **CONCLUSION:** There was no clear, trainable, physiological determinant of ball speed. The relationship between ball speed and arm length in females suggests that genetics play an important role in one's capability to produce high velocity in a forehand tennis stroke.

Low cost, experiential, smartphone-based laboratory exercises in the undergraduate neuromuscular teaching laboratory

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**PURPOSE:** Two important concepts in teaching neuromuscular physiology to undergraduates include 1) a description of how the motor unit (MU) converts motor neuron action potentials into muscle force to produce behavior, and 2) the role of proprioception in motor control. Experiential activities can enhance the learning of these phenomena. However, the equipment necessary to record efferent electrophysiology, motor output (movement of body segments), and afferent function is expensive and often inaccessible to teaching laboratories. The purpose of this presentation is to discuss the recording of muscle electrophysiology, limb acceleration, and reflex response with extraordinarily simple equipment.

**METHODS:** We developed an inexpensive, portable system capable of measuring both surface EMG and single MU action potentials. We record surface EMG with simple electrodes, a battery-powered amplifier (Backyard Brains, Inc.), and smartphone app (Spike Recorder) to display the signals. The system readily provides recordings of surface EMG, and the movable electrodes allow for rapid, unlimited adjustment of electrode position over the muscle. We also use a data collection app and the sensors on a smartphone to record and display real-time acceleration and rotation of body segments during manipulation of proprioceptive signals.

**RESULTS:** Using this system, we developed hands-on experiments called “The Hunt for a Motor Unit” and the “Neurophysiology Trust Fall”. We can, with remarkable success rates, find single MU’s. Students can often observe recruitment, rate modulation, and de-recruitment of their own single MU. Students can also easily observe the recruitment of additional motor units and modulation of the EMG signal during different behaviors, such as chewing, pinching, smiling, and nostril flaring. For the “Trust Fall”, we use the smartphone app to measure the latency of lower leg tilt following the postural reflex response to bilateral Achilles tendon vibration.

**CONCLUSION:** We have shown that simple, low cost equipment and experiential demonstrations can be implemented successfully to convey lessons to undergraduate students. This has improved our instruction of efferent and afferent function in human neuromuscular physiology.

## **Effects of an Exercise Intervention on Lung Cancer Patients Who Have Undergone a Lobectomy**

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Lung cancer is the second most commonly diagnosed form of cancer, and is often treated surgically via tumor resection and lobectomy. Removal of lung tissue often impairs cardiopulmonary function, reduces activities of daily living, and lowers quality of life. Exercise interventions improve cardiopulmonary health and may attenuate the negative effects of lung cancer and its treatment. **Purpose:** To evaluate the response of lung cancer patients who had previously undergone a lobectomy to a structured, supervised 12-week exercise intervention, and compare these results with all other cancer patients completing the same exercise intervention. **Methods:** Nine male and female lung cancer survivors who had previously undergone a lobectomy, were recruited to participate in a 12-week exercise-based rehabilitation program. The program consisted of one hour sessions, three days per week, and included cardiovascular endurance, muscular strength and endurance, balance, and flexibility exercises. Subjects completed pre and post assessments of cardiopulmonary function, consisting of a graded exercise test, yielding peak oxygen consumption ( $VO_2$  peak), and spirometry, yielding forced vital capacity (FVC) and forced expiratory volume ( $FEV_1$ ). Subjects were divided into two groups: surgical resection including lobectomy (LOB,  $n = 9$ ), and all other cancers (AOC,  $n = 205$ ). **Results:** There were significant improvements in  $VO_2$  peak in the LOB group (Pre:  $15 \pm 2$  mL/kg/min, Post:  $19 \pm 5$  mL/kg/min; +20%;  $p = 0.03$ ) and no significant changes in FVC and  $FEV_1$ . There were significant improvements in  $VO_2$  peak (Pre:  $21 \pm 0.5$  mL/kg/min, Post:  $24 \pm 0.6$  mL/kg/min; +13%;  $p = 0.00$ ) and  $FEV_1$  (Pre:  $95 \pm 1$  %-predicted, Post:  $97 \pm 1$  %-predicted; +2.2%;  $p = 0.02$ ) in the AOC group. Between group comparisons yielded no significant difference in improvement to  $VO_2$  peak for LOB vs AOC ( $p = 0.77$ ). **Conclusion:** Results from this study demonstrate that lung cancer patients who have previously undergone a lobectomy can safely and effectively complete an individualized, prescriptive exercise intervention. These data also show that lung cancer survivors who have previously undergone a lobectomy are able to improve cardiopulmonary function to the same degree as all other cancer survivors completing a rehabilitative exercise intervention.

## Influence of Remote Ischemic Preconditioning on Heart Rate Variability in Normoxia and Hypoxia

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Rapid transition from sea level to high altitude is accompanied by impaired physiological function; impairments that may have important health implications for both professional (e.g. the military) and recreational travelers, including the estimated 77 million annual visitors to Colorado. Among these physiological impairments is appreciable disruption of the autonomic nervous system (ANS). In light of the critical importance of the ANS to the maintenance of homeostasis, any intervention that may augment ANS function and provide protection from environmental challenges, such as low oxygen, is of clinical interest. In this regard, ischemic preconditioning, brief and repeated bouts of limb occlusion, may have relevance. **PURPOSE** To determine the influence of ischemic preconditioning on sympatho-vagal regulation of heart rate in normoxia and simulated high-altitude. **METHODS** Following initial screening, 10 healthy adults (7 men, 3 women; age:  $25 \pm 6$  years; body mass index:  $25.4 \pm 3.1$  kg/m<sup>2</sup> (mean  $\pm$  SD)) visited the laboratory on four randomly ordered occasions, separated by a minimum of 7 days. Each of the visits began with the inflation of automated pressure cuffs on alternate legs to either 20 mmHg (control condition) or 200 mmHg (ischemic preconditioning), in five-minute intervals, for a total of 40 minutes. Participants were then transferred to an environmental chamber in which the inspired oxygen concentration was either 20.9% (normoxia) or 15% (hypoxia). Beat-by-beat heart was recorded via 3-lead electrocardiogram during paced breathing (6 breaths per minute) over 10 minutes. **RESULTS:** Neither inspired oxygen concentration nor ischemic preconditioning affected heart rate variability (all  $P > 0.33$ ), as represented by the standard deviation of the R-to-R interval and the low-frequency/high-frequency power ratio: Normoxia:  $91.6 \pm 5.8$  vs.  $82.8 \pm 9.4$  ms;  $8.8 \pm 5.4$  vs.  $2.7 \pm 1.1$ ; Hypoxia:  $84.0 \pm 7.1$  vs.  $89.1 \pm 5.0$  ms;  $4.5 \pm 2.0$  vs.  $4.2 \pm 1.4$ . **CONCLUSION** These preliminary data indicate that sympatho-vagal balance is neither influenced by inspired oxygen nor ischemic preconditioning.

## Acute Intoxicating Effects of Dabbing Cannabis on Measures of Neuromotor Control

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**PURPOSE:** Recent cannabis legalization has led to higher rates of driving under the influence of cannabis. One popular means of ingesting cannabis is dabbing. Potent cannabis concentrate vapor is inhaled, leading to immediate, intense intoxication. However, the acute intoxicating effects of dabbing on neuromuscular function have not yet been objectively measured. There is a need for accurate and portable assessment of cannabis impairment. The purpose of this study was to examine the acute effects of dabbing on movement speed and balance using the smartphone as a movement sensor.

**METHODS:** This was an observational study at a private cannabis consumption event at an industry facility. Thirteen volunteer participants (22-44yrs) were observed before and after a voluntary session of recreational cannabis dabbing (range 1-5 dabs). Index finger tapping speed, arm movement speed, and postural sway with eyes open and closed was measured before and after consumption. For each task the accelerometer in an iPod Touch (100 Hz sampling rate) was used to record finger taps, peak acceleration during ballistic punching, and standard deviation of AP and ML sway.

**RESULTS:** There were no significant changes in tapping speed, arm movement speed, or sway with eyes open following cannabis consumption. However, the Romberg quotient (eyes closed sway/eyes open sway) increased from 1.34 to 1.55 after cannabis consumption ( $P=0.012$ ). Postural sway (total AP+ML sway) increased by 41% after cannabis consumption for the eyes closed condition ( $P=0.006$ ). The change in postural sway was not correlated with the number of dabs.

**CONCLUSION:** Cannabis use while driving is an increasing problem, and a portable roadside assessment of intoxication must be developed to objectively measure impairment. The results of this observational study provide the first objective scientific evidence that dabbing cannabis impairs balance. Because postural stability is an indicator of general neuromotor control extensively used in alcohol intoxication testing, the iPod Touch may be a useful tool to assess cannabis-intoxicated drivers.

Confidence in movement: A mixed methods case study of exercise and Parkinson's Disease  
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**Abstract:** Parkinson's Disease (PD) is a neurodegenerative disorder affecting individuals physical, psychological, social and functional status. Exercise programs may be an effective strategy to delay or reverse functional decline for people with PD and improve overall Quality of Life (QoL).

**Purpose:** This mixed methods case study explored mobility and activities of daily living (ADL) as two dimensions of QoL in individuals with PD participating in Parkinson's Wellness Recovery (PWR!) Moves exercise classes.

**Methods:** Twelve individuals with an average Hoehn and Yahr rating of 3.3 participated in exercise classes held twice per week for one hour at the Center for Active Living at the University of Colorado Colorado Springs. The validated PDQ-39 survey assessing QoL in individuals in Parkinson's was administered in addition to three-one-hour focus groups. To focus this exercise study, two of the eight dimensions of QoL were analyzed: mobility and ADLs.

**Results:** Paired sample t-tests were run to analyze overall QoL, mobility and ADLs of the PDQ-39. Results showed a slight decrease in overall QoL and mobility both with a medium effect size, while ADL components remained the same. In contrast to lack of significant quantitative findings, the lived experiences of participants and qualitative analysis revealed pronounced themes of confidence in movement and restored independence.

**Conclusion:** The juxtaposition of quantitative and qualitative data provides rationale for additional mixed methods studies exploring physical activity classes and QoL in individuals living with PD. By honoring the voices of individuals with PD, a more complete picture of the relationship between exercise and QoL can be understood. Therefore, future mixed methods research may help educate those with PD and their support system on the perceived benefits of physical activity to help increase mobility, independence and QoL while managing this degenerative disease. Moreover, the analysis of this project revealed an opportunity to adapt the PDQ-39 making it more appropriate for individuals living with advanced stages of Parkinson's Disease.

## Effects of an 8-week Physical Activity Intervention on Health-Related Fitness in an Underserved Community

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*Adams State University*

Engaging in regular physical activity (PA) and reducing sedentary behavior is one of the most important things that can be done to improve health. The benefits of PA and exercise are indisputable and far outweigh the risks in most populations. The ACSM recommends a minimum of 150 minutes of regular moderate- to vigorous-intensity PA per week. Historically underserved communities generally exhibit poorer levels of health-related fitness including cardiorespiratory fitness (CR), flexibility (FLEX), muscular fitness (MF), and body composition (BC).

**PURPOSE:** The purpose of this study was to investigate whether an 8-week PA intervention could improve health-related fitness in a historically underserved community. **METHODS:** Prior to the study participants completed a PAR-Q+ and HSQ. Week 1 was baseline FitnessAge (FA) testing, weeks 2-9 were PA intervention where participants attended at least 3 classes per week. Some intervention classes included strength training, circuit training, yoga, walking/jogging group and swimming. Week 10 was post-intervention FA testing. **RESULTS:** There was a significant improvement in all FA components for the 26 participants (N=7 males, N=19 females, mean age 41.8 years), except for CR FA. **CONCLUSION:** Overall FA improved as indicated by an increase in flexibility, increase in muscular fitness and a decrease in body fat percentage.

### *Changes in FitnessAge Scores Baseline-to-Post 8-Week Intervention (mean $\pm$ SD)*

<b>Variable (yr.)</b>	<b>Baseline</b>	<b>Post</b>	<b>% Change Score</b>
Overall FA	45.1 $\pm$ 17.0	39.1 $\pm$ 14.9	-13.3*
BC FA	48.5 $\pm$ 23.3	42.9 $\pm$ 22.7	-11.4*
CR FA	49.3 $\pm$ 24.9	45.7 $\pm$ 24.2	- 7.2
FLEX FA	43.1 $\pm$ 24.5	34.6 $\pm$ 22.6	-19.7*
MF FA	36.3 $\pm$ 14.5	28.6 $\pm$ 12.7	-21.3*

*Note:* Negative % change scores for FA indicates improvements in fitness.

*Note:* \* = significant change ( $p < 0.05$ )

This research was funded by a Title V Unidos Cooperative Grant.

Validation of the Smartphone as an Acceleration Sensor During Rapid Arm Movements

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**PURPOSE:** The ability to collect precise measurements outside the laboratory is often hindered by the lack of portability of research equipment. However, modern smartphones contain sensitive accelerometers, gyroscopes, and apps that can provide and record movement data. The smartphone is therefore a portable movement sensing platform. For testing protocols that involve the measurement of acceleration, smartphones can be substituted to precisely capture the changes in acceleration. The ability to produce rapid arm movements is important in daily function such as driving or catching oneself in a fall. The purpose of this study was to validate the iPod compared with an expensive lab accelerometer during slow and fast arm movements.

**METHODS:** Eighteen healthy subjects were studied (9 male, 9 female, 18-24 years). The protocol involved three trials of 20 jab punches across a range of speed. Subjects were seated with the right elbow at 90 deg. Subjects were instructed to punch forward with the forearm in the horizontal plane, starting with a “very slow” punch, and to progressively increase the punch speed to maximal over 20 repetitions. At least one second of rest was provided between punches. The iPod was securely strapped to the distal forearm and the accelerometer was attached to the iPod. The sensitive axis of the iPod and accelerometer was in line with the forearm travel during the punch. Data was recorded from the two devices simultaneously but separately, then merged into one data file for analysis. The peak acceleration was measured from the initial outward phase of each punch.

**RESULTS:** The peak acceleration values from the iPod and accelerometer tracked closely with each other across the range from slow to fast. The peak acceleration values from both devices were highly correlated across the range of speeds produced by a single subject ( $R^2$  range: 0.95-0.995). When the values were pooled across subjects (780 punches), the between-device correlation was high ( $R^2 = 0.99$ ).

**CONCLUSION:** The results indicate that the iPod is sensitive enough to precisely measure upper limb acceleration across a large range of movement speeds. This suggests that smartphones can be used to measure ballistic neuromuscular function in testing protocols outside of laboratory settings.

## Road Bicycle Saddle Shape Preference and its Potential Determinants

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### Abstract

The saddle is an integral part of riding a bicycle, however research examining determinants of cycling saddle preference/comfort is limited. **PURPOSE:** To determine if trained cyclists can differentiate between road bicycle saddle shapes and whether preferences are related to anatomy and/or cycling position variables. **METHODS:** Cyclists riding 5-12 hr/wk and training for a cycling event participated (21 M and 21 F). Pelvic anatomy (composition plus ischial tuberosity width) and overall body composition were determined by DXA. Cycling position variables were determined using 3D motion capture. Subjects then completed 3 separate saddle evaluations using identical cycling shorts while riding 3 differently shaped saddles (flat, convex widthwise and concave lengthwise). The 1<sup>st</sup> and 3<sup>rd</sup> evaluations were identical and occurred in the lab on an ergometer adjusted to the subject's personal cycling position. In a blinded, randomized design, subjects rode each saddle twice for 5 min. A 6-item visual analog comfort questionnaire (0-100 with 100 being extreme comfort) was completed after each bout. For evaluation 2, subjects rode each saddle for 1 wk on their road bike while maintaining normal riding hours with comfort assessed at the end of each week. Upon study completion, subjects chose a preferred saddle, which was collected independent of comfort ratings. **RESULTS:** For evaluations 1 and 3, comfort ratings were not different between saddles or across evaluation sessions. With prolonged testing, significant ( $p < 0.05$ ) differences were observed for overall comfort for convex vs. concave ( $72.5 \pm 18.0$  and  $61.2 \pm 17.9$ ) and flat vs. concave ( $70.7 \pm 19.1$  and  $61.2 \pm 17.9$ ). Evaluation 2 comfort ratings matched preferred saddle choice, but did not improve subjects' ability to differentiate saddles during evaluation 3. No relationships were observed between saddle comfort and any anatomy or cycling position variables. **CONCLUSION:** Trained cyclists in an acute, blinded setting cannot differentiate saddle shapes even when accustomed to the saddle. With longer exposure, cyclists can differentiate saddle shapes and demonstrate a preference that aligns with comfort ratings. However, no relationship was found between measured variables and saddle preference/comfort.

Supported by Specialized Bicycle Components.

Title: Do cardiologists and oncologists discuss or recommend exercise to their patients?

Authors: Kelli LeBreton<sup>1</sup> and Heather Leach<sup>1</sup>

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**PURPOSE:** Exercise improves physical and psychosocial health, and may reduce disease recurrence and mortality in heart disease and cancer patients. However, many of these patients do not meet exercise guidelines, and physicians may be integral for influencing their exercise behavior. This study examined determinants and barriers to discussing and recommending exercise to patients among cardiologist's (CARDIO) and oncologist's (ONC).

**METHODS:** Participants were CARDIO and ONC practicing in Colorado. An online survey asked, "How many visits do you discuss exercise with your patients?" and "What percent of patients have you recommended should exercise in the past month?" Responses were on a 5-point Likert scale, ranging from none to all. Determinants were age, time in practice, exercise training received in medical school, and exercise levels. Participants selected yes/no for the barriers of lack of time, knowledge, patient motivation, insurance reimbursement, or other priorities during appointments. Chi Square tests examined associations between specialty (i.e., CARDIO vs. ONC) and frequency of discussing or recommending exercise, and reporting barriers.

**RESULTS:** Of those contacted, 33.7% ( $n=25$  CARDIO,  $n=27$  ONC) responded to the survey. There was a significant association between age and whether time was a barrier to discussing exercise ( $X^2(2)=9.058$ ,  $p=0.012$ ). There was a significant association between specialty and discussing exercise at most/all patient visits ( $X^2(1)=8.889$ ,  $p=0.008$ ), and between specialty and recommending exercise to most/all of their patients ( $X^2(1)=6.920$ ,  $p=0.017$ ). There was a significant association between specialty and whether "other priorities during appointments" was a barrier to discussing exercise ( $X^2(1)=5.373$ ,  $p=0.28$ ).

**CONCLUSION:** Physicians 40-49 years old were most likely to perceive time as a barrier to discussing exercise. CARDIO were more likely to discuss/recommend exercise most/all of the time, and ONC were more likely to report 'other priorities during appointments' as a barrier to discussing exercise with patients. These findings may help inform targets for exercise promotion among CARDIO and ONC. Further research is needed to explore underlying reasons for ONC lower rates of exercise discussion and recommendation to their patients.

## **TITLE: CANNABIS USE HABITS IN RELATION TO PHYSICAL ACTIVITY**

**AUTHORS:** Jonathon K. Lisano, Kristina T. Phillips, Jeremy D. Smith, Laura K. Stewart

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**PURPOSE:** To describe cannabis use in individuals who use the compound relative to when they participate in physical activity (PA). **METHODS:** Self-reported, physically active individuals (N=105; 53% male; average age of  $31 \pm 11$  years), recruited using the snowball technique, completed a series of self-report questions through Qualtrics designed to describe participants use of cannabis products in relation to their PA. **RESULTS:** Respondents reported  $400 \pm 544$  minutes of PA per week, with 81.9% of respondents using cannabis in conjunction with PA at least 1-time per week. Cannabis use was reported in combination with a total of 28 individual and team based physical activities. The physical activities most commonly reported included: hiking, running, cycling, resistance training, yoga, and golf. Half of participants (53%) reported using cannabis within 1-hour of beginning PA, and 42% reported using most often within 1-hour after finishing PA. Only 5% of respondents reported using cannabis most often during PA. Nearly 46% of participants that reported using cannabis products within 1 hour before PA were using the *Cannabis Sativa* strain, with just over 36% reporting using a hybrid strain. Of the participants that reported cannabis use within 1-hour of completion of PA, 38% and 37% reported using *Cannabis Indica* and hybrid strains respectively. Common reasons for the use of cannabis before PA included: improved focus, enjoyment, motivation, and pain relief. The most frequent reasons for using cannabis products after PA were for relaxation, pain relief and as a recovery aid. The majority of participants (77%) reported feeling that the use of cannabis products had a positive effect on their PA performance. Fewer respondents (20%) felt like there was no effect of cannabis on their performance and only 2% of respondents felt that cannabis use had a negative effect on their PA performance. **CONCLUSION:** Cannabis is used before, during and after a wide variety of physical activities. Participants reported most frequently using *Cannabis Sativa* within 1-hour of PA and *Cannabis Indica* and hybrid strains within 1 hour after PA. Almost all respondents felt that using cannabis products did not negatively affect their performance.

## Abstract

**Title:** Nutrition Needs Assessment in Clients with Parkinson's Disease

**Authors:** Hayley Lucero, Margaret Harris, Andrea Hutchins

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**Purpose:** This study assessed nutrition knowledge and behavior of clients with Parkinson's Disease (PD) and whether knowledge was greater in active compared to inactive people. Nutrition plays a key role in managing symptoms of PD. Gut health or, conversely, gut dysbiosis, has recently been implicated as influencing PD management. Many food-medication-supplement interactions can occur with PD which may impact overall health and disease management. However, this study demonstrates that nutrition counseling is an overlooked health care intervention.

**Methods:** Twenty-nine individuals with PD were recruited from the Parkinson's Wellness Recovery (PWR) Moves class in the Center for Active Living at the University of Colorado Colorado Springs (active individuals) and from a monthly Parkinson's support group (inactive individuals). Participants answered a questionnaire (developed by researchers) on knowledge and behaviors pertaining to nutrition, including information on supplement and medication use. Data was analyzed using SPSS v. 24 using descriptive statistics and Chi Square to test for differences between active and inactive people.

**Results:** Participants' average age was  $76 \pm 6.3$  years old (69% males, 31% females). No significant differences were found between active and inactive individuals so results are presented in aggregate. Survey results showed participants were lacking nutritional knowledge, including how medications can interact with diet and supplements, and were not utilizing dietitians to help them understand nutrient and drug timing with meals. Only 21% of participants had spoken with a dietitian. About 59% of participants had no knowledge of specific protein intake guidelines related to their disease or medication use. Further, 90% of participants were taking supplements concurrently with their medications. Probiotics were used by 32% of the participants.

**Conclusion:** Nutrition can aid in the treatment of PD. Maintenance of good nutrition status, avoiding gut dysbiosis, and management of food-medication interactions can improve quality of life in this population. However, if patients are not informed of the nutrition implications of their condition and ways to manage the nutrition issues, they are not fully treating their symptoms, and therefore decreasing their quality of life.

**TITLE:** Skiing Economy During Classic and Skate Technique in Beginning and Advanced Cross-Country Skiers

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**AFFILIATION:** Colorado Mesa University- Grand Junction, Colorado

**PURPOSE:** Limited research suggests there is a difference in economy between the two primary cross-country ski techniques, skate and classic. Experience level of the skier may also have an impact on skiing economy. The purpose of this study was to investigate the influence of experience level on oxygen consumption in beginning and advanced cross-country skiers.

**METHODS:** One skate technique (V2) and one classic technique (double pole) were compared. Eighteen subjects, ten male and eight female, were tested. Both experience groups included nine subjects, five men and four women in each. All subjects completed two submaximal tests on a rollerski treadmill at a constant intensity according to sex; men skied at 6mph at 4% grade and women skied at 4.5mph at 4% grade. Metabolic data were collected to determine heart rate (HR), oxygen consumption and respiratory exchange ratio (RER). Rating of perceived exertion (RPE) was also obtained from subjects upon completion of each submaximal effort.

**RESULTS:** Skate (V2) technique was found to be less economical than classic (double pole) technique ( $p < 0.05$ ) in all skiers, while there was no significant difference in economy between beginning and advanced skiers for each technique. The RER was significantly lower in advanced skiers for both techniques. Negative correlations were discovered between hours of training per year and each of the following variables: skate economy, classic economy, skate HR, classic HR, skate RER and classic RER ( $r = -0.44$ ,  $r = -0.37$ ,  $r = -0.44$ ,  $r = -0.41$ ,  $r = -0.60$ ,  $r = -0.44$ , respectively, at  $p < 0.01$ ).

**CONCLUSIONS:** Although there was a trend towards significance in advanced skiers being more economical, hours of training per year may have a greater impact on economy.

## Electrical nerve stimulation elicits intensity-dependent changes in force steadiness in young and older adults

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Keywords: aging, electrical nerve stimulation, force steadiness

When individuals attempt to match a submaximal target force by performing a steady isometric contraction, the fluctuations in force are often quantified as force steadiness (coefficient of variation [CV] for force) to provide an index of the neural drive to muscle.

**PURPOSE:** To compare force steadiness of the wrist extensors during evoked and voluntary submaximal contractions in young and older adults.

**METHODS:** Thirteen young (5 men,  $25 \pm 4$  yrs) and 12 older (7 men,  $78 \pm 5$  yrs) adults participated in a 1-hr protocol that involved maximal voluntary contractions (MVCs) and voluntary and evoked isometric contractions to match a 10% MVC target force. Force steadiness during the voluntary contraction was compared with that evoked by wide, high-frequency (1 ms pulses at 100 Hz) and narrow, low-frequency (0.2 ms pulses at 50 Hz) neuromuscular electrical stimulation (NMES), and a voluntary contraction with superimposed submotor transcutaneous electrical stimulation (TENS). CV for force was compared between age groups with unpaired t-tests and within age groups by paired t-tests.

**RESULTS:** CV for force was less for young adults ( $1.82 \pm 0.43\%$ ) than older adults ( $2.80 \pm 1.08\%$ ) during the voluntary contraction with the wrist extensors ( $p < 0.03$ ). Force steadiness did not differ between age groups during the evoked contractions. However, older adults were steadier during both types of NMES (wide:  $2.01 \pm 0.67\%$ ,  $p < 0.04$ ; narrow:  $1.69 \pm 0.62\%$ ,  $p < 0.02$ ) than during the voluntary contractions ( $2.80 \pm 1.08\%$ ). Concurrent TENS did not influence force steadiness for older adults, but young adults were less steady during TENS ( $2.41 \pm 1.02\%$ ,  $p < 0.03$ ) than during the voluntary contraction by itself ( $1.82 \pm 0.43\%$ ).

**CONCLUSION:** The improvement in force steadiness for older adults during the NMES-evoked contractions indicates that the age-associated decline in force steadiness is attributable to changes in the neural drive to muscle, rather than the mechanical properties of muscle. In contrast, the decline in force steadiness for young adults during concurrent TENS suggests that heightened sensory feedback compromised the neural drive to muscle during the steady contraction.

## **Exploring Psycho-Emotional Response to Athletic Injury, Rehabilitation, and Readiness to Return in NCAA Division II Collegiate Athletes**

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When athletes are injured, they are susceptible to a negative emotional state (ES). Negative emotions impact their self-identity and their social relationships. These negative impacts result in negative experiences in rehabilitation (rehab) for injury, and could negatively impact their return to sport (RTS). Utilizing motivation positively, through intrinsic and extrinsic factors, can result in a positive experience. Understanding what is experienced during the injury, rehab, and RTS can be explored through an athlete's drive or motivation. **PURPOSE:** The purpose of the study was to explore the psycho-emotional response to athletic injury, rehab, and readiness to return in NCAA Division II collegiate athletes by exploring their experiences in real time: at time of injury through rehab and RTS. **METHODS:** Twelve athletes: women's basketball (WBB) = 2; men's lacrosse (MLX) = 3; softball (SB) = 1; women's soccer (WSC) = 1; women's track and field (WTF) = 1; men's track and field (MTF) = 1; football (FB) = 1; baseball (BSB) = 1; and wrestling (WR) = 1 completed the study. Days out from injury ranged from 3 to 48 days. Once an injury was sustained, the athletes participated in 20-minute initial interviews. At completion of interviews the athletes recorded daily journals until they were cleared to RTS. At time of return the athletes participated in exit interviews followed up with three days of journaling. **RESULTS:** Data sets in the form of the initial interview, injury journal, exit interview, and the return journal were analyzed. Each data set produced raw themes through line by line coding. Raw themes were analyzed to make general themes. The general themes were used to produce emergent themes to assess the data as whole. Four emergent themes were discovered: emotional reactions to injury; injury produces social implications; motivation as a driving factor for recovery; rehab experience impacts view of injury and return. Athletes have initial negative emotions relating to injury. They overcome these emotions through motivation, social support, and an intrinsic drive to RTS, which leads to a positive ES. These characteristics transition to their rehab. **CONCLUSION:** A positive rehab experience leads to a positive ES leading to a positive RTS. However, if they remain in a negative ES, their rehab will reflect this and lead to a negative RTS.

## The Effects of Varying Midsole Cushioning in Footwear on Gait in Females with Multiple Sclerosis

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**PURPOSE:** Multiple Sclerosis (MS) affects 2.3 million people worldwide and principally results in the breakdown of myelin sheaths surrounding axons in the nervous system. This breakdown elicits mobility impairments to such an extent that over 75% of MS patients experience difficulty in walking. Certain spatio-temporal measures of gait, such as shorter stride length and minimum toe clearance have been attributed to an increased fall risk. Additional kinematic contributors to elevated fall risk in people with MS (PwMS) include decreased step length, reduced gait speed, decreased cadence, and increased double support. Currently, there is limited research on the impact that different shoes types, particularly midsole thickness, have on gait in PwMS. This study investigated the effects of three conditions on the kinematics of gait in females with MS; a high cushioned Hoka One One shoe (e.g. One Clifton 3's), and a medium cushioned New Balance shoe (e.g. 85V1's), in comparison to unshod gait (e.g. barefoot).

**METHODS:** Females (N = 5;  $42 \pm 7$  years,  $1.66 \pm 0.1$  m,  $69.13 \pm 17.01$  kg) diagnosed with MS each underwent a two minute walk test in three different shoe conditions; a high cushioned condition using the Hoka One One Clifton 3 (HC), a medium cushioned New Balance 85V1 (MC), and barefoot. Spatiotemporal changes in gait were assessed using the Opal (APDM Inc., Portland, OR) wireless inertial sensors. **RESULTS:** Preliminary data demonstrate increased elevation at midswing and increased stride length in HC compared to MC. While not significant in our current, small sample, these results demonstrate strong trends with medium to large effect sizes for both midswing elevation (Cohen's  $d$  right leg = 0.479, P value = 0.344; Cohen's  $d$  left leg = 0.699, P value = 0.193), and stride length (Cohen's  $d$  right leg = 0.864, P value = 0.126; Cohen's  $d$  left leg = 0.828, P value = 0.138). **CONCLUSION:** Data collection and analysis is on-going, and current results indicate the potential for a more densely cushioned shoe to improve gait function in PwMS. Specifically, an increased midsole cushion may increase both stride length and elevation at midswing, each of which are kinematic contributors to falls. Thus, the simple acquisition of a pair of shoes could increase quality of life by reducing fall risk.

## A Smartphone-Based Instrumented Functional Reach Test

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**PURPOSE:** The Functional Reach Test (FRT) is an established measure of dynamic balance and limits of stability, which can be valuable in determining fall risk and frailty. FRT measures the maximum forward reach while in a stable standing position. The outcome of this test is a simple ruler-measured distance. The purpose of this study is to develop a smartphone-instrumented version of the FRT which can provide information on the degree of trunk tilt (reach) and postural stability at maximum reach.

**METHODS:** Young adults (5 males, 3 females, 21-24 yrs) were instructed to stand upright with shoulders flexed to 90deg. The subjects performed three trials of three reaches. They were instructed to reach progressively further, with the third reach being their maximum. Subjects were instructed to reach out, bending at the hips while maintaining their fists level with a wall-mounted ruler and hold each reach for five seconds as steadily as possible. An iPod Touch was attached to an elastic strap placed around the subject's torso immediately above the iliac crest. A data collection app was used to record gyroscope data, which reflected the trunk tilt position. Reach distance at each position was manually measured on the ruler.

**RESULTS:** The change in trunk tilt position obtained from the iPod Touch and the change in reach distance measured from the ruler were strongly correlated across the various reach distances. Within each subject, the trunk tilt position and the reach position were strongly correlated ( $R^2$  values ranged from 0.88-0.98). When the values were pooled across all subjects (94 reach positions), strong correlation was also observed between the change in tilt position and the change in reach distance ( $R^2 = 0.81$ ).

**CONCLUSION:** The results indicate that the smartphone can precisely measure changes in trunk tilt position during a functional reach assessment across a range of reach distances. This suggests that smart devices can easily be used to measure dynamic balance and limits of stability in remote field locations and clinical settings.

## Reproducibility of Free-living Physical Activity/Sedentary Behaviors in College

### Undergraduates

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**PURPOSE:** To determine the reproducibility of free-living physical activity/sedentary behaviors in college undergraduates.

**METHODS:** Twice during an academic semester, 20 college students wore activPAL and Actiwatch monitors for seven consecutive days. Subjects were instructed to wear the devices at all times. These devices were worn according to manufacturer's instructions. Sleep and non-wear time were determined via the Actiwatch; waking physical activity and inactivity parameters were determined with the activPAL. The weekly means of these parameters were compared via paired t-tests and used to determine the typical error (TE) and coefficient of variation (CV).

**RESULTS:** For the following waking day parameters, there were no significant differences between weeks one and two, so the average of both weeks are reported as the mean  $\pm$  SD together with the TE and CV: total number of steps ( $9647.0 \pm 4614.2$ , 1744.3, 18.2%), minutes spent stepping ( $104.0 \pm 47.9$ , 16.5, 15.5%), sedentary minutes ( $737.2 \pm 138.2$ , 53.7, 7.5%), MET-hours ( $25.0 \pm 3.2$ , 1.3, 5.2%), minutes spent standing ( $163.2 \pm 87.9$ , 34.4, 21.1%), minutes of light intensity activity (1.5-2.99 METs;  $192.2 \pm 99.1$ , 37.9, 19.4%), number of breaks from sitting/lying ( $48.1 \pm 15.9$ , 5.2, 11.1%), the number of breaks per sitting/lying hour ( $4.1 \pm 1.7$ , 0.6, 14.4%), the minutes of sitting/lying bouts that last at least 30 ( $475.5 \pm 163.3$ , 52.5, 11.1%) and 60 minutes ( $271.4 \pm 166.8$ , 59.7, 21.2%), percent of day spent sedentary ( $73.4 \pm 11.5$ , 0.04, 6.2%), percent of day spent in light intensity ( $19.1 \pm 9.5$ , 0.04, 19.0%), and percent of day spent in moderate-to-vigorous activity ( $\geq 3$  METs;  $7.6 \pm 3.6$ , 0.01, 17.4%). In contrast, total time spent in moderate-to-vigorous intensity activity ( $\geq 3$  METs) was significantly different between weeks one ( $78.9 \pm 39.6$ ) and two ( $70.8 \pm 33.9$ ;  $p < 0.05$ ). In addition, the number of minutes meeting the ACSM physical activity guidelines were also significantly different between weeks one ( $27.7 \pm 32.2$ ) and two ( $20.2 \pm 22.9$ ;  $p < 0.05$ ).

**CONCLUSION:** For college students, waking physical activity and sedentary behaviors assessed by activPAL are reproducible within an academic semester with the exception of moderate-to-vigorous physical activity. These results are likely explained by the lifestyle requirements demanded of a full-time college undergraduate.

## Perceptions of Wellness from an 8-week Physical Activity Intervention in an Underserved Community

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This study examined the feelings of wellness through individual's perceptions. Approaches of constructivism focused on the development of knowledge through an experiential reflective cycle. Interpretivism was used to examine the different perspectives of the participants in the study, and to investigate the feelings of wellness. **PURPOSE:** This study was conducted to examine perceptions of wellness following an 8-week physical activity (PA) intervention in a historically underserved community. The research question was: Does participating in PA influence perceptions of cognitive and emotional wellness? **METHODS:** This 8-week PA intervention started with 33 participants, who completed PA at least 3 times a week; 25 participants completed exit interviews. Participants were instructed to record journal entries after each bout of PA. Participants reflected on perceptions of cognitive, emotional and physical wellness, and inclusive excellence based on experiences during PA. The exit interview took place using computers rather than traditional face-to-face methods. Interviews were analyzed using open and axial coding. **RESULTS:** Major themes that emerged from the data included: enhanced perceptions of mental capacity, emotional wellness, physical wellness, and inclusive excellence. One participant's mental quote was "My capacity to tackle physical or mental tasks improved with being active and pushing myself." Another participant said "I believe it made me more relaxed and intentional..." A different participant quoted physical benefits: "I had a lot more energy and my body felt stronger. I also found that I was sleeping much better... would wake up with more energy." **CONCLUSION:** The participants indicated that through regular PA over an 8-week intervention, perceptions of physical and emotional wellness increased, as did mental capacity and understanding of inclusive excellence.

This research was funded by a Title V Unidos Cooperative Grant.

# THE DUNKIN-HARTLEY GUINEA PIG AS A NOVEL MODEL FOR THE STUDY OF SARCOPENIA

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## PURPOSE:

Sarcopenia, the age-related loss of skeletal muscle size and function, contributes to several chronic diseases. The purpose of this investigation was to characterize age-related changes in skeletal muscle of Dunkin-Hartley (DH) guinea pigs to evaluate the strain's potential as a model of human sarcopenia. DH guinea pigs have an age-related, progressive onset of knee osteoarthritis (kOA) starting at 4 months of age caused by increased inflammation, which could also contribute to skeletal muscle loss. As such, DH guinea pigs could be an accelerated model of sarcopenia relative to models already established. We hypothesized there would be an age-related decline in skeletal muscle mass over 10 months in DH guinea pigs similarly observed in humans.

## METHODS:

We compared age-related changes in skeletal muscle of DH guinea pigs to control strain 13 (S13) guinea pigs that do not develop kOA. We used the stable isotope deuterium oxide to evaluate fractional protein synthesis rates (FSR) in the gastrocnemius over two weeks in DH and S13 guinea pigs at 5, 9, and 15 months (mo) of age. In muscle from 5mo and 15mo guinea pigs, we characterized myofiber size distribution in slow twitch (ST) and non-slow twitch (FT) fibers using immunofluorescence. Sirius red staining quantified collagen composition of total protein content in skeletal muscle.

## RESULTS:

There was an age-related decline in FSR (%/day) in mitochondrial (5mo  $2.25 \pm 0.24$ , 15mo  $1.61 \pm 0.28$   $P < 0.05$ ), cytosolic (5mo  $2.55 \pm 0.19$ , 15mo  $1.85 \pm 0.31$   $P < 0.05$ ), and myofibrillar (5mo  $2.46 \pm 0.32$ , 15mo  $1.80 \pm 0.32$   $P < 0.05$ ) fractions of the gastrocnemius in DH, but not S13. By 9mo, collagen synthesis was lower than 5mo in both DH (5mo  $0.59 \pm 0.15$ , 9mo  $0.30 \pm 0.06$   $P < 0.05$ ) and S13 (5mo  $0.62 \pm 0.13$ , 9mo  $0.32 \pm 0.09$   $P < 0.05$ ), though collagen content (%) was unchanged in either strain ( $P > 0.05$ ). There was an age-related increase in gastrocnemius ST composition in DH (5mo  $14.77 \pm 2.98\%$ , 15mo  $27.62 \pm 8.07\%$ ) and a shift in myofiber size distribution to smaller ST and FT fibers.

## CONCLUSION:

We observed decreased skeletal muscle FSR at 15mo compared to 5mo in DH guinea pigs. Similar to humans, we observed a shift to smaller myofiber size in DH. Altogether, DH guinea pigs demonstrate characteristics of human sarcopenia while S13 do not by 15mo. Our results suggest that the DH strain may be a model for sarcopenia.

## Asymmetric Lower Body Force Output in NCAA Division II Athletes

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Symmetry exists in the universe, in nature, and even within the human body. However, over time the body develops an asymmetrical nature. For example, the body develops differences in limb length, favors handedness, and may have unequal force exertion. Asymmetrical force output potentially, depending on the severity, can be a problem for athletes and strength and conditioning (SC) coaches because it can cause athletes to be categorized as “high risk” for injury. To date, there is a limited research about what causes this asymmetry in the force output in athletes. **PURPOSE:** The primary purpose of this study was to determine if there was a relationship between lower body force output asymmetry and positioning on the field in NCAA Division II collegiate athletes, by measuring force output using symmetry angle (SA) while performing a barbell back squat (BS). **METHODS:** Fifty-three athletes: baseball (BB) = 8; softball (SB) = 13; men’s soccer (MS) = 11; women’s soccer (WS) = 11; women’s volleyball (VB) = 10 completed the study. The participants had a mean age of  $20.19 \pm 1.25$  yr., height of  $169.58 \pm 9.28$  cm, weight of  $70.52 \pm 10.91$  kg, time played in position of  $9.06 \pm 4.48$  yr., experience lifting weights of  $5.16 \pm 2.46$  yr., and symmetry angle of  $-0.36 \pm 2.90$  percent. Each participant performed a five-minute bike warm-up and one warm-up set of the BS before performing the test of three sets of one rep at 70% of their 1RM. The participants performed the test while standing on two force plates that measure local vertical peak force (N). **RESULTS:** An independent t-test showed there was a significant difference in mean values for SA between men and women ( $p = 0.01$ ). An ANOVA showed that there was significant difference in the SA values between sports ( $p = 0.03$ ), specifically between MS and VB (Tukey HSD,  $p = 0.02$ ). An ANOVA between position on the field and SA showed no significance ( $p = 0.18$ ). **CONCLUSION:** Position on the field does not have a noticeable effect on SA in these athletes, however the type of sport (upper body or lower body) and gender may have an effect on the SA of athletes. Males in lower body sports may be at “higher risk” for injury, so strength and conditioning coaches could implement more unilateral movements to potentially decrease the imbalances. Future studies may want to investigate how unilateral movements affect SA in all men’s and women’s sports.

# **Leg Strength Asymmetry Is Not Associated With Walking Ability, Fatigability or Fatigue in Multiple Sclerosis**

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*Purpose:* One of the first signs of Multiple Sclerosis (MS) is weakness of one side of the body, which is associated with asymmetric muscle activity during walking and greater reliance on the stronger leg. The role of leg strength asymmetry on walking ability, fatigability and fatigue is unknown in people with MS (PwMS). The purpose of this cross-sectional study was to determine whether leg strength asymmetry is associated with walking ability, objective measures of fatigability or subjective perceptions of fatigue during a 6-minute walk test (6MWT).

*Methods:* Maximal knee extensor strength was assessed in 19 PwMS, and a symmetry index was calculated based on the objectively defined more- and less-affected leg. Walking ability was determined by measuring the total distance covered during a 6MWT and fatigability by calculating the change in distance covered between minutes six and one. Perceptions of fatigue were assessed by obtaining ratings of perceived exertion (RPE) using the modified Borg 10-point scale during the first two and the final minute of the 6MWT.

*Results:* PwMS covered less distance ( $P=0.01$ ) and perceived greater exertion ( $P<0.01$ ) during minute six compared to minute one. Maximal knee extensor strength ( $P<0.01$ ) was different between the more- and less-affected side. The magnitude of asymmetry did not correlate with walking ability, fatigability, or perceptions of fatigue.

*Conclusion:* Maximal knee extensor strength asymmetry may not play an important role in walking ability or fatigability during a 6MWT in PwMS. Future lower limb symmetry studies in PwMS should assess the flexor muscle groups and include power rather than strength to determine asymmetries.

## **Renal Injury Risk Exposure from Non-Steroidal Anti-Inflammatory Drug Use and High Intensity Training: Pilot Study**

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Ingestion of non-steroidal anti-inflammatory drugs (NSAIDS) prior to endurance events has been associated with risk for acute kidney injury (AKI). High intensity functional resistance training (HIFRT) may also present risk for AKI due to high intensities and possible frequent NSAID ingestion. However, exposure rates to both HIFRT and NSAID ingestion are unknown.

**PURPOSE:** The purposes are to; A) quantify prevalence of NSAID use in a HIFRT facility, and then B) poll a random sample of HIFRT facilities in the United States (U.S.) to quantify the individuals that regularly complete the HIFRT workout, “Murph” (1 mile run, 100 pull-ups, 200 push-ups, 300 squats, and final 1 mile run). **METHODS:** For purpose “A”, 107 adult ( $36.5 \pm 11.1$  y, 53 males, 54 females) HIFRT athletes completed a questionnaire (QNR) quantifying frequency of NSAID use. For purpose “B”, the goal is to contact 106 gyms by phone or email representative of the U.S. HIFRT facility population. Gyms were stratified into respective states and a random sample was selected from each stratum based on their percentage of the population. Presently, 25 HIRFT gyms from 19 states have completed a QNR quantifying the proportion of members who completed “Murph” [the last time it was programmed](#) using reservation software systems. After completing [the QNRs from](#) all states, a U.S. exposure estimation will be calculated using the average percentage of membership completion (members completed/total membership) multiplied by the average total membership of all gyms then multiplied by the total number of HIFRT facilities in the U.S. (5,463). **RESULTS:** The NSAID QNR revealed 21% of HIFRT athletes have taken NSAIDS prophylactically, prior to workouts, and 20% have taken higher than the prescribed dosage. 36% of participants reported taking NSAIDS within the last week. The main reason for NSAID use was to decrease soreness. An initial exposure calculation made from 25 of the 106 planned phone QNR indicates an estimated 317,600 perform “Murph” each year. This calculation will be updated when our complete sample has responded. **CONCLUSION:** Many people complete “Murph” annually and there is a prevalence of NSAID ingestion within the Laramie, WY HIFRT facility. Exposure rates for nationwide risk of AKI during HIFRT exists. Future research should evaluate the effects of NSAID use prior to completing “Murph” on AKI.

# **Implementing Exercise is Medicine-On Campus Referral Program at The University of Wyoming**

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**PURPOSE:** Physical inactivity is a growing issue and Exercise is Medicine-On Campus (EIM-OC) is trying to increase physical activity on campus. EIM-OC suggests universities and colleges establish physical activity as a vital sign in every visit to student health and students who are not getting 150 minutes of moderate intensity exercise per week are referred to EIM to increase physical activity. The EIM-OC referral program was implemented at the University of Wyoming in March 2017. The purpose of this project is to describe the implementation and to present preliminary outcomes on participation in the EIM-OC referral program.

**METHODS:** Students engaging in less than 150 minutes of moderate intensity exercise per week were offered a referral to the EIM-OC program from UW Student Health. EIM-OC interns trained in ACSM guidelines and testing, guided clients in developing behavior change strategies and creating a free, individualized exercise prescription. Clients completed exit surveys following their meeting with EIM interns to evaluate program effectiveness and areas for improvement.

**RESULTS:** During the summer and fall semester of 2017, EIM received three referrals and one met to receive an exercise prescription. Prior to the start of the spring 2018 semester, an EIM program manager met with the medical professionals at student health to remind them of the EIM-OC referral program and its importance to the health of the students at UW. During the beginning of the spring 2018 semester, nine referrals have been made. Two clients have received exercise prescriptions with others pending.

**CONCLUSION:** The Exercise is Medicine-On Campus referral program initially had few referrals; participation of the medical staff and students are increasing. In the exit survey, student clients reported enjoying the program and received helpful tips on healthy behavior change. EIM-OC is constantly striving to improve the program and provide more resources to increase physical activity and exercise on campus. Future improvements to the program will include the opportunities for self-referrals, fitness assessments, and increasing EIM-OC staff's knowledge of evidence-based practice for stages of change.

## Effects of Resistance Training and Doxorubicin on Creatine Transporter and Creatine Kinase Expression in Fast Muscle

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Doxorubicin (DOX) is a potent chemotherapy drug used to treat numerous cancers, but its use is limited due to its toxicities. DOX treatment may lead to skeletal muscle dysfunction which compromises quality of life for cancer patients. It is suggested that DOX inhibits creatine transporter (CreaT) and creatine kinase (CK) expression in cardiac muscle, but little is known as to how it affects CreaT and CK expression in skeletal muscle. Additionally, resistance training has been shown to alleviate DOX-induced skeletal muscle dysfunction (weakness and fatigue), but the effects of resistance training on CreaT and CK expression in DOX-treated skeletal muscle is currently unknown.

**PURPOSE:** To investigate the effects of resistance training prior to and during DOX treatment on CreaT and CK expression in the primarily type II, or fast, extensor digitorum longus (EDL) muscle. **METHODS:** Thirty-six male, Sprague-Dawley rats were randomly assigned to one of four groups: sedentary+saline (SSS), sedentary+DOX (SSD), resistance training+saline (RRS), and resistance training+DOX (RRD). The resistance training protocol incorporated a raised cage model where food and water were elevated progressively which provided hindlimb loading 10 weeks prior to DOX injection and during the course of DOX treatment. Animals receiving DOX received 3 mg/kg DOX administered i.p. weekly for 4 weeks (12 mg/kg cumulative) and animals receiving saline received equivalent volumes of 0.9% NaCl as a placebo. Five days following the final DOX or saline injection, EDL muscles were excised, and Western blotting was performed to quantify CreaT and CK expression. **RESULTS:** No significant drug effect or activity x drug interaction was observed for CreaT expression, but a significant activity effect was observed for CreaT expression ( $p=0.0479$ ). No significant main effects or interaction was observed for CK expression. **CONCLUSION:** Resistance training prior to and during weekly DOX administration promoted an increase in CreaT expression suggesting that resistance training may play a role in alleviating DOX-induced skeletal muscle dysfunction by enhancing substrate availability for phosphocreatine synthesis.

## **Comparison of Incremental Trial Protocols Used to Determine Maximal Oxygen Consumption in Recreationally Trained Cyclists**

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**Purpose:** The purpose of this study was twofold: 1, to validate a regression equation published by Hawley and Noakes (1992) to predict maximal oxygen consumption ( $VO_{2max}$ ) from peak power production ( $W_{peak}$ ) attained during an incremental cycling trial with a high initial power output (HIP); and 2, to compare  $VO_{2max}$  values attained from this HIP protocol and a lower initial power output protocol (LIP). **Methods:** Twelve recreationally trained cyclists (9 males and 3 females), cycling at least 4 days/week or 6 hr/week, completed both the HIP and LIP protocols to measure  $VO_{2max}$  and  $W_{peak}$ . The HIP commenced with an initial power output of 2.5 or 3.5 W/kg body mass for females and males respectively. Power was increased by 50 W after 150 seconds, and 25 W every 150 seconds thereafter until volitional fatigue. The LIP began with an initial power output of 1.5 or 2.0 W/kg body mass for females and males respectively. Power was increased by 25 W every 120 seconds until volitional fatigue. During each trial, time to exhaustion was recorded to the nearest second to extrapolate  $W_{peak}$ , which was used to estimate  $VO_{2max}$  based on the equation of Hawley and Noakes (1992). **Results:** There was a significant difference ( $p < 0.001$ ) between the mean  $VO_{2max}$  values measured during the HIP protocol ( $50.56 \pm 7.28$  ml/kg/min) and the predicted mean values from the Hawley and Noakes equation ( $57.46 \pm 6.15$  ml/kg/min). However, there was no significant difference ( $p = 0.165$ ) in mean  $VO_{2max}$  values measured during the HIP and LIP trials,  $50.56 \pm 7.28$  ml/kg/min and  $51.48 \pm 6.94$  ml/kg/min, respectively. **Conclusions:** This study found that the regression equation of Hawley and Noakes (1992) was not valid for estimating  $VO_{2max}$  in recreationally trained participants. However, the HIP and LIP protocols yielded  $VO_{2max}$  values that were not statistically different, therefore, both protocols can both be used to determine  $VO_{2max}$  in recreationally trained cyclists.

## **Title: Complementary and Alternative Medicine Use in Cancer Survivors in a Structured Exercise Program**

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**INTRODUCTION:** Approximately 12.7 million people are diagnosed with cancer each year and many undergo conventional treatments including chemotherapy, radiation, and surgery. Complementary medicines supplement these conventional treatments while alternative medicine refers to practices intended to replace traditional cancer treatments. Complementary and alternative medicine (CAM) practices can include, but are not limited to dietary supplementation, Chinese herbal medicine, and physical manipulation. A yearlong 2012 survey found that cancer survivors spent \$4 billion on vitamins and minerals, \$1.2 billion on non-vitamin or mineral natural products, and \$500 million on massage. **PURPOSE:** To examine the use of CAM in cancer survivors currently participating in a structured exercise program. **METHODS:** Participants from the University of Northern Colorado Cancer Rehabilitation Institute (N=29) were given a 28-question, traditional paper and pencil, CAM survey. **RESULTS:** All respondents indicated that they were happy with the conventional medical treatments that they received, and 70% of respondents reported CAM use after their cancer diagnosis. Half of the respondents started CAM use after physician recommendation, while the other half of respondents started using CAM on their own. Also, 45% of respondents used some form of CAM while undergoing cancer treatment. Almost half of respondents (48%) claimed that CAM was very effective, while the other 52% of respondents were unsure. Only 1 one participant reported experiencing a CAM-related negative side effect. Respondents reported using dietary supplements (75%), vitamins (75%), and minerals (30%) with the most commonly used forms including Vitamins D and B, calcium, fish oil, astragalus, and ginseng. Other therapies used were massage (60%), acupuncture (25%), and cannabis (15%). **CONCLUSION:** A high percentage of cancer survivors participating in a structured exercise program reported using CAM. Consequently, cancer rehabilitation programs may want to consider providing information related to the safety and effectiveness of these products and practices to cancer survivors.

## The impact of 225-NFL Bench Press repetitions test on playing time in College Football Players

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**Purpose** The one repetition maximum bench press and NFL 225 repetition test are commonly used to assess upper-body muscular strength and endurance in football players. Little research has been done on the relationship of those tests across different positions and between starters and non-starters. Therefore, the purpose of this study was to determine if significant relationships exist between these upper body strength and endurance tests and playing status in Division I football athletes. **Methods** Archival data from Thirty-one NCAA Division I football players (age:  $20.1 \pm 1.4$  yrs, height:  $188.07 \pm 5.93$  cm, weight:  $112.4 \pm 19.5$  kg.) was utilized for this analysis. Following the completion of multiple warm-up trials, participants attempted to achieve their 1RM within 3-5 attempts. During the week after the 1RM testing, each player performed the NFL-225 test using a load of 225lbs (102.3kg), attempting to complete as many repetitions as possible without pause. One-way ANOVAs were used to detect significant differences between skill groups: big (linemen), medium (linebackers, quarterbacks, tight ends) and small (receivers, backs, and corners) ( $p < 0.05$ ) with a post-hoc Bonferroni used for between group comparisons. Each of the three position groups were further separated by starters and non-starters. Correlation analysis was conducted to examine the relationship in physical characteristics between groups as well as between starters and non-starters. **Results** There was a statistically significant difference in total reps of the NFL 225 test between big and small skills ( $20.85$  vs.  $13.44$ ,  $p < 0.05$ ). The correlation analysis showed a moderate to strong relationship between playing status and performance on the 1 RM bench press ( $r = .660$ ,  $p < 0.01$ ) and the NFL 225 test ( $r = .685$ ,  $p < 0.01$ ) for big skills group. There was no significant relationship discovered between playing status and performance on the 1RM and NFL 225 test for middle and small skills groups. **Conclusion** Based on the results of this study, it was found that for big skill players that playing status and upper-body strength and endurance are strongly related. Knowing this, strength and conditioning coaches can utilize testing results in the 1RM bench press and NFL 225 test to aid in identifying potential weaknesses, which may differentiate a starter or non-starter status.

## **Acute Effects of Performing Heavy Conventional Deadlifts on Vertical Jump and Peak Ground Reaction Force**

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Acute prior muscle activation has been shown to improve rate of force development (RFD), peak ground reaction force (GRF) and vertical jump height. One of the proposed mechanisms to these increases is post-activation potentiation (PAP), which can occur after lifting a heavy load. There is limited evidence suggesting that these improvements can be seen in highly trained male subjects performing a conventional deadlift immediately prior to a vertical jump.

**PURPOSE:** To determine if performing a submaximal deadlift immediately prior to a vertical jump can enhance peak GRF and vertical jump performance in Division II football players.

**METHODS:** Twelve male collegiate freshman football players age ( $19\pm 1$ ) volunteered for this study and randomly completed two trials, in a crossover design, over a two-week period. The control trial consisted of three vertical jumps with no prior muscle activation while the experimental trial had subjects perform three submaximal deadlifts at 80% of one repetition maximum (1RM) immediately prior to performing three vertical jumps. All jumps were performed on a force platform while measuring vertical jump height with a Vertec vertical jump tester. The jump eliciting the highest vertical jump was used to measure peak GRF in newtons (N) and then normalized to bodyweight in kilograms (kg). **RESULTS:** Results showed no significant ( $p > .05$ ) differences between the control and experimental trials in vertical jump performance and normalized peak ground reaction force. **CONCLUSION:** Results indicated that a heavy deadlift used to stimulate PAP, with minimal rest time, had no significant effect on vertical jump height or normalized GRF.

## Smartphone-based Assessment of Ballistic Lower Leg Movement

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**PURPOSE:** Rapid leg movements are functionally important, especially for reactive and protective movements in older adults or the functionally impaired. However, the equipment necessary to measure such actions is often expensive and restricted to the lab setting, thus limiting accessibility. The ability to easily track changes in this type of function in aging, disease progression, or with interventions can be clinically valuable. Apps on smartphones can record data from the sensitive onboard accelerometers. The purpose was to determine if a smart device can be used to accurately measure ballistic leg movement when compared with an expensive lab accelerometer.

**METHODS:** Twelve young (19 to 24 yrs) subjects were seated with the knee at a right angle and the lower leg hanging freely. An iPod Touch was attached to the anterior shank of the dominant leg with the Z-axis perpendicular to the distal lower leg. A uniaxial lab accelerometer was attached to the face of the iPod in line with the iPod Z-axis. The task was an arrested kick – a ballistic knee extension that did not go to full range of motion. The subjects performed two trials (one to practice the protocol, and one for data collection) of 20 kicks of increasing velocity, starting with “very slow” and progressing to maximal velocity. Acceleration was recorded from the iPod with an app and from the uniaxial accelerometer with a data acquisition system. The peak acceleration from the initial phase of each kick was measured from both devices. Correlations were computed between devices for the second trial of 20 kicks, across the range of velocity within each subject.

**RESULTS:** Between-device correlations, across velocities, were consistently high ( $R^2$ : 0.90 to 0.999). The  $R^2$  value across velocities from all subjects pooled (240 values) was 0.90. The iPod tracked the peak acceleration values from the accelerometer accurately across the range of kick velocity. Peak acceleration from the single maximal kick from each trial was correlated ( $R^2=0.74$ ) between devices.

**CONCLUSION:** Smart device-based accelerometers are sufficiently sensitive to detect acceleration during ballistic leg movements performed across a range of speeds. This suggests that measures of rapid, protective movements, such as ones needed to prevent falls, could be conducted outside the research lab.

Project title: Character Count: 10 (15-word max)

## **The Effects of Aging on Cortical Inhibition and Gait Coordination**

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Text: Character Count: 1,997 (2000 Character Max Including spaces)

**PURPOSE:** Levels of inhibition within the motor cortex are significantly associated with coordination of the upper extremities in healthy young and older adults, however, it is unknown if this same association exists for lower extremity control. Thus, this project aimed to identify how motor cortex inhibition contributes to gait symmetry in healthy young (YA) and older adults (OA).

**METHODS:** Two testing sessions occurred on separate days. Day one consisted of transcranial magnetic stimulation to assess motor cortex inhibition via the cortical silent period (cSP). Day two consisted of three walking conditions: a normal (self-selected pace) 6-minute walk, a dual-task (DT; self-selected pace) 2-minute walk, and a fast 2-minute walk. Phase coordination index (PCI), which incorporates the assessment of both accuracy and consistency of gait cycle generation, was the primary outcome measure and was assessed via wireless inertial sensors during over-ground walking.

**RESULTS:** Twenty-nine healthy adults participated in the study; 14 YA and 15 OA. The cSP duration was statistically different between the YA and OA for the right motor cortex ( $p=0.05$ ) with no statistical group difference for the left motor cortex ( $p=0.21$ ). There was a main effect of group, revealing a larger PCI for OA compared to YA ( $p=0.01$ ). Additionally, there was a main effect of condition indicating a greater PCI during DT ( $p<0.001$ ) and fast walking ( $p<0.001$ ) in comparison to normal walking. Linear regressions for the YA revealed a significant positive relationship between the left hemisphere cSP and the normal walk PCI ( $r=0.70$ ,  $p=0.01$ ) while OA, revealed a negative correlation between the left hemisphere cSP and normal walk PCI ( $r=-0.45$ ,  $p=0.10$ ).

**CONCLUSION:** The current results indicate that motor cortex inhibition is significantly related to gait coordination in YA when measured using PCI. Specifically, these findings indicate that *less* motor inhibition is associated with more symmetric gait in YA, whereas in OA *greater* motor inhibition is related to more symmetric gait. Taken together, these results suggest that cSP may be an important neurophysiologic marker of symmetric gait function and may undergo a fundamental shift in cortical control with advancing age, thus providing a neural marker when analyzing clinical populations with impaired mobility.

# Strength Requirements of Law Enforcement Officers: A Critical Review

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**Purpose:** The physical and diverse nature of daily tasks associated with law enforcement requires adequate muscular strength for optimal performance and injury prevention. A small body of research exists in which strength has been reported in law enforcement officer (LEO) populations. However, a critical review of this research has yet to be conducted. Therefore, the aim of this critical narrative review was to identify, critically appraise and synthesise the essential findings of current literature pertaining to the strength requirements of LEOs.

**Methods:** A comprehensive search of three databases utilising key search terms was conducted. Subsequently, inclusion and exclusion criteria were applied to yield all applicable studies. Two reviewers individually evaluated the final ten studies using a modified Downs & Black appraisal tool. Cohen's kappa coefficient ( $\kappa$ ) was used to evaluate interrater agreement and a final critical appraisal score was allocated to each study. Finally, significant findings were tabulated. **Results:** The mean modified Downs & Black score achieved was  $18 \pm 2.8$ , with substantial interrater agreement ( $\kappa = 0.654$ ). Most commonly reported measures of strength were 1RM Bench Press (8/10 studies) and Grip Strength (5/10 studies).

**Discussion:** Peer reviewed research in this field is limited and generally of poor to fair methodological quality. A narrow scope of strength-related outcome measures has been reported upon in the available literature. Therefore, conclusions drawn from these findings should be interpreted with caution.

## Fitness Profiles in Elite Tactical Units: A Critical Narrative Review

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**Objective:** Elite tactical units are frequently deployed in a variety of locations of high level fitness is required by this population. The aim of this critical narrative review was to identify and synthesize key findings of studies that have investigated the fitness profiles of elite tactical units. **Methods:** A systematic search of three databases was conducted using specific search terms to identify relevant studies. These studies were then assessed against key inclusion and exclusion criteria to determine those to be included in the review. Included studies were critically appraised, and level of evidence determined, while the relevant data were extracted, tabulated, and synthesized. **Results:** Fourteen identified studies ranged in percentage quality scores from 46% to 66% with a mean of 57.5%, with a moderate interrater agreement as seen in the Cohen's Kappa coefficient,  $\kappa = 0.496$ . A variety of fitness measures were used in various domains of fitness. The most common measures were in the areas of anthropometric measures, strength, power, and aerobic capacity. However, there was high variety in the tools and procedures to used these areas. **Conclusion:** Though fitness is a critical part of research and practice, there is no standardized measure or result for this population. Further research needs to be conducted in the development of a fitness profile using standardized outcome measures taht covers the spectrum of the fitness requirements for this population.

## Cross-shift Body Mass Change and Health Outcomes Related to CKDu in Guatemalan Sugarcane Workers

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**PURPOSE:** Repeated dehydration from heat stress and physical exertion is hypothesized to be a main cause of chronic kidney disease of an unknown origin (CKDu). The aim was to evaluate if seasonal changes in kidney health for three groups of sugarcane workers (highland sugarcane cutters (HC), local sugarcane cutters (LC), sugarcane planters (SP)) were related to the frequency of cross-shift dehydration (> 1% body mass (BM) loss = dehydrated, BM loss of ≤ 1% = hydrated).

**METHODS:** 376 male workers (HC n = 118, 28 ± 5 y, 160 ± 5 cm, 58.7 ± 6.0 kg, 0.87 ± 0.14 mg·dL<sup>-1</sup> blood creatinine (WBCr); LC n = 172, 31 ± 9 y, 161 ± 6 cm, 59.9 ± 8.5 kg, 0.91 ± 0.16 mg·dL<sup>-1</sup> WBCr; SP n = 86, 32 ± 11 y, 159 ± 5 cm, 60.0 ± 7.6 kg, 0.88 ± 0.15 mg·dL<sup>-1</sup> WBCr) participated. The study included baseline and three cross-shift data collections. At each time point, pre- and post-shift BM and WBCr (to calculate eGFR) were measured. Workers were divided into 4 groups based on the frequency of cross-shift dehydration (pre- to post-shift BM loss < 1% at 3, 2, 1, or 0 of the time points). Within each worker group, two-way (4 hydration groups X 2 time point) ANOVAs were used to evaluate main effects and interactions in WBCr, and eGFR. Statistical significance was set at  $\alpha < .05$ .

**RESULTS:** There was a significant difference in change of WBCr from pre-season to post-season between worker groups (HC -0.07 ± 0.20, LC 0.02 ± 0.25, SP -0.04 ± 0.15, *F-score* = 6.06, *P* = <0.01). 57 participants developed an eGFR <90 ml·min<sup>-1</sup>·1.73m<sup>-2</sup> and 11 participants developed an eGFR <60 ml·min<sup>-1</sup>·1.73m<sup>-2</sup>. Self-reported water intakes during work were 17 ± 4 L for HC, 15 ± 2 L for LC, and 5 ± 2 L for SP. Among each work group, there was no significant difference in change in eGFR between workers who were hydrated at 3, 2, 1, or 0 time points (HC *F-score* = 0.30, *P* = 0.74; LC *F-score* = 1.89, *P* = 0.32; SP *F-score* = 1.03, *P* = 0.38). There was a main effect of group for percent BM loss with HC increasing BM cross-shift and LC and SP decreasing BM cross-shift.

**CONCLUSIONS:** Chronic hydration status based on frequency of cross-shift BM >1% did not relate to workers' risk of developing kidney damage over the course of the sugarcane harvest for any worker groups. However, the HC maintained hydration better, drank more water, and had improved kidney function cross-season. A possible explanation is the amount and distribution of water consumption during the day.

## **Sex Differences in Reactive Driving with advancing age.**

Victoria Zablocki, Colorado State University; Prakruti Patel, Colorado State University; Evangelos Christou, University of Florida; Neha Lodha, Colorado State University

The ability to respond quickly is a key determinant of driving performance that declines with aging. Reports suggest that simple reaction times are faster in males than females. However, the effect of sex differences in driving response times for older adults remains unknown. The driving response time requires the contribution from both visual information processing and neuromotor control.

**PURPOSE:** The goal of this study was to determine sex differences in 1) driving response time and 2) the contribution of visual information processing and neuromotor control in older adults.

**METHODS:** In a simulated driving environment, older males (N=10; age=66.79 ± 6.63 yrs.) and older females (N=10; age=69.24 ± 5.58 yrs.) performed a reactive driving task that required responding to the unexpected brake lights of the car ahead by quickly moving the foot from the gas pedal to the brake pedal. All participants were right dominant and performed the task with the right ankle. We quantified 1) driving response time as the time from the onset of visual stimulus to the application of brake force, 2) the contribution of visual information processing by the pre-motor response time: the time between the onset of the visual stimulus and activation of tibialis anterior muscle, and 3) the contribution of the neuromotor control by the motor response time: the time from the activation of tibialis anterior muscle to the brake force onset. **RESULTS:** Our data suggest that driving response time was not significantly different between older male and female groups. Older females had significantly longer pre-motor response time (538 ± 142.44 ms) as compared with the older males (381.34 ± 100.41 ms). In contrast, the older females had significantly shorter motor response time (397.64 ± 71.07 ms) as compared with the older males (517.90 ± 70.07 ms). **CONCLUSION:** These findings highlight that there are no sex differences

in driving response time in older adults. However, older females require longer time to process visual information but execute faster movements. In contrast, older males require shorter time to process visual information but execute slower movements. Taken together, our data suggests that older male and female drivers adopt different strategies for reactive driving.