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EFFECTS OF AN OVERGROUND-BASED EXOSKELETON USER TRAINING PROTOCOL ON MOBILITY PERFORMANCE FOR UNTRAINED TASKS

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To expedite exoskeleton user training and ensure proficient performance in real-world setting, it is important to determine if the learned user-exoskeleton adaptation can be transferred to more tasks and operational environments than those explicitly trained on. We previously developed an overground-based (OG) training protocol consisting of practicing walking with a powered ankle exoskeleton on floor, sand-gravel, and stairs terrains, with and without carrying a rucksack.

PURPOSE: Evaluate the versatility of our developed OG exoskeleton training protocol in performing untrained army-relevant tasks and terrain conditions.

METHODS: N=9 males (23.8±5.5 years) received 2 training sessions. The untrained task or terrain conditions included an artillery transport task where subjects held a 60-lbs simulated artillery shell while walking on floor or a sand-gravel terrain (i.e., Artillery Floor (AF) and Artillery Sand (AS)) and walking on a cobblestone terrain with and without carrying a rucksack (i.e., Rucksack Cobblestone (RC) and Unload Cobblestone (UC)). Tasks were performed while wearing combat boots before the training (PRE) and wearing the powered exoskeleton after the training (POST). Outcome measures included the net oxygen consumption rate (VO₂), walking speed, and cost of transport (CoT).

RESULTS: Compared to PRE, subjects had significantly lower VO₂ for AF by ~7% (POST: 22.6±3.8, PRE: 24.3±2.9 ml/min/kg, p=0.035) and non-significantly lower VO₂ for UC and RC by 16% and 10%, respectively, during POST. However, subjects had slightly higher VO₂ for AS by 2% during POST. Subjects walked slightly faster for AF (by 3%) and RC (by 2%) but had a slower speed for AS (by 2%) and UC (by ~9%). Accordingly, subjects had non-significantly lower CoT for AF, UC, and RC by 10%, 8%, and 12%, respectively, but had higher CoT for AS by 4%.

CONCLUSION: The preliminary findings demonstrate that the learned exoskeleton adaptation was able to show some improvements for Artillery Floor, Unload Cobblestone and Rucksack Cobblestone but not for Artillery Sand. Our prior results also showed higher CoT when walking with a rucksack on the sand-gravel terrain at POST. Difficult terrains like the sand-gravel may be more critical in dictating the skill transfer than the task conditions for these steady-state tasks.

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PHYSICAL INACTIVITY AMONG ADOLESCENTS: A BEHAVIORAL INTERVENTION APPROACH TO ENHANCE SELF-EFFICACY AND OVERCOME EXERCISE BARRIERS

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Adolescents' insufficient physical activity levels raise concerns, necessitating effective interventions for sustained engagement. This research study employs a behavioral intervention approach to address this issue, focusing on bolstering self-efficacy and overcoming exercise barriers in Alyssa, a teenage participant. **BACKGROUND:** Adolescents often struggle with maintaining regular physical activity due to various barriers. Enhancing self-efficacy and providing strategies to surmount these barriers is vital. **PURPOSE:** This study aims to design and implement a behavioral intervention for Alyssa, emphasizing visualization, goal setting, and self-monitoring techniques to enhance her self-efficacy and foster consistent physical activity engagement. **METHODS:** An in-depth case analysis of Alyssa was conducted, identifying her strengths, weaknesses, and areas for improvement. Guided by Lox's behavioral approaches, the chosen intervention strategies encompass visualization, structured goal setting, and self-monitoring. **RESULTS:** The study emphasizes the role of visualization in enhancing Alyssa's self-efficacy, drawing from Bandura's constructive mental visualization concept. The integration of structured goal-setting and systematic self-monitoring techniques aims to empower Alyssa by offering measurable milestones and intrinsic motivation. **CONCLUSION:** This research underscores the potential effectiveness of behavioral interventions in promoting physical activity among adolescents. Empirical evidence supports their viability, highlighting the importance of consistent implementation for enduring benefits. By enhancing self-efficacy and equipping adolescents with strategies to overcome exercise barriers, this intervention contributes to fostering active lifestyles. Further research is imperative for tailoring interventions to diverse adolescent profiles, catering to their unique needs and preferences.

ASSESSING IMPLICIT AFFECTIVE EVALUATIONS OF EXERCISE WITH THE ACOUSTIC STARTLE EYEBLINK RESPONSE PARADIGM

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Physical inactivity continues to be a significant health epidemic of the 21st century. Physical activity and attitudes about physical activity often rely on self-report measures due to their low cost and ease of dissemination to large populations. However, exercise self-report is susceptible to response bias, tend to have low reliability, and studies often report small effects. In the field of psychophysiology, the acoustic startle eyeblink response (ASER) pattern has been shown to reflect differences in core affective states. Often, the affective stimulus used in studies are visual images, but exercise specific images have never been examined. A novel application of the paradigm would be to examine ASER modulation while viewing various exercise images, which would provide an objective psychophysiological measure of implicit affective responses to exercise.

PURPOSE: Develop a standardized norm-referenced exercise image collection and validate the affective modulation effect of the ASER following one's exercise preferences and attitudes. **METHODS:** The movement of the eyelid was monitored in a contactless manner via infrared reflectance oculography at 1 kHz while 26 participants (14 women; 20.4 ± 3.6 y) viewed monotone silhouette images of cycling, weight lifting, running, and neutral content and 50-ms bursts of white noise were presented binaurally via headphones. Participants rated the images according to their exercise preferences and attitudes. **RESULTS:** Startle responses while viewing congruent exercise images (exercise modalities aligned with their preferences and attitudes) exhibited significantly smaller amplitudes than those while viewing incongruent exercise images ($p < 0.05$), with a medium effect size ($d = 0.52$). **CONCLUSION:** The affective modulation of the eyeblink startle response is a robust phenomenon that can be used to measure implicit affective evaluations of exercise modalities.

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INTRACELLULAR OXYGEN AVAILABILITY DOES NOT LIMIT MUSCLE OXIDATIVE CAPACITY *IN VIVO* IN UNTRAINED YOUNG ADULTS

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Phosphorus magnetic resonance spectroscopy (³¹P MRS) is used to measure intramyocellular phosphocreatine (PCr) recovery kinetics (k_{PCr}) as a measure of the maximal rate of mitochondrial cellular energy production *in vivo*. Valid measurement of muscle oxidative capacity requires that oxygen availability is not limited (i.e., PO₂ >0.35 Torr), but intracellular oxygen content (PO₂) has not been evaluated during these protocols. **PURPOSE:** Determine whether intracellular oxygen availability limits oxidative capacity *in vivo* in untrained young adults. **METHODS:** Twelve young adults (35±3 years, mean±SD; body mass index: 24.6±3.6 kg·m⁻²; moderate-vigorous physical activity: 254±144 min·week⁻¹, 7 female) completed a 24-s knee extensor dynamic contraction protocol (maximal contraction every 2s at 120°·s⁻¹), 10min of recovery, and 8min of cuff ischemia while supine in a 3T MR scanner. Before, during and after the contraction protocol, simultaneous measurements of phosphocreatine (PCr) and deoxygenated myoglobin (dMb, by proton MRS) were acquired from the vastus lateralis muscle and used to calculate muscle oxidative capacity (k_{PCr} , s⁻¹) and PO₂ (Torr), respectively. Oxygen availability was quantified as intracellular PO₂ during the final 4s of contractions, which was calculated from the ratio of dMb during this timepoint to its maximal signal during ischemia and assuming dMb is half-saturated at 2.39 Torr. Pearson's product moment correlation was used to evaluate the linear relationship between PO₂ and k_{PCr} . **RESULTS:** Muscle oxidative capacity (k_{PCr}) averaged 0.0025±0.005 s⁻¹, consistent with the untrained status of these participants. Intracellular PO₂ declined rapidly, reached its nadir at 1.41±0.99 Torr during the final 4s of contractions, and remained greater than 0.35 Torr. PO₂ was not linearly related to k_{PCr} (r=0.452, p=0.140). **CONCLUSION:** These data indicate that, during a 24-s "oxidative capacity" protocol, vastus lateralis muscle PO₂ remains above its critical threshold and thus does not limit k_{PCr} in young, untrained adults. Further, the lack of association between PO₂ and k_{PCr} suggests that oxidative capacity is independent of oxygen availability provided PO₂ remains above the critical threshold for maintaining mitochondrial respiration *in vivo*.

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Wide Pulse High Frequency Neuromuscular Electrical Stimulation Evokes Greater Force in Women than in Men

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Purpose: It is unknown whether Wide Pulse High Frequency (WPHF) Neuromuscular Electrical Stimulation (NMES)-evoked force would differ between sexes. The potential sex-related differences in WPHF NMES evoked force level and induced discomfort in human elbow flexor muscles was studied. **Methods:** Twelve men: age = 23 ± 6 years, height = 178.6 ± 7.4 cm, body mass = 85.5 ± 15.4 kg; ten women: age = 23 ± 3 years, height = 162.2 ± 8.1 cm, body mass = 59.1 ± 5.8 kg) participated in this study. Approximately seven days after the initial visit where familiarization with testing procedures, pain tolerance and, maximum tolerable WPHF NMES intensity was determined, the subjects returned to the laboratory for the experimental visit. Prior to the WPHF NMES and concluding the 10th stimulation, the visual analog scale (VAS) for discomfort and flexion maximal voluntary isometric contractions (MVICs) for the dominant elbow flexor isometric strength was measured. The WPHF NMES was conducted via two 2×2 inch square stimulating electrodes on the proximal belly (cathode) and the distal tendon (anode) of the dominant biceps brachii muscle, using 1ms, 100Hz, square waveform. Ten sets of 10s on 10s off WPHF NMES at maximum tolerable intensities were performed. The NMES-evoked force was averaged and normalized as a percentage of the isometric strength. Discomfort, stimulation amplitude, absolute NMES-evoked force, and relative NMES-evoked force between sexes were compared through independent-samples t-tests. **Results:** There is a significant difference for the discomfort level between sexes (men: 22.4 ± 14.9 mm, women: 39.7 ± 12.7 mm, $p=0.009$). The WPHF NMES stimulation amplitude was significantly greater in men than in women (men: 16.2 ± 6.3 mA, women: 12.0 ± 4.5 mA, $p=0.042$). For the evoked force, no significant sex difference was found for the absolute NMES-evoked force (men: 18.5 ± 12.9 N, women: 25.3 ± 18.2 , $p=0.321$), but greater relative NMES-evoked force was found in women than in men (men: $8.96\pm 6.51\%$, women: $17.08\pm 12.61\%$, $p=0.033$). **Conclusion:** This study showed that even at the maximum tolerable intensity, WPHF NMES evoked larger relative involuntary elbow flexion force in women than in men, with women experiencing more discomfort than men.

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A MINIMAL TRAINING PROTOCOL IMPROVES STRENGTH AND AEROBIC FITNESS IN TRAINED AND UNTRAINED POPULATIONS

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PURPOSE: This study examined the effects of a minimal dose exercise strategy on body composition, strength, and aerobic fitness. **METHODS:** Participants, (6M/3F, (mean±SD), 31±6y, 174±12cm, 82±25kg, 31.8±10.7ml·kg·min⁻¹) Trained (VO₂max >35ml·kg·min⁻¹, 41.2±8.2ml·kg·min⁻¹, 3M/1F, 29±5y, 173±7cm, 68±6kg), and untrained, (24.2±3.8ml·kg·min⁻¹, 3M/2F, 32±7y, 175±15cm, 94±28kg) completed the 12-week intervention with testing at baseline (PRE), 6 weeks (MID), and 12 weeks (POST). Testing included one repetition maximum (RM) and 10RM of resistance exercises (overhead press, (OHP) lat pulldown, leg press, seated row, bench press, and deadlift). We assessed VO₂max, VO₂peak, running economy, vertical jump, and body composition. Participants exercised weekly at one-hour sessions, including interval (5x1min bouts at 105±17% of maximum wattage (Wmax) with 1.5min rest), resistance (one set of 25-30 repetitions to failure at 64±16%1RM), and functional plyometric training (10min of repeating exercises). **RESULTS:** Maximal (1RM) and submaximal (10RM) strength increased (vs. PRE, p<0.05), ≥17.8% and ≥25.7% respectively, at POST for all exercises (Figure 1a). Both trained and untrained increased 1RM and 10RM at POST (vs. PRE, p<0.05), except for trained OHP 1RM, bench press 10RM, and untrained seated row 1RM (Figure 1b). VO₂max increased (vs. PRE, p<0.05) at MID and POST. Untrained VO₂max increased 12% (vs. PRE, p<0.05). Trained VO₂max increased non-significantly (14%, p=0.2, Cohen's d=0.79) with a significant increase in Wmax 9% (vs. PRE, p<0.05). Participants maintained body composition, running economy, VO₂peak, and vertical jump (vs. PRE, p>0.05). Notably, untrained VO₂peak increased 13%, a substantial effect (vs. PRE, p=0.055, Cohen's d=1.37). **CONCLUSION:** This minimal dose intervention, one-tenth of current recommendations, improves strength and cardiovascular performance while preserving power, body composition, and running economy.

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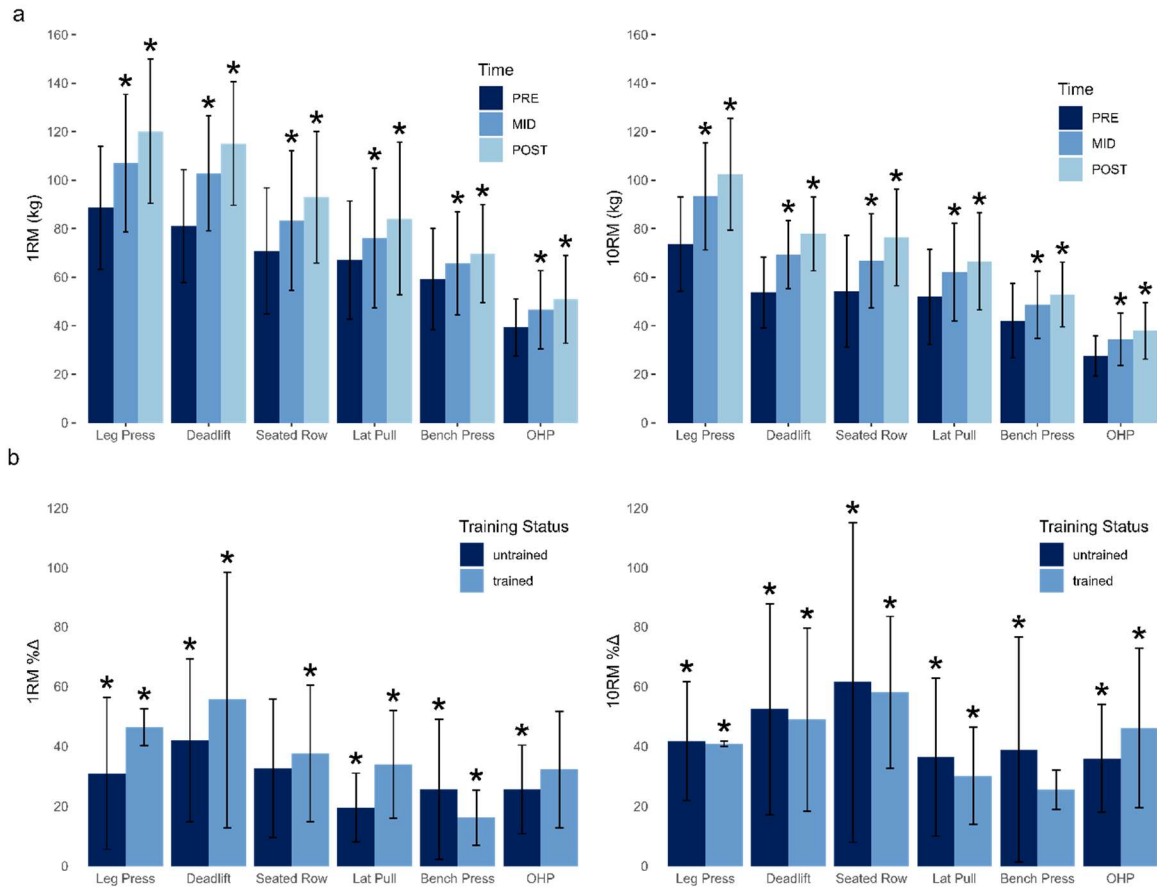


Figure 1.a. A minimal dose training program improves maximal (1RM) and submaximal (10RM) strength. b. Trained individuals exhibited a greater relative increase in strength. *Indicates significance (vs. PRE, $p < 0.05$)

THE ASSOCIATION BETWEEN FOOTEDNESS AND IMPACT ASYMMETRIES DURING RUNNING

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Lower extremity kinetic asymmetries have been identified during running gait. Some studies have identified an association between higher impact and running-related injuries (RRIs). One proposed explanation for bilateral asymmetries during gait is the relationship between gait asymmetry and footedness. Laterality may affect limb coordination leading to impact asymmetries during running, thus potentially influencing the risk of RRIs. **PURPOSE:** The purpose of this study was to investigate the association between footedness and tibial acceleration during running. A secondary purpose was to explore if this relationship differed between treadmill and outdoor running. **METHODS:** Forty-two healthy adult runners (12 females, 30 males; age, 32.07 ± 13.4 years; height, 174.1 ± 8.7 cm; mass, 70.8 ± 14.1 kg) ran 8 km outdoors and on a treadmill at a self-selected speed. VICON iMeasureU Blue Trident dual-g sensors (Low-g 1125 Hz/High-g 1600 Hz) measured peak vertical (PV) and peak resultant (PRES) tibial acceleration continuously over 8 km. The Lateral Preference Inventory, a valid and reliable 15-item questionnaire of laterality, was used to determine foot preference. A linear mixed-effects model was performed separately on PV and PRES as dependent variable. The fixed effects of footedness and location were included while individual participants were modeled as random effects. **RESULTS:** Foot dominance had a significant small association with mean PV (estimate [95% CI] = 2.09 [1.58, 2.60], $p < 0.001$) and mean PRES (estimate [95% CI] = 3.74 [2.93, 4.55], $p < 0.001$) during both outdoor and treadmill running. Right-foot dominant individuals had greater right compared to left PV and PRES both running outdoors and on a treadmill; however, the opposite held true for left-foot dominant individuals, who displayed higher PV and PRES on the right during both conditions. **CONCLUSION:** Our results suggest that the relationship between footedness and impact asymmetries during running could have clinical implications for assessment and management of RRIs associated with loading and that assessment of laterality may be considered as part of the clinical exam of runners; however, the limited sample size warrants further investigation into laterality and impact asymmetries during gait.

RELATIONSHIPS BETWEEN PHYSICAL ACTIVITY INTENSITY AND OSCILLATORY SHEAR INDEX IN HEALTHY PERIMENOPAUSAL PEOPLE

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The risk of Cardiovascular Disease (CVD) increases around the menopausal transition. Endothelial dysfunction, an early indicator of CVD, can be assessed via brachial artery flow mediated dilation (FMD), and is influenced by shear rate (SR). SR is the frictional force exerted by blood flow in the vessel. Oscillatory shear index (OSI) is a net value of blood flow. Higher OSI indicates poorer endothelial health. Habitual physical activity (PA) is known to be beneficial for endothelial health in various populations, yet the role of different PA intensities on OSI in perimenopausal people remains unclear. **PURPOSE:** To determine whether different habitual PA intensities and OSI are related in healthy perimenopausal people. **METHODS:** Forty-two (age=49±3 yrs) perimenopausal participants were included in this analysis. Perimenopause was defined as a change in menstrual cycle length of >7 days than normal up to ≥ 60 days but less than 1 year of amenorrhea. Participants wore an Actigraph PA monitor on the nondominant wrist for 7 days to objectively quantify PA. The R package GGIR was used to process multi-day objective PA with acceleration thresholds of 44.8 for light, 100.6 for moderate, and 428.8 for vigorous PA. Brachial artery dual-mode ultrasonography and tracking software (FMD Studio, Quipu) was used to measure blood flow at rest and FMD. SR was calculated by $SR = (4 \times \text{blood flow velocity}) / \text{diameter}$. Retrograde and antegrade SR were measured at rest from the first two minutes of the FMD test. OSI was calculated as $(\text{retrograde SR}) / (\text{antegrade SR} + \text{retrograde SR})$. Statistical assumptions testing was completely for all variables. Pearson's correlation was used to find relationships between variables. All analyses were completed in Rstudio (version 4.2.1). **RESULTS:** As expected, there was a significant negative correlation between FMD% and OSI ($r = -0.36, p = 0.019$). No significant relation between inactivity, vigorous, or moderate PA and OSI was observed, however there was a significant negative correlation between light activity and OSI ($r = -0.35, p = 0.024$). **CONCLUSION:** These data suggest that light-intensity PA may be important for reducing shear forces and improving endothelial function in perimenopausal people.

PHYSIOLOGICAL CORRELATES OF CYCLOCROSS PERFORMANCE

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Cyclocross is a discipline of cycling that involves racing a circuit over varied road and off-road terrain. The sport is characterized by intermittent changes in intensity as athletes navigate through the technical elements of the course including barriers, off-camber sections, turns, and steep ascents and descents. **PURPOSE:** The purpose of the study was to identify the physiological correlates of performance in cyclocross. **METHODS:** Ten experienced (USAC category 2 or 3) male cyclocross riders participated in the study (age 38.7 ± 4.7 years, mass 75.1 ± 7.7 kg, height 174.9 ± 6.2 cm, body fat $11.5 \pm 2.7\%$). Subjects performed aerobic and anaerobic laboratory tests on non-consecutive days. Aerobic values of VO_2max and OBLA were measured during a graded exercise test on a cycle ergometer. Anaerobic values of peak and mean power were measured during a 30-s Wingate Anaerobic Test. **RESULTS:** VO_2max ($r = -.72, p = .019$) and mean relative anaerobic power (W/kg) ($r = -.72, p = .019$) were significantly linearly related to USAC points obtained. While not statistically significant (all $ps > .05$), peak absolute anaerobic power (W) ($r = -.43$), peak relative anaerobic power (W/kg) ($r = -.52$), and mean absolute anaerobic power (W) ($r = -.46$) demonstrated a moderate strength of relationship. OBLA (W) and OBLA (VO_2) were both statistically non-significant and had weak correlation coefficients. **CONCLUSION:** Maximal measures of performance may be more important considerations for success in cyclocross racing than submaximal measures. Cyclocross requires athletes to sustain repeated explosive efforts with limited periods of recovery. Anaerobic power to perform those efforts and aerobic power to recover quickly are associated with success in the sport.

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RELIABILITY OF EQUIVITAL™ eq02+ LIFEMONITOR FOR MEASUREMENT OF HEART RATE VARIABILITY IN U.S. MILITARY PERSONNEL

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Heart rate variability (HRV) is a popular biometric used in several health and performance related contexts, including the quantification of autonomic cardiac control as part of a cardiovascular risk profile and as a recovery metric for physical readiness. Thus, it is important that the devices used for HRV measurement provide reliable data for the physiological monitoring of modern U.S. military personnel. **PURPOSE:** To determine the reliability of HRV metrics measured with the commercially available Equivital™ eq02+ LifeMonitor in healthy military personnel. **METHODS:** Twenty-two healthy U.S. Army Soldiers and civilians (5 females and 17 males; age: 27±9 y; height: 174±9 cm; body mass: 80.6±16.4 kg) completed two experimental trials (D1 and D2) separated by ≥2 d. Experimental trials occurred at the same start time for a given participant and participants followed the same pre-trial dietary and exercise restrictions. Following 20 min supine rest in a controlled environment (22±1°C, 40±15% relative humidity), HRV was assessed over a 5 min period during spontaneous breathing. Time domain analyses were performed using the standard deviation of R-R intervals (SDNN) to provide an estimate of overall HRV and the square root of the mean of squared differences between consecutive R-R intervals (RMSSD) for assessment of cardiac parasympathetic activity. The reliability of resting heart rate, SDNN, and RMSSD were assessed via intraclass correlation coefficients (ICC). **RESULTS:** Resting heart rate (60±7 vs. 62±8 bpm, P=0.003) was lower on D2 compared to D1 (60±7 vs. 62±8 bpm, P=0.003). SDNN did not differ between days (D2: 109±45; D1: 102±41 ms, P=0.323), but RMSSD was higher on D2 compared to D1 (98±46 vs. 83±44 ms, P=0.006). Resting heart rate (ICC=0.929) and RMSSD (ICC=0.930) demonstrated excellent reliability, whereas SDNN had good reliability (ICC=0.857). **CONCLUSION:** The Equivital™ eq02+ LifeMonitor has excellent reliability for assessing HRV in healthy, young adults as derived via RMSSD when standardizing dietary and exercise restrictions prior to measurement. These findings also highlight the importance of familiarization sessions when employing these devices in the field, given that resting heart rate and RMSSD differed between the two experimental visits.

The views expressed in this abstract are those of the authors and do not reflect the official policy of the U.S. Government, Department of Energy, Department of the Army, or Department of Defense.

DOES DOG OWNERSHIP IMPACT OLDER ADULT PHYSICAL ACTIVITY, BRAIN AND COGNITIVE HEALTH?

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Physical activity and social interactions resulting from dog ownership and dog walking may benefit older adults' brain health and reduce dementia risk. However, the relationship between pet ownership and brain-level indicators of dementia risk in older adults, including brain structure and function, remains unknown. **PURPOSES:** The purposes of this study were to pilot methods for examining behavioral risk factors (physical activity and social interaction) for dementia, as well as to determine differences in cognitive function and brain health (structure and function) in older adult dog owners compared to non-dog owners. **METHODS:** Older adult participants (n=25; age 75[4] years; 60% female) completed two study visits, consisting of the National Institute of Health (NIH) Toolkit Cognitive Battery and a 45-minute MRI brain scan that included structural brain imaging. The primary cognitive outcome was the fluid composite score from the NIH Toolkit. Participants also wore an activPAL physical activity monitor (24 hrs/d) and logged all dog walking for 7 days. **RESULTS:** Non-dog-owner and dog-owner mean(SD) step counts were 7106.8(2989.5) steps/day and 8972.2(5650.3) steps/day, respectively. Dog owners took an average of 1865 steps/day more than non-dog-owners. 10/11 dog walkers reported having gotten to know people in their neighborhood as a result of their dog. Of those, 9/10 said they regarded someone they had met through their dog as a friend, and 9/10 received one or more types of social support through someone they had met through their dog. The fluid cognition composite scores for dog owners and non-dog owners were 55.6(8.8) and 58.0(7.1), respectively. There were no group differences in gray matter volume, white matter volume, left or right hippocampal volume, and left or right cortical thickness, when controlling for age, sex, education and total intracranial volume. **CONCLUSIONS:** This pilot study demonstrated the feasibility of these study methods, and will inform a larger, fully-powered study. If our hypotheses are supported, this research could inform dementia prevention programs and policies that leverage the human-dog bond, such as supporting dog ownership in older adulthood or developing behavioral and environmental programs that support dog walking.

EFFECTS OF FAR-INFRARED RADIATION THERAPY ON RECOVERY AFTER A SIMULATED SOCCER-MATCH IN FEMALE SOCCER PLAYERS

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Our recent study showed that the 30-minute far-infrared radiation (FIR) lamp therapy on both bilateral knee extensors (KE) and flexors (KF) provided potent effects on reducing accumulated muscle damage and enhancing recovery from a 90-minute Loughborough intermittent shuttle test (LIST) performed over six consecutive days (Hsieh et al. *Int J Sport Physiol Perform* 2022). However, it is not known how the recovery after a single soccer match is affected by the FIR lamp therapy. Because soccer players normally play one match per week during a playing season, it is important to examine whether the FIR lamp therapy facilitates the recovery from a single soccer match.

PURPOSE: This study investigated the effects of a FIR lamp therapy on recovery of muscle damage and performance parameters after a LIST, which represents simulated soccer-match-related running activities.

METHODS: Twenty-four elite female soccer players (20-24 y) were assigned into FIR or sham treatment group (n=12/group). They performed a 90-minute LIST, and received a 30-minute FIR or sham treatment over KE and KF, respectively, at 2, 25, 49, 73 and 97 hours post-LIST. Maximal voluntary contraction (MVC) torque and muscle soreness of the KE and KF, plasma creatine kinase (CK) activity and several performance measures (e.g., countermovement jump: CMJ, Yo-Yo intermittent recovery test level 1: YYIR1) were measured before and 1, 24, 48, 72, 96 and 120 hours post-LIST. Changes in the measures were compared between groups by a mixed-design of two-way ANOVA.

RESULTS: The running distance covered during LIST and changes in the measures at 1-hour post-LIST were similar ($P>0.05$) between groups. Changes in MVC torque, muscle soreness and plasma CK activity at 24-120 hours post-LIST were smaller ($P<0.05$) for the FIR (e.g., MVC-KE torque decrease at 48 hours post-LIST: $-1\pm 2\%$, peak CK: 172 ± 42 IU/L) than sham group ($-11\pm 9\%$, 466 ± 220 IU/L). Performance measures recovered faster ($P<0.05$) to the baseline for the FIR (e.g., YYIRT: $0\pm 1\%$) than sham group ($-9\pm 6\%$).

CONCLUSIONS: These results suggest that the FIR therapy enhances recovery from a soccer match. Future studies are required to examine the mechanisms of FIR enhancement of recovery from a soccer match.

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WITHIN-DAY MEAL PATTERNING: IMPACTS ON REPRODUCTIVE AND METABOLIC HORMONAL STATUS AND PERFORMANCE

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A focus of female athlete research has been on 24-hour accumulated energy balance and reproductive cyclicality. Recently, within-day meal patterning has revealed a more sophisticated dynamic of energy and hormone interaction. **PURPOSE:** The purpose of this study was to identify the potential effects of meal patterning, including backload on reproductive cycle status and performance. **METHODS:** Two female junior elite caliber swimmers (16.8 and 15.6y) were assessed for (a) reproductive hormone levels (estradiol, progesterone), (b) bioenergetic parameters (energy intake [EI], energy expenditure [EE], energy balance [EB] resting metabolic rate [RMR]), (c) metabolic hormones (triiodothyronine [TT3], insulin-like growth factor 1 [IGF-1]), and (d) performance (400-m time trial). The athletes were tracked over 20 weeks which included one full season and a part of the next season. Backload was calculated as the percent of calories consumed after 6pm (Vescovi and VanHeest, 2016). Blood (following an overnight fast), RMR, and swim performance was assessed every two weeks. Dietary and activity records were completed by the athletes daily. Energy expenditure was calculated by the researchers from activity logs and training activities. **RESULTS:** The athletes exhibited transitions between ovarian suppression and normal cycling across the 20-weeks. Cycling of E2 and P4 ceased in both individuals after caloric backload increased over 70%. Hormonal cycling resumed at week 14 (between seasons), where training was reduced, and caloric backload was less than 60%. Additionally, when caloric backload had increased over 60%, swim velocity fell by 10-15% compared to the starting velocity. **CONCLUSION:** Junior elite female swimmers are capable of influencing reproductive hormone status via changes in bioenergetic dynamics. Within-day meal timing is a critical factor to consider when optimizing athletic performance and maintaining health. Long-term fasting coupled with increased backloading, results in decreased reproductive hormone values, metabolic hormone values, and sport performance. While it is unlikely that caloric backload is the sole explanation for ovarian suppression and subsequent resumption of menstrual hormone cycling, within-day caloric intake should be further investigated in competitive athletes.

HEALTH PERCEPTIONS OF NCAA CROSS COUNTRY AND TRACK AND FIELD STUDENT-ATHLETES

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Numerous studies have emphasized research dedicated to endurance athletes as the population of interest regarding body image and eating behavior, resulting in lack of empirical insight into track and field athletes who compete in other events or who do not identify as female. **PURPOSE:** The purpose of the study was to examine factors that may contribute to disordered eating in men and women collegiate track and field athletes. **METHODS:** 73 current NCAA track and field student-athletes (44 males and 29 females) completed an online questionnaire containing nine sub-surveys related to perception of body image and eating behaviors. **RESULTS:** The results showed a significant multivariate main effect of sex ($p < 0.05$) and event group ($p = 0.034$) with a non-significant interaction ($p = 0.189$). There were significant main effects of sex on the SATAQ-4 media subscale ($p < 0.05$), the Body Checking Questionnaire ($p < 0.05$), and the EAT-26 ($p = 0.046$), showing that female track athletes scored significantly higher on these measures than male track and field athletes, regardless of the event type. Significant main effects for the SATAQ-4 family subscale ($p = 0.010$), the BCQ ($p = 0.024$), the mBCQ ($p = 0.022$), and the Body Weighing Frequency and Attitudes section ($p = 0.034$) were found in throwers, resulting in reporting of higher pressures from these measures compared to other events, namely middle-distance athletes, regardless of gender. **CONCLUSION:** Overall, these findings suggested that female track and field athletes, regardless of event type, reported higher levels of internalizing body image from media, body checking behaviors, and disordered eating compared to male athletes. Throwers, regardless of gender, reported higher levels of internalization of body image from family, body checking behaviors, and weighing frequency and attitudes compared to other events, specifically middle distance. The findings may help inform athletic trainers, team physicians, and dietitians on screening practices to identify and track the key factors associated with disordered eating with collegiate track and field athletes, thereby enabling early intervention before the development of severe disordered eating behaviors or a diagnosable eating disorder.

COMPARISON OF BONE DENSITY IN COLLEGE MALE AND FEMALE ICE HOCKEY PLAYERS THROUGHOUT A SEASON

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Bone Mineral Density (BMD) is an important health indicator of one's bone health. Weight bearing activities are associated with an increase in BMD, though a reduction in BMD has been observed during a season in male basketball players (Klesges, et al, 1996). **PURPOSE:** To assess changes in BMD in male and female hockey players throughout their season.

METHODS: Collegiate female and male hockey players were recruited. Each subject was DXA scanned (GE Prodigy) for BMD and Bone Mineral Content (BMC), along with Body Mass (BM), Region % Fat (R%F), Fat Mass (FM), Lean Body Mass (LBM), LBM/FM Ratio, LBM/BMC Ratio, and Body Mass Index (BMI). Comparisons were made between pre and post season using a 2-way ANOVA (sex by test: pre and post season). Stepwise linear regression was used to determine what variables best correlated with BMD. **RESULTS:** 19 females and 25 males participated (Females age 20.44 ± 1.25 y, Males age 22.08 ± 1.15 y). No differences were observed pre to post season for males and females for BMD, BMC, BMI, BM, R%F, FM, LBM, LBM/FM Ratio, and LBM/BMC Ratio. A difference among the female players was observed (pre to post) in BMC and the LBM/BMC Ratio (BMC 5.54 ± 0.63 vs 5.37 ± 0.81 $p < .013$, LM/BMC 17.90 ± 1.17 vs 18.44 ± 1.40 $p < .009$). Difference between the two sexes were observed in all variables, excluding BMI. LBM was the best predictor for BMD for both pre and post measurements; (R=.834; R Square=.696; Adjusted R Square .688: $p < .001$, and R=.820; R Square=.672; Adjusted R Square .664: $p < .001$), respectively. **CONCLUSION:** There were no differences through-out the season except for a reduction in BMC and increase in LM/BMC in females. The increase in BMD in males is supported by past research and suggested to be related to an increase in testosterone, which has a positive relationship to LBM (Nieves, et al, 2009). This further supports the need for females to maximize their BMD during the period of peak growth.

COMMERCIALLY AVAILABLE WEARABLE MOTION SENSORS VERSUS OPTICAL MOTION CAPTURE: ARE WEARABLE MOTION SENSORS EQUIVALENT TO THE ‘GOLD-STANDARD’ MEASURING KNEE RANGE OF MOTION BEFORE AND AFTER TKA?

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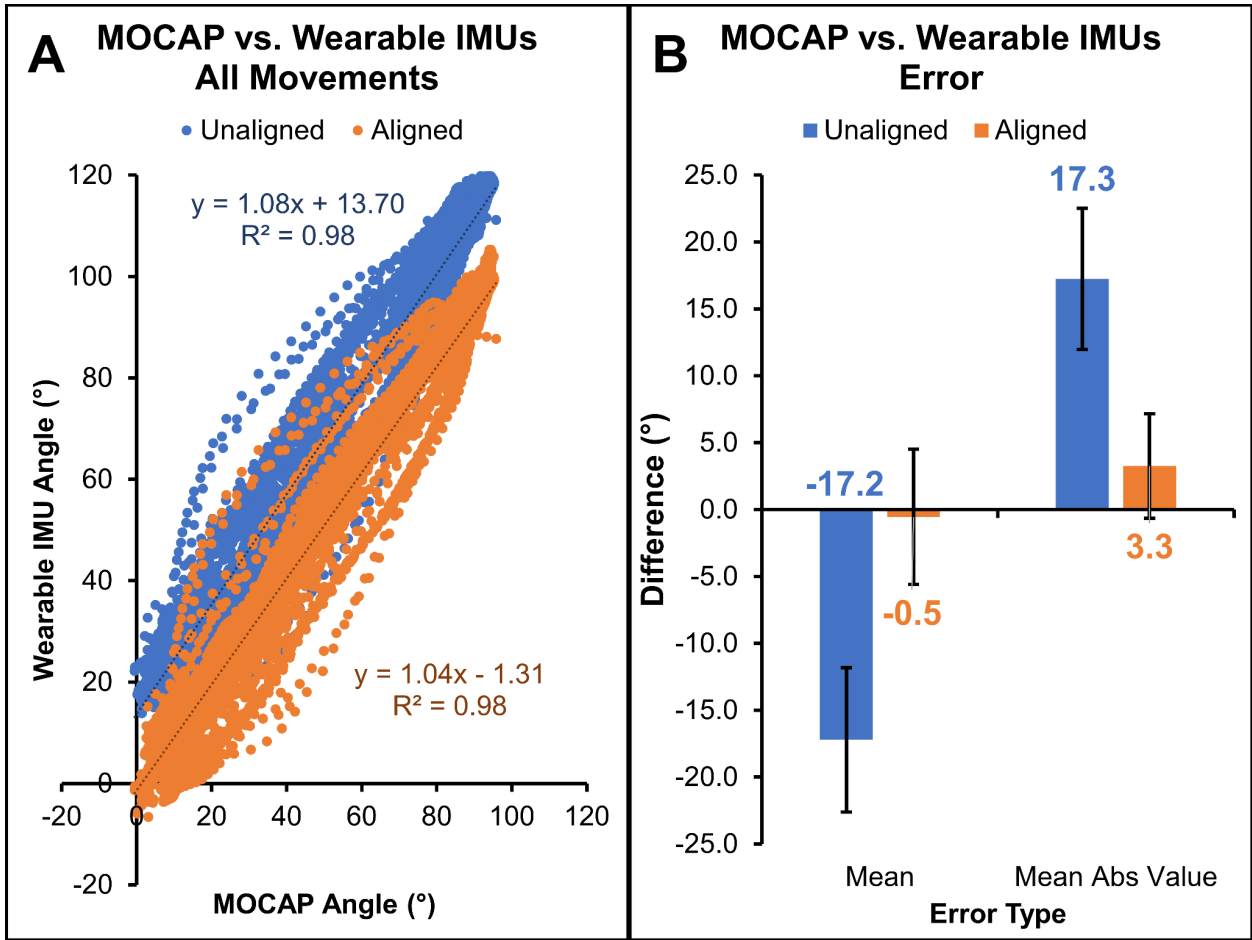
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Disclosures: S. Khodabakhsh (6 – Stryker), R. Marchand (2, 3B, 4, 5 – Stryker), R. Chapman (5, 6 – Stryker; 5 – RI Research Foundation; 6 – Nike)

INTRODUCTION: Around 800,000 total knee arthroplasty (TKA) procedures are conducted each year in the United States. Post-TKA, achieving optimal knee range of motion (ROM) is critical. While goniometry is often used to measure ROM clinically, it does not fully capture patients' daily-life challenges. Wearable inertial measurement unit (IMU) sensors could enhance real-world ROM assessment, but their accuracy and user applicability need further study.

PURPOSE: The present study had two specific aims: 1) To evaluate the precision of wearable sensors before/after TKA and 2) To investigate the reliability of sensor placement performed by patients. **METHODS:** Following IRB approval, we conducted an analysis of sagittal knee angles in 20 patients (10M, 67.7±7.4yrs, BMI=32.0±7.1) who underwent TKA. We compared wearable inertial measurement unit (IMU) sensors and optical motion capture (MOCAP) technology quantifying sagittal knee ROM during activities of daily living (ADLs). Patients independently placed sensors on the thigh/shank before and after TKA. MOCAP markers were then applied to their lower extremities and data were captured during diverse activities. If wearable sensor data were not properly aligned to the leg (‘unaligned’), data were mathematically corrected post-hoc (‘aligned’). Data was examined to determine the relationship between MOCAP and IMU readings. **RESULTS:** Wearable IMU data accuracy were consistent pre/post-TKA. Comparing IMU-based knee angles to MOCAP showed unaligned sensors had significant, strong correlations ($R^2=0.98$) but 13.7° knee flexion error. This error reduced to 1.3° when aligned to the leg mathematically (Figure 1). **CONCLUSION:** Wearable sensors provide valuable insights outside the clinic. However, the accuracy of these results varies depending on the patient's application. When the sensors were properly aligned, the error was <3.5°. Incorrect sensor self-application caused >15° errors. Therefore, proper training and sensor-to-leg alignment are essential for precise knee angle readings.



ASSESSING H:Q RATIOS DURING MUSCULAR FATIGUE IN FEMALE COLLEGIATE ATHLETES

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The hamstrings to quadriceps (H:Q) ratio describes the strength relationship between the two opposing muscle groups. While it varies at different speeds, an H:Q ratio of 0.75 at $180^\circ \cdot s^{-1}$ is considered normal and low risk of injury. The quadriceps and hamstrings may fatigue at different rates and therefore could cause the H:Q ratio to deviate from the norm. **PURPOSE:** The aim of this study was to investigate the change in H:Q ratio during an isokinetic fatigue protocol in female collegiate athletes. **METHODS:** Fourteen Division I female basketball ($n=4$) and volleyball ($n=10$) players (age= 20.0 ± 1.2 yrs; mass= 74.9 ± 8.4 kg; height= 1.77 ± 0.06 m) participated in a familiarization and a testing session. Maximum Voluntary Isometric Contraction (MVIC) during knee extension (KE) and knee flexion (KF) on the dominant leg were assessed pre and post fatigue protocol to quantify fatigue. The fatigue protocol consisted of five sets of 30 isokinetic ($180^\circ \cdot s^{-1}$) KE and KF repetitions at maximal effort on the Humac Norm Cybex dynamometer with 30s of rest between sets. MVIC and H:Q ratio data was analyzed with repeated measures analysis of variance. **RESULTS:** KE and KF MVIC significantly decreased from pre to post fatigue test $30 \pm 16\%$ and $26 \pm 13\%$, respectively ($P < 0.001$), but the magnitude of difference in fatigue between the muscle groups were not significantly different ($P = 0.27$). The average H:Q ratio at $180^\circ \cdot s^{-1}$ at the beginning of Set 1 was $0.74 \pm .08$ and by the end of Sets 1-5, it significantly increased to $0.91 \pm .13$, $1.08 \pm .21$, $1.03 \pm .22$, $1.06 \pm .30$ and $1.03 \pm .26$, respectively ($P = < 0.001$). The H:Q ratio after the 30s rest period at the beginning of each set also did not return to baseline values as Sets 2-5 had average pre H:Q ratios of $0.82 \pm .12$, $0.86 \pm .17$, $0.87 \pm .16$, and $0.88 \pm .17$, respectively ($P < 0.001$). **CONCLUSION:** In female Division I athletes, H:Q ratios increase above normal values indicating that the torque produced from the quadriceps, may be impacted to a greater extent than the hamstrings as fatigue ensues. This could possibly put female athletes at risk of injury when playing in a fatigued state. Further, this altered H:Q ratio does not return to baseline values even after short rest periods that mimic game playing.

PILOT STUDY: RELIABILITY OF MEASURING TAPE AS AN ASSESSMENT TOOL IN THE OBER'S TEST

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Ilio-tibial band flexibility is traditionally assessed with the Ober's Test, using a handheld goniometer or inclinometer. As an alternative, measuring tape is often used for this purpose in clinical settings, but there is currently no evidence to support its reliability. **PURPOSE:** The purpose of this study was to assess the inter-rater and test-retest reliability of measuring tape as a means of assessing the Ober's Test and ilio-tibial band flexibility. **METHODS:** A board-certified Athletic Trainer conducted two Ober's Tests on 26 healthy adults, 30 minutes apart, and two separate board-certified Athletic trainers (AT1, AT2) collected measurements of the test using measuring tape, measuring from the medial joint line of the patella to the training table. AT1 and AT 2 were blinded to each other's results. Test-retest and inter-rater reliability were assessed. **RESULTS:** Ober's Test measurements were 24.8 ± 5 cm for AT1, and 26.3 ± 3.7 cm for AT2. Test-retest reliability for the measuring tape assessment was .85 for AT1, and .55 for AT2, suggesting moderate to good test-retest reliability. Inter-rater reliability between the two Athletic Trainers was .61, suggesting moderate reliability. **CONCLUSION:** These preliminary findings suggest that measuring tape can be used to assess the Ober's Test with moderate to good reliability, but further research is needed to determine whether it can be used with a comparable level of reliability as a goniometer or inclinometer.

A DEVELOPMENTAL MODEL STUDYING BLOOD GLUCOSE VARIABILITY WHEN ACTIVE YOUNG ADULTS ASSUME AN OBESOGENIC LIFESTYLE

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The U.S. young adult population commonly regresses into a sedentary lifestyle (<5,000 steps/day) upon entering the workforce with added sugar consumption. These lifestyle factors lead young adults toward impaired glucose regulation and cardiometabolic disease risk. Limited ecologically relevant models have been developed to assess this transition. **PURPOSE:** This study aimed to determine if transitioning young adults to an obesogenic lifestyle model (OLM; ~5,000 steps/day + ~180 grams of sugar-sweetened beverage consumption) increases insulin resistance after 10 days. **METHODS:** Ten recreationally active men (age: 21±1 years; BMI: 25.4±1.3 kg·m⁻²; VO_{2peak}: 44.0±5.3 ml·kg⁻¹·min⁻¹) were randomized into three groups: Active control (*n*=3), sedentary control (*n*=3; <5,000 steps·day⁻¹), and OLM (*n*=4). 24h Continuous glucose monitors (CGMs) measured 24h mean glucose and blood glucose control via blood glucose variability (BGV) measures over the 10-day intervention period. BGV was measured using the standard deviation of 24h glucose, the 24h coefficient of variation, and the mean amplitude of glycemic excursions (MAGE). Physical activity accelerometers measured daily step counts throughout the 10-day intervention. Plasma insulin was measured using immunoassay electrochemiluminescence analysis, and the change in homeostatic model assessment 2 (HOMA2IR) was calculated as a measure of insulin resistance. **RESULTS:** OLM and sedentary interventions had significantly reduced step counts compared to the active group (OLM= 6,142±2,725 steps/day, Sedentary= 4,709±1,754 steps/day, Active= 13,211±6,318 steps/day, respectively; *p*<0.05). The OLM increased 24h mean glucose (OLM=7.35±0.34 mmol/L, Sedentary= 7.1±0.4 mmol/L, Active= 6.44±0.16 mmol/L). However, additional data is needed to determine whether the OLM increases blood glucose variability measures such as standard deviation of 24h glucose (OLM= 0.97±0.25 mmol/L, Sedentary= 0.86±0.12 mmol/L, Active= 0.72±0.09 mmol/L; *p*=0.245), coefficient of variation (OLM= 13.13±2.69 %, Sedentary= 12.3±2.5 %, Active= 11.11±1.15 %, *p*=0.549) and MAGE (OLM= 2.56±0.68 mmol/L, Sedentary= 2.3± 0.7 mmol/L, Active= 1.74±0.36, *p*=270). Our preliminary results hint that our OLM intervention may provide an acute increase ΔHOMA2IR (OLM= 0.73±0.8 mmol/L, Sedentary= 0.40±0.40 mmol/L, Active= 0.12±0.26 mmol/L, *p*=0.439). **CONCLUSION:** In a small sample, we report that a 10-day OLM intervention significantly increases 24h mean blood glucose. However, more data is needed to determine whether our OLM can induce increased BGV and insulin resistance in healthy young adults.

AUGMENTED REALITY FOR ADVANCED PROSTHETIC TRAINING IN NON-AMPUTEES

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Prosthetic abandonment is highly prevalent among upper extremity amputees and can be attributed in part due to the monotonous prosthesis training methods and techniques. Advanced technologies such as virtual, mixed, and augmented reality systems are being used as a tool for rehabilitative purposes and offer many advantages compared to conventional therapies. In particular, augmented reality combines real and virtual world aspects to create stimulating, goal-oriented experiences in which users feel immersed while simultaneously improving their motor learning. **PURPOSE:** The purpose of this study was to assess the effectiveness of a novel augmented reality prosthetic training game, *ARm-Strong*, in able-bodied individuals using a bypass prosthesis. **METHODS:** Thirty-two able-bodied participants (sixteen received *ARm-Strong* training=AR-INT; and sixteen received no training=CON), were introduced to a bypass body-powered prosthetic device. Participants in the CON group were tested during two visits (8-12 days apart) to perform the Jebsen Hand Function Test (JHFT) using the bypass prosthesis. The AR-INT attended three sessions (4-6 days apart), in which they also completed pre- and post-assessments of the JHFT, and engaged in the AR training game, *ARm-Strong*, on each of the three visits. The AR-INT group participants also completed the validated 21-item Augmented Reality Immersion questionnaire to evaluate their levels of engagement, engrossment, and immersion after using the *ARm-Strong* game. **RESULTS:** There was a moderate correlation in the AR-INT group between time to complete the *ARm-Strong* game and time to complete the JHFT ($r_s(13) = 0.514$, $p < 0.05$). Individuals in the AR-INT group felt positive feelings of engagement, engrossment, and immersion towards the *ARm-Strong* game, although the impression of immersion was significantly less than that of engagement (5.68 ± 0.74 vs. 4.75 ± 1.27 , $p = 0.002$) and engrossment (5.47 ± 0.95 vs. 4.75 ± 1.27 , $p = 0.005$). **CONCLUSIONS:** Results demonstrate that AR training is an engaging and motivating experience and improves function in activities of daily living for individuals learning to operate a prosthesis. Future implications from the results of this study may benefit prosthesis users by enhancing user experience during prosthetic training and ultimately lead to better rehabilitation and overall adherence to the use of a prosthetic device.

Effect of Post Activation Potentiation on Jump Performance in Division III Athletes

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Post activation potentiation (PAP) refers to an acute improvement of contractility following a maximal skeletal muscle contraction due to an increase in crossbridge formation. Plyometric exercises may be improved utilizing PAP protocols in training. **PURPOSE:** The purpose of the study was to determine the effect of PAP on counter movement jump (CMJ) following a dynamic (DYN) versus an isometric back squat (ISO). **METHODS:** 10 male and female Division III athletes participated in the study (Age: 20.2 ± 1.1 yrs, Height: $172.9 \text{cm} \pm 6.9 \text{cm}$, Weight: $79.1 \text{kg} \pm 13.1 \text{kg}$, Body Fat: $22.9 \pm 6.2\%$, 3RM: $95.2 \pm 31.2 \text{kg}$). Subjects completed a baseline visit which consisted of a three-repetition maximum back squat (3RM). Subjects then performed two experimental visits, a DYN and an ISO back squat. Following each intervention, subjects completed CMJ trials at 4, 6, 8 min rest intervals. **RESULTS:** CMJ at the 6min interval was significantly less in the DYN trial ($4,573 \pm 832 \text{W}$) compared to the ISO trial ($4,656 \pm 856.4 \text{W}$, $p < 0.05$). **CONCLUSION:** The study provides evidence that subjects were able to better maintain their CMJ following ISO rather than DYN due to less fatigue. This could allow strength and conditioning coaches to complete more work without additional fatigue.

THE ACUTE EFFECTS OF FOAM ROLLING ON HAMSTRING MUSCLE STIFFNESS

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BACKGROUND: Elevated hamstring stiffness (K) or large intramuscular variation in K is believed to increase athletes' risk of experiencing a hamstring strain injury. Therefore, athletes at risk for hamstring strain injuries may benefit from warm-up activities that reduce muscle stiffness and increase K homogeneity. **PURPOSE:** To compare the effects of performing a warm-up with and without foam rolling (FR) on K . **METHODS:** Twenty-one healthy participants completed this study. Each participant performed 5 min of bilateral stationary cycling (0.5 kP at 60 rpm) followed by five sets of unilateral FR with 1 min duration of 30 seconds between sets. Before the warm-up and every 15 min following the intervention over a 2-hour observation stiffness of the biceps femoris (K_{BF}) and semimembranosus (K_{SM}) at 25%, 50%, and 75% muscle length was measured using shear-wave elastography. Changes over time were compared between the FR leg and the contralateral leg which served as a control (CON) using 2x7 (condition x time) repeated measures ANOVA with Bonferroni post-hoc test.

RESULTS: After the completion of the warm-up K_{BF} and K_{SM} decreased in the proximal and middle regions ($p < 0.05$) but not in the distal region (BF: $p = 0.117$, SM: $p = 0.080$). However, no differences in K_{BF} or K_{SM} were observed between conditions over time in either muscle ($p > 0.05$). Additionally, post-hoc analysis found no differences at specific time-points except for proximal K_{SM} which was lower in FR leg than CON (FR: 1.77 ± 0.16 m/s, CON: 1.94 ± 0.29 m/s, $p = 0.045$, Cohen's $d = 0.56$). **CONCLUSION:** The warm-up was effective at decreasing muscle stiffness in the proximal and middle muscular regions, but not the distal region. However, these effects were similar between legs with the exception of proximal K_{SM} 120 min post warm-up. As such FR appeared to minimally effect passive stiffness of the leg that was rolled.

VALIDITY OF A MAXIMAL HEART RATE DURING AN INTERMITTENT CYCLE TEST: A PILOT STUDY

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PURPOSE: The purpose of this study was to validate a cycle ergometer field test capable of eliciting a maximal heart rate (HR_{max}) that can be completed independently in a fitness setting.

METHODS: Seventeen participants (F=14, M=3), aged 20 to 21 years completed the incremental and intermittent field (experimental) test in a random order with an average 6.88 ± 1.80 days between them. During each test the subjects pedaled at 60 repetitions per minute (rpm) wearing the Polar H10 tracking heart rate (HR). Expired gasses were measured by the Parvo metabolic cart. During the incremental test VO_2 max criteria was evaluated. During the gold standard incremental test, subjects started at 50 watts and every two minutes there was a 25-watt increase; subjects continued this for as long as they could while pedaling at 60 rpm.

Requirements to meet VO_2 max were: 90% of predicted HR_{max} , Respiratory Exchange Ratio > 1.15, and a VO_2 plateau of 150ml O_2 during the last two stages of the test. During the intermittent field test, the Rating of Perceived Exertion (RPE) 6-20 scale was used to determine effort. The intermittent field test started with a three-minute warm up (RPE: 8-9), then a three-minute intense period (RPE: 13-14), then a two-minute easy period (RPE: 8-9). The previous two phases were repeated for a three-minute intense period (RPE: 13-14), then a two-minute easy period (RPE: 8-9). The final phase was two minutes of maximal effort (RPE: >17). Descriptive statistics were assessed for all variables. Differences between HR maximums were compared using paired t-tests. **RESULTS:** On average there was a 2.3 bpm (± 10.5) higher HR in the incremental test but no statistically significant differences. VO_2 max criteria were met by 76.5% of the participants. **CONCLUSION:** There were no significant differences between HR_{max} values between the tests suggesting the intermittent cycle test can be a valid method to assess HR_{max} . In workout classes such as Orange Theory where points are given when participants are in the target HR zone, this intermittent cycle test could easily be conducted to ensure that participants have an accurate maximum HR and goal HR zone.

WHAT IS THE RELATIONSHIP BETWEEN BODY IMAGE, EATING BEHAVIORS, AND INJURY IN DANCERS?

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Dancers are inundated with the image of the ‘ideal dance body’ from an early age (Langdon & Petracca, 2010). This image, often reinforced throughout dancers’ training can result in emotional distress surrounding one’s body image and behavior modification in the form of dietary restriction and excessive exercise (Eufrazio et al., 2021). An inappropriate reduction in caloric intake and high energy expenditure can lead to low energy availability (LEA) (Jagim et al., 2022). Over time, LEA can result in challenges to both health and performance, such as fatigue, physiologic dysfunction, and injury. **PURPOSE:** The research examined the relationships between body image, eating behaviors, and injury in collegiate dancers. **METHODS:** Online questionnaires, including the Eating Attitudes Test (EAT-26) and Body Shape Questionnaire v. 16 (BSQ-16) were administered to collegiate dancers attending a four-year college or university in the United States. Descriptive and inferential statistics were used to analyze the results. A Pearson Product Moment Correlation was used to examine the relationship between variables. All methods were approved by the IRB. **RESULTS:** A strong, significant, direct relationship ($r = .711$, $p < .05$) exists between eating behaviors and body image. No significant relationships were found between eating behaviors nor body image with recurrent injury, severity of injury, nor total injury. **CONCLUSION:** While collegiate dancers reported a wide range of attitudes regarding eating behaviors and body image, those who reported higher EAT-26 scores also reported higher BSQ-16 scores, indicating those with disordered eating behaviors also experience heightened concerns with their body image and vice versa. Ultimately, drawing attention to the parallels associated with body image and disordered eating behaviors within the dance community provides dancers, teachers, and sports medicine professionals with an awareness of the impact dance culture can create on mental and physical well-being in dancers.

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EXAMINING THE RELATION BETWEEN BODY COMPOSITION AND SUBSTRATE UTILIZATION FOLLOWING REDUCED EXERTION HIGH-INTENSITY INTERVAL TRAINING

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Compared to aged-matched women, men are at a greater risk for developing cardiometabolic disease, especially among middle-aged men who often cite lack of time as a barrier to exercise. Reduced exertion high-intensity interval training (REHIT) was introduced as a time-efficient approach to improve blood glucose and potentially attenuate disease onset. Although, it is unknown whether substrate metabolism is influenced by body composition (percent body fat and lean body weight) during and after a single bout of REHIT. **PURPOSE:** This study aimed to examine the influence of body composition on substrate utilization during and after a single bout of REHIT in recreationally active middle-aged men. **METHODS:** Seventeen recreationally active middle-aged men (Age: 51 ± 8 years; percent body fat: $17.9 \pm 5.2\%$; lean body weight: 143.6 ± 14.2 lbs; VO_{2max} : 44.2 ± 5.9 mL·kg⁻¹·min⁻¹; fasting blood glucose: 97 ± 7 mg·dL⁻¹) completed this study. Participants completed a control day (CON; 10 minutes quiet rest) and a REHIT day (10 minutes of unloaded cycling interspersed with two 20-second all-out sprints), each followed by 30 minutes of quiet rest and separated by at least 48 hours. Indirect calorimetry was performed to measure substrate utilization (fat oxidation, FatOx; carbohydrate oxidation, CHO Ox) and energy expenditure (EE) during the intervention and 30 minutes of excess post-exercise oxygen consumption. **RESULTS:** We observed a significant negative relationship between FatOx (mean= 2.5 ± 0.5 grams) and body fat percentage ($r = -0.558$; $p < 0.05$), CHO Ox (mean= 33.9 ± 7.8 grams) and body fat percentage ($r = -0.499$; $p < 0.05$), and EE (mean= 111.0 ± 15.6 kcal) and body fat percentage ($r = -0.681$; $p < 0.01$). No significance was observed between FatOx and lean body weight ($r = 0.329$; $p = 0.20$), although we observed a positive relationship between CHO Ox and lean body weight ($r = 0.490$; $p < 0.05$), and EE and lean body weight ($r = 0.773$; $p < 0.01$). **CONCLUSION:** Our findings suggest that recreationally active middle-aged men with lower levels of percent body fat utilize more fat and carbohydrates during and 30 minutes after a single bout of REHIT, ultimately leading to greater energy expenditure. However, lean body weight does not correlate with fat oxidation following REHIT exercise.

IRONMAN® TRIATHLON-RELATED FATALITIES FROM 2017-2022: A CASE SERIES

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In the sport of triathlon, the isolated and combined effects of swimming, biking, and running present extreme physiological stress and occasionally, these stressors overwhelm the human body resulting in death. Research suggests the average incidence-rate of triathlon-related deaths is 1.5 per 100,000 participants. Though the overall incidence rate of triathlon-related fatalities has been reported, few have identified trends among incidence rate and other factors including age, sex, portion of race, region, occupation, and cause of death. **PURPOSE:** To identify demographic and race day specific trends among Ironman® 70.3 triathlon-related fatalities from 2017 to 2022. **METHODS:** Data specific to triathlon-related fatalities between January 1st, 2017, and December 31st, 2022, were collected via NexusUni and other published news articles. Demographics such as age, sex, occupation, cause of death, and race day specifics including region of race, portion of race, and ambient temperature were extracted and descriptive statistics were analyzed. Total participation among triathlons were recorded from Ironman 70.3 Triathlons from 2017-2022 to calculate incidence rates per 100,000 participants. **RESULTS:** From 2017 to 2022, 16 Ironman 70.3 triathlon-related deaths (mean±SD; age 48±8) were recorded. The overall incidence rate was 17.0 per 100,000 finishers. Of fatalities, 68.75% were male and 87.5% occurred during the swim portion of the race. The largest causes of death were heart attack (25%) and drowning (25%). The mean ambient air temperature of the races with fatalities was 21.69±3.93°C. The mean ambient water temperature of the races with fatalities was 21.06±4.09°C. The region with the highest fatality rate per number of races was North America (0.30 per race). Finally, the athlete occupation with the highest percentage of athlete fatalities was engineer (18.75%). **CONCLUSION:** Triathlon-related deaths were most often experienced by males, during the swim portion of the race, and within North America. The swimming portion of the triathlon continues to represent the deadliest section and future safety measures should be focused on how to improve these outcomes.

EFFECTS OF PREFERRED VS. NONPREFERRED MUSIC ON RESISTANCE EXERCISE PERFORMANCE: A REPLICATION STUDY

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Replication studies can update information about a research claim through the addition of new evidence, while potentially offering additional support for original findings. Music has been studied extensively and evidence largely supports its use as an ergogenic aid; however, little is known regarding the effects of preferred vs nonpreferred music on resistance exercise.

PURPOSE: The purpose of this replication study was to investigate whether listening to preferred (PREF) or non-preferred (NON-PREF) music during resistance exercise influences motivation and bench press performance and determine the reproducibility of the original study.

METHODS: 28 resistance trained males ($n = 28$; $M_{\text{age}} 20.5 \pm 1.5$ years) completed 3 sessions: a baseline maximal bench press (1RM), and two repeated-measures counterbalanced testing sessions at 75% of their 1RM to failure while listening to either PREF or NON- PREF music.

Bench press repetitions to failure (RFT) and motivation, via a visual analogue scale, were recorded. **RESULTS:** No difference was found between music conditions for RFT ($p = .545$, Cohen's $d_z = .12$), although the effect size estimate was not significantly different from the original ($z = -1.88$, $p = 0.06$). For motivation there was no difference between music conditions ($p = .084$, $d_z = .34$) and the effect size estimate was significantly different from the original ($z = -4.44$, $p < 0.001$). **CONCLUSION:** Replication studies can better elucidate research claims which further enhances evidence-based practice. Contrary to the original study, the current study determined music had no impact on bench press performance or motivation. This would suggest that programming rather than music selection may be more meaningful to optimizing desired outcomes.

THERMOREGULATORY CAPACITY AND METABOLISM DURING MODERATE PHYSICAL ACTIVITY ARE UNAFFECTED BY HUMIDITY IN HOT CONDITIONS

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The ability to thermoregulate in hot and humid environments is critical to preventing exertional heat injury in the workplace. It is unclear whether environmental relative humidity (RH) affects thermoregulatory capacity and metabolism in hot conditions. **PURPOSE:** The purpose of this study was to evaluate the difference in thermoregulatory capacity and metabolism, defined by Metabolic Equivalent of Activity (METs), core body temperature (CBT), water loss, and heart rate, during intermittent exercise in hot conditions with differing relative humidity. **METHODS:** Healthy participants (n=30, age=25.3±7 yrs., Body Mass Index (BMI)=25.3±4.1 kg/m², sex: F=9 M=21) completed intermittent industrial work-related tasks in a 32,500 L metabolic chamber with an ambient temperature of 30°C for 60-180 minutes (mean: 91.1±21.7 min). Tasks were completed under high (n=18, 79±1.9%) or low humidity (n=12, 42.7±4.2%) conditions. Heart rate, CBT, and oxygen consumption (VO₂) were continuously monitored throughout the session. Water loss was calculated as (Body Weight_{pre-session} - Body Weight_{post-session}) + (Water consumed_{during-session} - Urine excreted_{during-session}). Water loss is expressed as an absolute value (kg) and as a percentage of body weight taken at the beginning of the study with other anthropometric measures. METs were calculated as VO₂/3.5/Body weight. Independent sample t-tests were used to compare the RH groups. Data are presented as Mean±SD. **RESULTS:** Age (high: 24.1±5.3 yrs vs. low: 27.2±9.3 yrs, p=0.25) and BMI (high: 25.1±2.8 kg/m² vs. low: 25.5±5.6 kg/m², p=0.83) did not differ between groups. Metabolic activity was not different across RH conditions (METs: high: 3.81±1.32 vs. low: 4.11±0.49, p=0.54). CBT (high: 37.3±0.7 °C vs. low: 37.5±0.4 °C, p=0.20) and heart rate (high: 110.4±21.7 bpm vs. low: 117.6±19.5 bpm, p=0.37) also did not differ. Water loss was not different when expressed as an absolute value (high: 0.7±0.5 kg vs. low: 0.9±0.3 kg p=0.44) or as a percentage of body weight (high: 0.9±0.6% vs. low: 1.2±0.4% p=0.14). **CONCLUSION:** These results demonstrate that when completing intermittent moderate-intensity exercise under hot conditions, thermoregulatory capacity and metabolism are unaffected by environmental relative humidity in young, healthy persons.

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METABOLIC RESPONSES TO EXERCISE MAY DIFFER BY TYPE AND INTENSITY IN BREAST CANCER PATIENTS

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Breast cancer treatment often causes negative metabolic adaptations that lead to poorer prognosis and increased cardiovascular disease risk. While exercise volume protects against cardiometabolic disease, the relationship between biomarkers of cardiometabolic health, exercise type (aerobic/resistance) and intensity among breast cancer patients remains unclear. **PURPOSE:** To investigate associations between self-reported exercise participation and cardiometabolic health among breast cancer patients undergoing active treatment. **METHODS:** Eighty-eight recently diagnosed breast cancer patients underwent a fasting blood draw, followed by assessments of waist circumference, weight, blood pressure and physical activity (via self-reported questionnaire) at baseline, 6- and 12-months post-diagnosis. Insulin, glucose, and triglyceride concentrations were determined via Baystate Hospital CLIA-approved assay techniques and insulin resistance (HOMA-IR) was established from fasting insulin and glucose concentrations. Multivariate and standard linear regressions were conducted to assess the association between exercise participation, exercise intensity, and exercise type with each cardiometabolic health factor (e.g. insulin, blood pressure). **RESULTS:** At baseline 48% of participants engaged in some form of exercise compared to 52% who did not, and these groups did not differ by age or body mass index. Exercise participation increased 24% within 12-months post-diagnosis (χ^2 test, $p < 0.001$). After controlling for potential confounding variables (e.g., age, race/ethnicity) we observed significant inverse associations between exercise participation and insulin ($B = -0.30$; 95% CI = -0.47 to -0.12), HOMA-IR ($B = -0.34$, 95% CI = -0.53 to -0.15), blood glucose ($B = -0.05$, 95% CI = -0.08 to -0.01), and triglycerides ($B = -22$, 95% CI = -39 to -5), but not systolic or diastolic blood pressures. Aerobic exercise participation was inversely associated with insulin ($B = -0.32$; 95% CI = -0.51 to -0.12, $B = -0.48$; 95% CI = -0.80 to -0.15), HOMA IR ($B = -0.36$; 95% CI = -0.57 to -0.14, $B = -0.53$; 95% CI = -0.89 to -0.18), triglycerides ($B = -20$; 95% CI = -39 to -1, $B = -42$; 95% CI = -74 to -10), for both moderate and vigorous intensities, however resistance training only demonstrated an association with insulin ($B = -0.37$; 95% CI = -0.64 to -0.10) and HOMA IR ($B = -0.38$; 95% CI = -0.67 to -0.08) only at moderate intensity. **CONCLUSIONS:** Moderate resistance and/or moderate-to-vigorous aerobic exercise may attenuate some breast cancer therapy-induced metabolic dysfunction. Further research using accelerometers and longer-term studies are warranted.

SEX DIFFERENCES IN THE EFFECT OF POST ACTIVATION POTENTIATION ON COUNTERMOVEMENT JUMP PERFORMANCE

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Post-activation potentiation (PAP) refers to an acute improvement of explosiveness following a loaded movement. The improvement occurs due to an increase in cross-bridge formations in skeletal muscle. **PURPOSE:** The purpose of the study was to compare the effects of PAP on countermovement jump (CMJ) in male and female Division III athletes. **METHODS:** Four male and six female athletes participated in this randomized crossover design (Age: Males = 19.75 ± 1.7 years, Females = 20.5 ± 0.5 years; Height: Males = 176.5 ± 3.64 cm, Females = 170.5 ± 6.94 cm; Weight: Males = 87.42 ± 14.44 kg, Females 73.5 ± 6.55 kg; Body Fat: Males = $18.45 \pm 5.59\%$, Females = $25.8 \pm 4.4\%$). Subjects completed a baseline visit which consisted of a three-repetition maximum back squat test (3RM). Subjects then performed two experimental visits, a dynamic (DYN) and an isometric (ISO) back squat, at least 48 hours between each visit. Immediately following each intervention, subjects completed CMJ trials at 4, 6, and 8 min rest intervals. **RESULTS:** There were no significant differences in CMJ between males and females for the ISO or DYN back squat ($p < 0.05$). **CONCLUSION:** Future researchers should continue to examine sex differences in PAP. Given the greater resistance to fatigue seen in females, it is possible that shorter rest periods may result in a difference in performance.

VALIDITY OF THE GREENTEG CORE BODY TEMPERATURE WEARABLE DEVICE DURING THE FALMOUTH ROAD RACE

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Valid core temperature (T_{CORE}) assessment methods available during exercise in the heat include rectal, gastrointestinal (T_{GI}), and esophageal temperature. However, these methods have limitations in a field setting. A novel wearable body temperature device (T_{DEV}) to predict T_{CORE} continuously has emerged, yet the validity and reliability remains unclear. **PURPOSE:** To examine the validity of T_{DEV} compared to T_{GI} during and at the finish of a warm weather road race. **METHODS:** Sixteen runners (n=10 males, n=6 females) ((mean \pm standard deviation) age: 48 ± 13 years, VO_{2max} : 47.98 ± 7.71 ml·kg⁻¹·min⁻¹) ran a self-paced 7.1-mile road race in hot, humid conditions (WBGT: $28.4^{\circ}C \pm 1.0^{\circ}C$). T_{DEV} (COREresearch, greenteg, Rümlang, Switzerland, Firmware Version 0.6.2) and T_{GI} (e-Celsius, BodyCAP, Hérouville Saint-Clair, France) were monitored during the race and at race finish. Repeated measures ANOVA with Bonferroni *post hoc* comparisons were used to compare T_{DEV} and T_{GI} during the race. Linear regression, mean bias, limits of agreement (LOA), typical error of the estimate (TEE), and interpretation of the effect, examined the relationship between T_{DEV} and T_{GI} during and at race finish. Significance was set to $p < 0.05$. **RESULTS:** During the race, average peak T_{GI} was $39.39^{\circ}C$ (38.38 - $40.6^{\circ}C$). No interaction was exhibited between time and device ($p=0.087$). *Good agreement* and a high, positive relationship (95% LOA $\pm 0.94^{\circ}C$, $r=0.84$) was displayed between T_{DEV} and T_{GI} during the race. T_{DEV} showed *fair agreement* and a low, positive relationship (T_{GI} : 95% LOA $\pm 1.20^{\circ}C$, $r=0.40$) compared to T_{GI} at race finish. The TEE suggests that the mean bias values may be attributed to error. **CONCLUSIONS:** During a warm weather race, T_{DEV} displayed overall *good agreement* with a mean bias of $-0.21 \pm 0.48^{\circ}C$ compared to T_{GI} and *fair agreement* at race finish with a mean bias of $-0.10 \pm 0.6^{\circ}C$, therefore it is not equipped to diagnose exertional heat stroke. Continued validation and enhancement of the algorithm for T_{DEV} in future, adequately powered studies with varying populations, environmental conditions, intensities, equipment and clothing worn, and at the upper limits of hyperthermia (i.e. $>39.5^{\circ}C$) are needed to establish appropriate validity for use during training and competition.

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RELIABILITY AND TIME COURSE OF POSTEXERCISE HYPOTENSION DURING EXERCISE TRAINING AMONG ADULTS WITH HYPERTENSION

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Postexercise hypotension (PEH) is the immediate decrease in blood pressure (BP) resulting from a single exercise bout lasting for up to 24 hr. The reliability and time course of change of PEH during an exercise training program are unknown. **Purpose:** To investigate the reliability and time course of change of PEH during aerobic exercise training among adults with hypertension. **Methods:** Prior to exercise training, participants (n=10) were determined to be PEH responders, defined as a ≥ 2 mmHg decrease in 24 hr ambulatory BP following a maximal graded exercise stress test versus non-exercise control. Participants underwent a 12 wk, supervised, aerobic exercise training program consisting of 40 min/session at moderate to vigorous intensity for 3 d/wk. BP was assessed with a home BP monitor pre- and post-exercise for all 36 exercise sessions. PEH was calculated as post- minus pre-exercise BP. RMANCOVA and GRMANCOVA determined the intercorrelation coefficients (ICC) of PEH for each exercise session with pre-exercise BP as a covariate. The Akaike Information Criterion (AIC) compared the goodness-of-fit of the models of PEH for each week of training. **Results:** Participants were obese (30.6 ± 4.3 kg·m⁻²), middle-aged (57.2 ± 10.5 yr) men (60%) and women with stage I hypertension ($136.5 \pm 12.1/83.4 \pm 6.7$ mmHg). On average, 32.6 ± 4.2 exercise sessions were completed with an exercise adherence rate of $90.6 \pm 11.8\%$. PEH occurred in $89.7 \pm 8.3\%$ of the sessions decreasing on average $9.3 \pm 13.1/3.2 \pm 6.8$ mmHg. ICCs indicated moderate reliability of PEH during training (GRMANCOVA ICC: 0.58 and RMANCOVA ICC: 0.63). AICs indicated the decrease in systolic BP (SBP) stabilized by 3 wk as the mean decreases were not different from 3-12 wk ($p > 0.05$), whereas diastolic BP (DBP) stabilized between 10-12 wk. **Conclusion:** PEH averaged 9 mmHg for SBP and 3 mmHg for DBP with moderate reliability over the 36 sessions of exercise training. PEH stabilized between 3-12 wk of exercise training for SBP and 10-12 wk for DBP. Among PEH responders, PEH appears not to be obscured by exercise training suggesting the antihypertensive effects of exercise training may be largely due to PEH, itself. Further studies are needed to confirm these promising findings.

LATE PREGNANCY AND EARLY POSTPARTUM MAY IMPACT THE MODULAR CONTROL OF WALKING: A CASE STUDY

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During pregnancy, changes in weight and weight distribution can affect balance and gait patterns and may require changes in the neuromuscular control of walking. Neuromuscular control can be characterized by modular control, groups of muscles activated together, based on the control organization (which muscles are grouped together) and complexity (the number of modules). **PURPOSE:** This case study aimed to determine the impact of pregnancy and early postpartum on the modular control of walking. We hypothesized that (1) modular control would become more complex and change in organization as pregnancy progresses to compensate for changes in weight and balance, and (2) return to early pregnancy complexity organization postpartum as the individual's weight and balance begin to normalize. **METHODS:** One 31-year-old pregnant female, who provided informed consent, performed 6 walking trials at her preferred speed while electromyography (EMG) was recorded from 9 lower extremity muscles at 8, 14, 20, 26, 32, and 38 weeks of pregnancy and 6 weeks postpartum. Modules were identified from EMG by non-negative matrix factorization. **RESULTS:** From 8-26 weeks of pregnancy, modular control complexity and organization was consistent (Fig. 1). At 32 and 38 weeks, increased complexity was observed, with the addition of an independent hamstring (H) module. Six weeks postpartum, complexity returned to early pregnancy levels, but a new modular organization was observed. The late pregnancy H module was retained while the plantar flexor (PF) and tibialis anterior (TA) modules merged into one PFTA module. **CONCLUSION:** Modular control organization and complexity was impacted in the third trimester of pregnancy and postpartum, potentially due to greater changes in weight distribution. In the future, kinematic and kinetic data will be used to understand how altered modular control relates to gait changes in late pregnancy and postpartum.

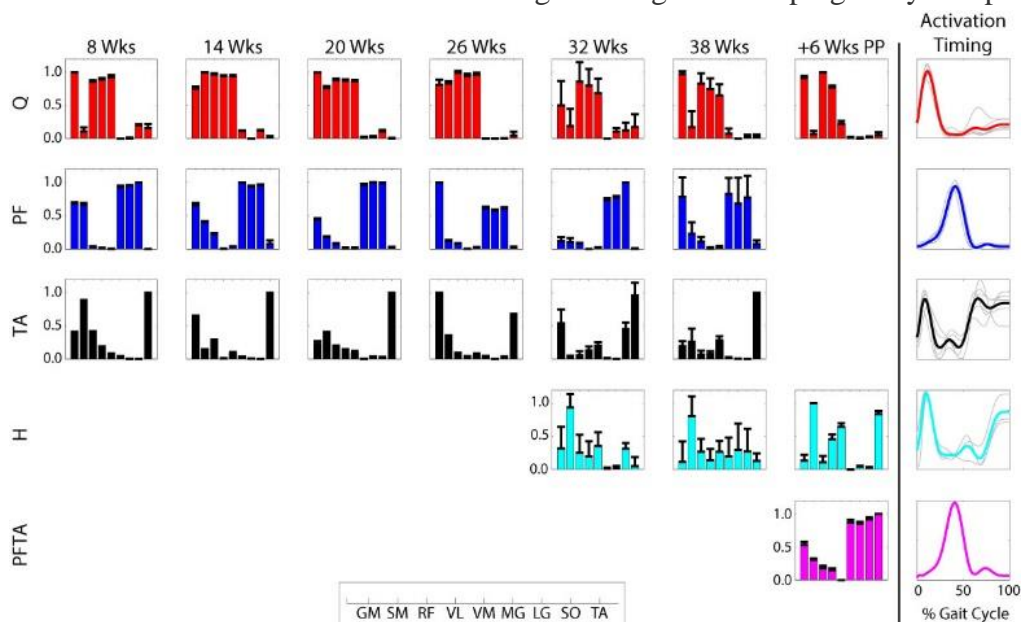


Fig. 1: Muscle modules during pregnancy and postpartum. Bar plots show module weights (strength of a muscle's association with a module). Average (colored line) and individual visit (grey lines) module activation patterns are shown on the right. Rectus femoris (RF), vastus lateralis (VL) and medialis (VM), and gluteus medius (GM) activity characterized the Q module. Soleus (SO) and medial (MG) and lateral (LG) gastrocnemius activity characterized the PF module. TA activity characterized the TA module. Semimembranosus (SM) activity characterized the H module. Merged PF and TA activity characterized the PFTA module.

NEACSM Abstract Submission

Investigating the Implementation Potential and Effectiveness of Exercise Physiology Services for Addressing Weight Management

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PURPOSE: The aim of this feasibility, natural history study was to examine the potential effectiveness of exercise physiology service for adult weight management. **METHODS:** Thirty-six adults (47 ± 12 yrs.) attending an outpatient exercise physiology clinic completed individualized nutrition and exercise interventions either in an integrative clinical setting or at home. The interventions were of varying lengths (5.8 ± 4.3 mo.) based upon exercise physiology testing results and health fitness goals. **RESULTS:** Fourteen participants were healthy weight, 13 were overweight, and 9 were obese. Statistical analysis revealed significant positive changes in several key measures over the duration of treatment. Across all patients, there was on average a $3.4 \pm 5.1\%$ reduction in body weight, a 2.0% increase in skeletal muscle mass (SMM), a 10.4% decrease in fat mass percentage (FM %), and a notable 22.4% reduction in visceral adipose tissue (VAT). In comparison to overweight participants, obese patients exhibited significantly greater reductions in body weight ($p = 0.003$) and skeletal muscle mass ($p = 0.04$), with comparable changes in fat mass ($p = 0.16$) and visceral adipose tissue ($p = 0.16$). When contrasted with normal-weight participants, obese patients demonstrated significantly greater reductions in body weight ($p = 0.009$) and visceral adipose tissue ($p = 0.032$), while experiencing similar changes in skeletal muscle mass ($p = 0.75$) and fat mass ($p = 0.64$). Conversely, overweight participants exhibited less pronounced reductions in body weight ($p = 0.43$) and fat mass ($p = 0.49$), along with marginal changes in visceral adipose tissue ($p = 0.5$). Their gains in skeletal muscle mass were also notably lower ($p = 0.7$) compared to normal-weight participants. **CONCLUSION:** The findings indicate positive outcomes in terms of improved body composition and adipose tissue distribution among the participants following the intervention, providing strong evidence for the feasibility and effectiveness of exercise physiology services in the context of weight management programs. Further research on the implementation of exercise physiology services is warranted to identify the outcomes and to further understand how to implement this valuable resource in a variety of settings.

SEX-SPECIFIC ADAPTATIONS OF SKELETAL MUSCLE FIBERS TO DISTINCT EXERCISE TRAINING PROGRAMS IN HEALTHY, OLDER ADULTS

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Older adults are susceptible to age-related skeletal muscle dysfunction, which increases physical disability and limits functional capacity. Specific exercise interventions, such as high-load, low-velocity resistance training or low-load, high-velocity power training, that optimally improve skeletal muscle function in older adults has yet to be defined. **PURPOSE:** To determine the effects of resistance and power training on skeletal muscle fiber contractile function in healthy, older adults. **METHODS:** Older males (n = 11) and females (n = 18) underwent 16 weeks of exercise training (leg press, extension and flexion), where one leg performed resistance training (80% one-repetition maximum or 1-RM, 3 sets of 8 repetitions) and the contralateral leg performed power training (40% 1-RM, 3 sets of 16 repetitions). Using vastus lateralis biopsies, single fiber force generation, myofilament mechanical properties and myosin-actin cross-bridge kinetics were measured pre- and post-exercise under maximal Ca^{2+} -activated conditions in slow-(myosin heavy chain, MHC, I) and fast-contracting (MHC IIA) fibers. **RESULTS:** Normalized force production, or specific tension (force/cross-sectional area), was increased in older males (13%, $p < 0.001$), but decreased with older females (6%, $p = 0.04$) with resistance training in MHC I fibers. The same fibers showed a greater number of strongly-bound cross-bridges in older males (26%, $p < 0.001$) and a reduced myofilament stiffness in older females (12%, $p < 0.001$), suggesting these are the molecular mechanisms responsible for the alterations in cellular force production. Normalized force production was increased in older females with power training in MHC I fibers (6%, $p = 0.02$), although a molecular mechanism was not evident. The fast-contracting MHC IIA fibers showed no alterations in normalized force production with either exercise regimen, although older males showed a trend ($p = 0.06$) for an increase with power training. **CONCLUSION:** The sex-specific responses to high-load, low-velocity resistance exercise at the cellular and molecular levels agrees with our previous work using a moderate-load, low-velocity exercise (60% 1-RM, Miller et al., 2017), strengthening the idea that the sexes respond differently to exercise, especially in the slow-contracting fiber type. In females, resistance training also reversed the most prominent age-related effects, specifically increased force production and greater myofilament stiffness, from our previous work (Miller et al., 2013).

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DIFFERENCES IN KNOWLEDGE OF LOW ENERGY AVAILABILITY CONDITIONS IN FEMALE CROSS-COUNTRY ATHLETES

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The female athlete triad (the Triad) and Relative Energy Deficiency in Sport (RED-S) are conditions associated with a myriad of health and performance consequences in athletes. As such, the 2022 parent study assessed total knowledge, confidence, and educational impact scores of the Triad and RED-S in collegiate female cross-country athletes, coaches, and athletic trainers. Female cross-country athletes demonstrated the lowest scores across the study population; therefore, it is necessary to investigate this lack of knowledge. **PURPOSE:** To explore differences in educational impact scores of the Triad and RED-S amongst female cross-country athletes. **METHODS:** Participants were recruited from United States collegiate women's cross-country teams. Participation included one-time completion of an online survey, which included items regarding demographic information, Triad and RED-S knowledge, and prior education. Educational impact scores were calculated by factoring knowledge and confidence scores. Associations between educational impact scores and participant characteristics (e.g., mileage, running experience, age, history of bone stress injury, division level participation, academic area of study, Triad or RED-S diagnoses, and Triad or RED-S training) were explored. **RESULTS:** A weak, significant correlation between peak career mileage and educational impact scores ($r = 0.195$, $p = 0.01$) was revealed. The following participant characteristics were associated with significantly higher educational impact scores in athletes: NCAA DI participants (2.6 points), related academic area of study scored (5.8 points), received education training on Triad (3 points), positive Triad diagnosis (5 points), and positive RED-S diagnosis (5.37 points). **CONCLUSION:** Our findings suggest that a potential contributing factor to the significant differences in Triad/RED-S diagnostic groups is that individual's may improve their awareness and/or knowledge of these conditions while working with a multidisciplinary treatment team during recovery. However, student-athletes often rely on education provided by their athletic department or program of study; as 68% and 78% of athletes previously reported that they had not received education on the Triad and RED-S, respectively. Therefore, education programs remain necessary to improve knowledge of the Triad and RED-S, as well as how to properly identify, treat, and prevent these conditions, and should be implemented early in an athlete's sporting career.

ELECTROPHYSIOLOGICAL INVESTIGATION OF ACTIVE-ASSISTED VS RECUMBENT CYCLING: A PILOT STUDY IN HEALTHY OLDER ADULTS

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Abstract

There is an association between acute bouts of aerobic exercise and improved cognition in adults, yet the exact nature of this relationship remains unclear. **PURPOSE:** The current pilot study aims to investigate how different modes of cycling (active-assisted [AA] cycling vs, recumbent bike [RB]) at different intensity levels (prescribed 65-70% HRmax and self-selected 12-13 RPE) modulate physiological responses, neurocognitive, and behavioral markers of cognitive function in healthy older adults. **METHODS:** A sample of 10 adults (aged 50-74) participated in baseline (no exercise), AA and RB cycling interventions at different intensity levels. The P3 event-related potential (ERP), a neural index of executive functions, was recorded at baseline and following each exercise condition during an auditory odd-ball paradigm. **RESULTS:** Pilot data revealed that both exercising VO_2 (mL/kg/min) and heart rate (HR, bpm) were greater for RB cycling (VO_2 : 14.28 ± 3.32 mL/kg/min, HR: 110.74 ± 18.01 bpm), compared to AA cycling (VO_2 : 11.90 ± 2.75 mL/kg/min, HR: 103.47 ± 14.06 bpm), at either intensity level (VO_2 : $t(9) = 4.278$, $p < 0.005$; HR: $t(9) = 2.57$, $p < 0.05$). Greater amplitudes (μV) within the P3 ERP component were associated with post-exercise RB cycling (4.11 ± 2.75 μV) compared to baseline (2.10 ± 2.47 μV ; $t(9) = 3.94$, $p < 0.005$), and AA cycling (2.99 ± 2.41 μV ; $t(9) = 3.53$, $p < 0.05$), in the central and central-parietal regions of interest. Further, post-exercise behavioral cognitive measures (accuracy) were significantly greater than baseline (95.77 ± 3.96 %) for both AA (99.23 ± 0.65 %; $t(9) = 2.69$, $p < 0.05$) and RB (99.19 ± 0.81 %; $t(9) = 2.64$, $p < 0.05$), when controlling for practice effects. **CONCLUSIONS:** These findings suggest that exercise modulated both neurocognitive and behavioral measures of executive functions in older healthy adults, and that different exercise modalities and intensity levels differentially impact both physiological and neurocognitive measures.

NOVEL FINDINGS OF OSTEOCHONDRITIS DISSECANS LESIONS IN A PEDIATRIC PATIENT WITH HISTORY OF LYME ARTHRITIS.

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Osteochondritis dissecans (OCD) is a localized disease of the subchondral bone in which there is osteonecrosis with secondary injury to the overlying articular cartilage. Repetitive trauma is theorized to be the primary mechanism. OCD types of lesions can result in pain, swelling, loose body formation, and arthritis. Surgical management is pursued when conservative management fails, with the long-term goal to minimize arthritis. Lyme arthritis, a late Lyme disease manifestation, is an inflammatory arthritis. **PURPOSE:** This case study presents the novel findings of two distinct osteochondritis dissecans lesions in an adolescent male with a history of Lyme arthritis and recurrent knee pain. **METHODS:** A 13-year-old male initially presented to orthopedics with right knee pain and swelling, later developing fever. PCR testing of the synovial fluid was positive for *Borellia* species, consistent with Lyme arthritis. He was treated with two courses of amoxicillin due to persistent swelling and concern for treatment resistant Lyme arthritis. At initial presentation, an MRI revealed a small stable OCD lesion to the lateral femoral condyle. He represented 7 months later with recurrent pain. Imaging revealed progression of the OCD lesion however it was stable in appearance and it was thought that his pain was likely secondary to post-Lyme inflammatory arthritis. He was treated with oral anti-inflammatories and a steroid injection and improved. His pain returned 12 months later with mild swelling noted. Examination revealed a nonantalgic gait. He had a right knee effusion and was tender over the lateral joint line and lateral femoral condyle. He had FROM though experienced pain with squatting. **RESULTS:** X-rays revealed patient's lateral femoral condyle OCD lesion had notable progression and revealed a new trochlear lesion. MRI confirmed these findings. Because of the progression of the OCD lesions, the patient was offered arthroscopy for drilling/possible fixation and synovial biopsy. Patient underwent drilling of both lesions, which were noted to be stable. Pathology from the synovial biopsy showed chronic inflammatory changes. **CONCLUSION:** This case study describes the findings of osteochondritis dissecans in a patient with a history of Lyme arthritis. This is a novel association with no previous description to our knowledge.

THE EFFECT OF CANNABIDIOL ON MAXIMAL AEROBIC PERFORMANCE: A PILOT STUDY

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Cannabidiol (CBD) is commonly used as a relaxant and pain reliever. It is speculated that CBD could be used as an ergogenic aid. **PURPOSE:** To investigate the effect of CBD on maximal aerobic performance. **METHODS:** Healthy, physically active adults were recruited (age: 35 ± 4.36 year; height: 170.60 ± 9.53 cm; weight: 72.39 ± 12.41 kg; bodyfat: 18.33 ± 7.74 %). Participants were asked to come in for three visits. Visit 1 consisted of protocol familiarization and baseline measurements. During visits 2 and 3, participants were given a 150mg dose of CBD or a placebo. After a 1hr waiting period, participants completed a graded exercise test on a cycle ergometer. Heart rate (HR), oxygen consumption (VO_2), carbon dioxide expiration (VCO_2), respiratory exchange ratio (RER), muscle oxygen (SmO_2), hemoglobin (THb), blood lactate (La^-), and rate of perceived exertion (RPE) were recorded at each stage, at the end of the test, and 5min post-test. **RESULTS:** There was no significant differences ($p > 0.05$) in HR, La^- , RPE, VO_2max , maximal aerobic power (MAP), SmO_2 , THb, and RER when comparing CBD and placebo. **CONCLUSION:** Although no significant differences were observed between CBD and placebo, the results of this pilot study support the notion that further research is needed to better understand CBD's effect on maximal aerobic performance.

POST-EXERCISE DIFFERENTIAL RESPONSE OF CENTRAL AND BRACHIAL BLOOD PRESSURE IN PATIENTS WITH CORONARY ARTERY DISEASE

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Brachial post-exercise hypotension is consistently observed in hypertensive and normotensive individuals but may be absent in patients with coronary artery disease (CAD). This attenuated response may be influenced by inter-individual variability and warrants exploration of exercise's distinct impact on central and brachial blood pressure (BP). Central BP, reflecting vital organ strain, holds promise for sensitively detecting post-exercise changes and abnormalities. **PURPOSE:** To determine central and brachial BP overall and individual responses 5, 15 and 30-min after combined exercise of different intensities in participants with and without CAD. **METHODS:** Seventeen participants with stable CAD and eighteen aged-matched controls (52-81 years) completed an acute bout of high and moderate-intensity combined aerobic and resistance exercise. Brachial (bSBP) and central systolic (cSBP) pressure were assessed via oscillometry and carotid tonometry, respectively. Group mean changes were examined with linear mixed models and post-exercise BP individual responsiveness quantified via the region of practical equivalence (ROPE) and highest density interval (HDI), a Bayesian method. Those with HDIs exceeding the ROPE (-3.20 to 3.20 mmHg) were considered post-exercise responders. **RESULTS:** Regardless of exercise intensity, cSBP was persistently increased during recovery in participants with CAD (difference 30–baseline (d_{30-bas})= 10, 95% CI: 4 to 17 mmHg, $p=0.001$) but was reduced in controls ($d_{30-bas}=-13$, 95% CI: -19 to -7 mmHg, $p=0.003$). bSBP was unchanged (CAD: $d_{30-bas}=-1$, 95% CI: -6 to 4 mmHg, $p=0.956$; controls: $d_{30-bas}=-4$, 95% CI: -9 to 2 mmHg, $p=0.326$). Individual response analyses confirmed overall trends (Figure). **CONCLUSIONS:** Post-exercise cSBP differed from bSBP, independent of exercise intensity. Furthermore, patients with CAD exhibited post-exercise central hypertension, an altered BP response consistent with higher risk. Central BP provides different information than brachial BP following exercise, which may impact risk assessment.

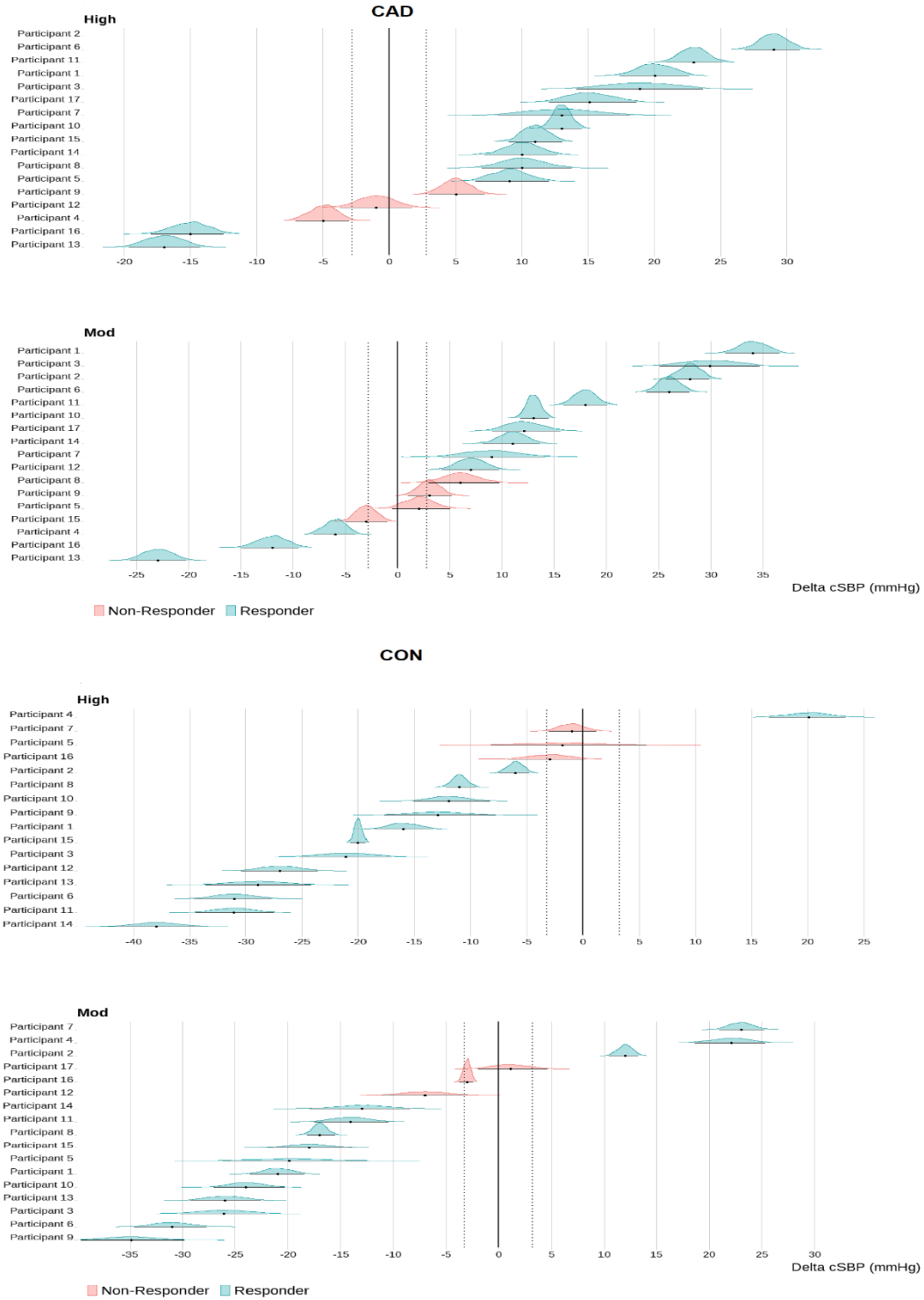


Figure. Central systolic blood pressure (cSBP) individual responsiveness after acute combined exercise in participants with coronary artery disease (CAD) and controls (CON). Delta was calculated as cSBP at the 30-minute time mark minus the baseline value. The vertical dashed lines represent the region of practical equivalence.

DIFFERENTIAL ACTIVATION OF DEEP AND SUPERFICIAL MULTIFIDUS FIBERS DURING WALKING: A PILOT STUDY

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Individuals with non-specific chronic low back pain commonly present with weak and atrophied deep spinal muscles (e.g. deep and superficial fibers of the multifidus) responsible for maintaining dynamic spine stability. Walking is commonly recommended to increase general physical activity and to alleviate low back pain. However, activation of the multifidus during gait has not been well documented due to the invasive nature of the measurement. Additionally, there is conflicting evidence to support differential activation between deep and superficial fibers of the multifidus during functional activities. **PURPOSE:** To determine if 1) a surface electrode can accurately record the activation patterns of deep and superficial multifidus fibers, and 2) deep and superficial multifidus fibers have similar activation patterns when measured via indwelling electrodes during walking. **METHODS:** Activation of the multifidus was recorded with two fine wire electrodes (one each in deep and superficial fibers) and one surface electrode in five healthy individuals (four males and one female; age=26±3.2 yrs; mass=85.76±20.3 kg; height=174.9±5.9 cm) during treadmill walking. Peak and average muscle activation during each gait cycle was normalized to a maximum voluntary activation. Paired t-tests were used to compare differences between activation from surface and indwelling electrodes of the superficial multifidus fibers, and activation between superficial and deep multifidus fibers measured with indwelling electrodes. **RESULTS:** There were no significant differences in peak or mean activation of the superficial multifidus between surface and indwelling electrodes. However, activation of the deep fibers of the multifidus produced significantly greater mean (9.8±5.4% vs. 5.3±4.1%, $p = 0.02$), and peak (29.3±10.2% vs. 17.9±12.2%, $p = 0.02$) compared to superficial fibers. **CONCLUSIONS:** Findings suggest that surface electrodes may be sufficient to describe the activation of the superficial fibers of the multifidus. Further, our results suggest superficial and deep fibers of the multifidus have different activation patterns and should be measured independently. These findings also highlight the surprisingly high peak activation levels of the deep multifidus (~30% of maximum), suggesting a substantial requirement during a low-level functional activity.

Thank you to the Westbrook College of Health Professions for funding this study.

CORTICAL THICKNESS AND NEUROCOGNITIVE FUNCTION IN COLLEGE-AGED SOCCER PLAYERS DIAGNOSED WITH ADHD

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Alterations in cortical structure have been identified in attention-deficit/hyperactivity disorder (ADHD) and it is suggested that these differences may put these individuals at increased risk for declines in cognitive performance, delayed development, and complications following brain injury. For example, reduced cortical thickness in the prefrontal cortex has shown to relate to worse performance in attention-based tasks. Majority of these ADHD-specific deficits have been primarily limited to adolescent studies, focusing on the early stages of neurodevelopment despite the ongoing risks. **PURPOSE:** The present study investigated cortical thickness in regions that have been previously related to attention and cognitive control, and assessed neurocognitive function using the Eriksen flanker task in college-aged soccer players diagnosed with ADHD.

METHODS: A total sample size of 60 adults (age \pm SD; 19.9 ± 1.9 years) consisted of age- and sex-matched samples with a ratio of 1:1 between two groups. Soccer players diagnosed with and medicated daily for ADHD were assigned into an ADHD group ($n=30$). Soccer players without ADHD were assigned into a non-ADHD group ($n=30$). Structural images were obtained and examined across the prefrontal cortex, regions of interest included superior frontal, caudal middle frontal, rostral middle frontal, lateral orbitofrontal, medial orbitofrontal, frontal pole, rostral anterior cingulate, and caudal anterior cingulate. FreeSurfer analysis provided structural outcomes for regions of interest of each lobe. All participants completed the Eriksen flanker task and performance was measured using accuracy and speed of congruent and incongruent trials.

RESULTS: Data displayed no significant differences between groups in the frontal cortical regions (all $p > 0.05$). Furthermore, both groups performed similarly in the Eriksen flanker task, with no significant differences in speed, accuracy, or congruency effect (all $p > 0.05$). Significant group differences in demographics were observed in the reported number of previous concussions ($p = 0.003$) and in additional diagnosis of a mental health disorder ($p < 0.001$) with the ADHD group reporting more for both. **CONCLUSION:** The assessment of ADHD using cortical thickness and Eriksen flanker task displayed no deficits in the present cohort. Additional structural and functional assessments may serve as more fitting tools to identify ADHD-specific deficits in college-aged athletes.

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POSTURAL EFFECTS ON POWER OUTPUTS AND LACTATE RECOVERY DURING THE WINGATE TEST

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The Wingate Cycle Test (Wingate) is one of the most popular and reliable measurements of anaerobic activity. While primarily completed in the seated posture, moving into a standing posture is a natural reaction to produce more power and reduce mechanical costs during a strenuous cycle exercise test. Previous research has conflicting results when completing the Wingate in different postures. **PURPOSE:** The purpose of this study was to examine the difference in power outputs and lactate recovery between seated, standing, and a combination of the two postures during the Wingate. **METHODS:** Fourteen college-aged subjects (21.79 ± 0.94 yrs, 179.3 ± 6.82 cm, 83.01 ± 13.19 kg) completed three Wingate sessions (seated, standing, combination). For inclusion into the study, subjects completed a peak oxygen consumption test to determine eligibility (peak VO_2 between 30-50 ml/kg/O₂). Postures for each Wingate were randomized and included seated, standing, and combination of seated and standing posture. Each session was separated by at least twenty-four hours of rest. Testing sessions began with a five-minute warm up, pedaling against 3.2% body mass with three 4-6 second sprints at 7.5% body mass separated by 60 seconds. Wingate testing used 7.5% body mass, followed by a five-minute cool down against no resistance. Blood lactate samples were collected via finger capillary puncture at baseline, immediately prior to and after the Wingate, then every five minutes for the next 30 minutes post-test. **RESULTS:** There were no significant differences ($p \geq 0.05$) between postures for peak power (W/kg), average power (W/kg), power drop (%), time at maximal speed (ms), and total energy produced (J). There were no significant differences between lactate samples at pretest and 20 or 25-minute post-test as well as immediate post-test and 15-minute post-test ($p \geq 0.05$). There were significant differences between all other lactate samples ($p = 0.00$). **CONCLUSIONS:** The Wingate may be performed in any posture when measuring power outputs and lactate recovery. Cycling postural changes during the Wingate do not affect power outcomes and lactate recovery response when compared to the original seated posture.

EFFECTS OF PREFERRED VS. NONPREFERRED MUSIC ON BENCH PRESS PERFORMANCE: AN EXTENSION STUDY

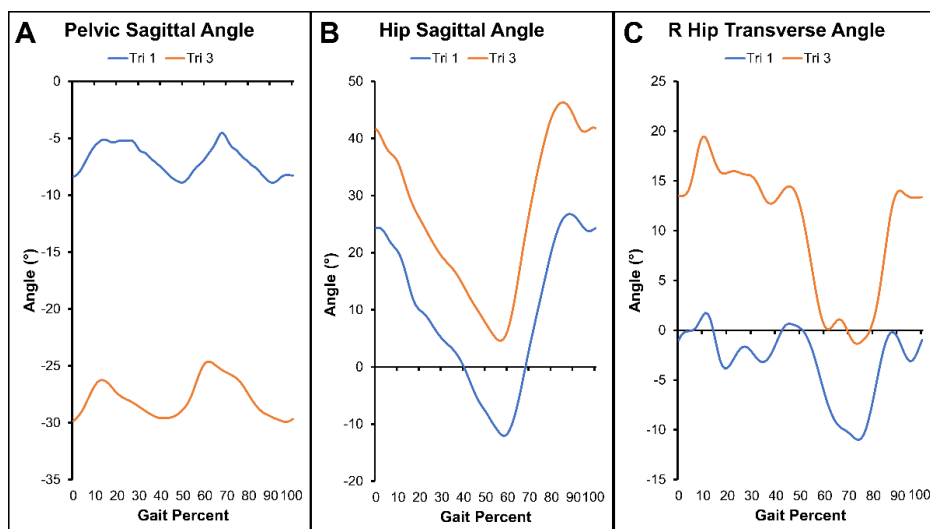
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The re-examination and re-evaluation of published findings is a fundamental necessity in the field of exercise science. Replication-extension studies provide replication evidence but also extend the results of prior studies in new and theoretically important directions (Bonett, 2012). **PURPOSE:** To extend previous research on the effects of preferred (PREF) vs. (NON-PREF) music on bench press performance and motivation; extension of an original study by Ballmann et al. (2021). **METHODS:** Forty-seven resistance-trained men and women ($M_{\text{age}} 20.6 \pm 1.5$ years) participated in current study. Subjects listened to conditions of PREF and NON-PREF music; a counterbalanced repeated-measures design was used. Both conditions consisted of bench press repetitions to failure (RTF) at 75% of previously tested 1-Repetition Maximum (1-RM). Ballmann's original study was extended by adding measurements of attentional focus and ratings of perceived exertion (RPE) in order to explore these hypothesized mechanisms of action. In addition, the participant sample was expanded to include females in an effort to be more inclusive and to explore potential sex differences. A two-way analysis of variance (ANOVA) was used to statistically compare the interactive effect of sex and music preference on bench press RTF and motivation. RPE and attentional focus were compared between conditions with a paired t-test and Wilcoxon signed rank test, respectively. Statistical significance was set at $p \leq 0.05$, and Cohen's d was calculated for effect size interpretation. **RESULTS:** The two-way ANOVA revealed no significant interaction or main effect of sex and genre on RTF. However, statistical significance found for the main effect of sex ($p=.015$) and genre ($p=.025$) on motivation. Attentional focus was significantly more external for PREF vs. NON-PREF music ($z=-3.11$, $p=.002$), but perceived exertion did not differ between music conditions ($p=1.00$, $d_z=.00$). **CONCLUSION:** Mixed findings on the effects of PREF vs. NON-PREF music genre on bench press performance may be due to the nature of the task (e.g., duration, intensity). Future research should examine more sophisticated musical elements, such as complexity, accents, and beat perception that may be more important than genre for performance outcomes.

EVALUATING THE CHANGES OF HIP FUNCTION IN EXPECTANT MOTHERS BEFORE AND AFTER DELIVERY

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INTRODUCTION: Approximately 800 women die *daily* worldwide from preventable maternal causes of death (COD). These CODs (e.g. prolonged labor, hemorrhage) are frequently connected to biomechanical limitations during childbirth. **PURPOSE:** There is increased risk for complications/death during labor/delivery if pelvis/hips anatomy does not biomechanically change enough. Monitoring pelvic/hip biomechanical changes throughout pregnancy may help detect complications that arise during or prior to labor/delivery. **METHODS:** Following IRB approval, 16 individuals (12 nulligravida controls: age 24.5 ± 3.4 yrs, mass 66.2 ± 12.0 kg, height 165.1 ± 4.6 cm) 4 gravid; age 29.7 ± 5.7 yrs, mass 70.4 ± 4.3 kg, height 167.1 ± 6.2 cm) were enrolled. All participants performed walking and stair ascent/descent while lower extremity optical motion capture and electromyography data (bilateral hip/knee flexors/extensors) were captured. Controls were assessed once, while gravid participants completed 5 timepoints (1 x T1, 1 x T2, 2 x T3, 1 x postpartum). Outcome variables included 3D peak pelvis/hip joint angles, peak EMG magnitude, and post-partum patient reported outcome measures (PROMs). A Spearman's Correlation evaluated connections between peak joint angles/EMG magnitude and post-partum PROMs. **RESULTS:** Significant differences between control subjects and expectant mothers later in pregnancy were found. Additionally, significant differences were noted during walking in peak joint angles in expectant mothers throughout pregnancy (Figure 1). We expect all variables will not be significantly different between control subjects and postnatal participants at the postpartum visit. Furthermore, we anticipate a significant correlation will exist between peak hip joint transverse plane angle changes and positive postpartum outcomes. **CONCLUSION:** These results demonstrate that changes in peak pelvic/hip joint angles may be a good predictor of birth preparedness and labor/delivery outcomes. To the best of our knowledge, this is the first report of connections between changes in lower extremity kinematics throughout gestation with postpartum outcomes. Quantifying these changes to potentially monitor for labor/delivery complications would be beneficial for expectant mothers and healthcare providers.



THE EFFECT OF TRNS ON THE SUBJECTIVE EXERCISE EXPERIENCE

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While regular physical activity is recommended by healthcare professionals and organizations to promote cardiorespiratory fitness, participation rates remain very low. A common self-reported barrier to not exercising is past negative experiences such as feeling undesirable levels of exhaustion and tiredness. Higher ratings of pleasure and enjoyment are associated with more physical activity compared to lower ratings. Numerous recent studies have shown that non-invasive brain stimulation modulates the top-down regulatory control of subjective feeling states such as fatigue and discomfort. **PURPOSE:** Determine the effect of transcranial random noise stimulation (tRNS) on the subjective exercise experience. **METHODS:** In counterbalanced order, 19 participants (11 women; age 21.7 ± 2.8 y; body mass index 28.7 ± 4.2 kg·m⁻²) completed two conditions: self-paced cycle ergometry for 30 minutes with active and sham/placebo tRNS. Affective valence ratings (Empirical Valence Scale; EVS) were collected each minute. **RESULTS:** Significantly higher (more pleasurable) EVS scores were reported during the active tRNS condition compared to sham ($p < 0.05$). **CONCLUSION:** tRNS stimulation improves the subjective exercise experience when the intensity is self-selected. Future research is needed to examine effect of the stimulation on physical activity behavior.

Supported by: The Rhode Island Foundation Medical Research Grant

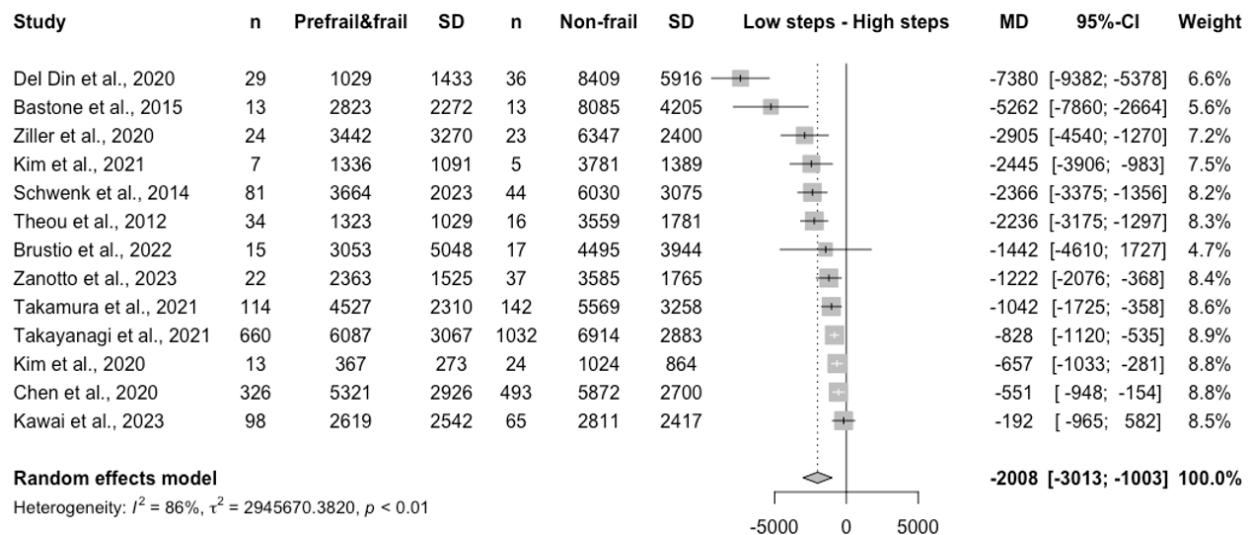
ASSOCIATION BETWEEN DAILY STEPS AND FRAILITY IN OLDER ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Frailty is a significant health challenge for the aging population, increasing vulnerability to adverse health outcomes such as chronic disease, falls, disability and mortality. Early detection and monitoring of frailty are critical for effectively managing frailty. Daily steps, as a measure of physical activity, holds valuable information about health status and may serve as an indicator of frailty. **PURPOSE:** To examine the association between daily steps and frailty in older adults. **METHODS:** PubMed, SPORTDiscus and Web of Science databases were searched for published studies up to June 2023. The search terms were ("daily step" or "steps per day" or "step count" or "number of steps" or "step volume") AND ("frailty" or "frail" or "pre-frailty" or "pre-frail"). The inclusion criteria were peer-reviewed articles in English involving older adults aged ≥ 65 years, device-measured daily steps and reported frailty status. Pooled estimates of mean differences with 95% confidence intervals (CI) between frailty groups (non-frail, prefrail, frail) were obtained using random-effects models. The prefrail and frail group was combined in the primary analysis. **RESULTS:** Thirteen articles comprising 3383 participants (71.21 ± 6.69 years, 75.58% female, 42.45% prefrail and frail) were included to the analysis. Daily steps were significantly lower in the prefrail and frail combined group compared to the non-frail group (MD=-2008, 95% CI: -3013, -1003, $I^2=86\%$, Figure). This association was consistent across subgroups stratified by health conditions, regions, wearables placement, and frailty measurement. Further analysis within the three frailty groups revealed that the prefrail group accumulated 805 steps/day (95% CI: 583, 1027, $I^2=67\%$) less than the non-frail group, but 956 steps/day (95%CI: 468, 1444, $I^2=32\%$) more than the frail group. **CONCLUSIONS:** Current evidence suggested that older adults with frailty tend to have lower daily steps compared to non-frail older adults. Daily steps may be an indicator of frailty status in older adults.

Figure: Forest plot of daily steps between prefrail&frail group vs. non-frail group



QUALITY OF MOVEMENT: ACCELERATION PATTERNING ASSOCIATED WITH A PUSH UP

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PURPOSE: Muscular endurance (ME) is an essential component of exercise. ACSM recommends ME ability is best determined via Push Up (PU) test, where the individual raises their body by extending arms and lowers to “down” until chin touches the mat. Maximal numbers of PU are used to rank ME. Based on these criteria counting PUs can be subjective and based on observe skill. Because of individual movement variations, not all PUs may promote muscle endurance nor provide equal strengthening benefit. The aim of this study is to use triaxial accelerometry (TA) to create line graphs and observe differences in PU quality between individuals. **METHODS:** College-aged women (N=10) were fitted with low energy Bluetooth TA and asked to complete 5 straight leg PU’s using ACSM criteria. Acceleration data was graphed, values for each repetition time (msec) & Z-axis (m/s^2) were calculated for each subject. Using a single blinded approach where graphic analysis came first, researchers were able to identify impairments or compensations during the push-up including; head movement (HM), scapular winging (SW), lumbar lordosis (LL), pelvic movement (PM), and L-R imbalance(L/R). **RESULTS (See Table 1):** Substantial variation was found between individual PUs in this sample. More optimal PUs with less impairments had more consistent wave shape. Variation at the bottom, top, and concentric portion of the PU graphs was consistent with impairments observed on video. The high variability between repetitions and individuals during PUs decreases test-retest reliability and interrater reliability. **CONCLUSION:** Integrating measurement tools such as TAs into fitness assessments could lead to increased reliability and more accurate identification of exercise impairments. Because the PU assessment encapsulates numerous fitness-related factors such as motor control, muscular strength, core strength, and muscular endurance, more standardized measurements for quality of the PU could be clinically beneficial provide more robust assessment and programming.

Table 1

Subject	Average Repetition Time (msec)	Average Repetition Acceleration (g)	IDENTIFIED IMPAIRMENT
1	1.8(+/- .18)	0.95 (+/- .11)	SW, LL, PM
2	1.7 (+/- .13)	1.03 (+/- .11)	SW, HM
3	1.6 (+/- .12)	1.07 (+/- .12)	SW, HM, MP, LL
4	1.3 (+/- .29)	0.63 (+/- .06)	SW
5	1.51 (+/- .16)	0.82 (+/- .11)	SW, HM, LL
6	1.5 (+/- .18)	0.71 (+/- .04)	LL, L/R
7	1.3 (+/- .30)	1.25 (+/- .17)	LL
8	2.0 (+/- .18)	0.52 (+/- .05)	HM
9	1.4 (+/- .03)	1.3 (+/- .17)	LL, PM
10	1.3 (+/- .16)	1.3 (+/- .21)	LL, PM

INVESTIGATING THE IMPACT OF A BRIEF, HIGH-INTENSITY EXERCISE BREAK DURING PROLONGED GAMING ON ESPORTS PERFORMANCE

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Previous research shows that mental fatigue leading to decreased cognitive functioning may occur after 2 hours of continuous activity. This decline could be detrimental to esports athletes who may play for 3 or more hours at a time. Use of a moderate-intensity exercise break following 1 hour of gaming did not improve cognitive functioning more than continuous play. Increases in blood glucose levels are typically related to increases in cognitive functioning. Therefore, research should be done to investigate the relationship between glucose levels and cognitive function during long-duration gaming and how the use of an active exercise break may impact this relationship. **PURPOSE:** The purpose of this study was to investigate the impact of low-volume, high-intensity exercise during continuous gaming on esports performance compared to a passive break and to determine the relationship glucose levels and fatigue may have on cognitive function both with and without exercise. **METHODS:** Twenty subjects completed a familiarization trial before returning to the lab having fasted for 3 hours. Pre-measurements including blood glucose, perceptual fatigue, eye tracking, and accuracy and speed using the aim training platform, AimHero, were conducted. The participants played Apex Legends for 2.5 hours before completing either 4 minutes of exercise followed by 5 minutes of rest and a measure of exertion, or a 9-minute break in the control condition. After another 2.5 hours of gaming, participants completed the post-tests. Participants returned for the second trial after at least 24 hours. **RESULTS:** The main finding was a significant increase ($p < 0.001$) in fatigue in both conditions over 5 hours with a significantly greater ($p = 0.007$) decrease in pupil diameter in the control condition (con = -0.225 ± 0.210 , ex = -0.149 ± 0.166 mm) but with no differences in glucose (con = 94.05 ± 9.33 , ex = 98.30 ± 10.05 mg/dL, $p = 0.356$) or perceived fatigue (con = 5.18 ± 1.69 , ex = 4.47 ± 2.05 , $p = 0.719$) between conditions. However, there was no consequential decrease ($p > 0.05$) in aiming accuracy or speed in either condition. **CONCLUSION:** The findings suggest that long-duration gameplay results in increased levels of fatigue, but may not result in decreased game performance when a break is taken, despite whether the break is active or passive, but an exercise break may alleviate the increase in physiological fatigue.

PREDICTORS OF CAFFEINE CONSUMPTION PATTERNS IN HIGH SCHOOL ATHLETES

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Caffeine is the most widely used supplements by athletes. Caffeine's performance enhancing benefits include increased pain threshold, decreased perceived exertion, and performance benefits. Caffeine's benefits and accessibility have led to increased consumption in young athletes, despite limited research in this population and potential draw backs for youth consuming caffeine including sleep disturbances and fatigue. In addition, little research has been published examining the patterns of consumption. **PURPOSE:** The purpose of this study was to examine caffeine use among high school athletes and the factors that affect caffeine use, such as sex, age, and ethnic/cultural background. **METHODS:** Three hundred and ninety-seven Rhode Island high school athletes (age: 17.1 ± 1.2 years) completed a cross-sectional online survey to assess their supplement and caffeine usage. A multivariate logistic regression analysis was performed to characterize associations between use and non-use and independent variables that included ethnicity, grade, sex, and sport played. Confidence Intervals (CI) were calculated for all model parameter estimates. A separate ANOVA was run to compare caffeine consumption across grades. A value of $p \leq 0.05$ was set as statistical significance for all analysis. **RESULTS:** Across all subjects, 59% of variance in overall caffeine use related to the individual's ethnicity, grade, age, and sex based on the r-square value, with significant results for sex and ethnicity. 66.7% of young women consumed caffeine, compared to 38.2% of young men (95% CI, 0.27-0.55). 56% of athletes identifying as Caucasian reported caffeine use, compared to 33% of athletes from underrepresented backgrounds (95% CI, 0.86-4.44). Caffeine use increased monotonically, and 12th graders had a significantly higher consumption prevalence (49.1%) compared to all other grades (9th grade: 12.6%; 10th grade: 14.9%; 11th grade: 21.9%;). Coffee and energy drinks were the primary sources of consumption. **CONCLUSION:** Caffeine use among young athletes is related to factors including sex and ethnicity; and increases over time. Information from this study indicates high caffeine use by high school athletes, despite a lack of research examining sport performance efficacy in the teenage population. More research should be done to investigate the risks-benefits of caffeine consumption as it pertains to performance and possible side effects in this population.

Supported by: The Clean Competition Grant from the Rhode Island Foundation.

VETERANS' MOTIVATION, PREFERENCE, AND FEEDBACK AFTER COMPLETING NOVEL EXERCISE TREATMENT

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Abstract

Exercise treatments are essential for providing care for people with mobility limitations. However, patient perspectives on exercise treatments are often not investigated. **PURPOSE:** The purpose of this study was to evaluate how Veterans valued and perceived different components of a novel Physical Therapy (PT) treatment addressing mobility, motivation, and exercise adaptation. **METHODS:** This study was an ancillary study of an ongoing Randomized Controlled Trial among middle to older aged Veterans (≥ 50 years old) with slow walking speed. Structured participant satisfaction interviews were conducted after 8-week PT treatment. Mixed methods assessment was employed to evaluate rating-based responses and qualitative themes derived from open-ended responses. **RESULTS:** Twenty-three participants completed the interviews (average age 73 years, 96% male). Overall, participants were satisfied with the PT program (80%) and over 85% responded that PT program met its objectives by improving their mobility. All participants had a plan to continue exercising after the PT treatment. Factors that influenced Veterans' motivations for meeting their goals were 1) exercise instructor, 2) scheduled appointments, and 3) personal goals. Most participants rated aspects of behavioral coaching to be 'somewhat useful' or 'very useful'. Half of Veterans did not use the supplied exercise journal to keep track of their home exercises. A common reason for not using the exercise journal was having an exercise routine or tracking system that already worked for them. **CONCLUSION:** The PT treatment was well received among participating Veterans. All of them planned to continue their exercises after the treatment. Having a motivated instructor, scheduling treatment visits, and evaluating goals may help Veterans meet their long-term physical activity goals. Time and effort spent on behavioral coaching may be adjusted based on Veterans' baseline activity.

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MECHANISM OF ACTION OF INSTRUMENT ASSISTED SOFT TISSUE MOBILIZATION

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Instrument Assisted Soft Tissue Mobilization (IASTM) is a clinical method using specialized tools to treat skin, fascia, muscles, and tendons. Studies suggest it can enhance mobility and decrease pain. Although sometimes called a neuro-mobilization technique, research on how IASTM affects the neuromuscular system is limited. **PURPOSE:** To test whether and how IASTM modulates the nervous system in healthy young adults. **METHODS:** 18 healthy adults volunteered to participate in the study and signed informed consent approved by the IRB. Participants were randomly assigned to one of three equal groups (n = 6): control (C), sham (S), and instrument assisted soft tissue mobilization (IASTM). The IASTM group received 4-min treatment to the triceps surae. The S group received an intervention using the same strokes as IASTM, with a wooden tongue depressor and pressure less than 1N. The C group received no intervention. Maximal motor response (M_{max}) was recorded from the right soleus muscle by stimulating the tibial nerve. Stimulation intensity was reduced to 15% of the amplitude of M_{max} . Ten baseline H-reflexes were recorded. Following intervention, this same procedure was performed at 0-, 1-, 5-, 10-, 15- and 30- minute intervals. Data was normalized to respective baselines. A 3 x 7 repeated measure analysis of variance ANOVA with factors of GROUP and TIME was used to evaluate the effects of the IASTM on H-reflex amplitude. Statistical significance was set at $p < .05$. **RESULTS:** Analysis revealed a significant main effect of TIME ($F_{(5, 25)} = 6.76$, $p = .0004$), and significant interaction of GROUP x TIME ($F_{(10, 50)} = 2.64$, $p = .0011$). Post-hoc analysis showed significant effects between C vs. IASTM and S vs. IASTM (p 's < 0.001) indicating that IASTM inhibits H-Reflex 30- min post intervention. Data showed an inhibition trend starting at 5 min post intervention. **CONCLUSION:** These results demonstrate an inhibitory effect of IASTM on H-reflex, 30-min post intervention. Thus, use of IASTM may allow clinicians to inhibit the nervous system and appropriately utilize IASTM to manage conditions with excessive neuro-muscular tone. Further research with larger sample sizes is warranted.

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THE EFFECTS OF GRUNTING ON MAXIMAL VOLUNTARY ISOMETRIC HAND-GRIP FORCE

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The ability to generate maximal force in a short time is essential for athletes. Grunting during the execution of movements like throwing the shotput may improve muscle recruitment and force.

PURPOSE: The purpose of this study was to determine if grunting or thinking about grunting would increase maximal voluntary isometric contraction (MVIC). **METHODS:** 20 college aged individuals (12 male, 8 female) were subjects. Subjects were seated with the elbow of the dominant arm at 90° of flexion. Subjects performed 3 repetitions each of three conditions; 1) MVIC w/grunting, 2) MVIC w/o grunting and 3) MVIC w/the thought of grunting while using a hand-grip dynamometer. Repetitions for conditions were 3 seconds in length. Subjects rested 30 sec. between repetitions and conditions. MVIC w/grunting repetitions were valid if the lowest recorded decibel level was no less than 90% of the maximal decibel recorded. For the MVIC w/o grunting and MVIC w/the thought of grunting the maximal decibel level could be no more than 50% of the maximal decibel level recorded during the MVIC w/grunting. The three conditions were counterbalanced.

RESULTS: No significant interaction effect ($p=0.095$) was found for MVIC. A significant ($p=0.006$) between groups effect was found for the genders, males generated significantly more force than females. A significant ($p=0.00$) marginal effect was found for dB levels across conditions. Pairwise comparisons revealed that dB levels for both genders were significantly ($p=0.00$) greater during MVIC w/grunting. **CONCLUSION:** Subjects were significantly louder in MVIC w/grunting than in the other two conditions, there was no significant improvement in MVIC w/grunting. There appears to be no negative impact on force production when either males or females grunt while performing MVIC (Figure 1). In application it may be advisable instruct athletes to grunt or yell as loudly as possible when exerting maximal force is necessary.

Figure 1.



ACUTE EFFECTS OF PERCUSSIVE MASSAGE ON MUSCLE STIFFNESS, JOINT STIFFNESS AND FLEXIBILITY IN HEALTHY INDIVIDUALS

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Percussive massage involves rapid strikes to the muscle, in order to increase its blood flow and generate increases in range of motion or nutrient supply. However, the effects of this type of intervention on muscle tissue mechanical characteristics is still unclear. **PURPOSE:** To determine the acute effects of a handgun percussive massage on hamstring intramuscular stiffness, flexibility and knee joint stiffness in young healthy individuals. **METHODS:** Nineteen young healthy individuals (15 males and 4 females; age= 24.3 ± 3.7 yrs; mass= 80.7 ± 12.4 kg; height: 176.5 ± 8.7 cm), underwent 6 min of percussive massage along the length of each hamstring (3 min each leg) with a handgun. Before and after the massage the following measurements were taken: proximal, middle and distal biceps femoris passive muscle stiffness via Shear Wave Elastography (K_{BF}), passive knee stiffness via dynamometry (K_{Knee}) and flexibility via the Sit & Reach test (SR). Before the massage, repeated measurements (0, 10, 15, 30 min) were taken to serve as control (CTR) and repeated measurements were also taken after the massage (MAS: 0, 5, 10, 15, 30, 45, 60 min). A repeated measures ANOVA with Bonferroni post-hoc test was performed to determine changes from baseline in both conditions. **RESULTS:** For K_{BF} neither time effects (CTR: $P= 0.22$, $\eta= 0.07$; MAS: $P= 0.19$, $\eta= 0.08$) or location x time effects (CTR: $P= 0.11$, $\eta= 0.10$; MAS: $P= 0.27$, $\eta= 0.06$) were found for any condition. For K_{Knee} , no time effect between baseline and post-massage was found ($P= 0.09$, $\eta= 0.45$). In contrast, SR significantly increased from baseline in MAS at 30-, 45- and 60-min post-massage (25.36 ± 9.98 cm, 28.03 ± 10.17 cm, 28.27 ± 10.15 and 28.61 ± 9.97 cm respectively, $p < 0.05$, $\eta= 0.72$). **CONCLUSIONS:** Percussive massage causes acute increases in flexibility that are not explained by changes in muscle tissue material and mechanical properties. Studies investigating the long-term effects of this type of intervention are encouraged.

Support: The Therabody® company provided the device for the percussive massage.

ARE THERE RUNNING MOTION ABNORMALITIES ASSOCIATED WITH RUNNING-RELATED INJURIES

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Running-related injuries (RRI) are common with reported incidence and prevalence ranging from 19% to 92%. Because each runner has a unique running form, it is difficult to determine what constitutes normal and abnormal ranges of motion in running which may be associated with RRI. **PURPOSE:** The purpose of this was to compare the running motions of runners with and without RRI. **METHODS:** This retrospective comparative study included 50 runners who had never been injured (control group) and 105 runners who had experienced at least one RRI (RRI group). Running posture was analyzed using a motion analysis system (30 Hz, Exbody, South Korea). The forward head posture (FHP), trunk lean, hip rotation, horizontal movement of the center of gravity (COG), vertical movement of the COG, pelvic rotation, hip hike, step length, and type of strike were measured and compared. **RESULTS:** Univariate analyses revealed statistically significant differences in the FHP, horizontal movement of the COG, hip hike, horizontal movement of the COG, and step length between RRI and control groups (p -values < 0.05). The chi-square test for cross analysis showed that gender and the type of strike did not differ in their relationship with RRI. Logistic regression analysis showed that the measurements of FHP and left-right difference in hip hike were significantly associated with increased odds of injury occurrence (FHP, OR 1.521 95% CI 1.23-1.89; left-right difference in hip hike, OR 17.2, 95% CI 5.40-54.62). **CONCLUSION:** We found that the left-right balance of the pelvis and the spinal posture during running were associated with RRIs. In particular, injuries occurred more frequently when the left-right difference in hip hike was more than 3 degrees, or when the FHP was tilted for more than 9 degrees. Recognizing abnormal movements in runners through running motion analysis may aid in identifying runners at risk of injuries.

TITLE: EFFECTS OF SPIKE MIDSOLE FOAM AND BENDING STIFFNESS ON RUNNING ECONOMY AND MIDDLE-DISTANCE PERFORMANCE

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PURPOSE: The aim of the study was to quantify the effects of modern midsole foam on middle-distance performance and running economy (RE), both by itself and combined with a carbon-fiber plate. **METHODS:** Sixteen male trained runners completed four different visits on an outdoor track, running in three different spike conditions. We compared a traditional control spike (Control) to a spike with a modern midsole foam (PEBA) and to a spike combining a modern midsole foam with a carbon-fiber plate (PEBA+Plate). During the first three visits they performed 6 by 200m at self-perceived 800m race pace wearing each condition twice in a mirrored order (a-b-c-c-b-a) with 8 min rest between trials. Subsequently, they performed a 3,000m time trial using one of three shoe condition. During visit four, participants completed six 4 min trials at 19 km/h with each condition. Throughout the four visits, we measured performance (m/s for 200m repetitions and the 3,000m time trials) and RE (W/kg). **RESULTS:** The main effect for shoe condition was significant for speed at 800m pace ($p < 0.001$; $\eta^2 = 0.438$), speed during the 3,000m time trial ($p = 0.013$; $\eta^2 = 0.342$) and RE ($p < 0.001$; $\eta^2 = 0.694$; Figure 1). **CONCLUSION:** At 800m race pace PEBA+Plate resulted in 0.18 m/s (2.8%) faster 200m interval speeds compared to Control, but PEBA and Control were similar. However, speed during the 3,000m (1.8% and 3.3%) and RE at 19 km/h improved similarly in PEBA and PEBA+Plate compared to Control. Our results suggest that spikes with modern foams enhance performance and RE across middle distance and long-distance events. However, at mid-distance speeds the PEBA+Plate technology performed better than control, while modern foam alone did not significantly improve performance. This may be because when running at higher speeds, the effective longitudinal bending stiffness of the shoe needs to be higher (1).

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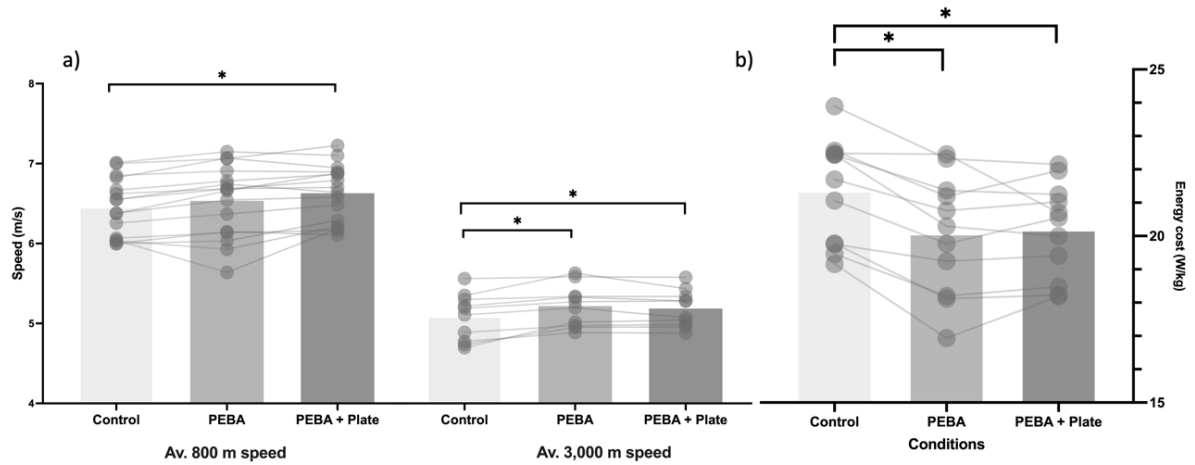


Figure 1. a) 800 m and 3,000 m average running speed; b) Running Economy ($\text{W}\cdot\text{kg}^{-1}$) at $19 \text{ km}\cdot\text{h}^{-1}$. $n = 12$. Bar graphs represent mean values and circles represent runners. $*p \leq 0.05$ during *post hoc* comparisons when main effect of footwear was significant.

EPIDEMIOLOGY OF INJURIES IN UNITED STATES HIGH SCHOOL TRACK AND FIELD JUMPING EVENTS FROM 2008-2019

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PURPOSE: To describe injury rates and patterns in high school track and field jumping events from a longitudinal national sports injury surveillance system in US high schools. **METHODS:** A descriptive epidemiological analysis was performed using data provided from the National High School Sports Related Injury Surveillance System, High School Reporting Information Online (RIO). Athletic Trainers (ATs) reported injury and exposure data through High School RIO: an internet-based sports injury surveillance system that captures data related injury and athletic exposures (AEs). Reportable injuries were those that occurred during a practice or competition, required medical attention, and limited the athlete's participation in a sport. Injury data from high jump, long jump, triple jump, and pole vault events were examined. Injury rate ratios (IRR) and injury proportion ratios (IPR) were calculated. **RESULTS:** A total of 727 track and field injuries due to a jumping event occurred during 5,486,279 AEs (1.33 injuries/10,000 AEs). Overall, the rate of jumping-related injuries in competition was significantly higher than in practice (IRR=2.63, 95% CI 2.25-3.06) and were significantly higher in practice for girls compared to boys (IRR=1.51, 95% CI 1.23-1.86). The most frequent site of a jumping-related injury was the thigh (20.3%) followed by ankle (18.2%), knee (16.1%), and lower leg (11%). The most common types of a jumping-related injury were muscle strain (29.0%) and ligament sprain (21.2%). Girls sustained a higher proportion of ankle injuries (IPR=1.63, 95% CI 1.15-2.32) and ligament sprains (IPR=1.55, 95% CI 1.16-2.09) than boys. Most athletes returned to activity within one week (43.1%, n = 312) or three weeks (34.7%, n = 243). Few jumping-related injuries resulted in medical disqualification for the season (4.4%, n = 31) or required surgery (4.9%, n = 35). **CONCLUSIONS:** Our findings suggest higher overall jumping-related injury rates during competitions versus practices with a greater rate of injury sustained during practice for girls. Most jumping-related injuries did not result in prolonged time away from sport. Muscular and ligamentous injuries of the thigh and ankle were most common, and female athletes experienced more ankle and ligamentous injuries. Results suggest the need for prevention strategies, particularly among female jumping athletes.

INTERACTION OF SLEEP, HORMONAL STATE, AND STRESS AMONG JUNIOR ELITE FEMALE SWIMMERS

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Quality and quantity of sleep impact and are impacted by psychological and physiological states. **PURPOSE:** The purpose of this study was to evaluate the relationships between (a) sleep quality and amount, (b) psychological state, and (c) a hormonal stress indicator in junior elite female swimmers across a competitive season. **METHODS:** As previously published (VanHeest et al., 2014), the groups were divided post-hoc into cyclic (CYC) and ovarian suppressed (OVS) based on estradiol and progesterone levels weeks 0 and 2. CYC (n=5) and OVS (n=5) female swimmers (15-17 yrs) were monitored over a 12-week season. Every two weeks, cortisol [CORT] (fasting blood sample) and stress sources and symptoms (Daily Analysis of Life Demands questionnaire [DALDA]) were assessed. Sleep duration (hours and minutes) and sleep quality (Lickert scale) were evaluated using an athlete daily diary. Swim performance was assessed every two weeks via 400m time trial. Two-way ANOVA (group X time) and post-hoc analysis was performed ($p \leq 0.05$). **RESULTS:** Sleep amount (average hours past week) was significantly greater in CYC versus OVS (~ 5 hours per week) across the season. At taper (Wk 12), CYC sleep duration was 10 hours longer than the OVS swimmers. Sleep quality was worse in the OVS compared to CYC across the 12-week season. OVS had significantly greater CORT than CYC across the 12-weeks, with the largest difference at Wk 6 when training demands were rapidly increasing. Sources of stress (DALDA-A) were significantly greater at all time points in OVS compared to CYC. Symptoms of stress (DALDA-B) under heavy training (Wk 2, 4 & 8) and taper (Wk 12) were higher in the OVS swimmers. **CONCLUSION:** Swimmers who exhibit ovarian suppression (due to low energy availability), appear to demonstrate lower sleep quality and quantity. Athletes who self-report elevated signs and symptoms of stress tend to have elevated stress hormones such as cortisol. Understanding the interrelationship of perceived stress, stress hormone status, and sleep dynamics remains critical to optimization of sport performance in elite athletes.

TIME-TO-CONTACT AS A MEASURE OF POSTURAL CONTROL DURING PREGNANCY: A CASE STUDY

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Although decreased postural stability during quiet standing has been associated with fall risk in pregnancy, the literature is equivocal on postural control changes during pregnancy and postpartum, suggesting a need for multi-dimensional postural control metrics. Time-to-Contact (TtC) is a metric that uses the position, velocity, and acceleration of the center of pressure (CoP) relative to the base of support (BoS) to quantify the time an individual has to redirect their CoP before a fall, with a longer TtC indicating greater control. **PURPOSE:** This case study aimed to evaluate TtC as a metric to investigate postural control during balance tasks of varying BoS during pregnancy and postpartum. We hypothesized TtC would 1) increase as pregnancy progressed, 2) decrease postpartum, and 3) increase with decreased BoS. **METHODS:** At 8, 14, 20, 26, 32, and 38 weeks gestation, and 6 weeks postpartum, the participant (31 years), who provided informed consent, balanced shod on a force plate for 30s in four stances with successively smaller BoS (side-by-side (SBS), semi-tandem (ST), full-tandem (FT), and single-leg (SL)). CoP (1000 Hz) and marker (200 Hz) data were collected to calculate TtC for the last 5s of each trial. A factorial ANOVA identified differences in TtC between timepoints and stances ($\alpha < 0.05$). **RESULTS:** Consistent with our first two hypotheses, across all stances, TtC increased as pregnancy progressed and decreased postpartum ($p < 0.001$, Fig. 1A), returning to 8-week levels for ST, FT, and SL (Fig. 1B). Contrasting our third hypothesis, SBS had longer TtC values than the other stances ($p < 0.001$, Fig. 1B); however, longer TtC were generally observed as mediolateral BoS decreased from ST to FT and SL. **CONCLUSION:** TtC was sensitive to changes in postural control as pregnancy progressed and to balance task. Increased TtC as pregnancy progressed suggests a need for greater control to meet increased balance demands.

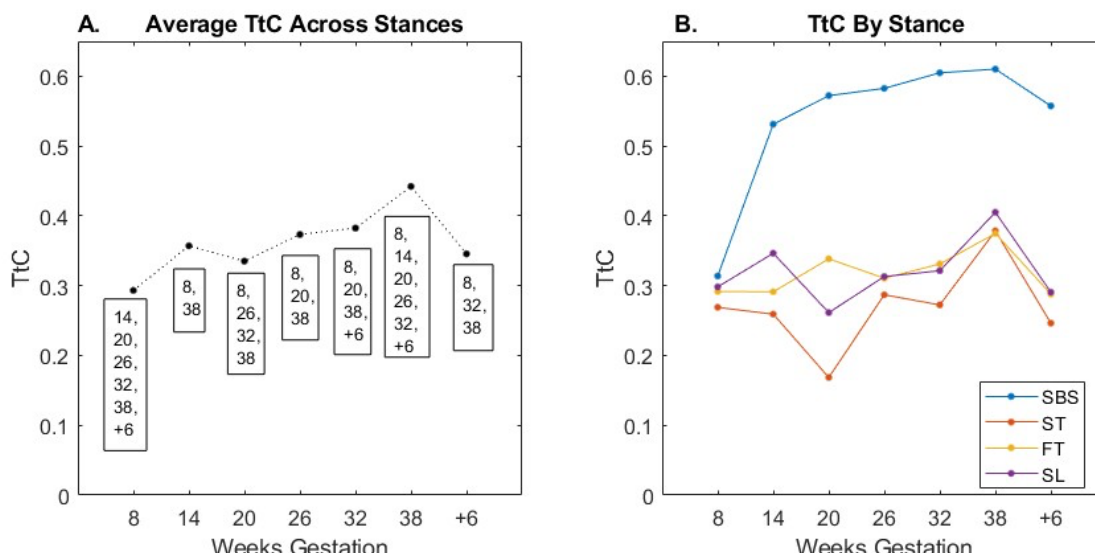


Figure 1. A. Average TtC across all stances. Significant differences in TtC from other timepoints are denoted below each datapoint. B. TtC across timepoints for each stance. For all stances, 38 weeks was significantly different than 8 weeks. For ST, FT, and SL, +6 weeks was significantly different than 38 weeks. For SBS, +6 weeks was significantly different than 8 weeks.

EFFECTS OF COLD STRESS ON THE OXYGEN COSTS OF INCLINE WALKING IN U.S. ARMY SOLDIERS

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Military operations often require warfighters to traverse steep slopes under prolonged cold stress. Yet the extent to which cold exposure impacts the oxygen costs of incline walking in modern military personnel is uncertain. **PURPOSE:** Evaluate the effects of cold stress on the oxygen costs of incline walking in U.S. military personnel. **METHODS:** Five U.S. Army Soldiers (4 males, 1 female; mean \pm SD; age, 26 ± 4 years; body mass (BM), 79.5 ± 20.3 kg; height, 172 ± 8 cm) completed three test visits at randomized temperatures (20, 10, and 0°C) while wearing shorts and t-shirt. Each visit included three 20-min treadmill walks that tested different combinations of speed (1.93-3.86 km·h⁻¹) and gradient (0-24%) at five matched vertical climbing speeds (0.00, 1.93, 3.86, 5.79, and 7.72 m·min⁻¹). Oxygen uptake measured by indirect calorimetry was divided by treadmill speed to determine the oxygen cost of walking. Heart rate was continuously monitored throughout each walk via Polar H1 heart rate monitor. Thermal sensation was measured during the final thirty seconds of each walk using a 9-point scale, with 4 indicating very hot and -4 indicating very cold. Significant pairwise differences between temperature conditions at matched speeds and gradients were assessed using a linear mixed effects model. **RESULTS:** Across all speeds and gradients, oxygen costs were significantly lower at 20°C (330 ± 112 mL·kg⁻¹·km⁻¹) compared to 10°C (343 ± 108 mL·kg⁻¹·km⁻¹) and 0°C (363 ± 97 mL·kg⁻¹·km⁻¹) ($p < 0.01$ for each). Heart rate was significantly higher at 20°C (100 ± 24 bpm) than 10°C (96 ± 23 bpm) ($p < 0.01$) but not significantly different than 0°C (101 ± 22 bpm) ($p = 0.15$). Thermal sensation was significantly higher (i.e., warmer) at 20°C (0.7 ± 1.2 a.u.) than 10°C (-0.9 ± 0.9 a.u.) and 0°C (-2.9 ± 0.8 a.u.) ($p < 0.01$ for each). **CONCLUSION:** Cold stress increases the oxygen costs of incline walking and intensifies the associated thermal sensation in U.S. military personnel. Identifying the impact of cold stress on oxygen cost improves the ability to anticipate and mitigate deleterious metabolic responses and subsequent performance decrements during dismounted military exercises.

The views expressed in this abstract are those of the authors and do not reflect the official policy of the U.S. Government, Department of Energy, Department of the Army, or Department of Defense.

THE ANALYSIS OF CADENCE AND VERTICAL OSCILLATION USING THE STRYD POWERMETER IN RUNNERS

Matthew Somma, Michael Lawrence, Georgia Karmue, Anna Lastra, Morgin Niedermeier, Alyssa Totzke, Gregory Violette

Running is among the most popular sport and recreational activities in the world. Large vertical oscillations (VO), the vertical movement of the body's center of mass, and a slow running cadence has been related to injury rates. Yet, accurate measurement of these measures in a clinical setting is difficult, as video analysis is not accurate. Wearable devices, such as the Stryd Power Meter™ (SPM) claim to provide these measures, however these claims have not been validated. **PURPOSE:** To determine the reliability and validity of the SPM to measure running cadence and vertical oscillation in recreational runners against a three-dimensional motion capture system. **METHODS:** Twenty healthy individuals (five males, 15 females; age: 24.5 ± 1.5 yr; mass: 67.1 ± 12.2 kg; height: 1.66 ± 0.01 m) were fitted for motion capture and two SPM devices. After warmup, participants ran at self-selected speed on treadmill for five minutes for each condition (self-selected cadence, +5% increased cadence, and +10% increased cadence). Changes in cadence were utilized to produce changes in both running cadence and VO. Average cadence and VO was measured for each condition with motion capture and the two SPM devices independently. Validity and inter-device reliability was assessed. **RESULTS:** Reliability for cadence between SPM devices was excellent (ICC = 1.00, $p < 0.001$), with a near perfect correlation ($r = 0.999$, $p < 0.001$). There was a significant difference in cadence between the SPM and motion capture ($p=0.046$) but the magnitude is trivial ($d=0.02$). Differences in VO between SPM and motion capture were significant ($p < 0.001$) with a very large effect size ($d = 2.63$), but data showed a large correlation ($\rho = 0.738$, $p < 0.001$) with near perfect reliability (ICC = 0.999, $p < 0.001$). **CONCLUSION:** The SPM can accurately measure and detect changes in cadence. It is unable to accurately measure VO but can moderately detect a change in VO with a change in cadence. These findings suggest that the device may be used to accurately measure cadence and if individuals are looking to make changes in VO in the clinical setting.

Effects of leg extension range of motion on proximal vs distal vastus lateralis microvascular response

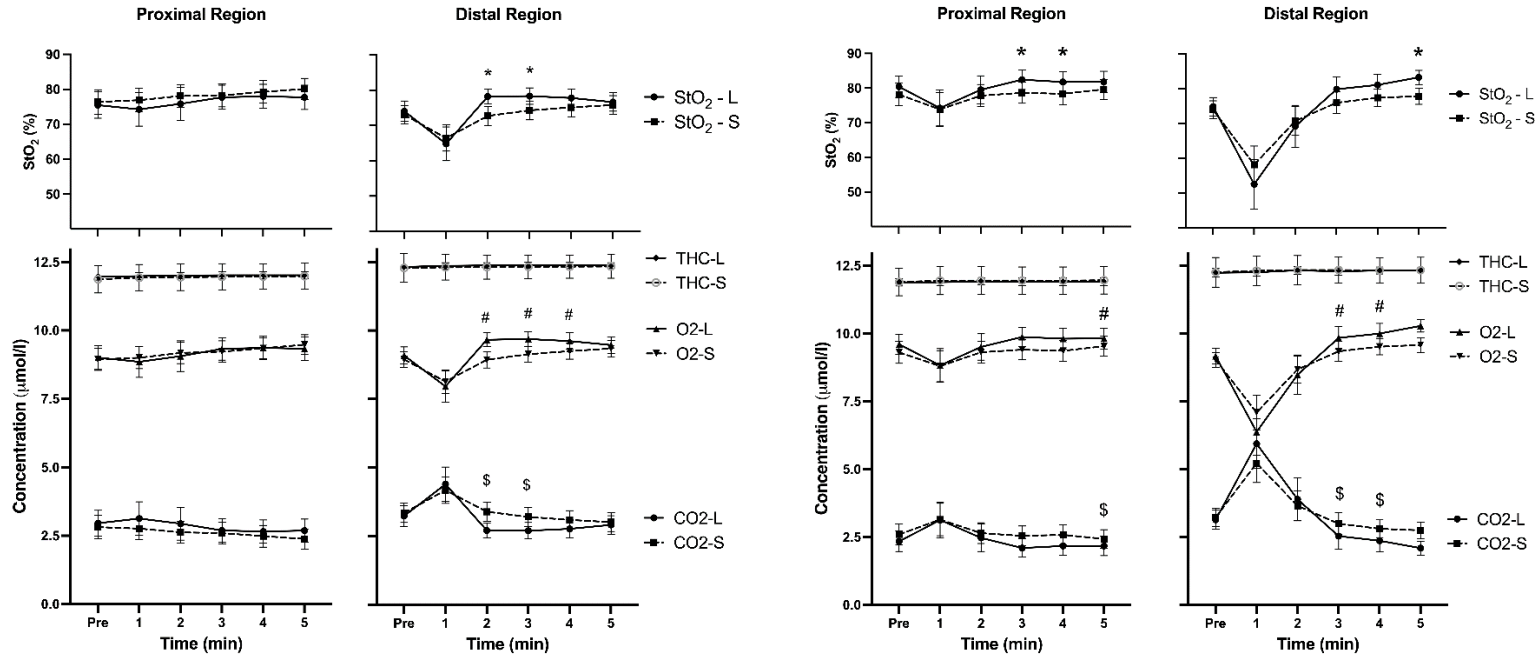
Nathan Steinberg, Catherine Fandel, Robert Bunis, Tom Kuriakose, Terrell Figaro, Davina Robinson, Carlos Rehbein, Jacob E. Earp

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Near-infrared spectroscopy (NIRS) can measure a muscle's microvascular response to exercise. This response varies along the muscle proximo-distally and is predictive of regional hypertrophy. While range of motion (ROM) is an essential factor of any exercise, its effects on regional microvascular response are unknown. **PURPOSE:** To compare the effects of ROM on regional microvascular response. **METHODS:** Twenty-one healthy, active participants performed both isokinetic (IK) and isometric (IM) leg extensions utilizing contralateral limbs. A set of 10 repetitions was performed for IM and IK at both short and long muscle lengths, resulting in 4 exercise conditions. Each set was separated by 15 min. IK was performed at 30°/s between 30-75° (short muscle length) and 75-120° (long muscle length) knee flexion. IM was performed with 70% of previously assessed maximal isometric strength at 55° (short length) and 95° (long length). Vastus lateralis microvascular response was measured at 33% (proximal) and 67% (distal) thigh length using NIRS with changes in oxygen saturation (StO₂), oxygenated hemoglobin (O₂), and deoxygenated hemoglobin (CO₂) reported in one-minute averages for 5 minutes post-exercise. These results were then compared using separate 2x2x5 (muscle length x muscle region x time) repeated measures MANOVAs with Bonferroni post-hoc tests for IM and IK. **RESULTS:** The overall microvascular response did not significantly differ between proximal and distal regions when leg extensions were completed in either exercise condition (IK: p=0.251-0.266, IM: p=0.075-0.086). However, post-hoc analysis revealed a greater physiological response distally when the exercise was performed at long muscle length versus short muscle lengths as evident by a greater hyperoxic response 1-3 min post exercise in IK and 2-3 min post exercise in IM (p<0.05). **CONCLUSION:** Performing leg extensions with greater knee flexion (long-muscle length) resulted in a greater distal microvascular response. These results suggest that ROM inhomogeneously stresses the muscle in a manner which may affect patterns of hypertrophy.

Isokinetic

Isometric



Regional microvascular response during isokinetic (left) and isometric (right) exercise performed at long (L) and short (S) muscle lengths (n=21). Changes in oxygen saturation (StO_2) and total (THC), oxygenated (O_2) and deoxygenated (CO_2) hemoglobin concentrations are reported. Significant differences are depicted for StO_2 (*), O_2 (#), and CO_2 (\$).

SEX DIFFERENCES IN THE EFFICACY OF THE sHORT BOUts OF eXERCISE FOR pRESCHOOLERS (step) INTERVENTION

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INTRODUCTION: Physical activity (PA) has been shown to have both short and long-term benefits for preschool-aged children (3 – 5 years of age). However, most preschoolers do not meet PA guidelines. As with older children and adolescents, female preschool-age children tend to participate in less moderate-to-vigorous PA (MVPA) than their male counterparts. However, it is unclear if this sex difference persists during PA interventions. **PURPOSE:** The purpose of this study was to examine sex differences in the efficacy of a 6-month intervention designed to improve the PA levels of preschool-age children using short bouts of PA. **METHODS:** This secondary analysis used data [baseline and 3-month (midpoint)] from the Short bouTs of Exercise for Preschoolers (STEP) study, which examined the efficacy of a short-bout PA intervention in preschoolers. The intervention was delivered 10 minutes per day, four days per week for six months. PA was assessed with accelerometers during the preschool day. An ANOVA was used to examine biological sex differences in changes in percent time spent in different PA intensities (sedentary, light, moderate, vigorous, and MVPA) from baseline to midpoint during the preschool day. **RESULTS:** Participants were included in this secondary data analysis if they had both baseline and midpoint PA data (boys, n=65 and girls, n=76). The intervention was significantly more effective in increasing boys' percent of time spent in vigorous PA ($p<0.01$) and MVPA ($p=0.02$) compared to girls. There was no significant difference in intervention efficacy between boys and girls for any other PA intensities. There was no significant interaction between biological sex and timepoint. **CONCLUSION:** The results of this analysis are consistent with the literature that boys are more physically active than girls. While both boys and girls are not meeting PA recommendations, interventions are needed to target girls specifically to close the gap to their male counterparts.

The STEP study was funded by: Robert Wood Johnson Foundation

EVALUATION OF SPORTS PERFORMANCE RECOVERY METHODS USED BY HIGH SCHOOL ATHLETES

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The utilization of recovery modalities has been widely researched among adult populations, however, uncertainty remains regarding the extent to which high school athletes are exposed to and practice recovery methods. **PURPOSE:** This study aimed to conduct an exploratory investigation into the utilization of recovery modalities among high school athletes in Rhode Island. **METHODS:** Three hundred ninety-seven Rhode Island high school athletes between the ages of 14-19 (age: 17.1±1.2 years) were invited to complete a cross-sectional online survey to assess their sport recovery and nutritional supplementation knowledge. Bivariate analyses comparing pairs of categorical variables were conducted using chi-squared tests with statistical significance set to a p -value of $p \leq 0.05$. **RESULTS:** Ice baths were the preferred method of recovery and the only one that was significantly different between modalities. Overall, chi square analysis revealed male high school athletes utilized ice baths as a recovery strategy significantly more when compared to their female counterparts. Within categories, male basketball players (6.8%), soccer players (4.5%) and cross-country athletes (3.5%) reported using ice baths significantly more often than other athletes. In contrast, within female high school athletes, 2.0% lacrosse, 2.0% of cross-country runners and 1.8% of basketball players utilized ice baths at a significantly higher frequency than other athletes. Despite 39.5% of young athletes reporting access to a sports performance specialist, such as a Certified Strength and Conditioning Specialist or a nutritionist, this access did not have an impact on recovery modality choice. Furthermore, it is worth noting that less than 2.0% of high school athletes reported that they incorporate nutritional practices as a part of their recovery regimen. **CONCLUSIONS:** The majority of these recovery modalities have produced conflicting results in studies involving adult athletes and have not yet been thoroughly explored in high school populations. Additionally, while nutritional practices are thought to have a significant role in recovery by researchers, few high school athletes incorporate this into their recovery strategies despite one-third of them having access to a nutritionist. Future research and educational programs should be designed to investigate and disseminate information on evidence-based recovery strategies in teenage athletes.

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ACCURACY OF BODY MASS INDEX VS BOD POD WHEN ASSESSING BODY COMPOSITION: A PILOT STUDY

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PURPOSE: This study challenges the Body Mass Index (BMI) chart and its validity as a body composition assessment tool. Using air displacement plethysmography (Bod Pod) as a reference method, we evaluated the correlation between BMI and %body fat (%BF) obtained by the Bod Pod. **METHODS:** Eighteen participants (9 male, 9 female; 19-85 years) underwent %BF assessment using the Bod Pod. Height and weight were measured and used to calculate BMI. **RESULTS:** Measurements obtained were used to categorize both BMI and %BF values, resulting designated categories were compared individually. We observed the most agreement of %BF with BMI when someone falls into the “Obesity” category ($> 30.0 \text{ kg/m}^2$). When the BMI places a person in the “Underweight” category the Bod Pod places them in the “Very Lean” category. Within the Bod Pod the average female body fat percentage was 34.64%, obese. The average male body fat percentage was 24.12%, overfat. The average BMI measured was 27.61 kg/m^2 , the overweight category, while the range was $18.51\text{-}39.81 \text{ kg/m}^2$. A significant positive correlation was found between BMI and BF% in males ($r = 0.79, p < 0.05$), and in females ($r = 0.76, p < 0.05$). **CONCLUSIONS:** BMI correlates strongly with the %BF obtained by the Bod Pod when the person is considered Obese. Our findings suggest that BMI will categorize someone as “overweight” more than the Bod Pod would.

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EXERCISE-HYPOGONADAL MALE CONDITION: LESSONS FROM ELITE MALE SWIMMERS

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Competitive male athletes may experience low energy availability (LEA) resulting in Exercise-Hypogonadal Male Condition (EHMC). Although energy status in female athletes has been investigated for decades, less data exists for male athletes. **PURPOSE:** We examined how energy deficiency contributes to endocrine problems, such as suppression of the HPG axis, in elite male swimmers across a training period. **METHODS:** Six elite caliber (Olympic) male swimmers (21-23 yr) were evaluated 8 times across a season (~monthly) for the following parameters: triiodothyronine (TT3), insulin-like growth factor-1 (IGF-1), testosterone (TEST), and swim performance (200m max effort: VEL). Athletes were categorized into normal (N) or TEST deficient (TD) groups, based on testosterone values, with TD having a TEST <10.4 nmol/l at any point. ANOVA and Tukey post-hoc was used ($p < 0.05$) to determine differences. **RESULTS:** Metabolic indicators of LEA were significantly different across the training period (TT3 lower in TD at time 5, 6, & 7 and IGF-1 in TD at time 6 & 7). There were group differences in TEST at times 2 through 8 with N having 4-7 nmol/l higher values compared to TD. At the end of taper (time 7), TEST and TT3 were significantly correlated ($R^2 = 0.75$; $p = 0.02$). **CONCLUSION:** Our study demonstrated EHMC in elite male swimmers across a training year. EHMC was characterized by low TT3 and TEST in these athletes at various time points throughout the season. However, a performance reducing effect of EHMC in this group was not evident, potentially due to the transient nature of EHMC in these swimmers. Visual assessment of individual athletes with EHMC indicated a decline in performance associated with decreased TEST and TT3. The data supports the need for both coaches and athletes to be aware of their energy and hormonal status to avoid EHMC and to optimize training responses.

COMPARING TWO DIFFERENT EXERCISE PRESCRIPTION METHODS TO INCREASE PHYSICAL ACTIVITY AMONG COLLEGE STUDENTS

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Most Americans do not meet the physical activity (PA) guidelines of 150 min of moderate and/or 75 min of weekly vigorous-intensity aerobic exercise or a combination of both and 2 d/wk of resistance exercise. Thus, there is a call for scalable and easily implemented strategies to increase PA. **PURPOSE:** To compare two different exercise prescription (ExRx) methods for increasing PA with the message: ExRx#1, meet the PA guidelines, or ExRx#2, perform as much PA as possible of any intensity, time, and type. We hypothesized ExRx#2 would increase PA more than ExRx#1 over the 12 wk intervention. **METHODS:** Healthy college students (n=78) were enrolled and randomized to ExRx#1 (n=39) or ExRx#2 (n=39). Of these, 53 students (24.0±5.1 yr, 25.1±3.6 m•kg⁻²) began the intervention (ExRx#1 n=29; ExRx#2 n=24) of which 71% were females who performed ≤2 d of structured PA in the last 12 wk. We measured PA via accelerometry and Timeline Followback (TLFB-E) at baseline and 12 wk. RMANCOVA tested differences within and between groups. **RESULTS:** At baseline, via accelerometry, ExRx#1 performed 93.1±46.5 min/d of moderate-vigorous intensity (MVPA) PA and ExRx#2 performed 91.4±46.5 min/d of MVPA, with no difference between groups (p=0.92). Over 12 wk, via accelerometry, MVPA min/wk was not different from baseline for ExRx#1 and ExRx#2 (ps>0.05). Over 12 wk, via TLFB-E, ExRx#2 performed 1.1±3.1 more PA sessions/wk (3.2±1.5) than ExRx#1 (2.1±1.5, p=0.049). **CONCLUSION:** When assessed by accelerometry, PA was not different from baseline, regardless of ExRx method, whereas frequency increased ~1 d/wk more in ExRx#2 than ExRx#1 via TLFB-E. Our findings illustrate the importance of utilizing both objective and self-report PA assessments to capture the different PA behaviors that may be influenced by different ExRx methods.

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HABITUAL PHYSICAL ACTIVITY AND NIGHT-TIME VASOMOTOR EXPERIENCES IN PERIMENOPAUSAL WOMEN

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Vasomotor symptoms (VMS), including hot flashes (HF) and night sweats (NS), disturb sleep. However, the independent effect of NS and HF on disturbed sleep is unclear. Further, the role of habitual physical activity (PA) on nighttime-HF and NS is unexplored. **PURPOSE:** To perform an exploratory analysis on the prevalence of VMS, night-time HF, and NS and their influence on sleep in a sample of high- and low-active perimenopausal people. **METHODS:** Higher- and lower-active perimenopausal people aged 43-55 were recruited for this study. Higher-PA was defined as ≥ 1500 MET min/wk vigorous activity or ≥ 3000 MET min/wk any activity (N=27) and lower-PA as < 150 min/wk of moderate activity or < 75 min/wk of vigorous activity (N=22). Participants wore sternal skin conductance monitors to measure number of VMS, HF and NS for 24 hours on 2 occasions, which were normalized for sleep time. The percentage of sleep time spent sweating was also calculated. Participants with non-zero counts for VMS/HF/NS were considered symptomatic for the corresponding symptom. The number of awakenings (NoA) was determined by actigraphy (ActiGraph wGT3XBT). Statistical analysis was performed using R studio (V2023.06.1+421). Chi-square tests were used to compare VMS/HF/NS prevalence between Higher- and Lower-PA groups. Wilcoxon tests were used to compare symptom rates between symptomatic groups. Pearson correlations tests were used to assess symptom correlations with NoA. **RESULTS:** There was no difference between Higher vs. Lower-PA groups in prevalence of VMS (81% vs. 77%, $p=0.72$), HF (46% vs. 38%, $p=0.56$), or NS (70% vs. 78%, $p=0.59$). In symptomatic people, the percent of time sweating at night was lower in Higher-PA ($13.1\% \pm 10\%$ vs. $27.5\% \pm 21\%$, $p=0.014$) with no difference in the number of NS (Higher= 0.31 ± 0.20 , Lower= 0.383 ± 0.24 , $p=0.6744$). There was no difference in VMS (Higher= 0.526 ± 0.31 , Lower= 0.468 ± 0.31 , $p=0.81$), or HF (Higher= 0.413 ± 0.29 , Lower= 0.500 ± 0.20 , $p=0.79$) between groups. There were significant correlations between HF and NoA ($r=0.62$, $p=0.01$), and VMS and NoA ($r=0.37$, $p=0.05$), but not between NS and NoA ($r=0.15$, $p=0.50$). **CONCLUSION:** Habitual PA appears to influence NS. However, HFs, but not NS, were associated with sleep disruption in menopausal women.

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COMPREHENSIVENESS, ACCURACY, AND READABILITY OF EXERCISE RECOMMENDATIONS PROVIDED BY AN ARTIFICIAL INTELLIGENCE-BASED CHATBOT

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Regular physical activity is critical for health and disease prevention. Yet healthcare providers and patients face barriers to implement evidence-based lifestyle recommendations. The potential to augment care with the increased availability of artificial intelligence (AI) technologies is limitless, however, the suitability of AI-generated exercise recommendations has yet to be explored. **PURPOSE:** The purpose of this study was to assess the comprehensiveness, accuracy, and readability of individualized exercise recommendations generated by a novel AI chatbot (i.e., ChatGPT). **METHODS:** A coding scheme was developed to score AI-generated exercise recommendations across ten categories informed by the American College of Sports Medicine's gold-standard exercise recommendations, including: 1) health condition-specific benefits of exercise; 2) exercise pre-participation health screening; 3) frequency; 4) intensity; 5) time; 6) type; 7) volume; 8) progression; 9) special considerations; and 10) references to primary literature. The AI chatbot was prompted to provide individualized exercise recommendations for 26 clinical populations using an open-source application programming interface. Two independent reviewers coded AI-generated content for each category and calculated comprehensiveness (%) and factual accuracy (%) on a scale of 0-100%. Readability was assessed using the Flesch-Kincaid formula. Qualitative analysis explored themes from AI-generated output. **RESULTS:** AI-generated exercise recommendations were 41% comprehensive and 91% accurate, with the majority (53%) of inaccuracy related to the need for exercise pre-participation medical clearance. Average readability level of AI-generated exercise recommendations was at the college level, with an average Flesch reading ease score of 31.1. Several recurring themes and observations of AI-generated output included concern for liability and safety; preference for aerobic exercise; and potential bias and discrimination towards certain age-based populations and individuals with disabilities. **CONCLUSION:** There were notable gaps in comprehensiveness, accuracy, and readability of AI-generated exercise recommendations. Exercise and healthcare professionals should be aware of these limitations when using and/or endorsing AI-based technologies as a tool to support lifestyle change involving exercise.

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