

GAME CHANGERS

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THE EFFECT OF A ROTATOR CUFF STRENGTHENING PROGRAM ON SHOOTING ACCURACY

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Lewinski and colleagues (2015) examined the level of shooting accuracy demonstrated by law enforcement recruits upon completion of their law enforcement firearms training in comparison with novice shooters. The authors found that the officers had no advantage over intermediate shooters, and a small advantage over novices. It is important that officers perform at their highest level when shooting, and rotator cuff (RC) strength may play a role in that performance; however, there is limited research in that area. **PURPOSE:** The purpose of this study was to examine the effect of an 8-week RC strengthening program on shooting accuracy. **METHODS:** Twenty-one healthy officer recruits (19 males and 2 females; age= 22 ± 0.63 yrs; pre-test weight= 85.1 ± 13.78 kg; height= 179.64 ± 7.92 cm) participated in the study and were randomly assigned to the control or RC exercise group (RCEG) upon completion of their pre-test shooting assessment. The pre-test shooting assessment allowed the researchers to classify the recruits as novice, intermediate, or experienced. Both groups participated in daily academy PT sessions, and the RCEG was given an additional 8-week RC strengthening program. Exercises for this program were completed 3x per week. Pre- and post-test scores for shooting accuracy, and measurements of RC strength using a hand-held dynamometer (MicroFET2; kgf), and handgrip strength (kg) were completed. **RESULTS:** A two-way ANOVA with repeated measures showed significant differences ($p > .05$) between pre-test shooting accuracy (213.77 ± 42.02) and post-test shooting accuracy (230.62 ± 28.39) values for both groups; however no significant ($p < .05$) differences were found between the control and RCEG. No significant ($p < .05$) differences in post-test grip strength and RC strength were found between the control group and RCEG. **CONCLUSIONS:** While the 8-week RC strengthening program did not improve shooting accuracy, the findings suggest that some component of training over the 8- weeks improved shooting accuracy in both the control and the RCEG. One plausible rationale is that the academy PT sessions had a positive influence on shooting accuracy; however, more research is needed to determine the cause of increased accuracy.

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COMPARISON OF DEVICE-DETERMINED PHYSICAL BEHAVIOR ESTIMATES IN OLDER ADULTS

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Numerous methods for processing ActiGraph (AG) tri-axial accelerometer data in adults exist. However, it is unclear if estimates of time spent in various physical behavior intensity categories (i.e., sedentary behavior/sleep (SB/SL) and light- (LPA), moderate- (MPA), and vigorous-intensity (VPA) physical activity) varies according to the method applied. **PURPOSE:** To compare outputs from multiple data processing techniques (vertical axis and 3-axes cut-points, raw vector magnitude thresholds) applied to older adults' AG data. **METHODS:** Older adults (N=65, 56.9% females; mean age=70.34±6.45 years) wore an AG on the right-hip for one week, including sleeping periods. Raw (80 Hz) and count data were filtered for wear-time using the Choi algorithm and only participants with ≥ 4 days with ≥ 10 -hours of wear-time/day were retained for analysis. Raw and count-based data were processed using five methods to derive estimates of time spent in intensity categories. One-way ANOVAs tested differences between the method estimates for each physical behavior intensity category. **RESULTS:** Across intensity categories, most estimates were significantly different ($p<0.05$) from each other. Notably, the Sasaki cut-points produced the fewest minutes spent in SB/SL (728 min/d), while the Hildebrand cut-points produced the greatest minutes in that category (1085 min/d). The Crouter model produced the fewest minutes spent in VPA (0 min/d), while the Sasaki cut-points produced the greatest minutes in that category (44 min/d). **CONCLUSION:** The estimated time spent in different physical behavior intensity categories varied considerably depending on the method applied to AG data. Research studies should move towards the harmonization of existing methods.

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Keywords: Physical Behaviors, Older Adults, Accelerometry

PREDICTING EXHAUSTION DURING LOAD CARRIAGE EXERCISE USING HEART RATE THRESHOLDS

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Heart rate (HR) is a cardiorespiratory predictor of exhaustion in Soldiers during heavy load carriage exercise. Identifying HR fatigue thresholds that are applicable for a variety of military load carriage modalities and mass configurations may allow for improved work/rest guidance in dismounted Soldiers. **PURPOSE:** Determine HR thresholds for predicting exhaustion during load carriage exercise that varies in total mass and distribution of the mass carried. **METHODS:** Six females and 34 males (mean \pm SD; age, 26 ± 7 years; body mass (BM), 79.7 ± 15.8 kg; height, 175 ± 8 cm) completed incremental load carriage walking tests at speeds from 1.16-1.97 m·s⁻¹ while carrying loads ranging between 0-66% BM with either the Modular Lightweight Load-Carrying Equipment (MOLLE) 4000 rucksack (n = 24) or a weighted vest (n = 16). Trials were terminated if the participant was unable to continue walking or exceeded a respiratory exchange ratio ≥ 1 . The Equivital EQO2+ chest belt physiological status monitor was used to measure HR as absolute (beats per minute, BPM) and relative to maximum (% HR_{max}) and reserve (% HRR). Receiver operating characteristic (ROC) curves were created for each of the HR measures to determine optimal thresholds to predict exhaustion during load carriage exercise. Optimal thresholds were identified for each HR measure as the highest calculated Youden index (J, sensitivity + specificity - 1). **RESULTS:** Optimal thresholds for predicting exhaustion were 137 BPM (J = 0.63), 73% HR_{max} (J = 0.66), and 65% HRR (J = 0.68). **CONCLUSION:** Heart rate work intensity guidance is an effective approach to mitigate exhaustion when carrying contemporary military loads. Scaling measurements to maximal and resting HR improves predictions of exhaustion and may limit subsequent performance decrements.

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.

COMPARING LIFESTYLE BEHAVIORS AND BODY COMPOSITION IN COLLEGE STUDENTS WITH AND WITHOUT HEALTH-RELATED MAJORS

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There are many lifestyle behaviors related to body fat percentage in college students, including physical activity, sleep, and screen time. College students in health-related (HR) majors may learn and apply more healthy lifestyles than college students in majors not focused on health (NHR). **PURPOSE:** To determine the differences in body composition, sleep, physical activity, and screen time in college students who are in the College of Health and Human Services (CHHS) at the University of New Hampshire and students who are in other colleges across the university. **METHODS:** Fifty-two college students (25 males, 27 females, aged 19.7 ± 1.4 years) from health-related majors ($n=21$) and non-health-related majors ($n=31$) participated. Participants ranged from freshmen to graduate students. They had their body weight, body fat percentage, body mass index, and skeletal muscle mass measured on the InBody 770 and then completed a screen-time questionnaire, University Student Physical Activity and Sedentary Behavior Questionnaire, and The Pittsburg Sleep Quality Index (PSQI). Data were analyzed using independent t-tests and Chi Square tests. **RESULTS:** Percent body fat and skeletal muscle mass were similar between HR and NHR majors ($p=0.487$ and $p=0.681$) and averaged $19.8 \pm 8.5\%$ and 31.5 ± 7.8 kg, respectively, for the entire sample. PSQI scores were higher, indicating poorer sleep, in NHR majors compared to HR (6.84 ± 2.8 vs 5.14 ± 2.5 ; $p=0.031$). Screen time scores were similar between majors ($p=0.586$) and averaged 1190 ± 513 minutes per week. Over 90% of the sample believed that they achieve sufficient levels of physical activity on most days with no differences between majors. There was a significant difference in the response to “Do you think you are currently sitting most of the day” between HR and NHR students ($\chi^2=9.9$, $p=0.044$) as 39% of NHR majors responded Yes while 5% of HR majors reported Yes. **CONCLUSION:** Body composition and lifestyle behaviors among NHR and HR students were rather similar, however, HR students tend to report better sleep and sit less throughout the day than NHR students. Both better sleep and less sitting time throughout the day could contribute to a healthier lifestyle in HR students than NHR students.

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THE EFFECT OF REFLEXIVE PERFORMANCE RESET ON RANGE OF MOTION AND HANDGRIP STRENGTH

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A warmup and cool down is critical to optimize sport performance. Reflexive Performance Reset (RPR) has the potential to be an optimal warm up that can be done in a short period of time.

PURPOSE: The purpose of this study was to investigate the effect of RPR on range of motion and handgrip strength. **METHODS:** 28 men and women participated in the study (age: 21 ± 2 years, height: 169 ± 11 cm, weight: 72 ± 46 kg, body fat: $23.7 \pm 9.8\%$, BMI: 24.9 ± 5.6). Subjects completed RPR, acupuncture (ACU), and placebo (PL) sessions in a randomized order, separated by 24 hr. Range of motion and handgrip strength were measured pre and post intervention.

RESULTS: Hip extension, ankle dorsiflexion, shoulder abduction, shoulder flexion, and right side handgrip improved following RPR compared to ACU and PL ($p < 0.05$). **CONCLUSION:** This study provides evidence that RPR can increase range of motion and handgrip strength. Future research is needed to investigate the effect of RPR on performance variables.

EFFECTS OF DISCRETE EXERCISE ON STRESS AND ANXIETY IN SEDENTARY ADULT WORKERS. A FEASIBILITY STUDY.

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Sedentarism increases the risk of weight gain, cardiometabolic diseases, and a variety of mental health illnesses. Working adults have been shown to accumulate the most hours of sitting per day, which has increased since the onset of the COVID-19. Exercise programming that is discrete, low cost, and requires minimal equipment in an office setting must be considered for working adults. **PURPOSE:** The purpose of this study was to determine the feasibility of a 4-week, bodyweight (BW)/isometric (ISO) exercise program on sedentary working adults and its effects discrete exercise on self-reported stress and anxiety. **METHODS:** A total of 10 participants met inclusion criteria. Participants reported to the laboratory on two separate occasions for pre and post testing and completed a 4-week virtual exercise program (3 sessions·wk⁻¹; 12 total sessions). During pre-and post-testing, resting measures were taken, and questionnaires (Hospital Anxiety and Depression Scale [HADS] and Perceived Stress Scale [PSS]) and physical testing (Hand Grip Test [HGT] and Timed-Up-and-Go [TUG]) were performed. At the conclusion of the pre-test session, all participants were familiarized with the BW/ISO exercises used in the program. The program included 11 exercises (6 BW and 5 ISO). The OMNI-RES was used to gauge ISO exercise intensity. Intensity progressively increased in sets and reps for BW and in OMNI-RES for ISO exercises. At the beginning of each session, participants recorded their Visual Analogue Scale (VAS) for stress and if all exercise were completed. Descriptive statistics were used for all demographic variables and resting measures. One-tailed, Dependent T-tests ($p < 0.05$) were used to compare pre- and post-means for blood pressure, HADS, PSS, HGT, and TUG. **RESULTS:** A total of 7 participants completed 91% of all sessions with a total of 97% of all sets and reps programmed were fully executed. Participants exhibited significantly lower diastolic blood pressure a reduction in PSS, a trend toward significance for HADS-anxiety scores, improved TUG and righthand HGT scores. **CONCLUSION:** Discrete BW and ISO virtual exercise programs are feasible for sedentary working adults in an office setting and may be beneficial for improving blood pressure, perceived stress, and possibly anxiety.

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EFFECTIVENESS OF A 6-WEEK GAIT RETRAINING PROGRAM ON A COLLEGIATE FEMALE RUNNER WITH CHRONIC EXERTIONAL COMPARTMENT SYNDROME

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Chronic exertional compartment syndrome (CECS) is an exercise-induced condition associated with increased intramuscular pressure that compromises circulation, prohibits muscular function, and causes lower leg pain. Currently, there is a lack of evidence for effective conservative treatments. One option that has shown increasing promise is the alteration of running technique to a non-rearfoot running strike. The effectiveness of a six-week gait retraining program in military personnel has been demonstrated, more research is needed within the running community. **PURPOSE:** The purpose of this case study was to utilize an intervention of gait retraining to avoid surgery and return to pain-free running in an athlete diagnosed with CECS. **METHODS:** A 20-year-old female cross-country runner diagnosed with CECS (December 2021) participated in a six-week, three sessions per week, gait retraining program. At initial consultation, an instrumented treadmill (100 Hz) was used to collect pressure and spatiotemporal metrics (e.g., cadence) at a self-selected speed. Video (240 Hz) was recorded from the sagittal plane to calculate tibial touchdown and foot inclination angles. The six-week intervention program incorporated verbal cues, visual feedback, ancillary drills, and at-home exercises aimed at implementing a non-rearfoot strike. Visual feedback was introduced via a fading paradigm model. Pressure and kinematic video data were recorded each session. Following each session, perceived rate of exertion (RPE) and lower extremity pain (0-10 scale) was noted. Additionally, 24 hours post-session the lower extremity pain/soreness was rated on a Single Assessment Numeric Evaluation (SANE) scale. **RESULTS:** The runner initially presented as a bilateral pronounced rearfoot striker with an unusually high cadence (190 steps/minute). Following the six-week retraining program, a non-rearfoot running strike was adopted and maintained six months post-intervention. The alteration in running technique also resulted in reduced average foot inclination and tibial touchdown angles, improving 16.4° degrees and 2° respectively. Cadence was also reduced to 182 steps/minute. In addition to improved kinematics, the self-reported lower leg pain/soreness improved throughout the entire retraining. **CONCLUSION:** The gait retraining program was successful as surgery was avoided with only nominal discomfort while running. These results support gait retraining programs as conservative interventions for runners experiencing CECS.

CANNABIDIOL (CBD) TREATMENT FOR CONCUSSION SYMPTOMS IN MIXED MARTIAL ARTS (MMA) ATHLETES

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Mild traumatic brain injury (mTBI) is frequent in the sport of mixed martial arts (MMA), which has experienced a rapid growth in popularity and athletes and coaches need an effective method to aid in concussion recovery. Unfortunately, there remains no specific treatment for mild traumatic brain injuries, but cannabidiol (CBD), a cannabinoid substance has exhibited promising therapeutic effects in rodent models. **PURPOSE:** Conduct on literature review of relevant studies on CBD and mTBI treatment to determine whether CBD treatment can mitigate concussion symptoms in MMA athletes. **METHODS:** Three search engines (Google Scholar, PubMed, and EBSCOhost) were used to collect studies and key words and phrases included “concussion and CBD”; “mild traumatic brain injury and CBD”; “CBD and mixed martial arts”; CBD and contact sports; and “chronic traumatic encephalopathy” or “CTE”. **RESULTS:** 28 studies were included in this literature review, which indicated that CBD is neuroprotective against excitotoxicity and neuroinflammation, effectively reducing neuronal cell death and metabolic dysfunction, the proposed cause of concussion symptoms. **CONCLUSION:** MMA athletes could benefit from immediate CBD treatment after a mTBI because CBD mitigates concussion symptoms by reducing the metabolic dysfunction following a mTBI. Randomized controlled trials and human studies are needed to further confirm these effects.

POST-PANDEMIC STUDENT PERSPECTIVES ON COLLEGE COURSE FORMAT

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PURPOSE: The purpose of this study was to determine if student perspectives on college course format (100% online, hybrid, and 100% in-person) has changed based on experiences during the COVID-19 pandemic. Differences in perspectives based on degree program of choice were also evaluated. **METHODS:** A cohort study design was implemented utilizing a convenience sample. Subjects ($N = 47$) were all current undergraduate students enrolled at the Lyndon campus of Northern Vermont University. Subjects included students from three degree programs: Atmospheric Sciences (ATM; $n = 18$), Business Administration (BUS; $n = 4$), and Exercise Science (ES; $n = 25$). All subjects received an initial request to complete the 13-item survey via an electronic link sent from their program's Department Chairperson. An email reminder to complete the survey was sent from the same individual, two days later. The survey included questions on previous educational experiences and current perspectives on 100% online (OL), hybrid (HB), and 100% in-person (IP) course formats. Preferences for general education (GE) and major specific (MS) course formats were each evaluated. Data were analyzed via a Chi Square analysis with alpha set at .05. **RESULTS:** Due to a small BUS sample size ($n = 4$), degree program specific statistical analyses were completed only between ATM and ES students. For the degree program specific analyses, no differences in student responses existed between ATM and ES students ($p > .05$). ATM, BUS, and ES student responses were combined for additional statistical analyses. More students ($n = 24$; 53%) reported less interest in taking OL courses now, compared to before the pandemic ($p < .05$). More students ($n = 19$; 41%) reported more interest in IP courses now, compared to before the pandemic ($p < .05$). Students reported a higher preference ($p < .05$) for IP, MS courses ($n = 36$; 73%), compared to GE courses ($n = 22$; 41%). More students ($n = 34$; 74%) reported IP as both their most enjoyed course format and the course format best for their learning ($p < .05$). In terms of the importance of course format when selecting a college to attend, 87% of students reported course format as extremely important ($n = 24$; 52%) or important ($n = 16$; 35%) in the decision-making process ($p < .05$). **CONCLUSIONS:** Based on educational experiences during the COVID-19 pandemic, subjects in this study reported a higher preference for IP courses now, compared to before the pandemic. The low BUS sample size was a limitation of this study. Future research should include additional degree programs to determine if differences exist.

PHYSICAL ACTIVITY AND DIET MOBILE APPLICATIONS TO IMPROVE CARDIOVASCULAR DISEASE RISK FACTORS: A META-REVIEW

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The literature on whether physical activity (PA) and PA and diet (PA+D) mobile applications (APPs) improve cardiovascular disease (CVD) risk factors is mixed. **PURPOSE:** We conducted a meta-review to compare the effects of PA and PA+D APPs on CVD risk factors. **METHODS:** We systematically searched five databases until January 12, 2022. Included systematic reviews (SR) and meta-analyses (MA): 1) reported the CVD risk factor outcomes of body mass index (BMI), waist circumference (WC), body weight (BW), blood pressure (BP), blood glucose (BG), blood lipids, and/or PA; 2) enrolled healthy subjects ≥ 18 years who may or may not have the Metabolic Syndrome and/or Diabetes Mellitus; 4) reviewed PA or PA+D APP interventions; and 5) had a non-APP control. **RESULTS:** In total, 17 reviews (9 SRs and 8 MAs) published between 2012-2021 qualified. Participant were middle-aged and mostly women ranging in number from 10 to 62,219. Interventions lasted from 1-24 months, with the most common behavioral strategies being personalized feedback (n=8), self-monitoring (n=7), and goal setting (n=5). Of the PA APP SRs (n=4), the following CVD risk factors improved: BMI and BW (n=2, 50%), BP (n=1, 25%), blood lipids (n=1, 25%), and PA (n=4, 100%). Of the PA+D APP SRs (n=5), these CVD risk factors improved: BMI and BW (n=2, 40%), BP (n=1, 20%), BG (n=2, 40%), and PA (n=3, 60%). Of the PA APP MAs (n=1), no CVD risk factor was reported to significantly improve. Of the PA+D APP MAs (n=7), these CVD risk factors improved: BMI (n=1, 14%; effect size [ES]: -0.64 kg/m^2 , 95%CI [-1.09, -0.18]), WC (n=1, 14%; ES: -2.46 cm , 95%CI [-4.56, -0.36]), BW (n=4, 57%; ES: $-1.79, -2.80 \text{ kg}$, 95%CI [-4.54, -0.41]), systolic/diastolic BP (n=1, 14%; ES: $-4.22/-2.87 \text{ mmHg}$, 95%CI [-6.54, -1.91]/ [-4.44, -1.29]), and BG (n=1, 14%; ES: -0.43% , 95%CI [-0.68, -0.19]). **CONCLUSION:** PA and PA+D APPs appear to be most consistent in improving PA levels and measures of body composition with favorable but less consistent effects on other CVD risk factors. Future studies are needed that directly compare and better quantify the effects of PA and PA+D APPs on CVD risk factors.

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Treatment with RRx-001, a Minimally Toxic NLRP3 Inhibitor in Phase 3 Clinical Trials, Improves Exercise and Skeletal Muscle Oxidative Capacity in Untrained Mice

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Introduction and Purpose RRx-001 is an NLRP3 inhibitor and Nrf2 agonist in Phase 3 trials for the treatment of cancer. The purpose of this study was to examine whether treatment with RRx-001, given its anti-inflammatory and antioxidant properties, improved exercise, and skeletal muscle oxidative capacity in mice on the general premise that better health outcomes correlate with more activity.

Material and Methods Male and female adult mice (n=6 per group) were subjected to an endurance exercise capacity (EEC) test until exhaustion on a motorized treadmill after 3 once weekly doses of either RRx-001 5 mg/kg, RRx-001 2 mg/kg or vehicle. The EEC protocol consisted of a treadmill velocity of 30 meters per min at an uphill inclination (slope of 10%) until the mice reached fatigue, which was defined as the inability of the mice to maintain the appropriate pace despite continuous hand stimulation for 1 min. The concentration of malondialdehyde (MDA), an indicator of lipid peroxidation, and creatine kinase (CK), an indicator of muscle damage, in the blood samples collected immediately after the acute exercise was determined with a commercial ELISA assay kit.

Results The exhaustive exercise times of the RRx-001 groups were significantly longer than that of the vehicle group ($p < 0.05$) by weeks 2 and 3. In addition, MDA levels in the gastrocnemius, soleus, and extensor digitorum longus muscles were significantly lower than those of the vehicle group were ($p < 0.05$) as were the serum CK levels ($p < 0.05$).

Conclusions In conclusion, this study found that RRx-001 has anti-fatigue properties, as evidenced by an increase in exercise capacity with RRx-001 treatment and protects against strenuous exercise-induced muscle damage and lipid peroxidation. This data potentially supports the use of RRx-001 in the clinic to improve exercise performance and reduce physical fatigue.

PHYSIOLOGICAL AND SUBJECTIVE CHANGES WHILE WEARING A FACEMASK WHEN PERFORMING EXERCISE AT DIFFERENT INTENSITIES

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Facemasks reduce the spread of respiratory disease, and their use has been mandated throughout the COVID-19 pandemic. Physical exertion increases distance traveled by expelled particles, therefore masking while exercising is recommended to help prevent transmission. However, there is limited literature assessing the influence of masking during exercise. **PURPOSE:** To investigate how the use of surgical masks while exercising at different intensities affects physiological and subjective measures. **METHODS:** Healthy, physically active individuals were recruited to participate in this study. Participants completed VO₂max testing on a bicycle ergometer and then completed two, forty-five-minute exercise trials (fifteen minutes at 40%, 60%, and 80% their VO₂R) in which facemask usage was randomly assigned. Heart rate (HR), oxygen saturation (SpO₂), respiratory rate (RR), ratings of perceived exertion (RPE), and dyspnea (Dys) were measured at each intensity. Dependent T-tests were conducted using SPSS (Version 27) and significance was set at p<.05. **RESULTS:** Thirty subjects (age: 20.4 ± 1.2 years; VO₂max: 40.12 ± 11.05 ml/kg/min, 57% female) completed the study. When comparing masked and unmasked trials, differences were found in HR, SpO₂, and RPE at 80% intensity (HR: 179.3 ± 11.1 vs. 176.7 ± 11.8, p=0.03; SpO₂: 94.5 ± 1.5 vs. 95 ± 1.4, p=0.04; RPE: 17.3 ± 1.4 vs. 16.7 ± 1.6, p=0.03). Differences were found in RR and Dys at all intensities (RR: 40% 17.6 ± 4.9 vs. 15.8 ± 4.9, p=0.02, 60% 23.7 ± 5.5 vs. 21.3 ± 6.2, p=0.01, 80% 35.8 ± 9.0 vs. 30.1 ± 8.8, p=0.00; Dys: 40% 1.2 ± 0.6 vs. 0.9 ± 0.6, p=0.00, 60% 3.1 ± 0.9 vs. 2.6 ± 1.0, p=0.00, 80% 6.05 ± 1.8 vs. 5.19 ± 1.7, p=0.00). **CONCLUSION:** The use of surgical masks appears to alter HR, SpO₂, and RPE at higher intensities and RR and Dys across all intensities. Individuals exercising at higher intensities should consider monitoring their intensity when wearing a facemask. The differences observed did not alter total exercise time or appear to pose a health risk to healthy subjects. Therefore, we encourage the use of facemasks in exercise facilities when there is an increased risk of spreading an airborne disease.

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THE EFFECT OF TECHNOLOGY BASED SELF-MONITORING VERSUS TRAINER SOCIAL SUPPORT ON EXERCISE ADHERENCE.

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Exercise adherence is vital to an individual's success in achieving training outcomes and goals because the majority of individuals often fail to adhere to their designed exercise programs following initiation. While different techniques to increase exercise adherence amongst the adult population have been reported, it remains unclear if exercise adherence increases more as a result of trainer social support and/or technology based self-monitoring. **PURPOSE:** The purpose of the study was to examine the effects of trainer social support and technology based self-monitoring techniques on exercise adherence. Specifically, this study examined a cellular app self-monitoring technique and a trainer social support technique compared to a control group in order to examine the impact on exercise adherence using the Godin-Leisure Time Activity (GLTA) questionnaire over a six-week period. **METHODS:** Twenty-one healthy participants participated in this study. The participants were randomly assigned into three groups: Trainer Social Support Group (TSS), Nike Training Club App Self-Monitoring Group (CA), and a control (CON) group. Participants in the TSS group received weekly text messages that targeted the components of self-monitoring, and they were also able to reach out to the trainer as many times as possible for advice, motivation, etc. Participants in the CA group used the Nike Training Club app to track their exercise patterns. Participants in the CON group were required to exercise without the use of the Nike Training Club app or trainer social support. Participants reported their GLTA scores weekly. Following 6 weeks of intervention, the GLTA scores were statistically significantly different between experimental groups. **RESULTS:** The TSS group saw the greatest improvement over the weeks (37.71 ± 14.0), followed by the CA group (22.79 ± 5.96), and then the control group (9.57 ± 6.82). **CONCLUSION:** These results demonstrate that 6 weeks of trainer support and cellular Nike app interventions elicited higher Godin-Leisure Time Activity (GLTA) scores compared to the control group who received no intervention. The results from this study support those by previous investigators suggesting that individuals who receive social support will report greater levels of physical activity.

BONE MINERAL DENSITY IN WEIGHT BEARING AND NON-WEIGHT BEARING EXERCISE PAIRED WITH RESISTANCE TRAINING

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The loss of bone mineral density (BMD) over time can lead to negative health-related consequences increasing the risk of bone fractures. Women are among those most at risk due to changes associated with menopause. Physical activity in the forms of weight bearing and resistance training have been shown to have a positive influence on BMD. **PURPOSE:** To determine if the addition of resistance training with swimming (SW, non-weight bearing) would bridge the gap in BMD when compared to soccer (SO, weight bearing) players that also participated in resistance training. **METHODS:** Healthy collegiate SO players and SW were recruited. Each subject was scanned through the use of a DXA scanner (GE Prodigy) for the lumbar spine region (L1-L4) which assessed BMC, BMD, and AM Z-score. All subjects also completed a total body scan that analyzed total body BMC, tissue % fat, fat mass (lbs) and lean mass (lbs). Independent t-tests were used to analyze each group to assess differences and a $p < 0.05$ was accepted for significance. **RESULTS:** 8 SO players and 12 SW participated (age: 19.5 ± 0.8 y, BMI 23.0 ± 1.2 , height 65 ± 2.1 in). Soccer players had a lower BMI when compared to SWs (SO: 22.99 ± 1.23 , SW: 25.06 ± 5.2 , $p < 0.03$). Soccer players had a greater BMD and higher AM Z-score versus SWs (SO: 1.31 ± 0.060 SW: 1.23 ± 0.02 , $p < 0.03$, and 0.9 ± 0.5 , SW: 0.4 ± 0.6 , $p < 0.04$), respectively. Soccer players had a greater value for total body BMC when compared to SWs (SO: 5.48 ± 0.40 , SW: 4.94 ± 0.382 , $p < 0.01$). Tissue % fat and fat mass (lbs.) were lesser in SO versus SWs (SO: 27.9 ± 3.5 , SW: 34.8 ± 7.0 $p < 0.10$; and SO: 37.9 ± 8.05 , SW: 48.20 ± 15.76 , $p < 0.07$), respectively. **CONCLUSION:** The subjects in both groups participated in resistance training, suggesting the addition of resistance training does not appear to completely negate the negative effects of lesser BMD in swimmers. However previous literature has observed as great as 23% increase in BMD in female SO players versus SW's that didn't participate in resistance training, whereas we observed only an 7% increase BMD in SO players versus SW's. This may suggest that resistance training may be helpful in athletes that participate in non-weight bearing sports.

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RELIABILITY OF PULSE WAVE VELOCITY ASSESSMENT

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Pulse wave velocity (PWV) is considered to be the criterion noninvasive metric of arterial stiffness which is considered to be a powerful indicator of future cardiovascular events. Augmentation index (AIx), is also used clinically as a measure of arterial stiffness. **PURPOSE:** This study was designed to assess the reliability of a trained operator's assessment of PWV in adults. **METHODS:** Nineteen apparently healthy participants (nine male and ten female; age=27±10 yrs) came to the Performance Assessment Laboratory on two occasions with no more than 48 hours separating these visits. Participants arrived for testing after an overnight fast. During the first visit, the participants' anthropometrics (body mass=83.2±24.4 kg; height=169.7±10.3 cm; body fat%= 24.8±7.3) were assessed using a Tanita Bioelectrical Impedance scale. Participants rested supine for 10 minutes in a quiet room prior to the assessment of cardiovascular variables using a SphygmoCor Xcel device. The order of testing after the rest period was blood pressure (peripheral and central) readings from the left arm with a 1-minute interval between trials. This was followed by duplicate readings of PWV, also with 1-minute intervals between trials. Similar procedures were done for visit two. **RESULTS:** All results are presented as means ± SD. The values for PWV (m/s) were 5.6±1.0 (visit 1), and 5.6±0.99 (visit 2). The corresponding values for AIx (%) were 7.6±11.8 (visit 1) and 7.1±14.6 (visit 2). No significant mean differences ($ps > .05$) were found between visit 1 and 2. Our analysis showed excellent reliability for PWV (ICC = 0.96) and AIx (ICC = 0.91), respectively. **CONCLUSION:** The trained operator's skill at reliably assessing PWV in accordance with the manufacturer's quality control standards is excellent. Therefore, we are confident that this operator's values can be trusted in studies in which multiple PWV readings are taken at different time points in the same individuals over the course of the study.

Correlation between exercise gaming data and clinical balance assessments

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INTRODUCTION/BACKGROUND: The COVID-19 pandemic has made seeing clients in person very difficult. Going virtual has made things tough for both Physical Therapists as well as patients. Motion-capture gaming software and optical sensor technology allow individuals to exercise remotely. These systems can also capture movement data remotely while a person engages in exercise. **PURPOSE/OBJECTIVES:** The objective of this study is to correlate kinematic data from an optical gaming system to in-clinic balance assessments. It is hypothesized that kinematic data from the gaming software will correlate strongly with some of the clinical tests used to assess balance performance. **METHODS:** Twenty healthy college aged individuals (convenience sample) participated in a one-time session of doing balance tests which included the star excursion balance test (SEBT) and the balance error scoring system (BESS). The assessments involving the game were space escape and recovery rapids. Rating of perceived exertion (RPE) and regular data for previous tests were taken down for data. **RESULTS:** For the regular tests, the participants were fairly similar compared to the normative values of the regular tests for the SEBT and the BESS. The correlation between the standardized tests and the tests involving the gaming system had a low Pearson correlation value resulting in no statistical significance (alpha set to $p = 0.05$). **DISCUSSION:** Based on the results and poor correlation, the null hypothesis can not be rejected. The correlation was stronger generally on the right limb vs the left. This may be due to the fact that most of the participants have their right leg as their dominant foot. As more variables were taken into consideration, the correlation did get stronger. Since the study was a convenience sample, there may be merit in trying again in a larger sample with either the same population or working with injured individuals that would benefit typically from the BESS or the SEBT. A suggested population would be people with chronic ankle instability.

Conflict of interest: Dr. Gauthier is a co-Founder of Games That Move You, PBC, a start-up company that licensed the gaming technology from The Ohio State U. She is serving as a PI, but will not perform recruitment, data collection, decision making, handle potential adverse events, be responsible for clinical interpretation of the study results or consent participants for this research. Other members involved are prepared and capable of doing the above. Her potential conflict is being managed in accordance with an approved conflicts management plan.

THE EFFECT OF POST-MEAL WALKING ON GLUCOSE VARIABILITY IN HEALTHY, INACTIVE, YOUNG WOMEN

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PURPOSE: The prevalence of abnormal glucose metabolism and diabetes is increasing in young adults. Previous studies have provided evidence that post-meal walking (PMW) can reduce postprandial glucose excursions in clinical populations. However, its effects in young, physically inactive women are yet to be determined. The purpose of this study is to examine the effects of post-meal walking on glucose control and glucose variability in young physically inactive women. **METHODS:** Thirteen physically inactive, non-hypertensive women (Age: 20 ± 1 years; percent body fat: $28.2 \pm 13\%$; BMI: $23.6 \pm 4.4 \text{ kg} \cdot \text{m}^{-2}$; fasting blood glucose: $90 \pm 7 \text{ mg} \cdot \text{dL}^{-1}$) completed the study during the early follicular or placebo phase of their contraceptive cycle. Participants completed a control day (CON; no exercise/excess physical activity) and PMW day (3 bouts of 15 minutes of brisk walking) over five days in a random order. Continuous glucose monitoring (CGM) recorded interstitial glucose responses at 5-minute intervals throughout their participation. Continuous activity monitors recorded physical activity throughout their participation. **RESULTS:** As expected, PMW increased daily metabolic expenditure (PMW = 35.8 ± 1.44 METs vs. CON = 33.7 ± 0.94 METs, $p < 0.05$) and daily step count (PMW = 13922 ± 3533 steps vs. CON = 8548 ± 2458 steps, $p < 0.05$). We observed no significant difference in 24-hour mean interstitial blood glucose between control and PMW days (PMW = $115 \pm 16 \text{ mg} \cdot \text{dL}^{-1}$ vs. CON = $115 \pm 17 \text{ mg} \cdot \text{dL}^{-1}$, $p = 0.88$). We also found no significant difference between 2-hour postprandial area under the curve (AUC) between control and PMW days for all three meals (Breakfast, PMW = 219 ± 30 AU vs. CON = 217 ± 28 AU, $p = 0.83$; Lunch, PMW = 231 ± 32 AU vs. CON = 238 ± 29 AU, $p = 0.53$; Dinner, PMW = 235 ± 30 AU vs. CON = 253 ± 50 AU, $p = 0.27$). **CONCLUSION:** These preliminary findings suggest that PMW does not improve acute glucose responses in young physically inactive women.

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THE ROLE OF HIGH HABITUAL PHYSICAL ACTIVITY ON ARTERIAL STIFFNESS IN HEALTHY PERI-MENOPAUSAL PEOPLE

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Cardiovascular disease (CVD) is a leading cause of death in women. Arterial stiffness, a subclinical CVD risk factor, increases around the time of menopausal transition. However, the role of high levels of habitual physical activity (PA) on arterial stiffness during perimenopause remains unknown. **PURPOSE:** This study aimed to determine whether high habitual PA influences arterial stiffness in healthy peri-menopausal people. **METHODS:** Healthy peri-menopausal people (n=21) were recruited for the study. Peri-menopause was defined using the STRAW+10 staging system. Participants were placed into high- (n=14) or average- (n=7) active groups based on self-reported habitual PA levels (High, ≥ 1500 MET-min/wk of vigorous-intensity PA or ≥ 3000 MET-min/wk of any PA and Low, < 150 min/wk moderate PA or < 75 min/wk of vigorous PA) according to the International Physical Activity Questionnaire and Physical Activity History Questionnaire. Participant characteristics, such as age, height, weight, body mass index, high density lipoproteins, low density lipoproteins, fasting plasma glucose, triglycerides, and total cholesterol levels, were measured. Arterial stiffness was assessed using pulse wave velocity (PWV), pulse transit time (PTT), and arterial wave analysis (augmentation indices AIx and AIx75). Two-tailed, independent t-test ($\alpha < 0.05$) was used to compare the PA groups. Non-parametric Mann Whitney U test was used for non-normally distributed variables. All analyses were completed in R studio, 2022.02.3, build 492. **RESULTS:** The average MET-min/wk was significantly different between high- and average- PA groups (4964.74 ± 2496.39 MET-min/wk vs. 1197.36 ± 505.69 MET-min/wk, $p = 0.0003$). All participant characteristics were similar between the groups (all $p > 0.05$). The variables for the assessment of arterial stiffness were not significantly different between high- and average-PA groups (PWV, 5.12 ± 1.15 m/s vs. 5.27 ± 0.68 m/s, $p = 0.76$; PTT, 65.04 ± 6.83 ms vs. 62.93 ± 4.09 ms, $p = 0.46$; AIx, $22.64 \pm 12.79\%$ vs. $27.14 \pm 7.06\%$, $p = 0.46$; and AIx75, $16.27 \pm 12.27\%$ vs. $17.29 \pm 9.12\%$, $p = 0.86$). **CONCLUSIONS:** Our preliminary data show that high amounts of daily PA does not lead to lower arterial stiffness measures in healthy peri-menopausal people with low CVD risk.

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ELECTROMYOGRAPHIC MEASUREMENTS OF FATIGUE IN MALE AND FEMALE COLLEGIATE ROWERS

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Measurements of fatigue using electromyography (EMG) during rowing can be indicative of the performance capacities of the muscles and used to create tailored training plans. **PURPOSE:** This study's primary aim was to compare muscle fatigue indicators using EMG between male and female collegiate rowers during a six-minute maximal effort bout on the rowing ergometer. **METHODS:** Ten male and ten female experienced rowers were recruited to participate in this study. Participants completed one visit and performed a maximal rowing exercise protocol. Surface EMG sensors were placed on the dominant side to measure the activity of the bicep brachii, triceps, latissimus dorsi, gastrocnemius, rectus femoris, bicep femoris, and gluteus maximus. EMG data were collected every minute during the six-minute protocol. To assess muscle fatigue, the mean frequency (F_{mean}) and median frequency (F_{mi}) were calculated in the frequency domain for each muscle. A two-way ANOVA (Minute of Exercise, Sex; Frequency) was used to compare the mean and median frequency of muscle activation between the sexes. A t-test was used to compare the slope and determine a difference in fatigue patterns between males and females.

RESULTS: Mean and median frequency was significantly different between male and female ($p < 0.01$; Figure 1) for all muscles except the gluteus maximus. Male participants had consistently higher F_{mean} and F_{mi} . These differences indicate a decrease in power output and have implications for the rate of fatigue in a given muscle. **CONCLUSION:** Females develop a significantly lower-frequency fatigue pattern than males, possibly due to sex-related neuromuscular adjustments to the all-out exercise protocol. This fatigue pattern plays a role in understanding the gap in performance observed in rowers and can be used to adapt training regimes.

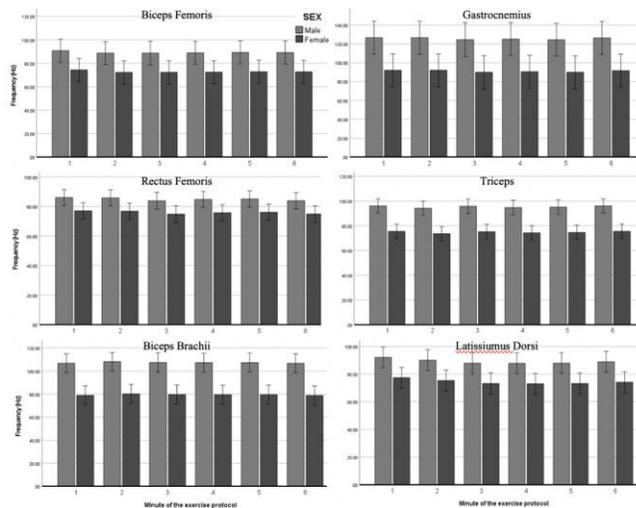


Figure 1: Average mean frequency of each muscle during each minute of the exercise protocol.

EXAMINING EATING BEHAVIOR, BODY IMAGE, AND SOCIAL IDENTITY AMONGST NCAA STUDENT-ATHLETES

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Clinically diagnosed eating disorder prevalence among college athletes are 10 in every 1000 individuals, placing them at higher risk for detrimental health outcomes. However, few studies have yet to examine risk factors for disordered eating and body checking behaviors in college athletes related to sport type and gender identity. **PURPOSE:** The purpose of the study was to examine mean differences among full-time collegiate student-athletes and nonathletes on measures of eating behavior, body checking, and social and personal identity. The secondary aim was to conduct factor analyses on the Body Checking Questionnaire (BCQ) and Male Body Checking Questionnaire (mBCQ). **METHODS:** A single survey was sent via email to eligible full-time college students and NCAA student-athletes ($n=174$ student-athletes; $n=85$ nonathletes). A 3X3 MANOVA assessed independent variables of sport type ($k=3$; team athlete, individual athlete, nonathlete) and gender identity ($k=3$; man, woman, other gender identity) on eating behavior, body checking, and identity measures. **RESULTS:** Significant differences were found with eating behavior, $F(2, 246) = 13.716, p < 0.001$, partial $\eta^2 = 0.103$, and body checking behaviors, $F(2, 246) = 26.374, p < 0.001$, partial $\eta^2 = 0.181$. A significant multivariate interaction of gender and sport type was found with the mBCQ, $F(3, 239) = 7.585, p < 0.001$, partial $\eta^2 = 0.050$. A simple effects test conveyed statistically significant and higher mean difference scores on the mBCQ for men who were nonathletes versus team sport athletes, 17.824, 95%CI [6.270, 29.379], $p = 0.003$, nonathletes versus individual sport athletes, 12.267, CI95% [0.456, 24.077], $p = 0.042$, and individual sport athletes compared to team sport athletes, 5.558, CI95% [0.016, 11.100], $p = 0.049$. Scores on the mBCQ were also significantly higher for women team sport athletes versus nonathletes, 9.043, CI95% [4.281, 13.804], $p < 0.001$, and team sport athletes compared to individual sport athletes, 6.083, CI95% [0.507, 11.569], $p = 0.033$. **CONCLUSIONS:** Overall, sport type had no significant mean differences outside of the mBCQ interaction. However, understanding the gender-sport type interaction in college student-athletes for body checking behaviors has implications for early intervention for preventing the development of eating disorders.

IMPACTS OF RETURNING TO A STANDARD MAJOR LEAGUE BASEBALL SEASON ON PLAYERS' SPRINT PERFORMANCE

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Major League Baseball (MLB) was able to return to a standard season in 2021 following a short season due to COVID-19. Previous research has shown that MLB players' sprint performance was negatively impacted between the 2019 and 2020 seasons potentially due to a lack of training availability. With the MLB returning to a standard schedule, the players' sprint performance could have been positively impacted due to more frequent training. **PURPOSE:** The purpose of this study was to determine if differences exist in MLB sprint performance between a season which was shortened by COVID-19 (2020) and a season that would resume as normal (2021). **METHODS:** Raw sprint speeds from the 2020 and 2021 seasons were gathered using the public Statcast database. In order to be included for analysis, sprints must be considered "competitive" using the same players from each season with at least 10 competitive sprints. Competitive sprints included home to 1st on weakly hit balls and base running of two or more bases that did not occur during a home run. Sprints from 2nd base to home on an extra base hit were excluded. Interval velocities were calculated at 0 to 30 ft, 30 to 60 ft, and 60 to 90 ft. A Mann-Whitney U test was used to compare seasonal values of each variable after assumptions were violated using Shapiro-Wilk and Levene's test. Cohen's *d* effect sizes estimates were also calculated. **RESULTS:** Athletes were statistically slower in the first interval ($p < 0.000$, $d = 0.461$), but not statistical different for the second and third intervals ($p < 0.237$, $d = 0.137$) ($p < 0.587$, $d = 0.058$). **CONCLUSIONS:** The 2021 season being statistically faster in the first interval compared to the 2020 season is interesting considering previous research shows that the 2019 season is also statistically faster than the 2020 season. The faster sprint times could be due to an increased training schedule following the shortened 2020 season. Future research should consider other potential factors for the increase in speed such as players being traded to different teams or starting a new training program.

DIFFERENCES IN FORCE STEADINESS AND FUNCTIONAL PERFORMANCE IN INDIVIDUALS WITH CHRONIC KIDNEY DISEASE COMPARED TO APPARENTLY HEALTHY INDIVIDUALS

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PURPOSE: The purpose of this study was to assess differences in force steadiness between individuals diagnosed with chronic kidney disease (CKD) and age-matched controls. The secondary purpose was to assess relationships between force steadiness and functional outcomes in each group. **METHODS:** Ten individuals with CKD stages 3-5 (9 male, 1 female; age=72±7.3 y; height=1.69±0.11 m; mass=96.1±20.3 kg; %body fat=34.2±7.3; BMI=32.9±6.6) and 7 healthy individuals (2 male, 5 female; age=63.0±9.7 y; height=1.68±0.09 m; mass=72.1±13.0; %body fat=30.0±13.1; BMI=26.0±6.7) completed two visits to the Lab. Visit 1 included a familiarization trial for maximal voluntary isometric contractions (MVIC) and submaximal trapezoid contractions at 30% and 70% of MVIC, and completion of the short physical performance battery (SPPB) and six-minute walk test (6MWT). The second visit consisted of 3 x MVIC, 3 x 30%MVIC, and 3 x 70% MVIC ramp contractions. Force steadiness was assessed as the coefficient of variation during the steady portion of ramp contractions. Group differences were assessed using independent-samples t-tests, and relationships between force steadiness and performance outcomes were assessed using Pearson product-moment correlations. **RESULTS:** Significantly lower performance was observed in 6MWT (p=0.016) and SPPB (p=0.002) in CKD compared to HC. Differences between groups for force steadiness were not observed at 30% (p=0.225) or 70% MVIC (p=0.057). A significant, negative correlation was observed between SPPB score and 30% force steadiness in CKD (p=-0.631; p=0.037), while this relationship was not significant in HC (p=0.282). Significant, negative correlations were observed between 6MWT and 30% (r=-0.833; p=0.02) and 70% (r=-0.857; p=0.01) force steadiness in HC, while these relationships were not significant in CKD (p=0.630 and p=0.552, respectively). **CONCLUSION:** Significant correlations noted in HC for functional performance and force steadiness were not observed in CKD. Future research should investigate changes to force steadiness and its relationship to functional performance within each stage of CKD.

THE EFFECT OF RESISTANCE BAND TRAINING AND ISOKINETIC TRAINING ON STRENGTH IN COLLEGE AGED FEMALES.

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COVID-19 heightened the importance of identifying resistance training exercises that could be completed at home. Resistance band training could provide an affordable way to complete resistance training outside of a gym environment. Additionally, a lack of data exists as to whether resistance band training is as effective in improving strength compared to isokinetic weight machine training. **PURPOSE:** Examining the effect isokinetic machines (Keiser A300) training vs. resistance band (Dasking) training had on one repetition maximum (1RM) in college aged females. **METHODS:** Twenty-four college-aged females (19.5 +0.95 years) volunteered for the study. Baseline and post-intervention measurements included height, weight, body mass index (BMI) leg press 1RM (Keiser A300) and chest press 1RM (Keiser A300). The exercise intervention consisted of resistance training exercises that were completed three times per week for four weeks. Each exercise session included a 5-minute warm-up, resistance training included 3 sets with 8-12 repetitions per muscle group. ANOVA: Two-Factor Without Replication (Excel 16.63) calculated whether there were significant ($p < 0.05$) differences between the results of the resistance band group and the isokinetic machine group. When significant differences were not present data was combined, and a T-Test (Excel 16.63) was used to determine whether there were significant differences in 1RM values pre and post resistance training intervention. **RESULTS:** Twenty-four participants successfully completed the study (13 resistance band, 13 isokinetic machines). There were no significant ($p > 0.05$) changes, between the groups, in mean height ($p = 0.62$), weight ($p = 0.20$), BMI ($p = 0.62$), 1RM chest press ($p = 0.06$) and 1RM leg press (0.18) following the 4-week intervention. When data was combined, a significant difference existed in 1RM for chest press ($\Delta = 15.8\%$) ($p < 0.001$) and 1RM for leg press ($\Delta = 14\%$) ($p < 0.001$). **CONCLUSION:** Four weeks of resistance training, using either resistance bands or isokinetic machines, significantly increases 1RM for chest press and 1RM for leg press in college-aged females.

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THORACIC SPINE MANIPULATION INCREASES HIP ADDUCTION FORCE BUT DOES NOT ALLEVIATE ASYMMETRIES

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High velocity low amplitude thrust (HVLAT) is a technique used by manual therapists to increase neuromuscular innervation in an attempt to mitigate bilateral imbalances. However, some HVLAT are utilized in the clinic without supporting empirical evidence. **PURPOSE:** To determine if HVLAT to the thoracic spine reduces hip adductor strength imbalances both immediately and 48 hours post-manipulation. **METHODS:** 11 subjects (5 male and 6 female, aged 25.8 ± 2.0 years, mass 79.5 ± 20.0 kg, height 1.7 ± 0.14 m) with unilateral hip adductor weakness completed bilateral maximum voluntary isometric hip adduction, pre-, immediately post-, and 48-hours after receiving a thoracic spine HVLAT. The limb that produced the higher force during the pre-HVLAT testing was designated as the uninvolved (UNI) limb and the weaker limb the involved (INV) limb. Force production was recorded with a uniaxial sensor and mean and maximal force production was calculated for each condition. A repeated measures analysis of variance was used to compare between limbs and across conditions, significance was set at $p = 0.05$. **RESULTS:** A similar pattern emerged for both mean and maximal force. For pre-HVLAT the UNI limb produced significantly more force than the INV limb for both mean (INV = 63.9 ± 35.8 N, UNI = 103.6 ± 41.8 N, $p = 0.004$) and maximal (INV = 94.6 ± 52.6 N, UNI = 113.7 ± 45.5 N, $p = 0.002$) measures. There was no significant difference between limbs immediately post-HVLAT. For 48 hours post-HVLAT the UNI limb again produced significantly more force than the INV limb for mean (INV = 104.3 ± 37.6 N, UNI = 117.5 ± 47.4 N, $p = 0.023$) and maximal (INV = 113.4 ± 39.9 N, UNI = 128.6 ± 50.4 N, $p = 0.036$) measures. **CONCLUSION:** INV force increased post-HVLAT, but UNI force production remained similar to baseline. Immediately post manipulation asymmetries were alleviated. However, 48 hours post manipulation revealed an imbalance comparable to pre-manipulation but at higher force output. Findings suggest that a HVLAT may improve hip adductor strength immediately post and maintain that strength over a 48-hour period but does not alleviate asymmetries.

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RELATIONSHIP BETWEEN BIOMECHANICAL ASPECTS WITH RUNNING PAIN AND FUNCTION IN RUNNERS WITH PATELLOFEMORAL PAIN

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Patellofemoral Pain (PFP) presents high prevalence in the general population and it is one of the main injuries in runners. In this context, it's important to investigate aspects that may be related to this condition, especially, if we consider the poor long-term prognosis and high disability levels previously reported. **PURPOSE:** The purpose of this study was to assess the relationship between posterolateral hip strength, hip and ankle mobility, and running kinematics in the frontal plane with running pain and function in recreational runners with PFP. **METHODS:** Cross-sectional study with 27 rearfoot strike runners (12 male/15 female; age = 30.1 ± 4.92 years; body weight = 76.8 ± 18.91 kg; height = 1.72 ± 0.10 m; body mass index = 25.54 ± 3.99 kg/m²). Posterolateral hip strength (abductors and external rotators) was assessed through a hand-held dynamometer. Hip internal rotation range of motion and ankle dorsiflexion were assessed through a digital inclinometer. The peak of trunk lean, contralateral pelvic drop, and hip adduction were assessed through the MyoResearch 3.14 - MyoVideo (Noraxon U.S.A. Inc). Running pain was assessed using the Visual Analog Scale, and function through the Anterior Knee Pain Scale. Pearson's Correlation Coefficient (r) was used to establish the relationship between the variables. Correlations were classified as negligible (0.0-0.3), low (0.31-0.5), moderate (0.51-0.7), good (0.71-0.9), or excellent (0.91-1.0). Good to excellent correlations were considered clinically meaningful. A significance level of $p < 0.05$ was adopted. **RESULTS:** Non-significant negligible/low correlations were found between hip abductors ($r = -0.22$; $p = 0.302$ / $r = 0.19$; $p = 0.351$) and external rotators ($r = -0.29$; $p = 0.156$ / $r = 0.02$; $p = 0.924$) strength, hip ($r = 0.07$; $p = 0.726$ / $r = 0.02$; $p = 0.922$) and ankle ($r = -0.13$; $p = 0.51$; $r = -0.02$; $p = 0.921$) mobility, peak of trunk lean ($r = -0.06$; $p = 0.747$; $r = 0.34$; $p = 0.083$), contralateral pelvic drop ($r = -0.04$; $p = 0.810$; $r = 0.04$; $p = 0.830$), and hip adduction ($r = 0.18$; $p = 0.351$ / $r = -0.23$; $p = 0.231$) with running pain and function respectively. **CONCLUSION:** Posterolateral hip strength, hip and ankle mobility, and running kinematics in the frontal plane did not present a linear relationship with running pain and function. Future studies should investigate the non-linear interactions between different aspects from a multifactorial biopsychosocial perspective.

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STUDENT-DRIVEN EXPERIENTIAL LEARNING: CREATING OPPORTUNITIES FOR SPORTS PERFORMANCE TECHNOLOGY AND DATA ANALYTICS

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Experiential learning opportunities, such as internships, provide an environment for students to gain career experience in their field of study. Students apply their classroom knowledge and enhance professional skills while furthering their understanding of and training in job-specific skills. **PURPOSE:** This internship aimed to gain hands-on experience working with a sports science technology, Catapult GPS, to analyze and inform coaching and performance staff on player performance and recovery metrics. **METHODS:** Twenty NCAA Division III men's soccer players from a small northeast liberal arts college wore Catapult One GPS tracking systems with Polar heart rate monitors to obtain performance data during training and games. Daily metrics were compiled and analyzed to assess player performance, and load management after each session. During the season, players completed a survey each morning to rate their perceived level of rest, motivation, soreness, and readiness for the day. Post-activity surveys were administered to rate players' self-perceived stress levels, overall performance, difficulty, and activity readiness. Data were used to establish a well-rounded analysis of the player's performance and recovery. **RESULTS:** A detailed interpretation of daily and weekly performance data was shared with the coaching staff to optimize player performance and enhance recovery. Consistent communication provided a means for the development of professional and interpersonal skills. Using Catapult One GPS tracking technology and accompanying software provided a means to integrate technology and analytics to optimize player performance and recovery. **CONCLUSION:** This innovative internship experience provided the opportunity to implement advanced player-tracking technology and data analytics in a small Division III men's soccer program. The initiative to create student-driven experiential learning opportunities for new technology, research, and professional skills improves student employability and career opportunities.

VISION TRAINING AS A TOOL TO IMPROVE NECK REACTION TIME AND STIFFNESS

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Clinicians continue to be challenged to develop strategies that will decrease the incidence of sports related concussions (SRCs). Proposed strategies have included implementing vision training and neck strengthening protocols. **PURPOSE:** To determine if an 8-week neck strengthening program and/or vision training program will improve neck sternocleidomastoid (SCM) reaction time in response to an external load. **METHODS:** Forty subjects (M = 13; F = 27) (age = 19.93 ± 0.70 yrs; mass = 69.66 ± 14.96 kg; height = 167.62 ± 9.75 cm), the majority of which were right hand dominant (R = 36; L = 4), were pre- and post-tested for electromyographic (EMG) activity of the right and left SCM in response to an external load applied to the head. The external load was applied via a weight drop connected to head gear using a pulley system. Subjects were randomly assigned to one of 4 groups: neck strengthening, vision training, combination of neck strengthening and vision training, or control. Training was performed twice per week for 8-weeks. 4x3 (group x vision; foveal, right/left peripheral) ANOVAs compared the delta for right and left SCM activity for peak EMG, time to peak EMG, and SCM activation time. Significance was set at $p \leq .05$. **RESULTS:** The vision training group decreased right SCM activation time pre- to post-test by 0.018 ± 0.061 sec, which was significantly different from all other groups ($p \leq .05$). The left SCM peak EMG activity decreased in the neck training group pre- to post-test by 20.64 ± 55.27 μ V which was significantly different from all other groups ($p \leq .05$). There were no significant differences in pre- to post-test changes in activation time of the left SCM, left and right SCM time to peak EMG activity, and right SCM peak EMG activity ($p \geq .05$). **CONCLUSION:** Vision training appears to enhance SCM activation time on the dominant side when exposed to an external force. Changes in EMG activity with the neck strengthening group may indicate different training effects on the non-dominant side of neck musculature. Further research is needed to determine potential utilization of vision training and/or neck strengthening protocols as concussion prevention strategies.

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CRITERION VALIDITY OF A SMART GARMENT WHEN COLLECTING RESPIRATORY RATE DATA DURING EXERCISE

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Wearable technology has grown in use when collecting various physiological measures, including respiratory rate (RR). A wearable smart garment with inductive plethysmography materials embedded within the garment has been recently developed as a prototype to measure RR during exercise. This garment may be a more practical option to collect RR data during field-based settings in comparison to an industry standard spirometer. **PURPOSE:** To determine the criterion validity of a smart garment when collecting RR data during exercise in comparison to a spirometer. **METHODS:** 16 male participants volunteered to participate in this study (age: 24.6 ± 4.3 yrs; height: 180.7 ± 6.7 cm; body mass: 88.0 ± 10.0 kg). RR data was simultaneously collected via the smart garment and Cosmed Quark CPET metabolic cart during 5 minutes of 3.0 mph Walking, 5 minutes of 5.0 mph Jogging, and 5 minutes of 6.5 mph Running. **RESULTS:** Paired *t*-tests identified *trivial* to *small*, and non-significant ($P > 0.05$) differences in RR measures between RR data collected by the smart garment and spirometer during the Jogging and Running conditions, and *moderate*, but non-significant differences in RR measures were observed during the Walking condition (Table). Although *strong* Pearson correlations were identified during the Jogging ($r = 0.560$, $P = 0.058$, $R^2 = 0.314$) and Running ($r = 0.567$, $P = 0.055$, $R^2 = 0.321$) conditions, a *trivial* correlation was observed during the Walking ($r = 0.046$, $P = 0.893$, $R^2 = 0.002$) condition, with all correlations being non-statistically significant ($P > 0.05$). **CONCLUSIONS:** Although this unique smart garment holds potential as a valid method of monitoring RR in field-based settings, more research is required to determine the criterion validity of this prototype, particularly during walking conditions. In addition, further refinement of the garment may be needed due to the notable loss of data during exercise.

Supported By: Massachusetts Manufacturing Innovation Initiative (M2I2), Commonwealth of Massachusetts

Table. RR (breaths/min) Comparisons Between Smart Garment and Spirometer (mean \pm SD)					
Condition	Smart Garment	Spirometer	Mean Difference	Effect Size	Data Loss
Walking – 3.0 mph (<i>n</i> = 11)	23.47 \pm 4.65	19.20 \pm 4.78	+4.26 \pm 6.52	<i>g</i> = 0.90 <i>moderate</i>	31.25% (5/16)
Jogging – 5.0 mph (<i>n</i> = 12)	28.89 \pm 9.02	29.25 \pm 6.54	-0.36 \pm 7.62	<i>g</i> = 0.05 <i>trivial</i>	25% (4/16)
Running – 6.5 mph (<i>n</i> = 12)	33.04 \pm 10.95	36.94 \pm 8.31	-3.90 \pm 9.26	<i>g</i> = 0.40 <i>small</i>	25% (4/16)
Abbreviations: RR, respiratory rate.					

DIFFERING HYPERTROPHY PATTERNS FROM OPEN AND CLOSED-CHAIN TRAINING AFFECTS LIMB INERTIA AND MODEL RUNNING KINETICS

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PURPOSE: To determine whether kinetic chain pattern during knee extensor strength training influences quadriceps femoris center of mass, moment of inertia about the hip, and modeled joint kinetics during running in a predictable manner. **METHODS:** Twelve participants completed 8 weeks of both unilateral open (OKC) and closed (CKC) kinetic chain resistance training on opposing legs. Changes in quadriceps femoris muscle volume (VOL_{QF}), center of mass location (CoM_{QF}), and moment of inertia (I_{QF}) about the hip were determined from MRI scans. Regional hemodynamics during OKC and CKC bouts early in the training program were measured using near-infrared spectroscopy (NIRS) and used post-hoc to predict changes in CoM_{QF} . Practical effects of hypertrophic responses to exercise type on running kinetics were determined using a simulated gait model extrapolated from experimental differences between conditions.

RESULTS: While increases in VOL_{QF} were similar between OKC ($\Delta 79.5 \pm 87.9 \text{ cm}^3$) and CKC ($\Delta 60.2 \pm 110.5 \text{ cm}^3$, $p=0.29$), the patterns of hypertrophy differed; a distal shift in CoM_{QF} ($\Delta 2.4 \pm 0.4 \text{ cm}$, $p<0.001$) and increase in I_{QF} ($\Delta 0.017 \pm 0.014 \text{ kg}\cdot\text{m}^2$, $p<0.001$) occurred in OKC but not in CKC (CoM_{QF} : $\Delta -2.2 \pm 2.0 \text{ cm}$, I_{QF} : $\Delta -0.022 \pm 0.020 \text{ kg}\cdot\text{m}^2$, $p>0.05$). Regional hemodynamics assessed by NIRS during a single training session displayed similar exercise and regional differences and predicted 39.6% of observed changes in CoM_{QF} . Gait modeling revealed that an estimated 2 cm proximal shift in thigh CoM significantly reduced hip flexion moment (1.7%) and impulse (3.1%) and hip extension impulse (2.0%). **CONCLUSIONS:** Exercise selection influences muscle shape sufficiently to affect running kinetics, and these changes may be predicted in part from NIRS measurements during a single workout. Specifically, CKC exercise provides a more proximal pattern of hypertrophy than OKC, which is more preferential for running.

Evaluation of Low Albumin as a Risk Factor for Postoperative Admission, Unplanned Readmission, and Extended Length of Stay after Anterior Cruciate Ligament (ACL) Reconstruction.

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Anterior Cruciate Ligament Reconstruction (ACLR) is a common procedure frequently performed in the outpatient setting. Malnutrition has been shown to be negatively associated with outcomes in many orthopedic procedures.¹⁻⁶ **PURPOSE:** The purpose of this study was to establish the impact of malnutrition, as assessed by preoperative serum albumin <3.5 g/dL, in patients undergoing ACLR. **METHODS:** A retrospective review of the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database was performed for patients undergoing ACLR between January 2016 to December 2021. Binary logistic regression models were used to calculate the odds of postoperative admission, readmission, and extended length of stay. **RESULTS:** 32,943 total cases were identified, of which 3,475 (10.5%) included serum albumin levels drawn within 90-days pre-procedure. Of the 3,475 cases with serum albumin data, 114 (3.3%) cases had serum albumin <3.5 g/dL. After controlling for age, sex, ASA class, race, BMI, and diabetes mellitus status, multivariate regression analysis showed that preoperative hypoalbuminemia significantly increased the adjusted odds ratio postoperative admission (adjusted odds ratio 3.272, CI 2.031-5.269, p<0.001), unplanned readmission (adjusted odds ratio 5.981, CI 1.931-18.527, p=0.0017), and extended length of stay (adjusted odds ratio 4.301, CI 2.238-8.265, p<0.001). **CONCLUSION:** Preoperative malnutrition, as defined by preoperative serum albumin <3.5 g/dL, is significantly associated with increased odds of postoperative admission, unplanned readmission, and extended length of stay in patients undergoing ACLR. This highlights the importance of screening for malnutrition as a preoperative risk factor.

VALIDITY AND RELIABILITY OF THE PLYOMAT® DEVICE FOR VERTICAL JUMP HEIGHT MEASUREMENT

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While many devices have been designed to improve the accessibility of vertical jump height measurement, these systems can be very costly for practitioners to purchase and maintain. Recently, a new switch mat was developed but has not currently been assessed for its validity and reliability. **PURPOSE:** The purpose of this study was two-fold: to investigate the criterion validity of the Plyomat® (PM; Athletic Assessment Technology, Lawrenceville, GA, USA) jump testing device when compared to a force plate (FP) and to assess the test-retest reliability of the Plyomat® jump testing device. **METHODS:** Forty-eight Division III football players (age: 19.63 ± 1.27 yrs, height: 175.9 ± 24.1 cm; body mass: 80.0 ± 11.0 kg) were recruited from a college in the northeastern United States. Each participant completed a total of three maximal countermovement jumps with their hands on their hips with 30 seconds of rest between attempts. Participants then repeated this testing protocol 24-48 hours later. To maintain consistency with the Plyomat®, all jump heights were calculated using time in the air derived from the force plate rather than takeoff velocity. **RESULTS:** A very strong, positive correlation was observed between FP and PM ($r = 0.95$ [0.91, 0.97], $p < 0.001$). Independent samples t-tests indicated jump heights from PM were significantly higher than FP ($p < 0.001$), though the effect size was negligible ($d = 0.16$, mean difference = 1.01 cm). Additionally, results indicated PM yielded a high degree of test-retest reliability of the highest jumps measured on each testing day (ICC(2,1) = 0.85 [0.69, 0.92]; SEM = 2.36 cm). **CONCLUSION:** The Plyomat® provides a valid and reliable performance testing solution for the vertical jump exercise which may be more practical and/or affordable than other jump testing devices.

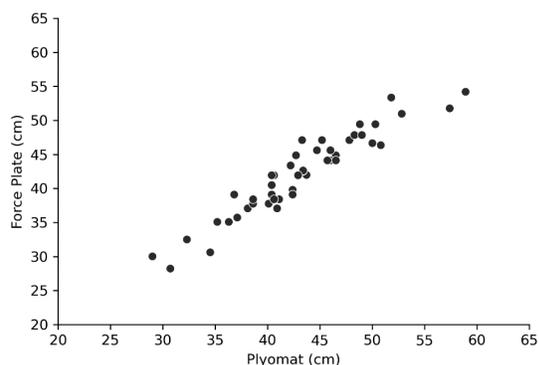


Figure 1: Linear relationship between Force plate and Plyomat® measurements.

Conflict of Interest Statement: Athletic Assessment Technology LLC donated the Plyomat® for the purpose of this study. No financial payments were received by the research team.

DIFFERENCES IN MAXIMAL-ISOMETRIC-STRENGTH AND RATE-OF-FORCE-DEVELOPMENT BETWEEN INDIVIDUALS WITH CHRONIC KIDNEY DISEASE AND APPARENTLY HEALTHY CONTROLS

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Aging-related declines in strength and rate of force development may be exacerbated in individuals with chronic kidney disease (CKD) compared to age-matched controls. **PURPOSE:** The purpose of this study was to assess differences in neuromuscular characteristics between individuals with CKD compared to age-matched apparently healthy controls. **METHOD:** Ten individuals with CKD (9 male, 1 female; age = 72 ± 7.33 y; height = 1.69 ± 0.11 m; mass = 96.1 ± 20.3 kg; %body fat = 34.2 ± 7.29 ; BMI = 32.9 ± 6.58) and 7 healthy individuals (2 male, 5 female; age = 63.0 ± 9.68 y; height = 1.68 ± 0.09 m; mass = 72.1 ± 13.0 ; %body fat = 30.0 ± 13.1 ; BMI = 25.97 ± 6.74) came to the laboratory on two different occasions separated by at least 72 hours. Visit 1 consisted of completion of isometric familiarization during a leg extension protocol. Visit 2 consisted of three maximal voluntary isometric contractions (MVIC) of the right knee extensors with 2 minutes rest between trials. Rate of force development was assessed as the slope of the isometric force-time curve at 50 ms (RFD₅₀), 100 ms (RFD₁₀₀), and 200 ms (RFD₂₀₀) relative to contraction onset. Contraction onset was assessed via manual onset determination methods. Group differences for MVIC were assessed using independent samples t-tests, while RFD₅₀, RFD₁₀₀, and RFD₂₀₀ were analyzed using Mann-Whitney U test. **RESULTS:** Results of this study indicated no significant differences between CKD and HC for MVIC ($p = 0.615$), RFD₅₀ ($p = 0.425$), RFD₁₀₀ ($p = 0.596$), or RFD₂₀₀ ($p = 0.930$). **CONCLUSIONS:** Isometric strength and rate of force development were not significantly different between HC and CKD individuals. Future research should evaluate changes to MVIC and rate of force development across stages of CKD.

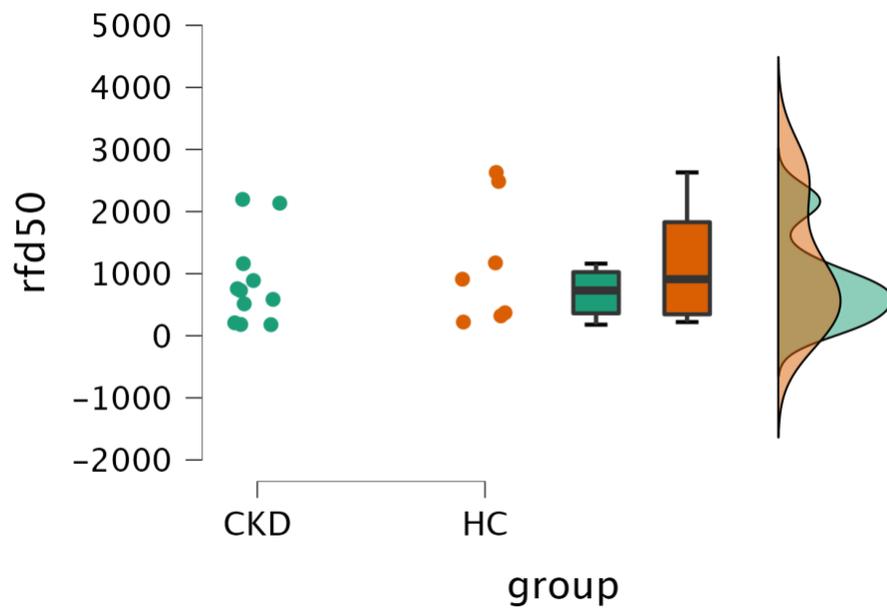


Figure 1: Rate of force development at 50 ms in healthy control and CKD groups

LONG COVID SYNDROME IN AN OLDER ENDURANCE ATHLETE SUGGESTING INDICATION FOR POST-COVID CARDIAC SURVEILLANCE

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As Covid becomes endemic, evidence of post-Covid sequelae proliferates. Studies recognize post-infectious complications in older, co-morbid patients and low prevalence of persistent symptoms in young, elite athletes. However, few cases identify unremitting problems after Covid in older, elite athletes, who may have exacerbated repercussions due to age. **PURPOSE:** This study aims to highlight long covid presentation in an older elite athlete and provide evidence for post-covid cardiac surveillance to facilitate early treatment and prevention of chronic complications. **METHODS:** A 54 year-old male endurance athlete with history of rheumatoid arthritis and asthma was evaluated in the ED due to dyspnea, intermittent chest tightness, elevated heart rate, palpitations, and abnormal d-dimer on outpatient labs. 70 days before presentation patient aborted iron-man participation after developing dyspnea and fatigue and was found to be covid positive. Following initial clinical improvement, some symptoms persisted limiting his return to athletics. Outpatient workup identified an ECG with new sinus arrhythmia and resting heart rate 80-90 bpm on patient's watch, previously 50-60 bpm. On chart review, blood pressure was 130/100, with normotensive values before covid. Cardiology obtained an echocardiogram indicating normal ejection fraction, mild left ventricular hypertrophy, and mild tricuspid regurgitation. Patient had no prior echocardiogram for comparison, but denies cardiac history. Although cleared for activity, patient remained limited by symptoms. Repeat d-dimer was elevated to 0.55 mg/L and patient presented to the ED for pulmonary embolism rule-out. **RESULTS:** On ED presentation, BP was 153/114 and ECG showed sustained sinus arrhythmia. Labs were unremarkable, including negative troponin. CTA eliminated PE and patient's presentation was attributed to long covid syndrome, with further outpatient workup indicated to exclude myocarditis. **CONCLUSION:** This patient underwent multiple cardiopulmonary tests, without cardiac MRI and inflammatory markers to diagnose clinically suspected myocarditis. Further, patient's echocardiogram noted mild abnormalities, which could progress to cardiac demise. Earlier diagnosis and treatment of long covid syndrome may accelerate treatments including anti-hypertensives or corticosteroids for myocarditis and also limit unnecessary testing. Consideration should be made for surveillance of long covid syndrome in older elite athletes to expedite diagnosis, reduce risk of cardiac complications, and prompt faster return to athletic participation.

DOES THE COMBINATION OF EXERCISE AND HEAT THERAPY IMPROVE MEASURES OF CARDIOVASCULAR HEALTH?

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Nearly half of U.S. adults suffer from some form of cardiovascular disease, reflected in high blood pressure (BP) and low heart rate variability (HRV). Previous research has shown that exercise is an essential lifestyle intervention to improve cardiovascular health. In addition, heat therapy, in forms of hot baths or saunas, may provide complementary or additive cardiovascular health benefits. **PURPOSE:** To investigate how exercise alone (Ex), heat therapy alone (HT), and combined exercise + heat therapy (ExHT) impact overnight BP and HRV in individuals with normal to elevated BP. **METHODS:** Eight participants (4M, 4F; Age: 26 ± 9 , BMI: 28.2 ± 6.5) took part in three randomized, counterbalanced trials one week apart: Ex, HT, and ExHT. Exercise consisted of 30 min treadmill walking at 60% heart rate reserve. Heat therapy consisted of 45 minutes in a hot (42°C) leg bath, immersed to mid-calf. The ExHT session consisted of matched exercise followed by 45 min heat therapy as described. The night before and after each session, BP and HRV were taken overnight (11pm-6am) using automated ambulatory monitors. **RESULTS:** Mean daytime systolic (SBP) was 126 ± 12 , and diastolic (DBP) was 76 ± 7 mmHg with 4 participants exhibiting elevated BP ($>120/80$ mmHg). BP decreased overnight in all participants. Nighttime SBP was significantly lower after ExHT (111 ± 16 mmHg, $p=0.008$) and HT (111 ± 13 mmHg, $p=0.031$) compared with pre-trial baseline (117 ± 9 mmHg). DBP was significantly lower after ExHT (64 ± 9 mmHg, $p=0.005$) compared with baseline (67 ± 10 mmHg). Nighttime HR was significantly lower after HT (baseline: 68 ± 18 beats/min, HT: 63 ± 14 beats/min, $p=0.008$). Nighttime HRV was not different between baseline and any trial ($p=0.314$). **CONCLUSION:** All treatments tended to result in lower blood pressures compared with baseline, but only combined ExHT reduced both SBP and DBP. This indicates that individuals with elevated SBP, DBP, or both would benefit most from combined exercise and heat therapy treatments. While HR and SBP were reduced after HT, there were no differences in nighttime HRV following any treatment. Alterations in nighttime BP regulation do not appear linked to cardiac autonomic activity.

Acknowledgements: This project was supported in part by the New England ACSM New Investigator Award (B. Ely).

NONSURGICAL MANAGEMENT OF SYMPTOMATIC HALLUX LIMITUS WITH PHYSICAL THERAPY AND EXTRACORPOREAL SHOCKWAVE THERAPY

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Hallux limitus (HL) can cause forefoot pain in both runners and the general population which may limit physical activities and quality of life. Conservative management is initial treatment with surgery reserved for advanced cases. Extracorporeal shockwave therapy (ESWT) is used in a variety of musculoskeletal disorders due to its proposed effect on pain modulation and tissue remodeling, and physical therapy is added to optimize function. **PURPOSE** Describe changes in functional outcomes of ESWT and physical therapy (PT) in runners with HL who failed other conservative management. **METHODS** Retrospective chart review identified 13 runners who received ESWT and PT for HL. Functional outcomes were characterized using the Foot and Ankle Ability Measure (FAAM) at baseline and following treatment. Patients received at least 3 weekly sessions of ESWT over the first MTP joint capsule and supporting structures. Patients were prescribed PT focused on intrinsic foot muscle strengthening and joint mobilization. **RESULTS** FAAM ADL subscale scores improved from pre-treatment (median 76, IQR: 51 to 83) to best post-treatment (median 80, IQR: 64 to 83), $p=0.0156$. FAAM sport subscale scores improved from pre-treatment (median: 11, IQR: 10 to 24) to best post-treatment (median: 23, IQR: 14 to 30), $p=0.0081$. Minimally clinically important difference (MCID) was achievable in the FAAM ADL subscale for 8 of 13 patients. Five of 8 patients (62.5%) met MCID. MCID was achievable in the FAAM Sport subscale for 9 of 13 patients. Five of 9 patients (55.6%) met MCID. MCID was achievable in either FAAM ADL and/or FAAM Sport subscales for 10 of 13 patients, of which 7 of 10 patients (70%) met MCID in one or both subscales. **CONCLUSION** ESWT combined with PT is well-tolerated and may be an effective nonsurgical treatment option for running athletes with symptomatic hallux limitus who have failed alternative conservative management.

AEROBIC EXERCISE AS A TREATMENT FOR METHAMPHETAMINE ADDICTION: A LITERATURE REVIEW

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Methamphetamines (METH) are the second most abused group of drugs in the world affecting more than 1.5 million people in the United States. Individuals with METH addiction have a very high relapse rate due to the drug's damage to neurotransmitter systems that control emotion, mood, memory, decision making, and behavior. There is currently no pharmaceutical treatment for methamphetamine addiction, but recent studies demonstrate aerobic exercise may reduce cravings in men with METH addiction. **PURPOSE:** The goal of this review was thus to analyze the existing body of literature on aerobic exercise's potential utility as a treatment strategy for methamphetamine addiction. **METHODS:** A literature search was conducted using the databases Pubmed, Sportdiscus, and Google Scholar. The key search terms used were, "methamphetamine addiction" OR "methamphetamine use disorder" AND "aerobic exercise" OR "running". Articles included were peer-reviewed human experimental studies and literature reviews on aerobic exercise methods as a treatment for methamphetamine addiction. Articles excluded from this review were animal studies and aerobic exercise intervention for substances other than methamphetamines. **RESULTS:** In short, in controlled laboratory-based interventions, aerobic exercise was found to significantly reduce cravings for methamphetamine and addicts were able to sustain from METH use during the experimental period. Notably, one aerobic exercise intervention resulted in increased levels of serotonin and dopamine in participants' blood immediately after intervention. **CONCLUSION:** Current research evidence highlights the potential benefit of aerobic exercise as part of METH addiction treatment strategies; however, longer term effects of aerobic exercise in this subject population remain to be studied.

CRITERION VALIDITY OF THE SMART GARMENT WHEN COLLECTING RESPIRATORY RATE DATA DURING REST AND RECOVERY

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Wearable technology allows the collection of various physiological measures including Respiratory Rate (RR) during rest and recovery in field-based settings. A new smart garment prototype with embedded inductive plethysmography materials has been developed, which may provide a more feasible method to collect RR data than the industry standard spirometer.

PURPOSE: To determine the criterion validity of the smart garment when collecting RR data during rest and recovery as compared to the spirometer. **METHODS:** 16 males volunteered to participate (age 24.6 ± 4.3 yrs; height: 180.7 ± 6.7 cm; body mass 88.0 ± 10.0 kg). Both the smart garment and the Cosmed spirometer collected 5 minutes of seated and supine RR data prior to (Rest) and following (Recovery) a 15-minute treadmill exercise protocol. **RESULTS:** Paired *t*-tests identified *trivial* to *small* and non-significant ($P > 0.05$) differences in RR measures in both seated and supine positions at Rest and Recovery between the smart garment and spirometer (Table). *Very strong* to *nearly-perfect* and statistically significant correlations were also identified at Rest in the seated ($r = 0.806$, $P = 0.009$, $R^2 = 0.650$) and supine ($r = 0.965$, $P < 0.001$, $R^2 = 0.931$) positions as well as during Recovery in the supine position ($r = 0.849$, $P = 0.002$, $R^2 = 0.721$). However, a *moderate* and non-statistically significant correlation was identified during Recovery in the seated position ($r = 0.483$, $P = 0.095$, $R^2 = 0.233$).

CONCLUSIONS: Although criterion validity of this novel smart garment was observed in the seated and supine positions during resting and post-exercise recovery states, more research utilizing this prototype in larger sample sizes is still needed, as a loss of RR data during the collection process was consistently noted.

Supported By: Massachusetts Manufacturing Innovation Initiative (M2I2), Commonwealth of Massachusetts

VALIDITY OF A SMARTPHONE APPLICATION TO CALCULATE MEASURES OF HEART RATE VARIABILITY

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Heart rate variability (HRV) metrics are commonly utilized to assess autonomic nervous system function. Currently, HRV metrics are processed using third-party software platforms after data collection. A newly developed smartphone application may offer a method of instantaneous HRV processing and calculation, but the validity of this technique remains unknown.

PURPOSE: To determine the criterion validity of the Elite HRV smartphone application when calculating HRV metrics in reference to third-party software. **METHODS:** Five minutes of R-R interval and natural log of root mean square of the successive differences (lnRMSSD) resting HRV data were simultaneously collected using two Polar H10 heart rate monitors (HRM) obtained in both seated and supine positions from 22 participants (14 males, 8 females; age: 21.82 ± 2.11 yrs; height: 172.05 ± 7.93 cm; body mass: 74.01 ± 12.62 kg). One HRM was paired to a Polar V800 watch and processed using third-party software applying different artifact correction filters, and one HRM was paired to the Elite HRV smartphone application for processing. **RESULTS:** *Moderate* and significant differences were observed in the seated position ($P = 0.022$), and *moderate*, but non-statistically significant differences were observed in the supine position ($P = 0.087$) when No correction level filter was applied (Table). However, validity was restored in both the seated and supine positions when applying a Very Low ($P = 0.096$; $P = 0.692$, respectively) or Low ($P = 0.324$; $P = 0.810$, respectively) artifact correction level filter. Additionally, *excellent* agreements ($ICC_{3,1} = 0.938 - 0.998$) and *very-strong* to *nearly-perfect* ($r = 0.889 - 0.997$) relationships were observed across all correction levels with the Elite HRV accounting for 79% to 99% ($R^2 = 0.79 - 0.99$) of the variance.

CONCLUSIONS: The Elite HRV smartphone application is a valid tool to calculate and process lnRMSSD data at rest in both the seated and supine positions.

Supported By: Undergraduate Research Experience Grant, American College of Sports Medicine New England Regional Chapter (NEACSM)

Table RR (breaths/min) Measure Comparisons Between Smart Garment and Spirometer (mean \pm SD)					
Condition	Smart Garment	Spirometer	Mean Difference	Effect Size	Data Loss
Resting – Supine ($n = 12$)	10.28 \pm 4.74	10.88 \pm 4.28	-0.60 \pm 1.27	$g = 0.13$ <i>trivial</i>	25% (4/16)
Resting – Seated ($n = 9$)	11.69 \pm 4.00	11.75 \pm 3.14	-0.06 \pm 2.37	$g = 0.02$ <i>trivial</i>	43.75% (7/16)
Recovery – Seated ($n = 13$)	21.62 \pm 9.11	18.15 \pm 5.45	+3.47 \pm 8.05	$g = 0.46$ <i>small</i>	18.75% (3/16)
Recovery – Supine ($n = 10$)	14.54 \pm 4.90	16.00 \pm 4.25	-1.46 \pm 2.59	$g = 0.32$ <i>small</i>	37.5% (6/16)
Abbreviations: RR = respiratory rate.					

IMPACT OF EXERCISE ON KNEE EXTENSOR FUNCTION IN INDIVIDUALS WITH KNEE OSTEOARTHRITIS

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Alterations in neuromuscular activation patterns and knee extensor (KE) weakness are thought to contribute to mobility impairments in knee osteoarthritis (KOA). Physical activity and exercise can have a beneficial effect for reducing impairment and improving function. However, prolonged exertion may contribute to muscle fatigue and pain-related alterations in neuromuscular function. A better understanding of the impact of an exercise bout on KE function is needed to better understand mobility limitation in KOA. **PURPOSE:** This study investigated the impact of an exercise bout on KE function and muscle activation patterns in individuals with KOA. **METHODS:** Thirteen adults with symptomatic KOA (Age: 66 ± 4.2 years, BMI: 25.3 ± 3.8 kg/m²) participated in this study. Participants completed 5 overground walking trials at a preferred pace and three maximal isometric KE contractions on an isokinetic dynamometer at 60° of knee flexion before and after a 20min treadmill walk (20MTW). Early (0-100 ms) and late (100-200 ms) rate of torque development (RTD100, RTD200), and peak torque were extracted and normalized to body mass (kg). Electromyography (EMG) was collected during walking for the vastus lateralis (VL), biceps femoris (BF), and medial gastrocnemius (MG). Principal Component analysis (PCA) was used to determine the dominant patterns of muscle activation in each muscle and extract PC scores. Paired samples t-tests were used to compare torque, RTD, and PC scores between pre and post 20MTW ($\alpha = .05$). **RESULTS:** There was no significant difference post 20MTW in peak torque ($p > .05$) but there were significant decreases in RTD100, RTD200, scores for the MG PC6, BF PC8 and a significant increase in MG PC7 scores post 20MTW (all $p < .05$). **CONCLUSION:** Knee extensor function is altered in individuals with KOA after a prolonged walk. The change in RTD but not peak torque is indicative of lower motor unit recruitment and a change in recruitment pattern. This in conjunction with the altered muscle activation patterns post exercise may be a compensatory strategy to maintain locomotion after exertion.

TITLE: MANAGEMENT OF REFRACTORY PLANTAR FASCIITIS WITH COMBINED SHOCKWAVE THERAPY AND PLATELET RICH PLASMA INJECTION

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Plantar fasciitis is one of the most common causes of foot and heel pain in adults. While conservative treatment may be effective, a portion of cases may not respond to current non-surgical modalities. Shockwave therapy (SWT) and platelet rich plasma (PRP) intralesional injections have each been described as effective treatments on their own. However, the combined use has not been adequately described. **PURPOSE:** To present two cases of plantar fasciitis treated successfully through SWT combined with PRP measured using functional gains from Foot and Ankle Ability Measure (FAAM). **METHODS:** Two runners presented with heel pain (70-year-old female, and 73-year-old male) and with MRI findings of plantar fasciitis. The female had 8 months of heel pain, 3 months physical therapy (PT) prior to starting SWT. The male had a remote history of non-surgical heel pain (opposite foot) with gradual increase in current pain and 3 weeks of activity limiting pain prior to starting SWT. SWT was combined with PT. Due to ongoing symptoms, each elected to proceed with a single leukocyte-poor PRP injection. **RESULTS:** The female runner completed 7 sessions of SWT and met minimal clinical important difference (MCID) for both sport and ADL subscales at week 10. However, she was unable to return to her preferred level of running and subsequently completed a PRP injection at week 28 followed by 2 SWT sessions. At week 42 (11 weeks post PRP) she was able to proceed with return to running. The male runner initially completed 5 sessions of SWT and met MCID at for both subscales at week 21. However, he was unable to return to running; repeat MRI revealed worsening fascia thickening and partial tearing. He subsequently completed a PRP injection at week 29 followed by 2 SWT. At 51 weeks (22 weeks post PRP) he met MCID for both subscales and has returned to running. **CONCLUSIONS:** While both runners had measurable gains in function following SWT, limitations in tolerance to running persisted and responded to use of PRP injection. These cases highlight how combined SWT and PRP may be effective in challenging cases of plantar fasciitis in running athletes.

COMPARISON OF EXTRACORPOREAL SHOCKWAVE THERAPY FUNCTIONAL OUTCOMES FOR PATELLAR VERSUS QUADRICEPS TENDINOPATHY

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Patellar tendinopathy (PT) and quadriceps tendinopathy (QT) are common causes of anterior knee and thigh pain in athletes. Extracorporeal Shockwave Therapy (ESWT) has been shown to improve function in tendon conditions. Outcomes comparing treatment response by tendon treated in the knee (PT, QT) and differences by sex have not been adequately characterized.

PURPOSE: The purpose of this study was to evaluate differences in outcomes for treatment of PT and QT with ESWT. A secondary measure was to evaluate whether there are sex differences in treatment response. **METHODS:** A database of individuals treated with ESWT between 2017 and 2021 by a sports medicine physician (AST) was screened for patients treated for diagnosis of PT or QT. All completed at least 3 ESWT sessions at the affected region and had baseline and follow-up functional outcome surveys completed (Victorian Institute of Sport – Patellar Tendon [VISA-P]). **RESULTS:** There were 16 PT patients (4F, 12M) and 6 QT patients (3F, 3M; for n=22 age 34±13 y.o.). For PT, initial and final VISA-P were 47±19 and 66±14, respectively, with 69% meeting minimal clinically important differences (MCID; 13-point improvement between initial and final score). For QT, initial and final VISA-P were 38±20 and 59±32, respectively, with 67% of patients meeting MCID. Across both pathologies, 71%F and 67%M met MCID. No statistically significant change (final-baseline) in MCID was found between the PT and QT groups (PT vs QT p=0.83), or as a function of biological sex between or within condition groups (Overall F vs M p=0.64, PT_F vs PT_M p=0.66, QT_F vs QT_M p=0.79, PT_F vs QT_F p=0.77, PT_M vs QT_M p=0.84). **CONCLUSIONS:** Our results suggest that ESWT may be an effective treatment for PT and QT, with no differences observed by binary sexes. Studies in larger patient populations and across different tendon conditions may substantiate these findings.

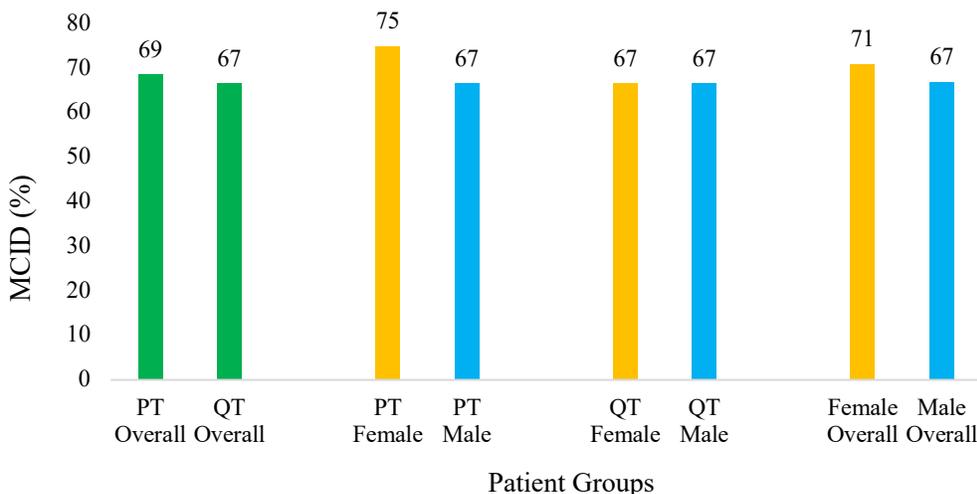


Figure 1. Percent of patients achieving minimal clinically important difference within and between patellar and quadriceps tendinopathies and binary sexes.

SKELETAL MUSCLE OXIDATIVE CAPACITY EVALUATION IN CHILDREN WITH CEREBRAL PALSY: PRELIMINARY RESULTS OF AN ONGOING STUDY

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Individuals with cerebral palsy (CP) have a 32% higher energy expenditure to perform basic activities like walking compared to age-matched, typically normally developing (TD) people. Individuals with CP complain about physical fatigue and poor body movement coordination, factors that limit their ability to walk long distance. Low locomotor muscle oxidative capacity contributes to effort intolerance. Near-infrared spectroscopy (NIRS) allows non-invasive determination of the muscle oxygen consumption ($mV'O_2$) recovery rate constant (k), which is directly proportional to oxidative capacity.

PURPOSE: Twofold: 1) to determine the reproducibility and reliability of a NIRS-based test to assess muscle oxidative capacity in young individuals with CP; and 2) to compare muscle oxidative capacity in CP versus TD.

METHODS: Three young men with CP (23±1 years) and diagnosis of motor function impairment level II to III (Gross Motor Function Classification System), and three sex- and age-matched TD (CON; 23±1 years) took part in the study. Gastrocnemius muscle k was measured twice by NIRS using repeated intermittent arterial occlusions after 10 s of muscle activation: greater k indicates greater oxidative capacity. Within-subject reliability was assessed by coefficient of variation (CV) and interclass correlation coefficient (ICC). Paired t-test was used to compare groups. Significance was set at $p \leq 0.05$. Results are presented as mean±SD. Data and statistical analyses were performed using Prism9 (GraphPad, US).

RESULTS: Test-retest CV (and ICC) was 9.6±5.5% (ICC=0.23) in CP and 5.4±3.8% (ICC=0.96) in CON. Resting muscle tissue saturation was within normal ranges in both groups (CP 71.0±2.7%, CON 65.0±8.0; $p=0.41$). Individuals with CP had a 37% lower k compared to CON (CP 1.04±0.61min⁻¹, CON 1.65±0.66min⁻¹; $p=0.24$).

CONCLUSIONS: While the average CV was consistent with previous findings, in the CP group the variability was wide (CV range 0.4-16.9%) and reliability low. Accounting that the sample is yet small, these preliminary results suggest that the usual two repetitions used to calculate k are not enough to ensuring reproducibility of the assessment in the CP population. Our pilot data indicated CP have ~37% lower k than TD peers, a difference with similar magnitude to the walking energy cost.

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EFFECT OF RESISTANT STARCH SUPPLEMENTATION ON PLASMA suPAR CONCENTRATIONS IN PATIENTS WITH CHRONIC KIDNEY DISEASE

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Soluble urokinase plasminogen activator receptor (suPAR) is a potential biomarker that has been previously associated with systemic inflammation in patients with Chronic Kidney Disease (CKD) and has demonstrated greater accuracy in predicting CKD incidence and progression years before other known markers of nephropathy. Recent evidence has emerged supporting the efficacy prebiotic high amylose resistant starch (HAM-RS2) supplementation in patients with CKD, with notable attenuations in uremic toxic production, systemic inflammation, and oxidative stress via bacterial production of anti-inflammatory compounds. **PURPOSE:** The purpose of this study was to determine if HAM-RS2 supplementation would have a normalizing effect on gut microbiota, resulting in decreased plasma suPAR concentrations in patients with CKD. **METHODS:** Sixty-five stage 3-4 CKD patients (age: 30-75 years) were randomized into one of two groups across 16 weeks: 1) HAM-RS2 and usual care or 2) placebo (cornstarch) and usual care. For week 1, dosage for both groups was 15 grams/day and increased to 33 grams/day for weeks 2-16. Plasma suPAR concentrations were measured at baseline, week 8, and week 16, while stool samples were collected for analysis of microbial composition at baseline and week 16. A linear mixed effects model was calculated to determine if the change in suPAR levels across the three assessment times differed between the prebiotic group and the control group. **RESULTS:** The interaction between condition and time was not significant, $F(2,85) = 0.18, p = .83, \eta_p^2 = .004$, indicating no differences in suPAR changes between the prebiotic and control groups. The main effect for time was not significant, $F(2,85) = 1.03, p = .34, \eta_p^2 = .02$, indicating the sample as a whole did not change in suPAR levels across the three assessment times. **CONCLUSION:** These results indicate that 16 weeks of HAM-RS-2 supplementation did not have a significant effect on decreasing plasma suPAR concentrations via changes in gut microbiota composition. Further investigation into whether prebiotic supplementation, coupled with an aerobic exercise regimen, has a mitigating effect on suPAR concentrations is warranted.

Age-related Shift to Slower Myosin Heavy Chain Isoforms is Sex-specific: A Systematic Review and Meta-analysis

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Sarcopenia, or the age-related decline of skeletal muscle mass and function, reduces whole muscle contractile capacity increasing physical disability. An age-related shift in myosin heavy chain (MHC) isoforms may contribute to sarcopenia, as MHC I fibers produce less force and have slower contractile velocities than MHC II fibers. MHC isoform composition could also be altered by differential fiber atrophy. For instance, if MHC II fibers become smaller with age than MHC I fibers, overall MHC I composition of the whole muscle would be increased. **PURPOSE:** To determine the effects of aging on MHC isoform composition and fiber size in human skeletal muscle using a systematic review and meta-analysis. **METHODS:** Study inclusion criteria included: peer-reviewed publications in English, outcome comparisons between healthy young (18-40 years) and older (60-85 years) adults, and vastus lateralis muscle samples. Random effects models were used to calculate the standardized mean difference (SMD) in MHC composition and fiber size comparing young and older adults. **RESULTS:** A total of 25 studies (25 included males; 4 included females) were examined for the systematic review and meta-analysis. Older male adults had greater MHC I expression ($p < 0.0001$, $SMD = 1.51$, 95% Confidence interval (CI): 0.87, 2.14) and reduced MHC II expression ($p = 0.0003$, $SMD = -1.32$, 95% CI: -2.02, -0.61) compared to young males, while MHC isoform expression remained unchanged with age in females (MHC I: $p = 0.84$, $SMD = 0.13$, 95% CI: -1.19, 1.46; MHC II: $p = 0.64$, $SMD = -0.26$, 95% CI: -1.36, 0.84). Single fiber cross-sectional area decreased similarly with age in males and females (MHC I: $p = 0.02$, $SMD = -0.74$, 95% CI: -1.38, -0.11; MHC II: $p < 0.00001$, $SMD = -3.25$, 95% CI: -4.4, -2.1). **CONCLUSION:** Sarcopenia in older males may be influenced by their age-related increase in MHC I expression, as this should lead to lower force production and slower contractile velocity in their skeletal muscles. Although females did not show age-related changes in MHC expression, a limited number of studies have addressed this issue, indicating that future work should include or focus on females. Exercise or pharmacological countermeasures that shift MHC expression towards faster isoforms in males and/or that increase fiber size in both sexes should decrease the prevalence of sarcopenia.

MISSED FINDINGS OF A DEVELOPING OSTEOSARCOMA, A CASE OF SHOULDER PAIN IN PEDIATRIC SPORTS MEDICINE

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Osteosarcoma is the most common primary malignancy of bone in children and adolescents. The incidence of osteosarcoma is bimodal, the first peak occurring between ages 10-14 years and the second occurring after age 60. Osteosarcomas typically present with localized pain and swelling at the primary lesion site; systemic symptoms are uncommon. **PURPOSE:** The purpose of this case study is to describe the chronologic changes in presentation and radiographic findings in an adolescent patient with a developing osteosarcoma who presented with shoulder pain to a pediatric sports medicine clinic. **METHODS:** A 13-year-old female presented with 4-8 weeks of right shoulder pain after an injury sustained during a lacrosse tournament. Family reported initial x-rays taken at an urgent care were negative for fracture or other notable findings, these initial images were unable to be obtained for review. Examination revealed tenderness along the acromion and limited passive range of motion and strength. No swelling, abnormal sensation, or perfusion was noted. The patient was treated conservatively with formal physical therapy. They returned weeks later with worsening pain, difficulty sleeping, acute swelling over the shoulder, and decreased range of motion. No known fever, fatigue, or weight loss. Examination revealed swelling over the anterior aspect of the shoulder, limited range of motion as well as decreased strength. Due to the acuity of symptoms, imaging was obtained. **RESULTS:** X-ray revealed an extensive mixed sclerotic and lytic aggressive bone lesion in the proximal humeral metaphysis extending distally and into adjacent soft tissues. MRI revealed an aggressive infiltrative appearing mass involving much of the humerus extending from the humeral head to the distal diaphysis with prominent extraosseous extension and intra-articular extension into the glenohumeral joint. Upon review of the patient's outside imaging, which was later obtained, a radiopaque abnormality with ill-defined borders is identified overlying the medial border of the humeral metaphysis, likely the missed finding of the patient's developing osteosarcoma. **CONCLUSION:** This case reinforces the importance of accurate interpretation of diagnostic imaging in the context of patient history and examination findings. Further, this case highlights that misinterpretation of diagnostic imaging may lead to delayed diagnosis and treatment.

IMPACT OF RESIDENT INVOLVEMENT IN ORTHOPEDIC SHOULDER SURGERY: A NSQIP DATABASE STUDY

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The impact of resident involvement in various subspecialties of orthopedic surgery has been well documented. However, the literature concerning resident involvement in shoulder surgery is limited. **PURPOSE:** The purpose of this study was to examine whether resident involvement across all orthopedic shoulder surgeries is associated with adverse 30-day outcomes.

METHODS: We conducted a search of the American College of Surgeons National Surgical Quality Improvement Program database for all patients who underwent orthopedic shoulder surgery from 2010 – 2012. Data extraction included pre-operative demographics and comorbidities, operative characteristics, and 30-day post-operative outcomes. Cases were categorized into “Attending alone” and “Attending and resident in operating room” groups. Independent t-test and Chi-square or Fischer’s exact test were used for continuous and categorical variables, respectively. A logistic regression model using propensity scores was used to calculate adjusted odds ratios for outcomes. **RESULTS:** We analyzed 5,648 patients who underwent orthopedic shoulder surgery; 3,455 patients were in the “Attending alone” group, while 2,193 were in the “Attending and resident in the operating room” group. Resident presence in the operative room was significantly associated with any complication, defined as any medical, surgical, or other complication within 30 days of the initial operation (OR 1.37, CI = 1.12 - 1.67, $P = .002$). Resident presence in the operating room was not associated with any individual medical, surgical, or other complication, except for bleeding transfusions ($P = <.001$). **CONCLUSION:** This is the first study to analyze the impact of resident involvement on 30-day outcomes in all orthopedic shoulder surgeries. Our findings show that resident involvement across all orthopedic shoulder surgeries does not present an increased risk for 30-day complications. Our study can aid surgeons in counseling their patients who express concern about a resident’s participation in their surgery.

COME ALIVE OUTSIDE: FINDINGS FROM A COMMUNITY-BASED PHYSICAL ACTIVITY PASSPORT PROGRAM

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Children who spend more time outdoors engage in more physical activity and less sedentary behavior than children who spend less time outdoors. *Come Alive Outside* (CAO) Kid Passport Program was intended to incentivize children to be active and engage in outdoor activities.

PURPOSE: describe findings from a field test of the CAO passport program. **METHODS:** Passports were distributed to children in pre-kindergarten to 6th grade (N=196) in schools throughout Rutland County, Vermont, during summer 2018, winter 2018-2019, and summer 2019. Children earned points and prizes for completing activities and finding secret codes at local outdoor sites. Activities recorded in returned passports were manually entered into an electronic format, and descriptive statistics, including reach and activity engagement, were calculated. **RESULTS:** A total of 196 passports were returned, 49 from Summer 2018, 59 from Summer 2019, and 88 from Winter 2018-2019. First graders returned the most passports (20%), while 6th graders returned the least (5%). An average of 9.65 activities were completed across all 3 seasons, with the highest completed in summer 2019 (14.05). The most popular activities included visits to local parks/playgrounds and outdoor exploration activities. **CONCLUSION:** The most popular activities were those that children could complete relatively independently and when convenient for families. Activities offered only on specific days/times were perhaps less accessible and convenient, as they were the least popular/completed. The CAO passport program demonstrates potential for incentive-based programs to encourage children to be active outside and increase physical activity. Future research is warranted to examine how community-based, physical activity programs may increase engagement in the outdoors across different populations and age groups.

Skeletal Muscle Fiber Force Declines with Chronic Kidney Disease in Juvenile and Adult Mice

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Juvenile and adult chronic kidney disease (CKD) patients frequently have compromised physical performance, which gets worse with increasing disease severity. Examining the underlying mechanisms behind this contractile dysfunction can be difficult to impossible in humans, especially in juveniles, but can be accomplished using animal models. **PURPOSE:** To characterize changes in cellular and molecular skeletal muscle function with CKD in juvenile and adult mouse models. **METHODS:** Single fiber function as well as myosin-actin interactions and myofilament properties were examined *ex vivo* in slow (soleus) and fast (extensor digitorum longus) contracting muscles of juvenile (6 weeks old) and adult (16 weeks old) CKD and control mice. CKD was induced by 0.2% adenine diet for 3 weeks (early-stage CKD) starting at 3 weeks of age for juveniles and for 8 weeks (late-stage CKD) starting at 8 weeks of age for adults. **RESULTS:** Specific tension (maximal isometric force divided by cross-sectional area) was reduced in all myosin heavy chain (MHC) I, IIA, and IIB fibers in juvenile (23-30%) and adult (36-51%) mice with CKD due to a reduction in strongly bound myosin-actin cross-bridges (25-30% for juveniles, 30-73% for adults). Additionally, myofilament stiffness was reduced in MHC IIA fibers from juveniles (25%) and adults (49%) as well as MHC IIB fibers from adults (52%), which should also play a role in reducing force production. For adults, myosin-actin interactions were slower in MHC I (20-39%) and IIA (33-42%) fibers, which should lead to slower contractile velocities. For juveniles, myosin-actin interactions were slower only in MHC IIA (16-28%) fibers and were faster in MHC IIB (10%) fibers. In general, juvenile early-stage and adult late-stage CKD showed similar molecular mechanisms leading to reduced force production and, potentially, contractile velocity, although alterations were typically largest in adult late-stage CKD. **CONCLUSION:** Our findings indicate that physical function in juvenile early-stage and adult late-stage CKD is being impaired on the molecular level due to intrinsic contractile deficits independent of skeletal muscle atrophy. Interventions that affect these specific molecular myopathies may prove effective in stalling or reversing disease progression, potentially improving the quality of life for these patients.

PSYCHOLOGICAL DETERMINANTS OF AFRICAN-AMERICAN MEN MEETING AND NOT MEETING AEROBIC PHYSICAL ACTIVITY GUIDELINES

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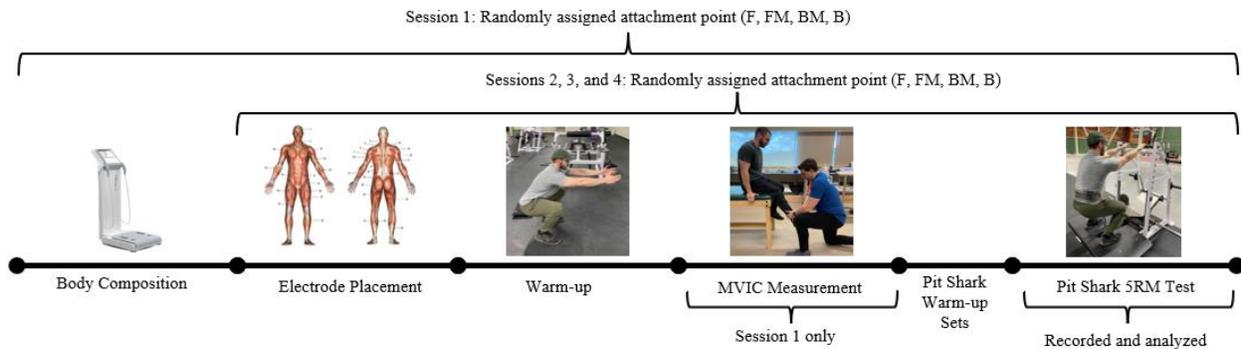
Lack of adherence to national physical activity (PA) guidelines contributes to high rates of chronic diseases. To increase adherence to PA guidelines, research has focused on psychological determinants (relative autonomy index [RAI], self-efficacy, autonomy, competence, and relatedness) identified as strong predictors of PA behaviors. Unfortunately, there is a lack of research to understand how these determinants may influence the PA behavior of African-American (AA) men. **PURPOSE:** This study examined the differences in known psychological determinants of PA in a sample of AA men who met aerobic PA guidelines and AA men that did not meet aerobic PA guidelines. **METHODS:** Participants completed an online survey about their PA participation from the previous month and their psychological status related to PA. Respondents reporting 150 minutes or more of moderate/vigorous PA met the guidelines. Those with 149 minutes or less of moderate/vigorous PA did not meet guidelines. A MANOVA examined differences in psychological variables between the groups. Statistical significance was accepted at $p < 0.05$. A forward stepwise logistic regression identified predictors of meeting aerobic PA guidelines. **RESULTS:** Of the 134 men (age=36.7±9.8 yrs.; BMI: 24.9±5.9) who responded to the survey, 59.7% reported meeting aerobic PA guidelines. Men who met aerobic PA guidelines scored significantly ($p < 0.0001$) higher in RAI than men not meeting aerobic PA guidelines (10.24±7.72 vs. 5.58±4.89). Autonomy ($p < 0.001$) and competence ($p = 0.003$) were significantly higher in men meeting aerobic PA guidelines. Task self-efficacy (7.18±0.22 vs. 6.24±0.27; $p = 0.008$) and scheduling self-efficacy (6.91±0.22 vs. 5.11±0.27; $p < 0.001$) were significantly higher in men meeting aerobic PA guidelines. Five variables (scheduling self-efficacy, “show off-shying away,” calmness, “competence-incompetence,” and intrinsic motivation) correctly predicted 79.3% of respondents who met or did not meet aerobic PA guidelines. **CONCLUSIONS:** These results demonstrate that psychological determinants of PA differ significantly between men meeting and not meeting aerobic PA guidelines. Additionally, in this sample, select psychological variables were able to predict meeting aerobic PA guidelines with 79.3% accuracy, highlighting the significance of psychological determinants and PA engagement in AA men. Future research should include larger sample sizes and greater diversity of AA men to examine possible differences between AA men and other populations.

DIFFERENCES IN MUSCLE ACTIVATION PERFORMING THE BELT SQUAT EXERCISE AT VARIOUS ATTACHMENT POINTS

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There is no current literature examining the differences between the four distinct belt attachment points on the Pit Shark. These attachment points may impose greater and/or lesser activation of lower body muscles, which could affect an individual’s training based on their specific needs. **PURPOSE:** To examine the differences in lower limb and erector spinae (ES) muscle activation between belt squat attachment points on the Pit Shark belt squat machine. **METHODS:** 6 resistance trained individuals participated in 4 laboratory visits. The first session consisted of body composition measurements including height, weight, lean and fat body mass. Baseline measurements of maximal voluntary isometric contraction (MVIC) of the gluteus maximus (GM), erector spinae (ES), rectus femoris (RF), and biceps femoris (BF) were also taken during visit one. Each visit consisted of subjects completing a five-repetition maximum (5RM) at one randomly assigned attachment point while EMG data was recorded. **RESULTS:** There was no significant difference in ES, BF, GM, and RF activation between attachment points ($p>0.05$). However, there was a significant difference in 5RM load between the front (F), back-middle (BM), and back (B) attachment points ($p<0.05$). **CONCLUSION:** Although muscle activation was similar, load was different throughout the attachment points, indicating a possible biomechanical advantage present based on each attachment point. Further testing is required in order to draw stronger conclusions on the interaction of biomechanics and muscle activation. Additionally, sex differences should also be examined for muscle activation on the Pit Shark.

Figure 1.
Study Timeline



EXERCISE SCIENTIST QUALIFICATIONS, SKILLS AND PROFESSIONAL FOCUS: A CONTENT ANALYSIS OF JOB POSTINGS IN AMERICA

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Growth in the field of clinical exercise science and the potential impacts on overall health and wellbeing have driven the need for qualified, clinically trained, exercise professionals. And yet, it is not well understood what specific credentials employers are seeking when hiring clinical exercise physiologists. **PURPOSE:** The purpose of the study was to examine the potential career opportunities for aspiring professionals in exercise science, exercise physiology, kinesiology or equivalent fields had upon graduation with a bachelor's degree. **METHODS:** Search platforms including Indeed and USA Jobs were examined. All jobs examined on these search platforms were filtered to show results from postings within one week of data collection. All jobs were screen recorded within 24 hours upon the start of the data collection and all positions were located nationally throughout the United States. Search terms used to filter jobs included "Exercise Physiology", "Exercise Science", "Exercise Professional", "Exercise Prescription", "Exercise Specialist", and "Kinesiology". **RESULTS:** Jobs ranged from part-time to full-time and included positions within the clinical setting such as physical therapy technicians, and cardiovascular technicians as well as employment opportunities related to personal training, wellness and fitness instruction, and strength and conditioning. CPR/ AED certification and basic life support were the predominantly required certifications. Other certifications may have been required for a selected job from a governing body that meets national accreditation including ACSM, NSCA, ACE, NATA, AFAA, NETA, and NASM. **CONCLUSION:** Job postings related to exercise related professions are widely varied and accessible for graduates with bachelor's degrees within the United States. However, credentialing and certification requirements are wide ranging and may not necessarily call for a bachelor's degree. These findings indicate the importance for undergraduate exercise science degree programs to identify and market advanced skills and knowledge gained with successful completion of a college degree.

VIRTUAL REALITY GAIT REHABILITATION IN INDIVIDUALS LIVING WITH CHRONIC STROKE

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Stroke is a leading cause of adult disability and can cause deficits such as inefficient gait velocity, endurance, and symmetry.¹ Research studies suggest that virtual reality (VR) has a potential application in gait rehabilitation. VR may be able to further improve gait and mobility in stroke patients by requiring the user to adapt to real-life situations presented to them in a controlled virtual environment. VR can increase motivation, engagement, and adherence to rehabilitation exercises directly improving the rehabilitation outcomes.² **PURPOSE:** The purpose of this study is to evaluate the effectiveness of treadmill training in an immersive virtual environment for people with chronic stroke. **METHODS:** This study is a longitudinal pilot study with twenty individuals experiencing chronic stroke symptoms. The VR environment for treadmill training was coded in Unity 3D to create a customizable environment that simulated real-life situations. An avatar was controlled in the virtual environment by streaming positional data from inertial orientation sensors (Xsens) on the torso and limbs of the participant. During the 30-minute sessions, participants walked on the treadmill performing virtual tasks by stepping over and on obstacles presented at varying distances along a straight path. Real-time performance feedback for obstacle navigation was provided. Participants trained 5 days a week for two weeks. Clinical assessments were recorded pre- and post-training. **RESULTS:** Clinical assessment scores for two participants are

recorded in Table 1. Participants showed a clinically significant improvement in the DGI. There were also improvements in the FSST, BBS, and TUG assessments.

CONCLUSIONS: These results support the need to further assess the utilization of VR treadmill training on

balance, mobility, and gait function in individuals experiencing chronic stroke symptoms.

REFERENCES: ¹Boehme et al. *Circulation Research* (2017); ²Chen et al. *BioMed Research International* (2016). **FUNDING:** The Rhode Island Foundation.

	Participant 1			Participant 2		
	Pre	Post	Δ	Pre	Post	Δ
FSST (s)	8.26	5.02	-3.24*	10.77	9.42	-1.35*
BBS	49	54	5*	51	56	5*
DGI	11	19	8**	13	21	8**
TUG (s)	10.27	8.70	-1.57*	17.85	16.57	-1.28*

FSST- Four Square Step Test; BBS - Berg Balance Scale;

DGI - Dynamic Gait Index; TUG- Timed UP and Go;

* - improvement; ** - clinical improvement

PERCEIVED BENEFITS AND BARRIERS TO EXERCISE AMONG WOMEN SURVIVORS OF SEXUAL VIOLENCE

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Sexual Violence (SV) is a pervasive public health issue primarily perpetrated against women. Exercise can improve health among trauma-exposed communities, although little research has focused on promoting physical activity (PA) among women survivors of SV. **PURPOSE:** To report on perceived benefits and barriers of exercise among women survivors of SV and compare perceptions by PA and post-traumatic stress disorder (PTSD) statuses. **METHODS:** Amazon Mechanical Turk[®] implemented an online, cross-sectional survey of women survivors of SV which assessed sociodemographic information, exercise levels, PTSD symptoms, and exercise perceptions. Participants were US women aged 18-65 with a self-reported a history of SV. The Exercise Benefits and Barriers Scale (EBBS), used to assess exercise perceptions, is comprised of five benefits subscales (life enhancement, physical performance, psychological outlook, social interaction, and preventative health) and four barriers subscales (exercise milieu, time expenditure, physical exertion, and discouragement). Scores on each subscale were standardized in a Likert 4-point response format (range: 1=strongly disagree; 4=strongly agree) to allow for direct comparisons between subscales, with higher scores indicating higher levels of agreement. An open-ended option to write-in additional perceived benefits/barriers was included. Subscale scores were compared by PA status (active; insufficiently active) and PTSD status (provisional PTSD; no PTSD). **RESULTS:** 355 women completed the survey, with 83.6% ($n=297$) experiencing provisional PTSD and 33.5% ($n=112$) were physically active. The most highly endorsed perceived benefit was physical performance ($M=3.16$, $SD=0.54$). Open-ended responses included improved mental health and fitness. The highest scored barrier was physical exertion ($M=2.89$, $SD=0.63$), with open-ended responses including pain, poor health, unsafe exercise environments, the pandemic, and lack of time/childcare. Active women scored significantly higher on benefits life enhancement, physical performance, psychological outlook, and social interaction ($P_s<0.05$; Cohen's $d_s=0.25-0.48$), with no significant differences found among barriers. Women with PTSD scored significantly higher on benefits social interaction and lower on physical performance and preventative health. They scored significantly higher on barriers exercise milieu, high time expenditure, and family discouragement ($P_s<0.05$; Cohen's $d_s=0.34-1.18$). **CONCLUSION:** Findings provide information for exercise promotion among women survivors of SV with differing levels of baseline activity and PTSD symptoms.

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IMPACTS OF CANNABIS USE TIMING, BIOLOGIC GENDER, AND IRON SPORT PARTICIPATION ON PERCEIVED RECOVERY

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PURPOSE: The purpose of this study was to investigate possible impacts of cannabis use, gender, and iron sport participation on perceived recovery. **METHODS:** Five hundred and thirty three iron sport athletes were surveyed regarding their timing of cannabis use in relation to training (pre-exercise, intra-exercise, post-exercise), biologic gender (male, female, other), and iron sport training style (powerlifting, bodybuilding, strongman, Olympic weightlifting). Perceived recovery was assessed via a modified version of the Perceived Recovery Status Scale adapted for inclusion in the survey. A 3x2x4 between-groups factorial ANOVA was used to measure significant interaction effects on perceived recovery. Partial eta squared effects sizes (η^2) were calculated as follows: small: 0.01-0.06; moderate: 0.06-0.14; and large: >0.14. **RESULTS:** There was no statistically significant interaction effect of cannabis use timing, biologic gender, and iron sport participation on perceived recovery ($p = 0.382$; $\eta^2 = 0.003$). Main effects also revealed no significant effect of cannabis use timing ($p=0.419$, $\eta^2 = 0.006$), gender ($p=0.935$, $\eta^2 < 0.001$), or iron sport participation ($p=0.407$, $\eta^2 = 0.006$) on perceived recovery. **CONCLUSION:** Perceived recovery is not impacted by timing of cannabis use, biologic gender, or iron sport participation. To our knowledge, this is the first such investigation into cannabis use in iron sports athletes specifically. Follow-up research should aim to investigate differences in perceived recovery between cannabis users and non-users.

VALIDITY OF A HEART RATE GARMENT TO COLLECT LNRMSSD DATA DURING REST AND POST-EXERCISE RECOVERY

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Heart rate variability (HRV), the natural fluctuation of successive R-R intervals, has been historically recorded using an electrocardiography (ECG) device. However, the recent emergence of a garment embedded with laminate conductive ECG electrodes may provide a feasible alternative for collecting HRV data in field-based settings. **PURPOSE:** To determine the criterion validity of a novel smart garment when collecting HRV measures in reference to the Polar H10 heart rate monitor (HRM). **METHODS:** Five minutes of natural log of the root mean square of successive R-R interval differences (lnRMSSD) data were collected prior to (Resting) and following (Recovery) a 15-minute treadmill exercise protocol in both a seated and supine position from 16 males (age: 24.6 ± 4.3 yrs; height: 180.7 ± 6.7 cm; body mass: 88.0 ± 10.0 kg). Data were simultaneously collected using the smart garment with the Polar H10 HRM situated underneath. **RESULTS:** *Strong to nearly-perfect* and statistically significant ($P < 0.05$) correlations were identified between devices during the Resting – Supine ($r = 0.985$, $R^2 = 0.970$), Resting – Seated ($r = 0.608$, $R^2 = 0.370$), Recovery – Seated ($r = 0.529$, $R^2 = 0.280$) and Recovery – Supine ($r = 0.704$, $R^2 = 0.496$) conditions, accounting for 28.0% to 37.0% and 49.6% to 97.0% of the variance in lnRMSSD data during the seated and supine conditions, respectively. In addition, *trivial to small* and non-significant differences in lnRMSSD data were observed between the smart garment and the HRM during the Resting – Supine ($P = 0.904$), Resting – Seated ($P = 0.112$), and Recovery – Supine ($P = 0.185$) conditions (Table). However, *moderate* and statistically significant differences were observed during the Recovery – Seated ($P = 0.011$) condition. **CONCLUSIONS:** Criterion validity of the novel smart garment was observed when collecting lnRMSSD data, but further exploration of the validity should be examined during post-exercise recovery conditions.

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Table. lnRMSSD (ms) Data Comparison Between Smart Garment and HRM (mean \pm SD)					
Condition	Smart Garment	HRM	Mean Difference	Effect Size	Data Loss
Resting – Supine (<i>n</i> = 14)	4.14 \pm 0.65	4.13 \pm 0.61	+0.004 \pm 0.12	<i>g</i> = 0.02 <i>trivial</i>	12.5% (2/16)
Resting – Seated (<i>n</i> = 15)	4.24 \pm 0.81	3.96 \pm 0.45	+0.28 \pm 0.64	<i>g</i> = 0.43 <i>small</i>	6.25% (1/16)
Recovery – Seated (<i>n</i> = 15)	3.25 \pm 1.32	2.41 \pm 0.73	+0.85 \pm 1.12*	<i>g</i> = 0.79 <i>moderate</i>	6.25% (1/16)
Recovery – Supine (<i>n</i> = 14)	2.81 \pm 1.16	2.51 \pm 0.83	+0.31 \pm 0.82	<i>g</i> = 0.30 <i>small</i>	12.5% (2/16)
Abbreviations: lnRMSSD = natural log of the root mean square of successive R-R interval differences; HRM, heart rate monitor. *Significant difference between devices (<i>P</i> < 0.05).					

INDIVIDUALS WITH HISTORY OF HAMSTRING STRAIN PRESENT WITH ELEVATED STIFFNESS AT THE POINT OF INJURY

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Hamstring strains are one of the most common athletic injuries and has the highest reinjury risk among all musculoskeletal injuries. The likelihood of reinjury after joint function is recovered suggests that tissue quality is impaired at the site of injury. **PURPOSE:** To determine if individuals who have successfully recovered from a unilateral hamstring strain injury present with differences in muscle stiffness between injured and non-injured limbs. **METHODS:** Two individuals who experienced unilateral semimembranosus (SM) strains at different muscle locations (proximal: PI or distal: DI) and were medically cleared to return to activity took part in this case study. Both participants completed a single testing session during which hamstring strength, flexibility, and regional muscle stiffness were measured on both the injured and non-injured limbs. Maximal voluntary isometric contractions (MVIC) were used to measure hamstring strength via isometric dynamometry. Flexibility was assessed utilizing a straight leg raise test. SM muscle stiffness was measured using shear wave elastography at 25% (proximal), 50% (mid) and 75% (distal) muscle length. At each location the average stiffness of a 3 cm² area was measured and compared between the injured and non-injured limbs. **RESULTS:** For PI, the injured limb was 15.2% stronger than the non-injured but for DI the injured limb was 5.4% weaker. Regarding flexibility, the injured limb was 13.2% less flexible for PI, but 1.2% more flexible for DI. For PI, the proximal portion of the SM was 29% stiffer than the injured limb but only 4% and 8% stiffer in the mid and distal regions. For DI, the distal portion of the SM was 16% stiffer in in the injured limb but was 6% and 9% less stiff in the middle and proximal regions away from the injury. **CONCLUSION:** Despite both individuals receiving medical clearance to return to activity both presented greater localized stiffness at the portion of the muscle adjacent to the point of injury. As this is a case study, we suggest further research to determine if localized muscle stiffness can be used as a measure of muscle quality or if it is related to reinjury risk.

EFFECT OF DYNAMIC AND GLUTEAL RESISTANCE EXERCISE WARM-UP PROTOCOLS ON LOWER EXTREMITY JUMP LANDING MECHANICS

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Poor neuromuscular control of the femur by the gluteal musculature is associated with non-contact and overuse injuries to the knee. Acute bouts of resistance exercises targeting the gluteal musculature are prescribed as part of a warm-up protocol with the goal of improving subsequent neuromuscular control and athletic performance. **PURPOSE:** The purpose of this study was to determine the effect that moderate-intensity gluteal muscle resistance exercises as part of a warm-up protocol have on single leg jump landing biomechanics in healthy college-aged females. **METHODS:** Seventeen healthy, college-aged females (mean \pm SD; age = 21.4 ± 1.9 years; height = 166.9 ± 5.7 cm; body mass = 62.5 ± 7.4 kg) performed three single leg hop trials per leg after completing no warm-up (CON), a dynamic warm-up (DWU), and a dynamic warm-up with gluteal resistance exercises (DWU+GRE) across three laboratory visits. Lower extremity kinetic and kinematic variables were assessed during the jump landings from the point of initial contact to deepest knee flexion using three-dimensional motion capture and force plate recordings. Biomechanical differences between dominant and non-dominant limb landings were also assessed. **RESULTS:** Dominant limb hip internal rotation angle after DWU+GRE ($2.03 \pm 9.92^\circ$) was significantly greater ($p \leq 0.05$) compared to CON ($-3.36 \pm 7.74^\circ$). Peak knee adduction moment (56.8%), peak knee flexion angle (5.7%) and peak knee external rotation angle (17.0%) were significantly greater ($p \leq 0.017$) in the dominant limb across warm-up protocols. **CONCLUSION:** A single-bout of GRE prior to movement did not induce significant biomechanical changes during jump-landings. Significant biomechanical differences between the

dominant and non-dominant limb during landing were identified. Clinicians prescribing DWU+GRE should consider previously reported athletic performance benefits as the rationale for prescription rather than changes in movement patterns.

GAIT RETRAINING FOR REDUCTION OF VERTICAL LOADING RATE USING REAL-TIME AUDITORY FEEDBACK PROVIDED BY EARPHONES

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Running-related injuries (RRI) are common with reported incidence and prevalence ranging from 19% to 92% depending on the population studied and the definition of RRI. Among various biomechanical risk factors implicated in RRI, a high level of vertical loading rate has been associated with patellofemoral pain, tibial stress fractures, and plantar fasciitis in runners.

Recently, gait retraining program using real-time visual feedback was found to reduce vertical loading rate as well as lower the risk of RRI in novice runners. **PURPOSE:** The purpose of this case study was to examine instantaneous vertical loading rate (IVLR) before and after a gait retraining program using real-time auditory feedback provided by earphones.

METHODS: Two male novice runners (Runner A with age of 23 and body mass index (BMI) of 22.2; Runner B with age of 26 and BMI of 27.5) were enrolled in this study. The primary outcome was the change in IVLR acquired at 2 different speeds, 8km/hour (“slow”) and 12km/hour (“fast”) after participating in 8 sessions over 2 weeks of gait retraining for landing stiffness modulation. They were instructed to run at comfortable speeds on a treadmill identified during the initial visit. Auditory feedback was provided through the earphones to “run softer” if the IVLR was greater than 70 body weight (BW)/sec. Total running time was set to 15 minutes with real-time auditory feedback provided at all times during the first four sessions then progressively removed in the last four sessions. **RESULTS:** At 8km/hour, the IVLR of Runner A decreased from 99.9 BW/sec to 32.3 BW/sec while that of Runner B from 63.7 BW/sec to 40.7 BW/sec after 2-week of gait retraining. Likewise, at 12km/hour, the IVLR of Runner A decreased from 113.8 BW/sec to 32.7 BW/sec while that of Runner B from 98.7 BW/sec to 65.7 BW/sec. **CONCLUSION:** These results demonstrate that 2-week gait retraining using real-time auditory feedback provided by earphones can be useful in decreasing vertical loading rate in both slow and fast paces. These earphones may allow runners to not only reduce but also continue monitoring IVLR in natural training environments and potentially help prevent RRI.

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THE EFFECTS OF 4-WEEKS OF STATIC STRETCHING ON HAMSTRING MUSCLE STRUCTURE

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Routine static stretching (SS) is commonly performed with the goals to increase joint flexibility and reduce injury risk. However, the effects of routine SS on muscle hamstring structure remains unknown. Of great interest are the effects of SS on muscle structure of the proximal biceps femoris (BF) and semimembranosus (SM), the portions of the muscle most susceptible to stretch and running based strain injuries respectively. **PURPOSE:** To determine the effects of 4-weeks of SS on BF and SM muscle structure throughout the muscle. **METHODS:** Fourteen healthy active participants who did not routinely perform any stretching exercises took part in this study. Participants were randomly assigned to either a SS group or a control group (CON). SS performed 5 sets of 30 s hamstring stretches 5 times per week for 4-weeks, while the control group maintained their normal activities habits. Prior to and after the intervention participants had BF and SM structure assessed at 25% (proximal-muscle), 50% (mid-muscle) and 75% (distal-muscle) muscle length using B-mode ultrasound. The structural measures recorded were fascicle length, fascicle angle, and echogenicity. Comparisons were then made between groups over time using paired t-tests. **RESULTS:** No differences over time were observed for either BF or SM fascicle length ($p=0.341-0.980$) or fascicle angle ($p=0.341-0.980$) at any location for either SS or CON. For SS, echo-intensity at the proximal SM significantly decreased (pre: 128.0 ± 15.9 , post: 104.5 ± 22.3 , $p=0.044$), however no differences were observed at any other SM region or any BF region ($p=0.192-0.863$). **CONCLUSION:** Consistent with previous studies that were restricted to the mid-portion of the muscle, we found no significant changes to muscle fascicle length or fascicle angle. However, we did observe a localized decrease in echo-intensity at the proximal SM, the most common location of stretch based hamstring strain injuries, suggesting a change in composition of the muscle at this location. While echo-intensity has been shown to be inversely related to muscle adiposity and fibrotic tissue accumulation, additional research is necessary to determine the cause of the observed change as well as its potential impact on resiliency to stretch based hamstring strain injuries.

VALIDITY OF A SMART GARMENT TO COLLECT R-R INTERVAL DATA DURING REST AND POST-EXERCISE RECOVERY

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New wearable technologies provide a more feasible method to collect R-R interval data to calculate heart rate variability (HRV) metrics. A novel smart garment that utilizes conductive laminate electrodes embedded within the garment to allow for R-R interval data collection has recently been developed. **PURPOSE:** To determine the criterion validity of the smart garment when collecting R-R interval data in reference to the Polar H10 heart rate monitor (HRM). **METHODS:** 16 male participants volunteered for the study (age: 24.6 ± 4.3 yrs; height: 180.7 ± 6.7 cm; body mass: 88.0 ± 10.0 kg). 5 minutes of R-R interval data were collected simultaneously using a Polar H10 HRM with the smart garment over the HRM in both the supine and seated positions. Data were collected before (Resting) and after (Recovery) a 15-minute treadmill exercise protocol. **RESULTS:** *Trivial to small* and non-significant differences were observed in the R-R interval data between devices during Resting – Supine ($P = 0.375$), Resting – Seated ($P = 0.161$), Recovery – Seated ($P = 0.348$), and Recovery – Supine ($P = 0.341$) conditions (Table). Furthermore, *very strong to nearly-perfect* significant correlations in R-R interval data were identified between devices during the Resting – Supine ($r = 0.999$, $P < 0.001$, $R^2 = 0.998$), Recovery – Seated ($r = 0.902$, $P < 0.001$, $R^2 = 0.814$), Recovery – Supine ($r = 0.759$, $P = 0.002$, $R^2 = 0.576$) conditions. However, only a *strong* significant correlation in the R-R interval data was identified between devices during the Resting – Seated ($r = 0.658$, $P = 0.008$, $R^2 = 0.433$) condition. Overall, the smart garment accounted for 43.3% to 99.8% of the variance in the R-R interval data collected by the HRM across all conditions. **CONCLUSIONS:** The novel smart garment is a potentially valid tool for collecting R-R interval data during resting and post-exercise recovery conditions.

Supported By: Massachusetts Manufacturing Innovation Initiative (M2I2), Commonwealth of Massachusetts

Table. R-R Interval (ms) Data Comparisons Between Smart Garment and HRM (mean \pm SD)					
Condition	Smart Garment	HRM	Mean Difference	Effect Size	Data Loss
Resting – Supine (<i>n</i> = 14)	955.37 \pm 146.70	956.99 \pm 146.86	-1.63 \pm 3.19	<i>g</i> = 0.01 <i>trivial</i>	12.5% (2/16)
Resting – Seated (<i>n</i> = 15)	833.43 \pm 130.01	871.30 \pm 100.18	-37.87 \pm 98.98	<i>g</i> = 0.33 <i>small</i>	6.25% (1/16)
Recovery – Seated (<i>n</i> = 15)	591.57 \pm 68.64	599.76 \pm 75.55	-8.19 \pm 32.68	<i>g</i> = 0.11 <i>trivial</i>	6.25% (1/16)
Recovery – Supine (<i>n</i> = 14)	682.70 \pm 84.12	698.20 \pm 85.13	-15.51 \pm 58.70	<i>g</i> = 0.18 <i>trivial</i>	12.5% (2/16)
Abbreviations: HRM, heart rate monitor.					

EVALUATING AND INCREASING HIGH SCHOOL ATHLETES' UNDERSTANDING HOW RECOVERY IMPROVES PERFORMANCE AND REDUCES INJURY RISK

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It is well known to the medical community that nutrition, sleep, hydration, active recovery, and mental wellness all have significant impacts on athletic performance and rates of injury. It is not well studied if high school student athletes understand this information.

PURPOSE: The purpose of this study was twofold. The first was to evaluate the understanding that High School student athletes have of how the aforementioned 5 different topics of recovery impacts their athletic performance. The second was to investigate if educating the student athletes about the 5 topics of recovery via a one time information session made a difference in their understanding.

METHODS: 19 student athletes (19 males, age 15-18, all private school students) were given a Likert scale before and after the intervention. The intervention was a single 45-minute information session that educated the students about the 5 topics. The Likert scale (based on 1-5) assessed student athletes' knowledge on how the five aspects of recovery impacted their athletic performance. A two-tailed t-test was calculated to determine the mean Likert scale score for each of the 5 topics.

RESULTS: There was an increase in knowledge reported by the student athlete in all five of the topics. Four of the five topics showed significantly higher levels of knowledge ($P < 0.05$), with the exception of the topic hydration ($P = 0.14$). Most significant result was active recovery through ACL prevention exercises ($P < 0.00000007$).

CONCLUSION: These results demonstrate that as a collective group, the students all showed an increase in knowledge after the information session. To the best of our knowledge, this is the first report of an effective method to educate highschool student athletes on how 5 topics of recovery contribute to and can increase athletic performance. This study calls for a larger population sample to assess different academic settings to determine if student athletes could benefit from information regarding recovery as part of their physical Education curriculum. Additionally, a further study to evaluate if this information increases performance and reduces the rates of injury in High school athletes.

A Declaration of Exemption was granted by Middlesex Health IRB on June 10th 2022.

THE ACUTE AND CHRONIC EFFECTS OF STATIC STRETCHING ON LOCALIZED HAMSTRING MUSCLE STIFFNESS

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Hamstring strains are one of the most common musculoskeletal injuries in athletics. While mid-muscle hamstring stiffness is positively related to injury, the proximal region where injuries most commonly occur, is the least stiff part of the muscle. This has led to the speculation that the relatively low stiffness in the proximal hamstring compared to the rest of the muscle increases localized strain in this region and increases the risk for injury. Presently, it's unknown how static stretching influences stiffness throughout the hamstring. **PURPOSE:** To determine the acute and chronic effects of static stretch on intramuscular stiffness. **METHODS:** Thirty healthy active participants had passive stiffness of their biceps femoris (BF), semimembranosus (SM) and semitendinosus (ST) measured at 25% (proximal), 50% (middle), and 75% (distal) muscle length before and after a single bout of stretching using shear-wave elastography. Then participants either performed routine stretching (SS, n=15) or no stretching (CON, n=15) for 4 weeks before repeating stiffness assessment. Variation in stiffness was calculated via ranked linear regression and comparisons between locations and times were made via repeated-measures ANOVAs. **RESULTS:** Acutely after stretching BF and SM stiffness decreased while ST was unchanged ($p=0.369$). However, decreases in stiffness only occurred in the stiffest portion of the muscles ($p=0.000-0.001$) resulting in a decrease in BF ($\Delta\beta=-0.053\pm 0.0177$) and SM ($\Delta\beta=-0.149\pm 0.0037$) stiffness variation. Chronically, an intervention-by-time effect was present for BF and ST ($p<0.05$) demonstrating an increase in stiffness but not SM ($p=0.221$). While no differences were observed in any specific locations for BF, SS resulted in an increase in stiffness in the proximal-SM, proximal-ST, and mid-ST. Furthermore, chronic SS did not affect stiffness variation. **CONCLUSIONS:** SS results in contrasting acute and chronic effects, acutely decreasing stiffness in the distal region, and chronically increasing stiffness in the proximal regions. The acute decrease in stiffness variation SS may provide temporary protection from proximal hamstring injuries by better distributing muscle strain however additional research is needed to validate this claim. Further research is also needed to explain chronic increases in muscle stiffness after chronic SS and its implications for health and performance.

HYPERTROPHIC CARDIOMYOPATHY: A SYSTEMATIC REVIEW OF THE CONDITION THAT CONTINUES ITS GRIP ON ELITE ATHLETICS

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Hypertrophic cardiomyopathy (HCM) is considered the most common cause of sudden cardiac death (SCD) in young, and generally healthy athletes. Affected athletes can collapse during a practice or game as a result of SCD, yet little is known about methods for early detection and diagnosis, and alternative treatment models that can replace current options that require lengthy recovery periods and long-term medication use. **PURPOSE:** To explore the prevalence of HCM in young athletes, to highlight the clinical manifestations and current guidelines regarding the detection and diagnosis of HCM, and to critically evaluate alternative treatment options. **METHODS:** A comprehensive search of electronic databases Google Scholar, PubMed, and Web of Science for relevant studies published in peer-reviewed journals through September 2022 was conducted. Inclusion criteria were that a study had to be a) written in English, b) published in a peer-reviewed journal, and c) studied HCM in athletes who chronically participate in high-intensity sports. **RESULTS:** A total of 19,055 studies were identified and 16 were included in this review. These studies show that while HCM is a rare occurrence, approximately one in every 500 people, its effect on the individual is devastating. In addition to a number of unpleasant clinical manifestations (e.g., arrhythmias, syncope, and dyspnea), affected athletes require daily medication use, discontinuation of all high-intensity athletic activity, and potentially invasive surgical interventions (e.g., septal myectomy). Fortunately, alternative methods with preliminary yet promising long-term results include alcohol septal ablation (ASA), a catheter-based procedure that injects alcohol into the septal myocardium for the purpose of shrinking the tissue over weeks to months. Additionally, new efforts for early detection include using modern technology such as a cardiac MRI, portable EKG, or echocardiogram, to identify morphologically significant expressions (via cardiac structure and electrocardiographic findings) of HCM in athletes prior to participation in high-intensity sports. **CONCLUSION:** HCM is a devastating and career-ending illness that warrants further systematic investigation into ways to identify and treat it before it leads to SCD. Modern technology can be used to detect HCM before it becomes fatal, and to treat individuals with the appropriate interventions.

ADAPTATION OF LEG FORCES AND IMPULSES IN ABRUPT AND GRADUAL ONSET SPLIT-BELT TREADMILL WALKING

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Adaptation is a gradual change in a movement parameter in response to a change in environment. Adaptation indicates predictive control of motion and is characterized by aftereffects, in which the movement parameter gradually changes back to baseline levels upon a sudden transition back to the baseline environmental state. Studies of adaptation to split-belt treadmill walking found propulsive force aftereffects after gradual onset split-belt walking but not after abrupt onset split-belt walking, although this discrepancy could have been caused by other methodological differences. **PURPOSE:** The purpose of this study was to compare adaptation of ground reaction forces during abrupt and gradual onset split-belt walking. We hypothesized that there would be aftereffects in braking force and propulsive force after both abrupt and gradual onset adaptation, indicating predictive control. **METHODS:** Ten subjects completed the gradual onset split-belt walking protocol and ten other subjects completed the abrupt split-belt protocol. Each experiment began with a 2-minute slow baseline (0.7m/s) and 2-minute fast baseline (1.4m/s). For all baseline trials, both treadmill belts moved at the same speed. For the gradual group, fast belt speed accelerated to 1.4m/s over 350s. For the abrupt group, fast belt speed increased suddenly to 1.4m/s. After 15 minutes of split-belt adaptation, the fast belt immediately decelerated to the slow belt speed (0.7m/s). We calculated step length symmetry, braking and propulsive impulses and peak forces. We compared the first 5 steps of post-adaptation to the last 5 steps of the slow baseline trial using a mixed-model ANOVA and post hoc t-tests. **RESULTS:** Both groups exhibited significant aftereffects in peak braking force exerted by each leg ($p < 0.001$). The abrupt group had significantly lower aftereffects for fast leg propulsive force ($p = 0.001$) and higher aftereffects for slow leg propulsive force ($p = 0.011$), whereas propulsive force aftereffects were significantly lower for the fast leg (fast leg: $p = 0.019$; slow leg: $p = 0.11$). There were significant aftereffects in fast leg propulsive impulse for the abrupt group ($p < 0.001$), but not the gradual group (fast leg: $p = 0.07$; slow leg: $p = 0.138$). **CONCLUSIONS:** These aftereffects indicate predictive control of braking and propulsion during adaptation to both gradual and abrupt onset split-belt walking.

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CRITERION VALIDITY OF A SMART GARMENT TO COLLECT HEART RATE DATA DURING EXERCISE

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With the advent of wearable technology, field-based physiological measurements are now possible in a variety of forms. A smart garment embedded with laminate conductive electrocardiography electrodes may offer a novel method of heart rate (HR) monitoring for longer periods of use, but the validity of this garment remains unknown. **PURPOSE:** To determine the criterion validity of a smart garment when collecting HR data during exercise compared to an industry standard heart rate monitor (HRM). **METHODS:** 5 minutes of R-R interval data were simultaneously collected from 16 male participants (age: 24.6 ± 4.3 yrs; height: 180.7 ± 6.7 cm; body mass: 88.0 ± 10.0 kg) using Polar H10 HRM and smart garment devices during each exercise condition (Walking – 3.0 mph, Jogging – 5.0 mph, Running – 6.5 mph). R-R interval data from both devices were then processed using third-party software to derive HR measures. **RESULTS:** *Trivial to small*, and non-significant, differences in HR measures were observed between the smart garment and the HRM during the Walking – 3.0 mph ($t_{12} = 1.944$, $P = 0.076$), Jogging – 5.0 mph ($t_8 = 1.678$, $P = 0.132$), and Running – 6.5 mph ($t_4 = 1.023$, $P = 0.364$) conditions (Table). *Very strong to nearly-perfect* and statistically significant correlations in HR data were identified between devices during the Walking – 3.0 mph ($r = 0.726$, $P = 0.005$, $R^2 = 0.527$), and Jogging – 5.0 mph ($r = 0.977$, $P < 0.001$, $R^2 = 0.955$) conditions. However, although a *very strong* correlation was observed during the Running – 6.5 mph condition, this correlation was not statistically significant ($r = 0.802$, $P = 0.103$, $R^2 = 0.643$). **CONCLUSIONS:** Results suggest adequate criterion validity of the smart garment during both Walking and Jogging exercise. However, criterion validity remains unclear during Running, likely due to large data loss in this sample (68.75%).

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Table. HR (bpm) Measure Comparisons Between Smart Garment and HRM (mean \pm SD)

Condition	Smart Garment	HRM	Mean Difference	Effect Size	Data Loss
Walking – 3.0 mph ($n = 13$)	89.50 \pm 12.87	94.27 \pm 9.29	-4.77 \pm 8.86	$g = 0.43$ <i>small</i>	18.75% (3/16)
Jogging – 5.0 mph ($n = 9$)	131.19 \pm 19.86	133.63 \pm 18.30	-2.44 \pm 4.36	$g = 0.13$ <i>trivial</i>	43.75% (7/16)
Running – 6.5 mph ($n = 5$)	148.99 \pm 26.49	156.67 \pm 15.65	-7.68 \pm 16.80	$g = 0.35$ <i>small</i>	68.75% (11/16)

Abbreviations: HR, heart rate; HRM, heart rate monitor.

WEARABLE AIR POLLUTION MONITORING DEVICES (WAPMDs) AND BEHAVIORAL IMPLICATIONS ON PHYSICAL ACTIVITY (PA) AND ACTIVE COMMUTING (AC): A RAPID REVIEW

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Introduction: Air pollutants such as particulate matter (PM) are responsible for premature mortality and may reverse health benefits derived from physical activity (PA) and active commuting (AC). Wearable air pollution monitoring devices (WAPMDs) may be a low-cost, feasible solution to increase public awareness in reducing personal exposure, but short- and long-term behavioral changes with using WAPMDs during PA/AC have been seldom documented. **Methods:** A search strategy combining air pollution, PA/AC, and wearable devices was performed across PubMed, Cochrane Trials, and SCOPUS to identify all relevant studies conducted until June 2022. Eligible studies were required to combine real-time quantitative data from WAPMDs with qualitative data of potential behavioral changes during PA/AC. Data extracted included study design, sample size & description, study duration, WAPMD(s), PA/AC and behavioral outcomes, results, and limitations. **Results:** Twelve eligible studies were included in the final review. Sample sizes ranged from 1- 400 and mainly consisted of children and/or young- & middle-aged adults from high-income countries. Most participants reported surprise after air quality readings from WAPMDs detected higher levels in green spaces, contrary to pre-existing beliefs. Participants' responses about behavioral changes in reducing air pollution exposure during PA/AC after interventions were mixed, stating either motivation or inaction amongst themselves and/or their social networks. **Conclusion:** Current literature about WAPMD air quality readings and their influence on reducing personal exposure during PA/AC is lacking and weakened by geographical and sociocultural confounders. Future studies should monitor continuous feedback from WAPMDs and document behavioral changes towards protecting one's health during PA/AC. Deploying WAPMDs and evaluating feasibility and acceptability in resource-scarce areas with poor air quality may help to influence community awareness and public policy, thereby preserving health benefits of PA/AC.

CARDIORESPIRATORY AND METABOLIC RESPONSES TO LOW-INTENSITY BLOOD-FLOW RESTRICTED RUNNING

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Low-intensity (LI) aerobic exercise with blood-flow restriction (BFR) has been shown to increase heart rate (HR), oxygen consumption (VO_2), and ratings of perceived exertion (RPE), sometimes to similar levels as high-intensity (HI) exercise. Distance runners could potentially benefit from using LI running with BFR in training periods of reduced volume or intensity, possibly due to injury. **PURPOSE:** To compare HR, VO_2 , blood lactate (BLa), and RPE during acute sessions of LI running with BFR and HI running without BFR. **METHODS:** Fifteen female distance runners (age 23 ± 4 yrs, height 1.67 ± 0.50 m, body mass 57.6 ± 5.7 kg, $\text{VO}_{2\text{max}}$ $51.0 \pm 4.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) participated in three randomized experimental testing sessions where they ran for 12-minutes under the following conditions: LI control (40% of $\text{VO}_{2\text{max}}$), HI (80% $\text{VO}_{2\text{max}}$), and LI with BFR (BFR: 40% $\text{VO}_{2\text{max}}$). VO_2 , HR, and RPE (6-20) were measured at rest, and every 3-minutes. HR and RPE were also measured 3-minutes post-exercise (3minPost). BLa was measured at rest, immediately post (ImmPost), and 3minPost. Data were analyzed using repeated measures ANOVA and post hoc t-tests with Bonferroni corrections. **RESULTS:** VO_2 remained steady among each condition ($p=0.075$), but the average VO_2 differed between the conditions ($p<0.001$), as HI ($39.4 \pm 3.9 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) was greater than BFR ($25.3 \pm 2.6 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) and both of those were higher than LI ($22.5 \pm 3.1 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$). HR increased at the onset of exercise and differed between the 3 conditions ($p<0.001$). The average HR for HI, BFR, and LI were 166 ± 8 bpm, 142 ± 13 bpm, and 124 ± 11 bpm, respectively, wherein $\text{HI} > \text{BFR} > \text{LI}$. BLa was similar in the HI and BFR conditions ImmPost and 3minPost ($p>0.05$), and both were higher than LI ($p<0.017$). Average RPE in the HI (11 ± 2) and BFR (12 ± 2) conditions were similar ($p=0.236$), while LI (9 ± 1) was significantly lower ($p<0.001$). **CONCLUSION:** HI running elicits greater VO_2 and HR responses than BFR running, suggesting that HI running would result in more robust long-term training responses. However, if one cannot engage in HI running because of injury and rehabilitation, BFR running at LI could be a feasible alternative to HI and LI running in times of decreased training volume and intensity.

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HIGH HABITUAL PHYSICAL ACTIVITY CORRESPONDS TO GREATER BRACHIAL ARTERY FLOW-MEDIATED DILATION IN HEALTHY PERI-MENOPAUSAL PEOPLE

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Perimenopause is characterized by variable menstrual cycle length, symptoms (e.g., hot flashes), and increased cardiovascular disease (CVD) risk. Endothelial dysfunction is an early CVD indicator assessed via flow-mediated dilation (FMD). High habitual physical activity (PA) is associated with enhanced endothelial health in various populations. However, the role of habitual PA on endothelial function during perimenopause remains unclear. **PURPOSE:** This study aimed to investigate differences in FMD between high- and low-active healthy perimenopausal people. **METHODS:** 42 healthy people aged 43-55 were included in this analysis. Participants were peri-menopausal according to the STRAW+10 criteria (Early, change in menstrual cycle length of >7 days than normal; Late, ≥ 60 days but less than one year of amenorrhea). Participants were recruited into high-(n=27, ≥ 1500 MET-min/wk vigorous-intensity or ≥ 3000 MET-min/wk any PA) or low-(n=15, <150 min/wk moderate or <75 min/wk vigorous PA) based on self-reported habitual PA levels on the International Physical Activity Questionnaire. Endothelial function was assessed via the brachial artery (Cardiovascular Suite, V4.0) and the data was used to measure the baseline diameter, peak diameter, absolute (mm) and relative (%) FMD response, and the shear rate stimulus. Participant characteristics and FMD outcome variables were compared between groups using a two-tailed, independent t-test ($\alpha < 0.05$, R studio, 2022.02.3 build 492). Mann-Whitney U tests were used for variables with non-normal distributions. **RESULTS:** Habitual PA was significantly greater in the high-active group (high=4046.43 \pm 1994.62 MET-min/wk, low=851.93 \pm 563.15 MET-min/wk, $p=2.67e^{-7}$). There were no differences in blood pressure, fasting plasma glucose, or cholesterol levels (all $p > 0.05$); however, BMI was different between groups (high=28.00 \pm 7.25 kg/m², low=37.23 \pm 10.59, $p=0.0018$). The absolute FMD response was significantly higher in the high-PA group (high=0.17 \pm 0.14 mm, low=0.11 \pm 0.08 mm, $p=0.01$). Relative FMD response (high=5.11 \pm 4.40%, low=3.34 \pm 2.20%, $p=0.09$) showed trends toward significance. No other outcome variables were significantly different between groups (baseline diameter, high=3.43 \pm 0.41 mm, low=3.28 \pm 0.31 mm, $p=0.23$; maximum diameter, high=3.60 \pm 0.41 mm, low=3.39 \pm 0.34 mm, $p=0.1$; shear rate area, high=21819.42 \pm 9792.12 s⁻¹, low=26042.42 \pm 8480.82 s⁻¹, $p=0.17$; and time to peak dilation, high=40.93 \pm 14.14 s, low=51.40 \pm 21.29 s, $p=0.15$). No outcome was significantly different between early-(n=17) or late-(n=25) peri-menopausal groups. **CONCLUSION:** Our preliminary results suggest that in healthy, peri-menopausal people, high habitual PA is related to greater absolute FMD. In this population, high habitual PA may be an important component for delaying endothelial dysfunction.

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COMPARING EMG ACTIVITY DURING STANDING AND SEATED YOGA POSES AMONG HEALTHY ADULTS

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Yoga is increasing in popularity, and with regular practice, has the potential to increase muscle strength and endurance. To date, there has been no comparison of muscle activation between seated and standing yoga poses. **PURPOSE:** The purpose of this study was to determine muscle activation during four standing yoga poses versus the chair version of the same pose.

METHODS: This study was approved by the university's IRB committee. Twenty-six healthy adults, 7 males and 19 females with an average age of 23.73 ± 1.64 consented to participate. Surface electromyographic (EMG) was collected using the Noraxon TeleMyo 2400GT (Noraxon Inc, Scottsdale, AZ, USA). Electrodes were placed over the muscle bellies of bilateral biceps femoris (BF), rectus femoris (RF), external obliques (EO) and the erector spinae (BE) on the side of the non-dominant leg. Subjects viewed a series of 8 videos of one of the researchers performing the poses (four standing and their chair equivalent) in a randomized order. Subjects then performed each pose for 10 seconds while data was collected. Non-parametric Wilcoxon Signed Ranks Test was used to compare EMG activity between standing and chair poses for all muscles. **RESULTS:** The mean rank for rectus femoris (RF) = 258.05 μv in standing and 158.95 μv in sitting. The mean rank for biceps femoris (BF) = 273.06 μv in standing and 144.94 μv in sitting. The mean rank of external obliques (EO) = 197.06 μv in standing and 219.94 μv in sitting. The mean rank for erector spinae (BE) = 129.56 μv in standing and 79.44 μv in sitting. There was a significant difference in muscle activation between standing and modified poses for almost all muscles except for right EO while holding peaceful warrior and extended side angle poses ($p > 0.05$). **CONCLUSION:** Muscle activation was higher in the legs (BF, RF) during the standing poses, and core activation was higher during the seated poses (EO).

FOOT DROP IN A NEW RUNNER

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PURPOSE: The purpose of this case report is to discuss an interesting case of foot drop in an otherwise healthy young male. **METHODS:** A 19-year old male presented for right-sided ankle weakness. For three weeks he was unable to walk on his right heel and he developed numbness in his anterior shin. He recently started running three weeks ago and had been running five miles a day five days per week. Prior to beginning running he had noticed mild weakness with dorsiflexion but did not have foot drop. He spends 6 hours per day sitting cross legged at his computer. On examination he had diminished sensation of his right dorsal foot and lateral shin, he had 4/5 strength of right ankle dorsiflexion and great toe dorsiflexion and right foot drop with walking on his heels. **RESULTS:** EMG result was consistent with right peroneal neuropathy at the fibular head. There was no electrodiagnostic evidence of large fiber polyneuropathy or right lumbosacral radiculopathy. **CONCLUSION:** The patient's foot drop was secondary to common peroneal nerve entrapment (CPN). Patient had symptoms of both superficial peroneal nerve and deep peroneal nerve entrapment (DPN), with weakness of dorsiflexion from DPN entrapment being the most prominent sign, as is consistent with this entrapment. The patient's CPN entrapment at the fibular head was the result of external compression from sitting cross legged in combination with entrapment caused by running. The patient was given a stretching regiment, instructed to rest and to not to sit cross legged and after two weeks symptoms resolved.

PERFORMANCE ANXIETY IN YOUTH ATHLETES: CAUSES, PHYSIOLOGICAL EFFECTS, AND IMPLICATIONS FOR PERFORMANCE AND WELL-BEING

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Performance anxiety affects youth and adolescent athletes in ways that impair development, decrease performance, and hinder participation in organized sports. The result of increased pressure and anxiety on youth athletes includes sport participation dropout rates of roughly 70% by age 13, and decreased participation in sports increases sedentary behaviors and associated health risks. In order to optimize learning and development—and ultimately a lifelong commitment to physical activity—youth sport practitioners can best serve their athlete populations by understanding the linkages between anxiety and sport and by utilizing methods and approaches that reduce anxiety and improve performance. **PURPOSE:** The purpose of this literature review was to identify the causes, physiological effects, and performance implications of anxiety experienced by youth athletes in sporting environments. **METHODS:** Research publications were identified in Google Scholar and databases (SPORTdiscus, APA PsycInfo, and Wiley Online Library) using combinations of search terms including “youth athletes,” “performance anxiety,” and “physiological effects.” A total of 40 peer-reviewed publications were included in the literature analysis. **RESULTS:** Evidence suggests that acute performance decrements related to stress and anxiety result from the over-activation of the sympathetic nervous system, variation in visual scanning and fixation behaviors, altered attention or reliance on working memory, and/or impaired cognition and decision-making. The impacts of sympathoadrenal arousal further include elevated heart rate and blood pressure, increased ventilation, pupil dilation, increased blinking frequency, impaired short- and long-term memory, confusion, irritability, frequent urination, and tissue catabolism (associated with cortisol and prolonged stress). Importantly, biopsychosocial factors, including the athlete’s training environment, must be considered: specifically, youth athletes experience heightened stress responses from a threat state, an ego-involving climate, and social evaluative threats. **CONCLUSION:** Research indicates that the high prevalence of anxiety in youth and adolescent sporting environments can be mitigated by positive relationships with adults, social support, and psychological skills training. Specific strategies include demand appraisal restructuring, emotional regulation, and a reduction in social evaluative threat. Youth sport practitioners must also receive appropriate coaching education and employ evidence-based strategies for cultivating optimal training environments.

SEX-ASSOCIATED DIFFERENCES IN MUSCULOSKELETAL HEALTH AND FAT DEPOSITION AFTER EXPOSURE TO SPACEFLIGHT ANALOGUE ENVIRONMENTS

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PURPOSE: Space environments are associated with muscle loss, decreased bone density, and changes in fat deposition due to reduced weight-bearing in microgravity or partial gravity. Biological sex may influence the trajectory of musculoskeletal losses. Moreover, how the presence of traditional sex hormones (e.g., testosterone or estrogen) may influence sex differences on muscle and fat characteristics after such exposure has not been identified.

METHODS: 120 male and female rats underwent castration/ovariectomy or sham surgery. After 2 weeks recovery, animals were placed in a microgravity-analogue (0% partial weight-bearing [0PWB]), Martian gravity-analogue (40PWB), or control environment (100PWB) for 28 days ($n = 10$ rats per loading condition per sex). Peripheral quantitative computed tomography (pQCT) measurements were obtained pre- and post-intervention to measure percent changes in muscle area, total fat area, intramuscular fat area, and subcutaneous fat area in the tibial compartment of the right hind leg. Statistical analysis was performed in SAS using a modified ANOVA between the groups of interest (males v. females at various loading conditions) controlling for baseline measurements as a covariate. **RESULTS:** At 0PWB, castrated females had greater ($p < 0.05$) loss in percent total fat area and percent subcutaneous fat area compared to castrated males. At 40PWB, intact females had greater ($p < 0.05$) loss in percent total fat area, percent intramuscular fat area, and percent subcutaneous fat area compared to intact males. Castrated females at 40PWB had greater ($p < 0.05$) decreases in all muscular metrics measured compared to castrated males. **CONCLUSION:** Significant differences in musculoskeletal health and fat deposition were observed between male and female rats after exposure to spaceflight analogue environments, particularly in the partial gravity (40PWB) model. The absence of sex hormones exacerbated these differences. This suggests we may need to consider both biological sex and sex hormonal profiles if we are to optimize astronaut musculoskeletal health and fat deposition in spaceflight environments.

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EFFECT OF POST-MEAL WALKING STEP CADENCE ON PEAK TO NADIR BLOOD GLUCOSE IN WOMEN

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PURPOSE: Post-meal walking (PMW) performed after breakfast, lunch, and dinner has been shown to blunt blood glucose spikes in diabetics and those at-risk for diabetes. However, no studies have examined the potential enhancing effect of greater step cadence during PMW on the blood glucose response in physically inactive young women. **METHODS:** Eleven healthy, physically inactive women (Age: 20 ± 1 years; percent body fat $29.8 \pm 10.1\%$; BMI 23.5 ± 4.8 kg/m²) completed the study during the early follicular or placebo phase of their contraceptive cycle. Participants completed bouts of 15 minutes of brisk walking on a PMW day following breakfast, lunch, and dinner. 24-hour daytime ambulatory blood glucose and accelerometry data were measured and analyzed. **RESULTS:** A median split was performed based on step cadence over the 15-minute exercise bouts to distinguish slow (cadence: 39 ± 22 steps/min) vs. fast walkers (cadence: 100 ± 19 steps/min). Time from peak to nadir blood glucose after dinner was lower for fast walkers (37 ± 3 min) vs. slow walkers (50 ± 14 min) with PMW ($p=0.048$). No differences were found between slow-walker and fast-walker time from peak to nadir blood glucose after breakfast (fast walkers: 37 ± 12 min vs. slow walkers: 35 ± 7 min, $p=0.787$) and lunch (fast walkers: 33 ± 11 min vs. slow walkers: 40 ± 22 min, $p=0.524$). **CONCLUSION:** Greater step cadence during PMW leads to faster decreases in blood glucose following dinner in physically inactive, young women. These data suggest the benefit of brief post-dinner fast walking to restore glucose homeostasis.

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Stretch Activation Improves Force Production During Fatigue in Skeletal Muscle Fibers

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Stretch activation is the delayed increase in muscle fiber force that follows a rapid stretch and may improve skeletal muscle performance during locomotor activities with repetitive cyclical contractions, such as running. Although historically considered minimal in skeletal muscle compared to calcium-activated force, our recent work shows stretch activation had a greater effect on force production with increasing inorganic phosphate (Pi) levels in fibers from slow-contracting muscles. As peripheral muscular fatigue includes Pi accumulation, these results suggest stretch activation may improve force production in fatigued skeletal muscle. **PURPOSE:** To determine the effects of fatigue (low pH, high Pi) at low and high calcium (Ca^{2+}) concentrations on stretch activation in individual fibers from slow- and fast-contracting skeletal muscles compared to control (high Ca^{2+} at normal resting levels of pH and Pi). **METHODS:** Single fibers from soleus and extensor digitorum longus (EDL) muscles of female C57BL/6NJ mice were stretched 0.5% of their muscle length at normal and fatigued pH (7.0, 6.2) and Pi (5, 30 mM) as well as at high (pCa 4.5, pCa = $-\log(\text{Ca}^{2+}$ concentration)) and low (pCa 5.1) Ca^{2+} concentrations. **RESULTS:** Calcium-activated force production decreased from control to high calcium fatigue to low calcium fatigue conditions, as expected. In contrast, stretch activation increased from control to high calcium fatigue and either remained high or returned to control levels at low calcium fatigue. This resulted in stretch activation providing a larger relative force from control to high calcium fatigue to low calcium fatigue in soleus ($12 \pm 1\%$; $28 \pm 1\%$; $35 \pm 2\%$; $p < 0.001$) and EDL ($18 \pm 1\%$; $32 \pm 1\%$; $40 \pm 1\%$; $p < 0.001$), as determined by the ratio of stretch to calcium activated force. **CONCLUSION:** Stretch activation is a significant modulator of force production under fatiguing conditions in fibers from both slow- and fast-contracting muscles. This mechanism would reduce fatigue effects in activities such as running, when the antagonistic muscle rapidly stretches the agonist muscle, if the delayed increase in force due to stretch activation happens when the agonist muscle is shortening. Timing and physiological relevance of stretch activation during fatigue will be examined in future work.

AORTIC STIFFNESS INCREASES DURING PROLONGED SITTING INDEPENDENT OF INTERMITTENT STANDING OR PRIOR EXERCISE

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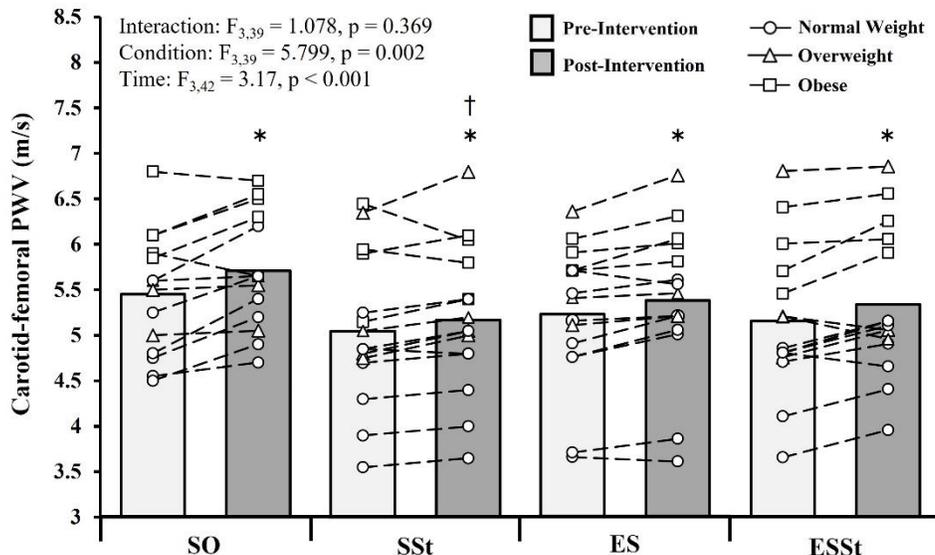
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Adverse vascular responses can occur during prolonged sitting, including stiffening of the aortic artery which may contribute to cardiovascular disease. Few studies have investigated the impact of intermittent standing and/or prior exercise as strategies to attenuate these potentially deleterious vascular changes. **PURPOSE:** To investigate central vascular health responses during prolonged sitting, with and without intermittent standing and/or prior exercise.

METHODS: Fifteen males aged 18 to 31 years were recruited. Subjects completed a control condition (Sitting Only [SO]), and three randomized strategy conditions (Sitting Plus Standing [SSt], Exercise Plus Sitting [ES], Exercise Plus Sitting Plus Standing [ESSt]). For all conditions, measurements of carotid-femoral pulse wave velocity (cfPWV) were taken at pre- and post-intervention, and brachial and central blood pressure (BP) at pre-, 1-hour-, 2-hours-, and 3-hours-intervention. **RESULTS:** cfPWV significantly increased from pre- to post-intervention for all conditions (all $p \leq 0.043$), as did brachial and central mean and diastolic BP for the control condition (all $p \leq 0.022$). Brachial and central systolic BP were significantly higher during SO compared to ESSt at 1-hour, and compared to ES for central systolic BP (all $p \leq 0.036$).

CONCLUSIONS: Strategies of intermittent standing and/or prior exercise may not prevent aortic stiffening during sitting but may attenuate BP elevations in the brachial and aortic arteries. Future research should investigate causal mechanistic links between sitting and aortic stiffening, and other attenuation strategies.



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