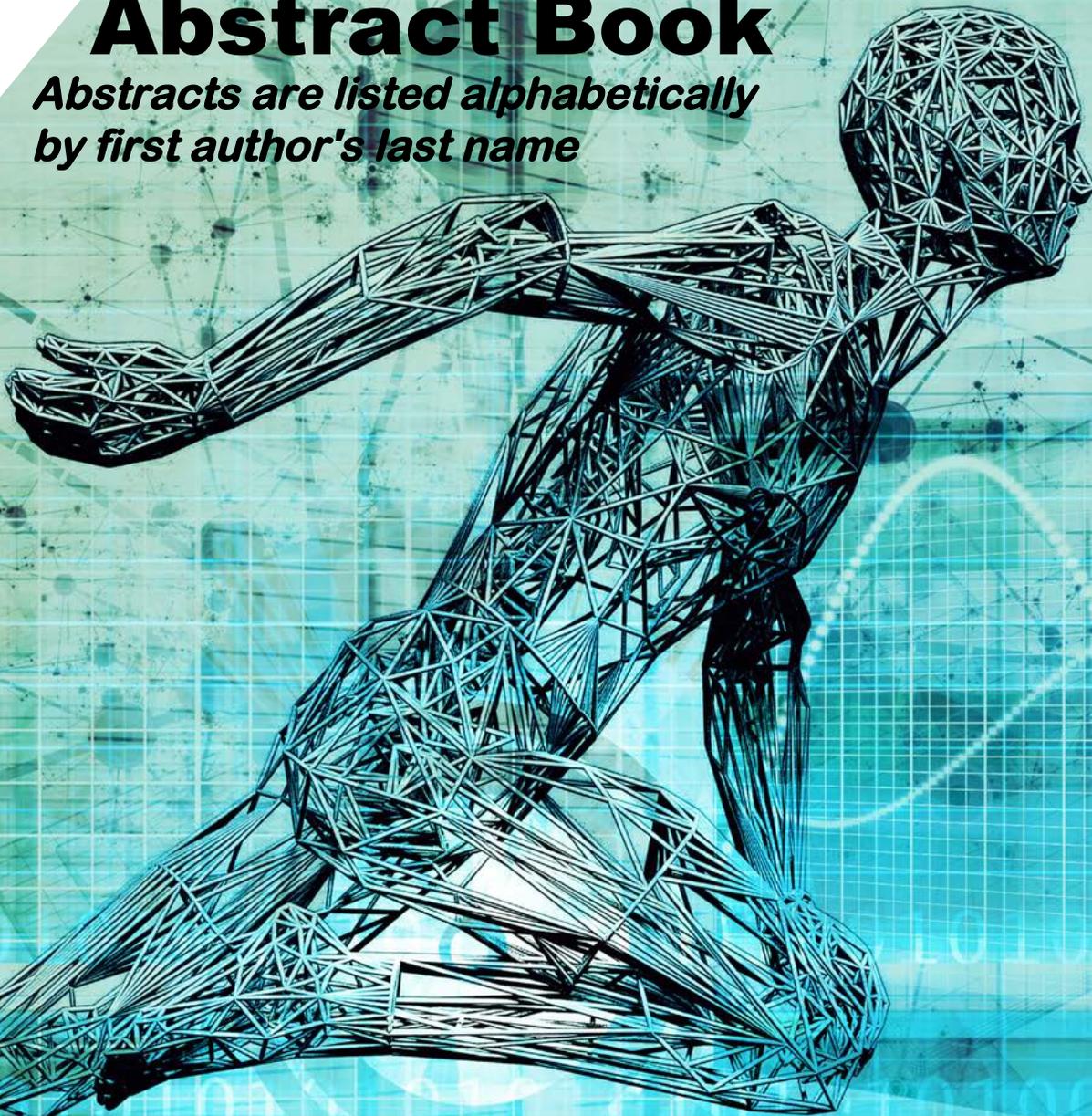


# Progress in Motion

## Abstract Book

*Abstracts are listed alphabetically  
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## THE EFFECT OF COVID-19 ON PARTICIPATION IN EXERCISE AND CHANGES IN OVERALL BODY WEIGHT

Jessica Alsup, Lindsay Parisi, Colline Butler, Vanessa Desota, Amelia Fields, Shane Grenier, Heather Malloy, Dawson Rego, and Antoinette Walley  
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According to the American College of Sport Medicine (2018), all healthy individuals between the ages of 18 and 65 should regularly participate in aerobic exercise as well as resistance training exercise. There are numerous reasons healthy adults are not active. These reasons are often described as barriers. In March of 2020, the COVID-19 Pandemic changed the way many people in the United States conducted their day to day lives. **PURPOSE:** The researchers aimed to examine whether the COVID-19 pandemic has influenced individuals' ability to participate in aerobic exercise, resistance training exercise, as well as any influence the pandemic has had on overall body weight. **METHODS:** Individuals between the ages of 18 and 65, living in the United States, who self-identified as "healthy" were asked to complete a twenty-two question survey (through google forms). Individuals who were pregnant at the time of the survey or who had been pregnant at any point since June 2019 were asked not to participate in this survey. **RESULTS:** Of 155 respondents, 107 identified as female, 46 as male, and 2 as non-binary. The mean age of subjects was  $33.28 \pm 14.92$  years. Respondents reported participating in significantly less days per week ( $2.12 \pm 1.89$ ) of resistance training during the COVID-19 pandemic in comparison to before the pandemic ( $2.52 \pm 1.91$  days). Overall mean reported change in body weight was a  $1.82 \pm 14.90$  lb increase, with females reporting a  $2.37 \pm 16.23$  lb increase, males reporting  $1.20 \pm 10.93$  lb increase, and non-binary individuals reporting a  $2.00 \pm 9.90$  lbs. **CONCLUSION:** The COVID-19 pandemic may have impacted the ability of individuals to participate in resistance training exercise. Possible explanations include the inability to access a fitness center as well as potentially access appropriate equipment. More research should look into aerobic exercise and body weight changes due to the COVID-19 pandemic. A limitation of this research is that data was collected in April of 2021, which was approximately 13 months after the start of the pandemic in the US.

## **PROTOCOLS, ORGANIZATION AND USE OF FITNESS ASSESSMENT DATA AT FITNESS FACILITIES IN MAINE**

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For the last 14 years a survey has been sent out worldwide to determine fitness trends. Established fitness trends emerge from this survey, yet limited data exists on fitness assessments in commercial gym settings. Exercise Science programs have strict learning outcomes and accreditation standards for fitness assessment protocols, but individuals translating that into commercial practice remains largely unknown. **PURPOSE:** The purpose of this study was to determine what fitness assessment protocols are used along with how data is utilized by facilities that offer personal training to patrons in the state of Maine. Our hypothesis was that gyms would not follow proper fitness assessment protocols as taught in the University setting. **METHODS:** An online search for all gyms or personal training services across the state of Maine was conducted, yielding 110 facilities in total. One representative from each facility was emailed and asked to fill out a survey to ascertain information in three core areas: 1) type and number of patrons using the facility and personal trainer certifications possessed, 2) fitness assessment data management and selection, and 3) location and length of time the facility has been in operation. The survey consisted of 14 multiple choice questions and 1 short answer question. A second email reminder was sent to the same representative, which yielded a response rate of 6.3%. **RESULTS:** Small gym facilities were among the highest responders to the survey (71.4%) indicating a willingness for smaller gyms to share their approach to fitness. Commercial gyms do not appear to follow protocols taught in the classroom setting at the college level for Exercise Science degrees with zero respondents using the ACSM or NSCA as a standard fitness assessment protocol. The majority (71.4%) of respondents used “custom fitness assessments,” however, the majority of fitness assessments included cardiorespiratory endurance (57.1%), muscular strength (71.4%) and endurance (57.1%) and flexibility (85.7%). **CONCLUSION:** Overall, it was determined that commercial gyms do not follow proper fitness assessments protocols taught in a classroom setting but closely mimicked them.

# NEGATIVE IMPACT OF COVID-19 RESTRICTIONS ON PHYSICAL ACTIVITY, SYMPTOMS AND QUALITY-OF-LIFE IN ELDERLY SMOKERS

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In attempt to limit community spread of COVID-19 disease and lessen the impact on healthcare services, restrictions were implemented including stay-at-home orders, shielding or working from home requirements. Restrictions posed challenges, particularly to elderly and those with chronic diseases, such as chronic obstructive pulmonary disease (COPD), already at higher risk of poor quality-of-life (QoL) and inactivity. **PURPOSE:** To determine the impact of COVID-19 restrictions on physical activity, symptoms and QoL in smokers with and without COPD. **METHODS:** COPD patients and smokers without COPD (controls; CON) enrolled in the *Muscle Health Study* completed a 7-day triaxial accelerometry for physical activity, symptom (mMRC, HADS) and QoL (SGRQ) questionnaires, before and after implementation of COVID-19 restrictions. **RESULTS:** Sixteen COPD (M/F=8/8; GOLD 1/2/3/4=10/4/1/1; 71±10 years) and 10 CON (M/F=3/7; 63±8 years) completed the study (follow-up duration: 25.0±3.6 months). None were diagnosed with COVID-19. Three COPD and 1 CON restarted smoking during pandemic. One COPD and 1 CON moved to homeworking, and 1 CON continued a full-time job, while all other participants were retired. COPD patients were less active than CON before COVID-19 (steps/day; p=0.012), but not after restrictions (Table). CON decreased steps/day (-1293[-3047,822]; mean[95%CI]) more than COPD (-194[-1025,637]), exceeding the clinically-meaningful difference (>600-1000). There was no clinically meaningful difference in symptoms (HADS, mMRC) following restrictions, however QoL was statistically and clinically worse in both groups post-restrictions (SGRQ total, p<0.001). CON reported a significant worsening of all SGRQ dimensions (symptoms of dyspnea and fatigue, activity and impact of respiratory disease), while symptoms were unchanged in COPD. **CONCLUSIONS:** We found that COVID-19 shielding and social restrictions resulted in clinically-meaningful reductions in physical activity, and worsening of QoL in elderly smokers. These finding were not limited to those with COPD.

**Support:** R01HL151452; ATS-2018-11; U01HL089897; U01HL089856

	COPD (n=16)			CONTROLS (n=10)		
	Pre	Post	Change (LLN, ULN)	Pre	Post	Change (LLN, ULN)
<b>N. Steps/day</b>	5154 (3161) #	3967 (3350)	-194 (-1025, 637)	7552 (2843)	5899 (3671)	-1293 (-3407, 822)
<b>mMRC</b>	1.3 (1.4)	1.9 (1.2)	0.6 (-0.5, 1.7)	0.9 (1.2)	1.4 (1.3)	0.7 (-0.5, 1.8)
<b>HADS Depression</b>	3.9 (3.0)	4.6 (4.3)	1.5 (-1.1, 4.2)	3.1 (3.5)	6.4 (4.9)	4.6 (0.9, 8.2)
<b>HADS Anxiety</b>	3.3 (3.5)	5.1 (3.8) *	1.7 (-0.7, 4.1)	4.2 (2.3)	5.0 (3.2)	0.7 (-1.5, 2.8)
<b>SGRQ Total</b>	30.3 (18.5) #	40.2 (16.1) *	11.8 (4.0, 19.6)	18.1 (21.3)	36.6 (24.9) *	23.5 (8.4, 38.6)
<b>Symptom</b>	33.2 (19.0)	32.2 (20.4)	-4.2 (-21.0, 12.7)	22.4 (25.1)	32.2 (27.1) *	14.2 (2.0, 26.4)
<b>Activity</b>	42.5 (24.9) #	58.1 (25.7) *	19.9 (8.2, 31.6)	25.4 (27.7)	50.4 (29.6) *	30.9 (11.1, 50.8)
<b>Impact</b>	22.4 (17.8) #	31.6 (14.7) *	11.1 (2.2, 19.9)	12.9 (18.2)	29.4 (24.0) *	21.2 (6.1, 36.3)

Data are mean (SD). COPD, chronic obstructive pulmonary disease. LLN, lower limit of normal (mean - 1.96 SD of the mean) ULN, upper limit of normal (mean + 1.96 SD). mMRC, Modified Medical Research Council Dyspnea Scale. HADS, Hospital Anxiety and Depression Scale. SGRQ, St. George's Respiratory Questionnaire. \* p<0.05 vs Pre; # p<0.05 vs CON

## **THE EFFECT OF BETA ALANINE ON BLOOD LACTATE AND 5 KM PERFORMANCE, A PILOT STUDY**

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During high intensity exercise, lactic acid causes hydrogen ion ( $H^+$ ) accumulation which lowers muscle pH. The  $H^+$  buildup creates an acidic state that decreases muscle function. Beta-alanine is a supplement which buffers excess  $H^+$  and may improve aerobic performance. **PURPOSE:** The purpose of the study was to determine if beta-alanine supplementation affected blood lactate ( $BLa^-$ ) and 5 km run time. **METHODS:** A total of five (age:  $20.4 \pm 1.9$  year, height:  $171.4 \pm 3.8$  cm, weight:  $70.1 \pm 7.3$  kg, body fat:  $14.4 \pm 2.9\%$ , and  $VO_2$  max:  $52.8 \pm 2.2$  ml/kg/min) recreational male runners were randomly divided into two groups: beta-alanine (BA) and placebo (PL). All subjects ran an initial 5 km distance before starting the supplementation period. Subjects in both groups consumed 3.2 g of beta-alanine or maltodextrin per day, respectively, for 4 weeks. At the end of the supplementation period, subjects completed an additional 5 km run.  $BLa^-$  was taken at the end of each performance. **RESULTS:** No significant time by group interaction was found between BA and PL for 5 km performance (BA  $23:29 \pm 1:34$  min pre vs.  $23:54 \pm 0:44$  min post, PL  $26:48 \pm 1:38$  min pre vs.  $24:54 \pm 1:06$  min post). No significant difference was found between BA and PL for post run  $BLa^-$  concentration (BA  $10.3 \pm 0.99$  mmol/L pre vs.  $10.1 \pm 2.4$  mmol/L PL  $10.3 \pm 2.85$  mmol/L pre vs.  $10.1 \pm 2.2$  mmol/L post). **CONCLUSION:** A four-week beta-alanine supplementation did not alter 5 km run time or  $BLa^-$  concentration in recreational runners. A larger sample size is needed to more accurately determine the effectiveness of beta-alanine. In addition, future research should include the administration of relative dosages and an examination of sex differences.

## **HIP INTERNAL ROTATION RANGE OF MOTION IN WEIGHT BEARING MEASURED BY USE OF A GONIOMETER**

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Active hip internal rotation (AHIR) range of motion (ROM) in weight bearing (WB) has previously been measured by use of video and imaging systems, typically within the framework of organized investigations. These technologies are not readily available in clinical settings due to a combination of cost, and the constraints of time and physical space. **PURPOSE:** To develop a clinically applicable method of measuring AHIR ROM in WB. **METHODS:** 10 members of the Merrimack School of Health Sciences participated in a pilot study. AHIR ROM was measured bilaterally utilizing a universal hand held goniometer. First, NWB ROM was measured in prone at 0 degrees hip flexion, then AHIR ROM in WB was measured bilaterally in a half kneeling position at 0 degrees hip flexion for the measured hip. Participants knelt on the ground with their lower legs straight behind them. The leg not measured was placed in 90° of hip flexion, assuming a half kneel position with the ipsilateral upper extremity on a table for balance. The lower leg of the measured hip was stabilized. Participants shuffled their forward leg across the ground in the direction of the measured hip, allowing their pelvis and trunk to rotate over the fixed kneeling leg. The end point was reached when the leg being shuffled began to externally rotate. Measurements were taken by setting the stationary arm of the goniometer to 0°, aligned with the sagittal plane, then lining up the movable arm with the bilateral PSISs. **RESULTS:** A significant difference was found between measurements taken in NWB and in WB (p-value < 0.01,  $M_{NWB}=48.3^\circ$ ,  $M_{WB}=29.3$ ). **CONCLUSION:** The results suggest there is a clinical need to consider measuring AHIR ROM in WB. The comparison of the traditional method of measuring AHIR ROM in NWB and AHIR ROM in WB produced both a statistically and clinically significant difference. Further investigation must be carried out to determine the accuracy and consistency of this method of measurement.

## FEMALE ENDURANCE TRAINED INDIVIDUALS HAVE LOWER LOCOMOTOR MUSCLE OXIDATIVE CAPACITY THAN MALE PEERS

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Near infra-red spectroscopy (NIRS), applied during a protocol of brief muscle contractions followed by repeated intermittent arterial occlusions, is a validated non-invasive methodology to estimate muscle oxidative capacity from the muscle oxygen consumption recovery rate constant ( $k$ ). Few studies sought to understand the relationship between sex and  $k$ , but results are controversial. Recently, Beaver and colleagues (JAP 2020) showed no differences in  $k$  of lower limb muscles between young males and females of varying aerobic fitness. **PURPOSE:** We sought to determine the role of sex and muscle on  $k$  in long-term endurance-trained individuals (i.e., >4 times a week for >3 years). **METHODS:** Fifteen females (20±1yrs; 61±7kg; 167±6cm) and 12 males (27±7yrs; 72±6kg; 179±5cm) visited the lab on four non-consecutive days. Female participants (n=15 mid-distance runners and n=2 long-distance swimmers) were members of the University athletic club. Males belonged to a triathlon team. Muscle  $k$  was determined in the *vastus lateralis* (VL) and medial *gastrocnemius* (GS) using a brief contraction period followed by intermittent muscle occlusions to measure oxygen consumption recovery over 6 minutes.

**RESULTS:** Two-way ANOVA showed a main effect of sex ( $p=0.012$ ), whereby females had lower  $k$  values in both muscles (Female VL: 1.69±0.48min<sup>-1</sup>; GS: 1.71±0.32min<sup>-1</sup>; Male VL: 2.05±0.35min<sup>-1</sup>; GS: 1.86±0.38min<sup>-1</sup>). There was no main effect of muscle ( $p=0.33$ ) on  $k$ , despite a tendency towards numerically lower  $k$  values in GS than VL in both sexes. There was no sex-by-muscle interaction ( $p=0.30$ ). **CONCLUSIONS:** Female endurance trained individuals have a lower  $k$  in locomotor muscles compared with male peers with same training history. Our findings suggest sex is a factor in determining muscle oxidative capacity.

**Supported by:** University of Rhode Island Manfredi Research Fund to LB; University of Rhode Island Institutional Funds to AA; R01HL151452 to HBR and AA.

## COMPENSATORY RESERVE INDEX: NORMATIVE VALUES OF A NEW VITAL SIGN SURROUNDING EXERCISE IN THE HEAT

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Hypovolemic shock is a threat to the health and safety of active individuals when exposed to extreme environmental conditions. Non-invasive measurement of central volume loss, opposed to traditional vital signs, has been shown to be a stronger indicator of the onset of hypovolemic shock resulting from dehydration or hemorrhage. Compensatory reserve index (CRI), a scale ranging from 0-1.0, categorizes the stages of shock as a predictive measure of the remaining reserve of blood volume before compensation is diminished. Utilization of CRI in a clinical setting has been validated, while normative values surrounding exercise have yet to be established. **PURPOSE:** To assess normative CRI values surrounding exercise in the heat in active adults. **METHODS:** Data was collected on 41 active adults. Age (mean±standard deviation [SD]): 44.7±15.7 years; VO<sub>2</sub>max: 42.7±9.2 ml/kg/min; percent body fat: 22.4±9.6%). CRI was assessed at baseline for 10 minutes in a supine position in a thermoneutral environment. At the road race, CRI was assessed for 2 minutes pre-race and post-race in the supine position. Heart rate and oxygen saturation were assessed alongside CRI. Environmental conditions were captured surrounding the race. Core temperature was assessed post-race. Descriptive statistics (mean±SD) were calculated and paired-samples t-tests were utilized to compare baseline to pre-race, baseline to post-race, and pre-race to post-race for the total sample. **RESULTS:** For the total sample, post-race CRI (mean ± SD: 0.70±0.32;) significantly diminished compared to baseline values (0.91±0.07; p<0.001). Post-race CRI was also significantly diminished (p<0.001) compared to pre-race CRI measures (mean±SD: 0.88±0.09). Resting heart rate increased from baseline (mean±SD: 59.6±10.4 bpm) to pre-race (65.4±11.2 bpm) and to post-race (85.1±16.9 bpm). Runners were characterized as hyperthermic following the race (core temperature: 38.90±1.20 °C). Environmental conditions upon finishing the race were 22.78 °C, 53% RH, and 21.67 WBGT. **CONCLUSIONS:** In the event of physical activity where progressive dehydration may occur, CRI monitoring may be able to detect compensatory patterns compared to baselines values, allowing for the early detection of hypovolemic shock. Monitoring CRI may prevent severe dehydration and collapse prior to its occurrence.

## **ALARM FATIGUE HAS RELATION TO BLOOD PRESSURE SURGE WITH PAGER SOUNDS IN FIREFIGHTERS**

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Fatigue is a physical, mental, and neurosensory bodily reaction due to labor loads which can decrease efficiency and performance. Alarm fatigue occurs when the sensory system becomes overwhelmed by the occurrence of alarms in the work environment. Alarm fatigue is a phenomenon that exists in clinicians and could also occur in firefighters. Previously we have found that the blood pressure (BP) surge that occurs with pager alerts is extreme in firefighters. **PURPOSE:** The purpose of this study was to analyze subjective alarm fatigue in firefighters in relation to stress and to the blood pressure (BP) surge experienced with pager alarms. We hypothesize that a firefighter with higher levels of assessed alarm fatigue will have a lower BP surge with alarm. We also hypothesized that a direct relationship exists between overall stress (total DASS-21 score) and fatigue (total Fatigue score). **METHODS:** Thirteen firefighters (36.6±9.3 yrs) answered 4 fatigue questions from the “Symptom Table on Fatigue Perception” which assesses physical, mental, and neurosensory fatigue. Firefighters also completed a DASS-21 survey which assesses overall stress. Also, during a work shift firefighters wore an ambulatory BP monitor for at least 12 hrs with BP automatically measured every 30 min. Data was analyzed when > 70% of readings were captured. Firefighters were instructed to force a BP reading when the pager alarmed to capture their BP surge. For each measurement the activity and call type were documented. **RESULTS:** Firefighters reported 12.8±9.2 years of service. Their subjective overall fatigue was 6.1±1.2 and overall DASS-21 score was 4.5±3.7. The group was hypertensive with average ambulatory BP of 128.3±9.0/ 77.6±8.3 mmHg. In response to pager alarms, systolic BP surged 22.4±11.6 mmHg and diastolic BP surged 15.9±12.5 mmHg. We found inverse relationships between fatigue and systolic BP surge ( $r = -.81, p=0.0002$ ), diastolic BP surge ( $r = -.59, p=0.01$ ), and years of service as FF ( $r = -.14, p=0.01$ ). There was no relationship between total stress and fatigue ( $r = .18, p=0.08$ ). **CONCLUSION:** These results suggest that more experienced firefighters with higher subjective levels of AF may experience lower systolic and diastolic BP surges during pager alarms.

Supported by: This work was supported by the American Heart Association Grant 19AIREA34450151(Fearheller).

## **A REVIEW OF LITERATURE EXAMINING FAMILY DOG OWNERSHIP AND YOUTH PHYSICAL ACTIVITY LEVELS**

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Higher youth physical activity (PA) is associated with favorable health outcomes. The PA Guidelines for Americans recommend school-aged children complete at least 60 minutes of daily PA. Only one in three children meet these guidelines. Dog walking and play are potential strategies to increase youth PA. **PURPOSE:** The purpose of this scoping review was to summarize the existing literature on familial dog ownership and youth PA levels and identify gaps in the literature to inform future studies. **METHODS:** A PubMed search conducted in December 2020 yielded 659 results using the following search terms: (Kids OR children OR adolescents OR youth OR families) AND (Dog OR pet) AND (Physical activity OR walking OR steps OR exercise OR obesity). Following abstract screening, 80 articles were full-text screened and 18 articles were selected for inclusion. **RESULTS:** A majority of studies were cross-sectional (88.9%). Study populations were adolescents (38.9%), elementary-aged (27.8%), combined adolescents and elementary-aged (27.9%), and preschool-aged children (5.5%). Most studies consisted of majority White, higher SES populations (88.9%). Of 9 studies that compared PA levels among youth with and without dogs, 77.8% reported a positive association between dog ownership and PA. Other major outcomes of interest included time outdoors, screen time, weight status, and emotional-behavioral health. **CONCLUSIONS:** The majority of studies investigating dog ownership and youth PA levels are cross-sectional, and suggest dog ownership is associated with increased youth PA. Longitudinal studies are needed to determine whether the relationship is causal. If a causal relationship is demonstrated, initiatives that reduce familial dog ownership barriers may help increase youth PA levels. Randomized trials testing interventions to increase dog-facilitated PA in youth are also needed. Finally, the current literature focuses on White, higher income families. Future studies should examine the relationship between dog ownership and youth PA in low-income and ethnic minority youth.

## **A SINGLE NIGHT OF SLEEP RESTRICTION DECREASES YOUNG ADULTS' PHYSICAL ACTIVITY AND INCREASES SEDENTARY TIME**

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Meeting sleep and physical activity guidelines, while minimizing sedentary time, each have beneficial impacts on numerous health outcomes. Sleep restriction may impact subsequent physical behaviors, but the direction and magnitude of these effects remains uncertain.

**PURPOSE:** The purpose of this study was to explore the effects of a single night of sleep restriction on subsequent physical behaviors (physical activity, sedentary time, and sleep), compared to a full night of sleep, in healthy young adults. **METHODS:** Seven (71%F,  $20.4 \pm 1.8$  yrs) healthy young adults participated in a free-living, randomized counter-balanced study in which they were assigned a night of sleep restriction (SR, e.g., 3 hrs sleep) and a night of full sleep (FULL, e.g., 8 hrs sleep) during a 14-day period. Participants were asked to wear an ActiGraph GT9X Link (Pensacola, FL) accelerometer on the non-dominant wrist and sleep logs were used to isolate waking hours. Paired t-tests ( $p < 0.05$ ) were used to compare mean percentage of time spent in Sedentary Time (SED), Light (LPA) and Moderate-to-Vigorous Physical Activity (MVPA), during the 24 hours after each sleep condition. **RESULTS:** Mean percentage of time spent in MVPA was significantly lower ( $p = 0.02$ ) following SR ( $14.2\% \pm 7.5\%$ ), compared with FULL ( $23.1\% \pm 12.8\%$ ). Percentage of time spent in SED was significantly higher ( $p = 0.02$ ) following SR ( $SR = 80.9\% \pm 9.8\%$ ), compared with FULL ( $68.5\% \pm 16.4\%$ ), while there were no differences in LPA between conditions ( $SR = 4.9\% \pm 2.5\%$ ,  $FULL = 7.53\% \pm 4.1\%$ ,  $p = 0.05$ ). **CONCLUSION:** In this small sample of healthy young adults, sleep restriction had deleterious effects on subsequent physical behaviors. Future studies should explore: 1) how physical behaviors are affected by a night of sleep restriction beyond the next-day (e.g., 48- and 72-hrs post-SR) and 2) the effects of chronic sleep restriction on physical behaviors.

## **Trehalose Prevents Palmitate Induced Mitochondrial Translocation of STAT3**

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Obesity-associated inflammation results in a progressive decline in health, resulting in a poor quality of life that limits healthspan, defined as the number of years spent in good health. Of the many cellular processes that decline with obesity, alterations in cellular homeostatic processes such as autophagy and changes in mitochondrial biology and function are especially important because numerous studies show a link between these and the development of metabolic and inflammatory diseases. Constitutive phosphorylation of STAT3 at serine 727 is observed in various types of human cancers, including 65% of malignant prostate tissues. Phosphorylation at ser 727 is required for mitochondrial translocation of STAT3(mitoSTAT3) and mediates non-transcriptional functions of STAT3. mitoSTAT3 is also known to regulate and regulated by autophagy. Thus STAT3 moonlights to control cell function via alternative mechanisms that depend on STAT3/mitochondrial cross-talk. We observed higher mitochondrial localization of STAT3 in peripheral blood mononuclear cells (PBMCs) and CD4+ T cells treated with physiologically relevant doses of dietary saturated fatty acid, palmitate, and carbohydrate, fructose but not glucose. Both palmitate and fructose treatments induced mitoSTAT3; however, autophagy suppression was observed only upon palmitate treatment. Trehalose, a dietary supplement and a known autophagy enhancer, improved autophagy and prevented palmitate-induced mitochondrial translocation of STAT3. However, the effect of trehalose was not observed on fructose-induced mitoSTAT3. Collectively, our data show differential regulation of STAT3 by dietary lipids and sugars. Further evaluation is needed to elucidate the mechanistic links among diet, mitoSTAT3, and cellular homeostasis.

Keywords: Autophagy, Fructose, Glucose, Inflammation, Mitochondria, Palmitate, mitoSTAT3.

## **PILOT STUDY: THE INFLUENCE OF PLYOMETRIC TRAINING ON COLLEGIATE DANCERS**

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Plyometric training is an effective method for improving jumping and leaping ability. Whether it can improve the performance of collegiate dancers, who perform a considerable amount of jumping and leaping in their normal training, is unknown. **PURPOSE:** The purpose of this study was to examine whether plyometric training can influence dancers' jumping ability, compared to activities normally performed in dance training. **METHODS:** Fourteen female collegiate dancers (age=21.1±2.4 yrs) underwent a six week training program. Nine participants followed a plyometric training program, while five completed a volume-matched dance training program, with common propulsive dance maneuvers selected to resemble the plyometric exercises that would be performed in the plyometric training group. Each group trained twice per week for the duration of the study. Changes in the squat jump, countermovement jump, and broad jump were used as outcome measures. The first three weeks of training were a series of beginner-level jumps (80 touches per session) and the final three weeks progressed to intermediate-level jumps (100 touches per session). Differences between pre and post-training program measures for each test were assessed using a two-tailed T test, and the alpha level was set to .05. **RESULTS:** Plyometric training resulted in significantly greater improvements in broad jump ( $25.7 \pm 6.1$  cm) compared to dance training ( $4.5 \pm 4.3$  cm) ( $p=.03$ ). No significant differences were observed between plyometric training and dance training in the countermovement jump ( $p=.56$ ), or the squat jump ( $p=.22$ ). **CONCLUSION:** These preliminary findings suggest that replacing some portion of traditional dance training with a volume-matched plyometric program may result in improvements in broad jumping for collegiate dancers, but not vertical jumping. Collegiate dancers seeking to improve their ability to leap horizontally may benefit from incorporating plyometric exercise.

## THE INFLUENCE OF SUDDEN VIGOROUS PHYSICAL EXERTION ON CARDIAC DEMAND UNDER AMBULATORY CONDITIONS AMONG FIREFIGHTERS

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Firefighters have a high prevalence of cardiovascular disease (CVD) and its risk factors compared to the general population. The poor heart health of firefighters is implicated in their increased the risk of sudden cardiac death (SCD) accounting for nearly 50% of all on-duty fatalities. Exercise may confer protective benefits against SCD in part due to the immediate blood pressure (BP) reductions of 5-8 mmHg following exercise, termed *postexercise hypotension* (PEH). **PURPOSE:** To examine the time course of PEH after a maximal cardiopulmonary graded exercise stress test (GEST) under ambulatory conditions among career firefighters. **METHODS:** Firefighters (n=19) completed a maximal GEST and a non-exercise control (CONTROL) in random order on separate nonwork days and left the laboratory attached to an ambulatory BP (ABP) monitor for 19hr. Ambulatory systolic BP (ASBP), diastolic BP (ADBP), and heart rate (AHR) were recorded at hourly intervals over 19hr. The Rate Pressure Product (RPP) an indicator of cardiac demand, was calculated as  $ASBP \times AHR \times 10^{-3}$  at each hourly interval over 19hr. Repeated measures ANCOVA tested if the ABP, AHR, and RPP responses differed after GEST vs CONTROL over 19hr. **RESULTS:** Firefighters were middle-aged ( $39.5 \pm 8.9$ yr), overweight ( $29.2 \pm 4.0$ kg/m<sup>2</sup>) men with elevated resting BP ( $123.1 \pm 9.6/79.8 \pm 10.4$ mmHg), while resting HR ( $67.7 \pm 11.3$ bpm) and RPP ( $8.4 \pm 1.7$ mmHg\*bpm\*10<sup>-3</sup>) were in normal ranges. ASBP ( $16.6 \pm 5.7$ mmHg) and ADBP ( $3.1 \pm 4.6$ mmHg) increased after the GEST vs CONTROL over 19hr ( $p < 0.01$ ). Similarly, AHR ( $9.4 \pm 7.9$ bpm,  $p = 0.02$ ) and RPP ( $2.5 \pm 1.1$ mmHg\*bpm\*10<sup>-3</sup>,  $p < 0.01$ ) increased after GEST vs CONTROL over 19hr. **CONCLUSION:** Surprisingly, the firefighters exhibited *postexercise hypertension* rather than PEH. The increases in ABP and AHR we observed resulted in a sustained increase in cardiac demand. Further investigation is needed in a larger, more diverse sample of firefighters to confirm our findings and determine whether the adverse hemodynamic responses we observed contribute to the high prevalence of SCD firefighters experience on the job.

# THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND COGNITIVE FUNCTION IN ELDERLY WITH COPD: A NARRATIVE REVIEW

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Cognitive function (CF) decline is strongly related to aging. Individuals diagnosed with chronic obstructive pulmonary disease (COPD) seem to be at higher risk of developing cognitive dysfunction at earlier age. Few studies reported COPD having a similar CF than people diagnosed with mild cognitive impairment. However, the prevalence of this manifestation remains unclear. Physical activity (PA) and exercise interventions, cornerstones of COPD management, are tools used to preserve or slower the CF decline. **PURPOSE:** To determine the effects of PA on CF in elderly with COPD. **METHODS:** Electronic searches of four databases (PubMed/MEDLINE, EMBASE, Science Direct, Cochrane Library, CINAHL) were performed on manuscripts published between Jan 2010-Dec 2020 using terms related to: CF/cognitive dysfunction, COPD/smokers, PA/exercise/training. **RESULTS:** On 38 screened, 4 studies met criteria. Three compared CF before-after pulmonary rehabilitation (PR), one before-after 4-week individualized exercise training program, in >60 years old smokers with COPD. Four CF domains were considered: *memory, attention, language, praxis ability*. All studies reported an improvement in short- and long-term *memory* (increase 5-15%) in COPD after traditional PR or exercise training program. In the studies administering PR, one reported a reduction in time-of-response to language task, showing a significant increase ( $p=0.024$ ) in the domains *language selection* and *attention*. The latter was not confirmed by a second study who reported no changes in selective *attention* ( $p=0.20$ ). Another study randomized 28 COPD patients in 20 sessions of either high intensity resistance+aerobic training, or aerobic training. Independently of the type of training, patients significantly improved ( $p<0.01$ ) selective and sustained *attention*, and *praxis ability* (i.e., conceptualize and organize movements to complete motor tasks). When methods were compared, the combination induced a larger increase ( $p<0.01$ ) in verbal performance and *praxis ability* compared to the aerobic-based program. **CONCLUSIONS:** Overall, exercise interventions lead to improvements in the four CF domains in elderly with COPD. One study suggested the combination of high intensity resistance+aerobic training provides superior benefits than aerobic only based programs. In addition, our review indicates there is a general lack of attention in routinely measuring CF in COPD enrolled in any exercise intervention, and thus this subject warrants further investigation.

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## **ADAPTATIONS OF GROUND REACTION FORCES IN ABRUPT VS GRADUAL SPLIT-BELT TREADMILL WALKING**

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Split-belt treadmill walking involves two treadmill belts moving independently of each other at designated speeds. Motor adaptation is defined as trial-to-trial modification of a movement based on sensory feedback gradually (Bastian et al 2008). A split-belt treadmill has been previously used to correct gait asymmetry in stroke survivors. **PURPOSE:** The purpose of this research is to compare motor adaptation in ground reaction forces during sudden and gradual onset split-belt treadmill walking in healthy adults. We hypothesized that in both sudden and gradual onset adaptation, propulsive and braking forces would show aftereffects, indicating predictive control of leg force during walking adaptation. **METHODS:** Six subjects were randomly assigned a trial of either gradual or abrupt acceleration of one treadmill belt. Each experiment consists of a 2-minute slow baseline (0.7m/s) and 2-minute fast baseline (1.4m/s), with a 2-minute rest after each trial. Participants assigned the gradual condition followed with a 1-minute slow baseline trial (0.7m/s) to transition into a 16-minute gradual increase from 0.7m/s to 1.4m/s on the assigned fast leg for a speed ratio of 2:1. Participants assigned the sudden condition followed with another 1-minute slow baseline trial (0.7m/s) and then immediately after the fast leg belt moved at a speed of 1.4m/s, for a ratio of 2:1. **RESULTS:** Preliminary data shows aftereffects in both propulsive and braking forces during split belt walking, particularly for forces from the fast leg. **CONCLUSIONS:** Aftereffects in both braking and propulsive ground reaction force suggest predictive control of forces in the anterior-posterior direction. Previous research found predictive control of only braking force during abrupt split-belt adaptation but predictive control of both braking and propulsion in gradual onset split-belt adaptation. Although more data are necessary for any firm conclusions, the presence of aftereffects in both braking and propulsive forces appear to support the hypothesized predictive control of leg force during split-belt adaptation. These findings overall suggest that differences in kinetic adaptations in prior studies arose not from gradual vs. abrupt onset of the split-belt condition, but other methodological differences, such as differences in belt speed between studies.

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## IMPACT OF WEATHER ON MARATHON PERFORMANCE ACROSS AGE

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Marathon performance slows as ambient temperature increases, but research to date has focused mostly on younger athletes. As individuals age, the ability to cope with increasing environmental temperature is impaired. It is unknown if marathon performance is impacted to a greater extent by ambient temperature in older runners and if the impact is similar between men and women. **PURPOSE:** The purpose of this study was to 1) describe how age and gender interact on the slowing of marathon running performance in major U.S. marathons, 2) quantify performance decrements associated with increasing WBGT and age, and 3) examine potential gender difference in performance aging and WBGT. **METHODS:** Marathon race results and weather data were obtained for five U.S. marathons (Boston, Chicago, New York, Twin Cities, Grandma's) for 17 to 24 years, 1993-2016. The fastest finishing time among men and among women at each year of age were compared with the course record (%CR). The race results were broken into quintiles based on WBGT (Q1 0-5.0°C, Q2 5.1-10°C, Q3 10.1-15 °C, Q4 15.1-20°C, and Q5 20.1-25°C). Linear regression analysis was used to model marathon finishing time by age, gender, and WBGT quintile. **RESULTS:** Ninety-two race years yielded 6,112 men finishers age 14 to 91 and 5,452 women finishers aged 14 to 88. A U-shaped relationship was found between age and %CR ( $R^2 = 0.792$ ,  $p < 0.001$ ), which was affected by gender ( $\Delta R^2 = 0.012$ ,  $p < 0.001$ ). For women, predicted finishing times increased at a higher rate with older age as compared to men. WBGT also affected the prediction of %CR ( $\Delta R^2 = 0.003$ ,  $p < 0.001$ ), with women showing more pronounced slowing with increased WBGT. For example, from Q1 to Q5 for WBGT, 30-year-old men slowed 5.3% and 60-year old-men slowed 11.8%. In contrast, 30/60-year-old women slowed 9.2/14.9%, respectively. **CONCLUSION:** As age increases, marathon performance slows and these decrements in performance are exacerbated by increased WBGT. Older men and women slow to a greater extent than younger individuals, and older women may be more impacted by increases in environmental temperature than older men.

## DOES SENSORY OR PAIN SENSITIVITY RELATE TO PAIN INHIBITION FROM NOXIOUS ELECTRICAL STIMULATION

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**PURPOSE:** Transcutaneous electrical nerve stimulation (TENS), a strong but *comfortable* tingling sensation, is used to alleviate pain. Another form of electrical stimulation, noxious electrical stimulation (NXES), can produce pain relief through different mechanisms, namely conditioned pain modulation (CPM); the phenomenon that “pain inhibits pain”. Aims: to assess how sensory sensitivity correlates to pain sensitivity, and to see if pain sensitivity relates to pain inhibition in response to NXES. **METHODS:** Healthy adults, age 18-30, were recruited to undergo tests of sensation (cold/hot detection, touch sensation) and quantitative sensory tests of pain (pressure pain threshold (PPT), cold (C)/hot(H) pain thresholds (PT)). They also completed a Sensory Hypersensitivity Scale (SHS) and Pain Sensitivity Questionnaire (PSQ). Participants underwent a single, 20 min treatment of NXES, administered via self-adhesive electrodes to the knee joint. Intensity of the stimulation was set to achieve 5/10 pain rating. Pain inhibition in response to the NXES was measured using PPTs before and immediately after the treatment.

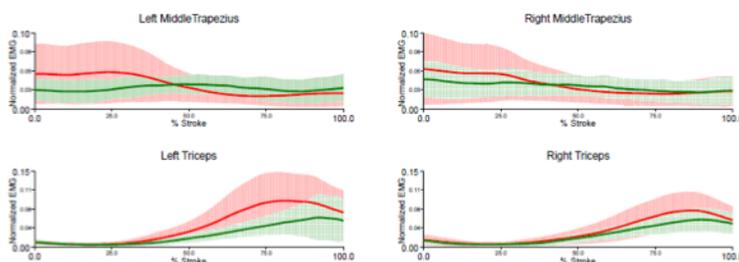
**RESULTS:** Seven participants have been tested thus far. The only objective measure of pain that correlated with SHS scores was the CPT ( $r = .738$ ,  $p = .058$ , though it didn't reach the level of statistical significance. PSQ did not correlate with SHS ( $r = .240$ ,  $p = .605$ ) or PPT, CPT, or HPT. However, PSQ correlated with pain inhibition at the wrist, ( $r = .830$ ,  $p = .021$ ) and the intensity of the NXES correlated with the magnitude of pain inhibition at the knee ( $r = .866$ ,  $p = .012$ ).

**CONCLUSION:** These preliminary results demonstrate that self-reported sensory and pain sensitivity do not relate to each other, but self-reported pain sensitivity appears to relate to the pain inhibitory response that is achieved through NXES. As expected, the intensity of the NXES related to the magnitude of pain inhibition which illustrates the need to use the highest level of electrical stimulation possible when using this treatment modality.

# THE RELATIONSHIP BETWEEN SWIMMERS' SHOULDER, MUSCLE ACTIVATION, AND UPPER EXTREMITY KINEMATICS IN COLLEGIATE ATHLETES

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Competitive swimmers often experience swimmer's shoulder, an overuse injury involving glenohumeral instability and rotator cuff impingement causing muscle weakness or fatigue, reduced range of motion (ROM), and shoulder pain. **PURPOSE:** The purpose of this research is to evaluate differences in upper extremity muscle activation and kinematic patterns in swimmers with and without shoulder pain. **METHODS:** Fifteen swimming participants (2 male and 13 female; age=19.8±1.8 yrs) were categorized into Pain or No Pain groups based on existing shoulder pain. Surface electromyography (sEMG) electrodes were used to measure bilateral upper extremity and trunk muscle activation patterns during the pull through phase of a freestyle stroke performed on a swim ergometer. Joint kinematics of the shoulder and elbow were recorded simultaneously using a Qualysis motion capture system. Data were recorded during five two-minute trials while participants executed a freestyle stroke. The Penn Shoulder Score (PSS) and The Disabilities of the Arm, Shoulder, and Hand (DASH) Outcome measures provided self-reported data on shoulder pain, mobility, and functionality. **RESULTS:** During the trials, the ROM of the shoulder joint was significantly higher in the No Pain group ( $p=0.018$ ). Elbow ROM was decreased in the Pain group but did not reach significance. EMG patterns in the Pain group deviated



**Figure 1:** Example EMG Pattern for Pull-Through Phase of Freestyle Stroke; **Red:** No Pain Group; **Green** – Pain Group

from the No Pain group in the middle trapezius and tricep muscles. Differences were seen predominantly in early pull through for the trapezius and in late pull-through for the triceps. Self-report surveys demonstrated significant differences in pain levels between the two groups (DASH  $p=0.002$ ; PSS  $p=0.004$ ).

**CONCLUSIONS:** These results demonstrate that the changes in the

muscle activation patterns and joint ROM during the pull through phase of the freestyle stroke are present due to shoulder pain. Understanding the mechanism for these alterations will be beneficial in decreasing injury, reducing pain, and improving freestyle technique.

## FEASIBILITY OF THE MOVESPRING “STEPS CHALLENGE” ON PHYSICAL ACTIVITY

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Advances are needed to help inactive individuals increase physical activity (PA), especially during the pandemic, where individuals face obstacles to meet PA guidelines. Using features on smart devices (GPS, pedometer) coupled with an app (MoveSpring) that is able to assist mobile users to track health metrics (steps, PA minutes) has the potential to give health experts tools to encourage adherence to PA guidelines. **PURPOSE:** To retrospectively evaluate feasibility of the MoveSpring “Steps Challenge”. **METHODS:** Each undergraduate (n=7,962), graduate student (n=1369), and faculty (n=420) of Southern Connecticut State University (SCSU) were directly emailed by the campus fitness center coordinator and invited to download MoveSpring and link to the “SCSU Steps Challenge” on their device (smartphone, smartwatch). They indicated stage of change (begin, increase, or sustain PA) and PA goal (6500, 10000, or 12500 steps/day). They could continuously view PA metrics (PA minutes, daily steps/distance covered), compare these metrics against others on a leaderboard, and self-report daily lifestyle metrics (ate  $\geq 3$ -4 servings of veggies, slept  $\geq 7$  hours, drank  $\geq 8$  glasses water). **RESULTS:** The challenge had 339 participants (156 undergraduate students, 57 graduate students, 126 faculty). Higher academic status was associated with greater duration of engagement (undergraduates median 28 days (IQR 17, 30), graduates 29 (26, 30), faculty 30 (28, 30) (H=14.6, df=2, p=.001)), step counts/day of engagement (5959 (4291, 9118); 7036 (4718, 8917); 8480 (5023, 11041) (H=12.2, df=2, p=.002), and proportion meeting 10000 steps/day (17%, 18%, 32%) ( $\chi^2=10.0$ , df=2, p=.007), but not proportion meeting 5000 steps/day (65%, 70%, 71%) ( $\chi^2=1.3$ , df=2, p=.53). Ninety-nine steppers reached their initial step goal. Engagement in self-report was low (<10% of person-days). **CONCLUSIONS:** Community-wide virtual exercise programming was feasible at SCSU using step-counting via device but not self-report. Faculty displayed higher levels of steps compared to students. Educational status and the relatively small amount of SCSU community members who participated may explain these findings. College students may be vulnerable to physical inactivity during the pandemic and warrant further attention in this area.

## **EFFECTS OF BACKPACK LOAD ON RESPIRATORY EXCHANGE RATIO (RER) DURING WALKING AT VARIOUS SPEEDS**

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Respiratory exchange ratio (RER) between the volume of expired carbon dioxide ( $\dot{V}CO_2$ ) and oxygen ( $\dot{V}O_2$ ) uptake can be used to indicate the type of metabolic fuel utilization during prolonged physical activity such as military load carriage. Quantifying the impact of external loading on RER is necessary to better understand nutritional requirements and physical work intensity of military-relevant exercise. **PURPOSE:** Examine the effects of varying military backpack loads on RER during treadmill walking. **METHODS:** Nineteen volunteers (age,  $23.8 \pm 7.0$  years; body mass (BM),  $75.1 \pm 13.5$  kg; height,  $173.4 \pm 7.5$  cm) walked at three speeds (0.45, 0.86, and  $1.34 \text{ m}\cdot\text{s}^{-1}$ ) while carrying four load conditions (0, 22, 44, and 66% BM) in the Modular Lightweight Load-Carrying Equipment (MOLLE 4000) rucksack. Measurements of RER were obtained using a laboratory open spirometry metabolic cart (Parvo Medics, TrueOne, Salt Lake City, UT). Planned contrasts between loads were analyzed for each speed and load condition. **RESULTS:** While walking at 0.45 and  $0.89 \text{ m}\cdot\text{s}^{-1}$ , RER was significantly higher when carrying the 66% BM load versus the 0 and 44% BM loads ( $p < 0.02$  for each). Respiratory exchange ratio significantly increased with added load while walking at  $1.34 \text{ m}\cdot\text{s}^{-1}$  ( $p < 0.02$  for each) in all but two comparisons (0 vs. 22% BM,  $p = 0.12$ ; 22 vs. 44% BM,  $p = 0.34$ ). **CONCLUSION:** Respiratory exchange ratio increases with added loading, and more drastically rises at higher walking speeds. This study finding emphasizes the necessity of adequate carbohydrate intake for warfighters engaging in strenuous field marches and dismounted movements.

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.

## **IMAGING FLOW CYTOMETRY (IFC) OPTIMIZATION OF ENDOTHELIAL MICROVESICLE (EMV) ANALYSIS FOR ASSESSMENT OF CVD RISK**

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Cardiovascular disease (CVD) risk for women increases dramatically during midlife. Since traditional risk factors may not fully explain CVD risk in women, novel tools to identify CVD risk and understand benefits of therapies (i.e. exercise) in this population are needed. Endothelial microvesicles (EMVs) are fragments derived from endothelial cell membranes (100nm-1 $\mu$ m), and are markers of endothelial health and CVD risk. However, measurement of EMVs via traditional flow cytometry is complicated by misidentified particles, resulting in false positive and negative results. This problem may be solved via Imaging Flow Cytometry (IFC).

**PURPOSE:** The purpose of this project was to develop a protocol to measure EMVs using IFC.

**METHODS:** Populations of interest included EMVs for endothelial cell activation (CD62e<sup>+</sup>) and apoptosis (CD31<sup>+</sup>/CD42b<sup>-</sup>). Whole blood was centrifuged (1,200xg, 15min, 22°C) to obtain plasma, which was centrifuged (4,500xg, 15min, 20°C) to obtain platelet-poor plasma (PPP), which was centrifuged (13,100xg, 2mins, 20°C) to obtain cell-free plasma (CFP). CFP was single-stained with BV421 (anti-CD62e<sup>+</sup>), APC (anti-CD31<sup>+</sup>), or PE (anti-CD42b<sup>-</sup>) antibodies. Labeled CFP was diluted using 1XfPBS to obtain 1:20-1:1280 dilutions and was placed in 96-well plates. Wells contained: unstained EMVs, single-stained EMVs, single-stained EMVs plus Triton-X, and fPBS and antibody-only controls. EMVs were imaged with the Amnis IFC (ImageStream mkII), collecting 1-25 million objects between 1-5min. The IFC raw image files were analyzed using Luminex IDEAS 6.2 software. Analysis provided object/mL counts for EMVs 100-900nm and, separately, <100nm, as well as images of the particles attached to the appropriate antibody. **RESULTS:** EMV samples stained with APC or PE in a 1:300 dilution (antibody:fPBS) showed consistent object/mL counts (~4 million) and one-to-one particle-to-antibody ratio. BV421 appears to need less dilute EMV samples to return reliable data. **CONCLUSIONS:** These results support using a more-sophisticated IFC technology to image and analyze the EMVs from plasma. Results from these data will lead to the development of a protocol to accurately and reproducibly identify EMVs denoting endothelial apoptosis and activation from plasma samples. Our long term goal is to evaluate whether EMV analysis improves CVD risk prediction in women.

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## IS HIGHER BMI ASSOCIATED WITH A MORE NEGATIVE AFFECTIVE RESPONSE TO EXERCISE AMONG OBESE/OVERWEIGHT INDIVIDUALS?

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Affective response to exercise is defined as the pleasure or displeasure experienced with physical activity (PA). Previous research indicates that individuals who experience a more negative affective response to exercise are less likely to engage in regular PA. While the majority of work has concentrated on normal weight vs. overweight samples, little is known about how affective response varies by BMI across the spectrum of overweight/obesity. **PURPOSE** To determine the relationship between BMI and affective response before, during, and after a single moderate-intensity exercise bout. **METHODS** Fifty-nine weight loss seeking individuals (BMI: 25-40 kg/m<sup>2</sup>) participated in a 30-minute moderate-intensity (65%-75% age predicted maximal heart rate) exercise session. Affect was measured immediately prior to, every five minutes during, immediately post, and 15 minutes post exercise. Affective response was measured using the Feeling Scale (FS), an 11-point scale ranging from -5 (Very Bad) to +5 (Very Good). During exercise affective was computed by averaging all FS measurements collected throughout the exercise session. Participants were stratified by BMI using a median split (BMI=32 kg/m<sup>2</sup>), into a lower BMI group (LB; 29.5±1.8 kg/m<sup>2</sup>) or higher BMI group (HB; 34.9±1.8 kg/m<sup>2</sup>). **RESULTS** Participants had a BMI of 32.1±3.3 kg/m<sup>2</sup>, were 47.1±10.3 years, and 79.7% were female. Given the association between BMI and PA engagement, BMI groups were compared on self-reported PA minutes over the past 6 months. Groups did not significantly differ from one another (LB: 177.1±191.8 vs. HB: 115±143.4 min/week; p=0.168). There were no significant differences in FS response between groups prior to exercise (LB=3.03±2.2 vs. HB=3.64±1.6; p=0.225), during exercise (LB=2.98±1.8 vs. HB=3.26±1.43; p=0.518), immediately post-exercise (LB=3.23±1.84 vs. HB=3.61±1.55; p=0.395), and 15-minutes post-exercise (LB=3.74±1.61 vs. HB=4.11±0.79; p=0.268). **CONCLUSION** Affective response before, during, or after a single bout of exercise did not differ by BMI group among individuals with overweight/obesity. While these findings warrant replication in more diverse samples, larger cohorts, and using differing modes or intensities of exercise, these results suggest that affective response may not fully explain the lower levels of PA commonly observed with increasing BMI. Further investigation into other factors which may influence exercise behaviors are needed.

## RELATION OF STRENGTH TRAINING PARTICIPATION TO INCIDENT KNEE REPLACEMENT: THE MULTICENTER OSTEOARTHRITIS STUDY

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ACSM Guidelines recommend exercise as an effective approach to managing symptoms of knee osteoarthritis (OA). Strength training is often prescribed because lower extremity weakness is common with knee OA and an antecedent to functional limitation, which can lead to knee replacement (KR). However, little is known about the impact of strength training participation on incident KR. Understanding this relation may assist clinical decision making and lifestyle choices for individuals with or at risk for knee OA. **PURPOSE:** To determine the association of self-reported strength training to incident KR. **METHODS:** Participants were included from Multicenter Osteoarthritis (MOST), a NIH-funded, longitudinal cohort study of individuals with or at risk of developing knee OA. Strength training participation status was obtained at baseline using the Physical Activity Scale for the Elderly (PASE) questionnaire. Participants were asked “Over the past 7 days, how often did you do any exercise specifically to increase muscle strength and endurance?”. Strength training participation was dichotomized into ‘never’ or ‘any participation,’ with ‘any’ participation defined by  $\geq 1$ -2 days/week of strength exercise. Date of first KR was confirmed from medical records. Participants without KR were censored at their last attended clinic visit. Cox proportional hazard regression was used to model differences in the risk for incident KR in relation to strength training participation, accounting for competing events (death or early withdrawal). Analyses were adjusted for age, sex, body mass index (BMI), radiographic knee OA, self-reported moderate-vigorous aerobic activity (never versus any), and knee pain severity. **RESULTS:** 2,704 MOST participants were included (age =  $62.5 \pm 8.1$ ; BMI =  $30.7 \pm 6.0$  kg/m<sup>2</sup>; 60.2% female). The proportion of participants in the “Never” versus “Any” strength training participation categories were 57.3% and 42.7%. The proportion of participants who had incident KR was 16%, and 19% withdrew or died. After adjusting for confounders and competing risks, any amount of strength training participation was associated with a 20% lower risk for incident KR compared to no strength training (hazard ratio [HR] 0.80, 95% confidence interval [CI] 0.66 – 0.98). **CONCLUSION:** Participants who do not engage in strength training exercise have a higher risk for incident KR.

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## **PLATELET RICH PLASMA (PRP) FOR ANTERIOR TALOFIBULAR LIGAMENT LAXITY: CASE STUDY AND PATIENT PERSPECTIVE**

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Lateral ankle sprain (LAS) is a common sports injury that affects many athletes and is associated with delayed healing. PRP infusions/injections have been increasingly used as a minimally invasive therapeutic treatment for sports-related tendon and muscle injuries. However, there is little data on the use of PRP for injuries of the anterior talofibular ankle ligament (ATFL). The patient reported in this case is a 49-year-old female runner with a 20-year history of recurrent ankle sprains and chronic pain that has failed conservative treatment. Reconstructive surgery was recommended, but she opted to receive PRP instead. **PURPOSE:** The primary purpose of this case report is to describe the minimally invasive use of PRP as a therapy to treat ankle laxity and pain secondary to chronic ATFL instability and tearing. The secondary purpose is to include the lived experience of a high-level athlete. **METHODS:** A sample of 5.0 cc of PRP was prepared per protocol from 55 cc of whole blood collected from the patient. Procaine and dexamethasone 400 ng/mL were added to the PRP for ultrasound-guided injection using a 25-gauge needle. The PRP was infused into the ATFL and the distal and proximal attachments of the ligament as well as the tibiotalar joint space and capsule. Weeks later, the patient was interviewed on her experience. **RESULTS:** The patient tolerated the procedure well and was instructed to avoid any impact activities for the next three weeks. After this period, she began a progressive walk-run program building up to 60-minute runs within 8 weeks post-procedure. She had no pain or new ankle sprains during this time. She was grateful to attempt a minimally invasive procedure before resorting to surgery; she is hopeful she will be able to return to high-level running within the year. **CONCLUSION:** PRP has potential as a minimally invasive therapeutic option for ATFL injury in runners. This procedure offers faster recovery time and less risk compared to reconstructive ankle surgery. More research with larger sample sizes needs to be conducted to determine its feasibility in the greater population.

## THE REPRODUCIBILITY OF POSTEXERCISE HYPOTENSION OVER A 12-WEEK EXERCISE TRAINING PROGRAM AMONG ADULTS WITH HYPERTENSION

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Postexercise hypotension (PEH) is the decrease in blood pressure (BP) resulting from a single bout of exercise persisting for up to 24 hr. Studies that have explored the reproducibility of PEH mostly did so in the laboratory among subjects with hypertension. The reproducibility of PEH during an exercise training program is unknown. **Purpose:** To determine the reliability of the manifestation of PEH during a 12-week aerobic exercise training program performed for 3 sessions per week at moderate intensity among adults with hypertension. **Methods:** Prior to beginning exercise training, the subjects (n=10) were determined to be PEH responders, defined as a  $\geq 2$  mmHg decrease in 24-hr ambulatory BP following a maximal graded exercise stress test compared to a non-exercise control session. Investigators measured BP with a home BP monitor for 10 minutes pre- and post-exercise for each session. The manifestation of PEH for a given exercise session was defined as a decrease in BP post- vs pre-exercise. **Results:** Subjects were obese ( $30.6 \pm 4.3 \text{ kg/m}^2$ ), middle-aged ( $57.2 \pm 10.5 \text{ yr}$ ) men (60%) and women with stage I hypertension ( $136.5 \pm 12.1/83.4 \pm 6.7 \text{ mmHg}$ ). The average number of exercise sessions completed was  $32.6 \pm 4.2$  for an overall exercise adherence rate of  $90.6 \pm 11.8\%$ . Of the exercise sessions completed, PEH occurred in  $89.7 \pm 8.3\%$  of them. **Conclusion:** PEH occurred after  $\sim 90\%$  of the exercise sessions over 12-weeks of exercise training. The high consistency by which PEH was elicited, among initially sedentary adults with hypertension who were PEH responders, reinforces the clinical importance of PEH as antihypertensive lifestyle therapy. Further studies with larger sample sizes are needed to confirm our promising findings.

# DO ACTIVE VIDEO GAMES IMPROVE FUNCTIONAL FITNESS? A SYSTEMATIC REVIEW AND META-ANALYSIS

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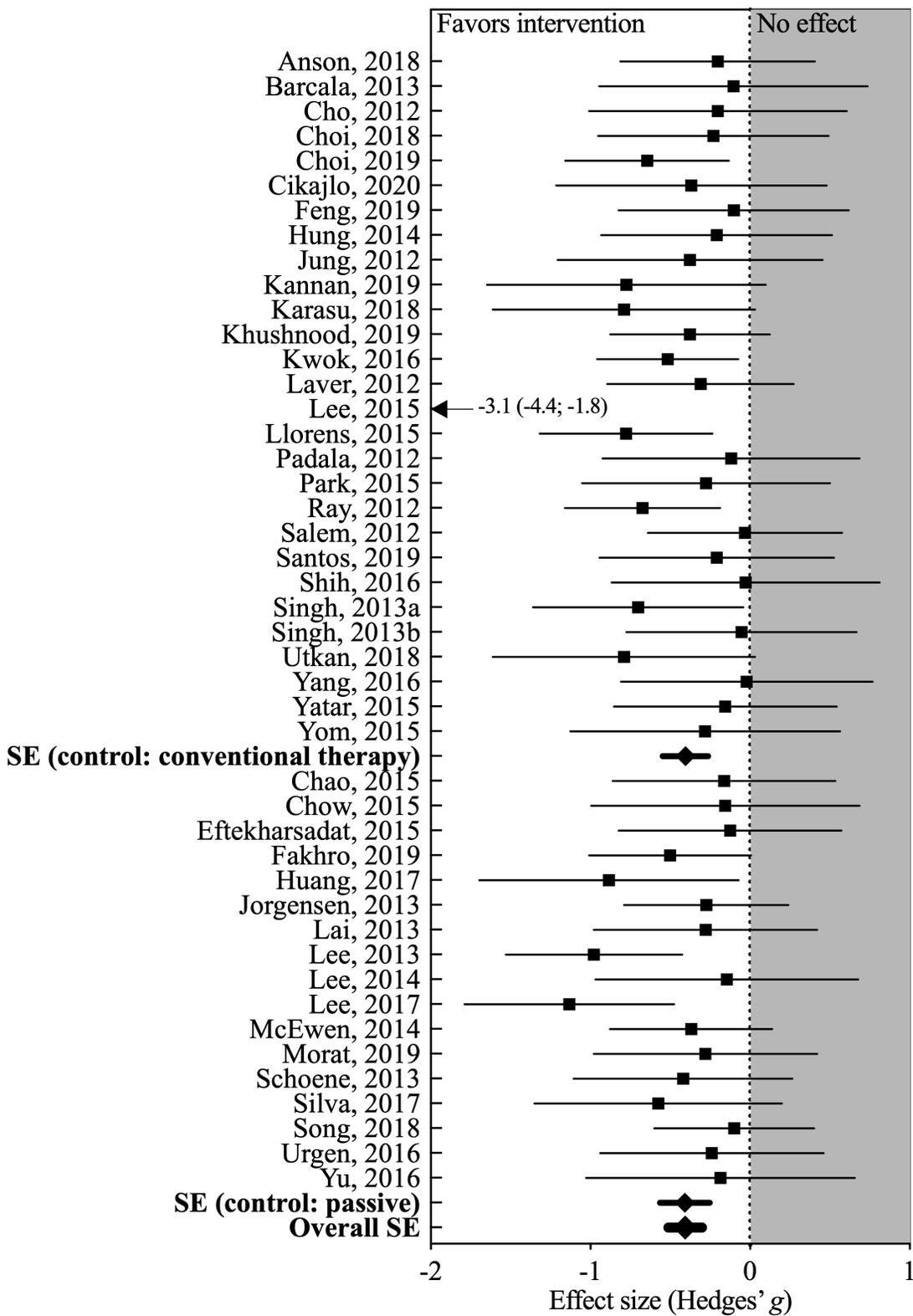
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Recent years have seen the rise of active video games (AVG), which require physical activity to be played. AVGs have gained popularity because of interactivity, engagement, and potential health benefits. Therefore, AVGs can be used as a physical intervention alone or in addition to conventional physical therapy to improve functional fitness parameters including mobility, balance, and risk of fall reduction, all of which can be measured by the Timed Up and Go (TUG) test. **PURPOSE:** To systematically examine the effect/impact of AVG on TUG test.

**METHODS:** For inclusion, a study must employ AVGs as the sole or primary part of an intervention to improve functional fitness, demonstrated by a decreased TUG test time. Only chronic effects were examined, and each condition should include at least 10 participants. Studies published by December 31, 2020 were examined in six international English academic databases (PubMed, Google Scholar, PsychInfo, Sport Discus, Medline, and Web of Science). **RESULTS:** Forty-six studies published between 2012 and 2020 with a total of 1,638 participants met the inclusion criteria. The average age was  $62.6 \pm 17.0$  years. The intervention length ranged from 1-15 weeks and total intervention time ranged from 75-3,600 minutes. The meta-analysis showed that AVG interventions significantly reduced TUG performance time (Hedges'  $g = -0.407$ ; 95% CI = -0.512 to -0.302;  $p < 0.001$ ). Subgroup analysis showed that when compared to passive control group (Hedges'  $g = -0.409$ ; 95% CI = -0.565 to -0.253;  $p < 0.001$ ) and conventional therapy control group (Hedges'  $g = -0.405$ ; 95% CI = -0.547 to -0.263;  $p < 0.001$ ), the AVG intervention group significantly improved TUG performance. **CONCLUSION:** There is a significant beneficial effect of AVG interventions on functional fitness performance as demonstrated by a time reduction of TUG performance.

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## **FLUID REPLACEMENT STRATEGIES IMPACT ON AUTONOMIC NERVOUS SYSTEM RECOVERY FOLLOWING PROLONGED EXERCISE IN THE HEAT**

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In sporting and laborer settings, optimal fluid replacement during physical exertion is extremely challenging and rarely achieved placing exacerbated strain on the cardiovascular system. It is not currently known if a prescribed fluid replacement strategy following exercise in the heat impacts autonomic nervous system (ANS) recovery the following day. **PURPOSE:** Investigate and compare the impact of a prescribed drinking versus ad libitum drinking fluid replacement strategy on ANS recovery following prolonged exercise in the heat. **METHODS:** Males aged 18-35 with a  $VO_{2max} \geq 45\text{ml/kg/min}$  participated in this study. Participants completed three exercise trials in the heat ( $36^{\circ}\text{C}$ , 36% relative humidity) on three separate days. Following exercise trials, participants were randomly placed into one of two groups: Ad Libitum (AL) or Prescribed Drinking (PD). Groups were kept consistent throughout the duration of the study. Participants reported to the lab the following morning for a follow-up visit to assess hydration status, recovery status, and heart rate variability (HRV). HRV was measured pre-trial, post-trial and at follow-up visits using a 3-lead ECG. HRV measures were analyzed using time domains (RMSSD and pNN50) and frequency domains (LF, HF, LF/HF ratio). A two-way repeated measures ANOVA measured differences in HRV pre-trial, post-trial, and at follow-up between fluid replacement groups (AL and PD). **RESULTS:** Fluid replacement was significantly greater in the PD versus AL group during the recovery period ( $p=0.012$ ,  $MD=1245\text{mL}$ ,  $95\%CI=[291, 2199]$ ,  $ES=0.88$ ), however both groups were euhydrated at the time of follow-up. HRV time domain indices (pNN50;  $p<0.001$ ,  $MD=24.23$ ,  $ES=0.41$ ) and frequency domain indices (LF/HF ratio;  $p<0.001$ ,  $MD=-1.98$ ,  $ES=0.18$ ) decreased significantly post-trial compared to pre-trial. HRV time domain indices (pNN50;  $p<0.001$ ,  $MD=-32.12$ ,  $ES=0.41$ ) and frequency domain indices (LF/HF ratio;  $p<0.001$ ,  $MD=2.38$ ,  $ES=0.18$ ) increased significantly at follow-up from post-trial. No statistically significant differences were found in HRV measures between drinking groups at any time points ( $p>0.05$ ). **CONCLUSION:** These findings suggest that fluid replacement is effective in helping restore HRV following prolonged exercise in the heat. Prescribed drinking leads to significantly more fluid consumption during recovery periods, although the magnitude of the effect of fluid replacement on HRV recovery measures needs to be further clarified.

## Validity of Smartwatch Technologies to Assess Heart Rate During Exercise in Extreme Hot and Cold Conditions

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Occupational workers are particularly vulnerable to thermal-related injuries as they often engage in outdoor work for prolonged hours in extreme heat and cold. A major shortcoming within current occupational safety guidelines is the lack of accurate wearable technology which can serve as a real-time, physiological based warning device if an individual is at risk for a heat or cold injury. **PURPOSE.** to assess the validity of heart rate (HR) collected from smartwatch devices during low, moderate, and high intensity work in extreme heat and cold. **METHODS.** This preliminary study employed a randomized cross-over design in which 12 males (age:22±1;body mass:75.5±6.9kg;maximal oxygen consumption:45.6±12mL/kg/min) performed a trial in the cold (Cold, 0°C) and hot conditions (Hot, 38°C). Each trial consisted of 3 blocks of 30 min treadmill exercise followed by 10 min of rest. Block 1 was low intensity exercise (Low), block 2 was moderate intensity exercise (Moderate) and block 3 was high intensity exercise (High). Participants wore a HR monitor (Polar H10), Apple smartwatch (Apple Watch Series 6) and Garmin smart watch (Garmin fenix 6S) during each exercise block. The extent of the agreement of each wearable device (Apple and Garmin) for HR within each temperature condition (Cold, Hot) and exercise intensity (Low, Moderate, High) was assessed with a Bland-Altman plot, which examined the limits of agreement (LOA, mean difference ± 1.96 x standard deviation) and mean bias. The Polar HR monitor served as the reference. **RESULTS.** The Bland-Altman plots reported low LOA between the smartwatches and the polar device across all intensities and temperature conditions (MB range = 1.77-21.89). During low intensity in the heat, the Garmin watch had the lowest bias and reported approximately 1.77 bpm lower than the Polar. **CONCLUSION.** The Apple and Garmin smartwatch devices may not be appropriate to assess HR during exercise in extreme environmental conditions.

## The Effect of High Intensity Interval Training on Resting Metabolic Rate

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High intensity interval training (HIIT) has been extensively studied among men, mixed training groups of men and women, but rarely in just women. Additionally, a lack of data exists as to whether resting metabolic rate increases after 4-weeks of HIIT training. **PURPOSE:** To determine the effects of HIIT on resting metabolic rate (RMR) and aerobic fitness in sedentary college-aged females. **METHODS:** Ten college-aged females ( $19.3 \pm 0.95$  years) volunteered for the study. Baseline and post-intervention measurements included height, weight, resting metabolic rate (RMR, kcal/min) (Cosmed Quark, Canopy), and estimated  $\text{VO}_2$  Max. All RMR measurements were conducted in the morning following an 8-hour fast. Aerobic fitness was assessed via the Ebbeling treadmill protocol. The exercise intervention consisted of HIIT workouts that were completed on a cycle ergometer, 3 times per week for 4 weeks. Each exercise session included a 5-minute warm-up, 10 HIIT sessions (1-minute high intensity, 1-minute active recovery) and a 5-minute cool down; totaling 10 minutes of high intensity exercise. Heart rate (HR) was measured continuously via heart rate monitors (Polar S610). High intensity was defined as a HR at or above 167 bpm ( $> 85\%$  max HR). Maximal HR estimation was calculated from the equation  $211 - (0.69 \times \text{age})$ . In addition, rating of perceived exertion (RPE scale 6-20) was to be “very hard” (RPE  $> 17$ ). **RESULTS:** Seven participants successfully completed the study. There were no significant ( $p > 0.05$ ) changes in mean height (Baseline: vs. Post:  $166.1 \pm 7.6$  cm), weight (Baseline: vs. Post:  $68.3 \pm 14.5$  kg) or BMI (Baseline: vs. Post:  $24.6 \pm 4.6$  kg/m<sup>2</sup>) following the 4-week intervention. A significant increase in RMR ( $1488 \pm 245$  kcals vs.  $1633 \pm 284$  kcals,  $p = 0.006$ ) and a significant increase in aerobic fitness (Pre:  $30.01 \pm 8.4$  ml/kg/min vs. Post:  $34.13 \pm 5.8$  ml/kg/min,  $p = 0.04$ ) were observed post HIIT intervention. **CONCLUSION:** A 4-week HIIT training program significantly increased RMR and aerobic fitness in college-aged females.

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## **EXAMINING ACTIVITY LEVELS AND CONTEXT OF YOUTH WITH AND WITHOUT DISABILITIES DURING THE SCHOOL DAY**

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Current data show that children with intellectual and/or developmental disabilities (IDD) are less physically active than their peers. The school setting may offer a promising solution to allow physical activity (PA) opportunities for children with and without IDD. However, there is a lack of data on current school-based PA levels of youth with IDD and limited comparisons between youth with IDD and their peers. **PURPOSE:** To compare the PA levels and PA context of youth with and without IDD during the total school day, physical education (PE), and recess.

**METHODS:** A total of 13 children (n = 3 with IDD) enrolled in first and second grade participated in the investigation. Accelerometry was used to assess PA during the total school day, physical education, and recess. Additionally, PA levels and context were assessed using the System for Observing Fitness Instruction Time (SOFIT) and Observational System for Recording Physical Activity in Children-Elementary School (OSRAC-E) during PE and recess, respectively. **RESULTS:** During the total school day, children with IDD spent less time engaging in sedentary activities ( $p = .032$ ) and more time in moderate intensity activities ( $p = .011$ ). During an inclusive PE class, children spent a majority their time in the seated position (56%) and engaged in the management lesson context (51%). Additionally, about 33% of the time was spent accumulating moderate to vigorous intensity PA. Children with and without IDD spent the majority of the recess period engaged in sedentary and light PA. Finally, during recess, children with IDD preferred solitary play compared their peers that preferred to be in a group or with another peer. **CONCLUSION:** It appears that the school setting is a viable option for youth with IDD to accumulate PA. However, these individuals seem to participate in non-traditional PA isolated from their peers.

## WHY DAILY PE IS THE SOLUTION TO THE OBESITY CRISIS

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**Purpose:** By failing to meet basic standards of physical fitness our children are growing increasingly sick. Depression, stress, and anxiety are at record levels. Poor fitness has a huge effect on school performance. A child who is not physically active is not assimilating information or thinking to their full potential. **In other words, there will not be better math scores until we have better health scores.** You cannot have a STEM genius without fitness. Animals, including humans, have what I call a *physical identity*. Physical identity is how we move, how we explore the outdoors, how we respond to nature: *what we do*. Physical identity is our pre-programmed way of relating to the world around us. The few schools that have adopted daily, aggressive physical education (P.E.) have seen not just improvement in overall student health, but improved performance in the classroom. This revolution should not just be in a few enlightened schools, but nationwide and especially in poorer school districts where other activity options are limited. My presentation will describe how low budget daily, high energy P.E. for every child, every year of school is vital to maintain physical identity and reverse the obesity crisis in our youth. **Methods:** Schools must provide daily physical education (P.E.) for every child, every day, every year. This can be achieved with an increase in the budget for more P.E. teachers and P.E. paraprofessionals. There must be a re-allocation of money from competitive sports that are now only serving a small percentage of the student population. Support needs to come from state legislatures to help enact this program. Finally, P.E. teachers must be educated on how each minute of class is spent with students in motion to gain health benefits. **Results:** Research supports that health and fitness is related to physical health, psychological health and academic health. This should not be available only to a minority of our youth or those whose parents have the means to send them to private schools. High quality physical education and maintenance of physical identity is our only hope to reverse the present health crisis. **Conclusions:** Our children are not getting sick from bad food and two-dimensional entertainment addictions in twenty or thirty years, they are sick NOW. This health crisis is costing society in myriad ways such as the inability to find military recruits due to obesity. The recent pandemic has put an exclamation point on this problem. We must act now by giving children a positive option that they have naturally in their DNA: We need to allow them to keep their physical identity, and the easiest way to do so is through daily physical education.

## **IDENTIFYING ACCELERATION PATTERNING ASSOCIATED WITH THE VERTICAL JUMP**

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Dynamic systems theory contends that an individual's movements are unique self-organized patterns to complete a goal-oriented task. Constraints (task, environment, or individual) result in a different systemic organization and therefore, different emerging movement patterns. In this view, specific functional tasks may have certain movement features which are predictive of outcomes. Using a low energy Bluetooth tri-axial accelerometer (TA), acceleration (ACC) data was recorded during vertical jump (VJ) assessment of university students. **PURPOSE:** This study hoped to resolve two questions: 1) Do identifiable acceleration patterns relate to VJ performance? 2) What are common acceleration associated patterns associated with VJ? **METHODS:** Subjects (N=19) took part in a VJ assessment and were fitted with a TA. ACC values were collected during VJ and were downloaded to a computer. Line graphs with lines for each of three acceleration axes were created for each trial. Analysis was completed using a rubric identifying features of ACC for 3 VJ phases (loading, takeoff and flight). Jumper height was ranked for high (HP) and low (LP) performances. Ten measured ACC values were then compared to 10 outcome measures (see table below) via correlation analysis. **RESULTS (See Table 1)** Notable group differences during loading are: HP tended to have greater downward ACC, and LP tended to have more forward acceleration. During take-off the HP tended to have a greater Y-Z acceleration ratio. Comparing acceleration to actual jump height, the Y-Z loading and load time appears to be lower for the HP. These correlations were weak and lacked statistical significance. **CONCLUSION:** Vertical jump is typically used to assess an individual's ability to produce power. While such values can provide valuable information about a performance, additional information about the mover may be gained through a phasic review of performance through accelerometry. Such insights might help for diagnosis of movement dysfunction and education. Though the measured values lacked statistical significance, there appear to be procedural differences in pattern of movement data related to outcome values for the VJ. This type of analysis has potential applications to monitor step-by-step movements in coaching and conditioning, and for enhancing pathological movement assessment in Physical Therapy.

**Table 1: Measured ACC values for 3 Phases of VJ**

Measure	High Performers (mean +/- S.D.)	Low Performers (mean +/- S.D.)
1. Y Peak Load (m/s <sup>2</sup> )	5.67 (+/- 4.09)	3.56 (+/- 1.18)
2. Z Peak Load (m/s <sup>2</sup> )	-1.12 (+/- 2.19)	-1.00 (+/- 0.75)
3. Y Peak Take-off (m/s <sup>2</sup> )	-2.01 (+/- 2.69)	-2.62 (+/- 1.40)
4. Z Peak Take-off (m/s <sup>2</sup> )	-1.14 (+/- 1.22)	-1.09 (+/- 0.78)
5. Time between Y-Z load (msec)	0.17 (+/- 0.10)	0.14 (+/- 0.09)
6. Time in flight (msec)	1.32 (+/- 1.61)	0.43 (+/- 0.14)
7. Y/Z load ratio	-2.07 (+/- 2.26)	-3.60 (+/- 11.16)
8. Y/Z Take off ratio	1.30 (+/- 1.73)	0.87 (+/- 4.47)
9. Jump HT Y/Z load ratio	-2.16 (+/- 8.62)	-4.43 (+/- 3.32)
10. Jump HT to load time ratio	135.59 (+/- 78.74)	246.74 (+/- 426.08)

## **WRIST-BASED ACCELEROMETER INTENSITY CLASSIFICATION: VALIDATION DURING ACTIVITIES OF DAILY LIVING IN A WHOLE-ROOM CALORIMETER**

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Objective measurements of physical activity during activities of daily living (ADLs) are important for understanding the relationship between physical activity and disease risk. Algorithms for research-grade, wrist-worn accelerometers have received little attention despite the wrist being the most common wear location among consumers. **PURPOSE:** The purpose of this study was to validate intensity classification algorithms for wrist-worn accelerometers against a criterion measure during ADLs. **METHODS:** An ActiGraph GT9X was worn on the non-dominant wrist while data from a custom-built whole-room calorimeter was used as the criterion measure (RC). Data were analyzed from 7 participants (Mean(SD); 7M; age(years): 27.9(2.6); weight(kg): 86.0(15.2); height(cm): 178.5(9.6)) for a 1-hour period during which four, 10-minute intervals each followed by 5-minute rests of ADLs were performed. Accelerometer data were processed via ENMOs (Euclidian Norm Minus One) and the Hildebrand 2014 (HB) wrist classification algorithm. Classification analysis was conducted in custom-made R scripts to determine accuracy of the Hildebrand algorithm's ability to classify sedentary+light, moderate, and vigorous activity. Wilcoxon Rank Sum tests were used to detect significant differences between methods ( $p < 0.05$ ). **RESULTS:** The Hildebrand algorithm overestimated minutes spent at moderate intensity compared to the criterion measure (Mean(SD); HB: 15.3(4.8) min; RC: 4.6(2.7) min;  $p < 0.05$ ). The HB algorithm underestimated minutes spent in sedentary+light activity (HB: 44.7(4.8) min; RC: 55.4(2.7) min;  $p < 0.05$ ). Balanced accuracy for light and moderate intensity was 81.9%. **CONCLUSION:** The availability of accurate, validated wrist-worn accelerometers for objective assessment of physical activity intensity would expand the potential for studies of the interactions between physical activity and disease risk. However, these data indicate that wrist-worn accelerometer intensity classifications for light and moderate activity intensities during ADLs were significantly different from the criterion measure of indirect calorimetry. These results suggest that additional studies are needed to develop effective wrist-based accelerometer algorithms focused on ADLs and other free-living behaviors.

## **PLANTAR FLEXION GONIOMETRY MEASURING FROM THE FIFTH RAY AND FROM THE BASE OF THE CALCANEUS**

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Ankle plantar flexion active range of motion is commonly measured clinically utilizing hand held goniometry, with distal alignment in the forefoot along the fifth ray. Distal alignment with the base of the calcaneus may be used as a more accurate measure of the motion, as plantar flexion occurs predominantly in the rearfoot at the talocrural joint. **PURPOSE:** The purpose of this investigation was to determine if a difference exists between the active goniometric measurement of ankle plantar flexion with distal alignment on the fifth ray versus the base of the calcaneus. **METHODS:** Eleven Merrimack College health science students, five females and six males, were recruited for this investigation. Plantar flexion measurements were taken using two different placements of a universal goniometer. One placement was positioning the distal arm parallel with the fifth ray and the other was positioning the distal arm parallel with the base of the calcaneus, both were seated, non weight bearing, with the knee at 90° of flexion. **RESULTS:** The measurements from the fifth ray had an average value of 64.27°. Measurement from the base of the calcaneus had an average value of 56.36°. This resulted in an average difference of 7.91° between the two methods. This was a statistically significant difference between the goniometric measurements of plantar flexion with a p-value < 0.01 **CONCLUSIONS:** These results demonstrate that goniometric measurement of ankle plantar flexion from the base of the calcaneus produces a significantly different result compared to measuring from the traditionally accepted fifth ray, with calcaneal values being smaller than the fifth ray values.

## **Mitochondria-Targeted Curcuminoid Modulates Immune Cell Function and Cellular Redox Balance**

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Mitochondria are critical regulators of inflammation, and immune cell mitochondrial function declines with obesity, raising the possibility that obesity-associated changes in the mitochondria drive inflammation and accelerate pathologies such as allergies, autoimmune disorders, type-2-diabetes (T2D), and cancer. One such obesity-associated change is the decline in function of mitochondrial redox regulatory rheostat nicotinamide nucleotide transhydrogenase (NNT). As a dominant regulator of the mitochondrial redox environment, NNT drives inflammation and thus plays a significant role in health and disease. We observed a reduction in NNT expression, an increase in cellular redox imbalance, and higher inflammation in peripheral blood mononuclear cells (PBMCs) from obese human subjects and in cells treated with dietary saturated fatty acid; palmitate (all,  $p < 0.05$ ). Silencing NNT in cells from lean subjects mimicked obesity-induced effects, demonstrating that the effects are secondary to impaired NNT function. Furthermore, we observed that the novel mitochondria-targeted curcuminoid and mitochondrial STAT3 inhibitor; mitocur 1 increased NNT expression and prevented the production of proinflammatory cytokines in PBMCs from obese subjects and in cells treated with palmitate. To elucidate the effect of mitocur on mitochondrial and cellular reactive oxygen species production, we utilized fluorogenic dyes dichlorofluorescein diacetate and mitochondrial superoxide indicator mitosox. Interestingly, we observed that mitocur did not alter mitochondrial superoxide production but significantly reduced obesity and palmitate-induced cellular hydrogen peroxide levels ( $p < 0.05$ ). Mitocur also induced the expression of mitochondrial complexes III-V in PBMCs from obese subjects. Collectively, our data pinpoint the therapeutic potential of mitocur in alleviating obesity-associated inflammation.

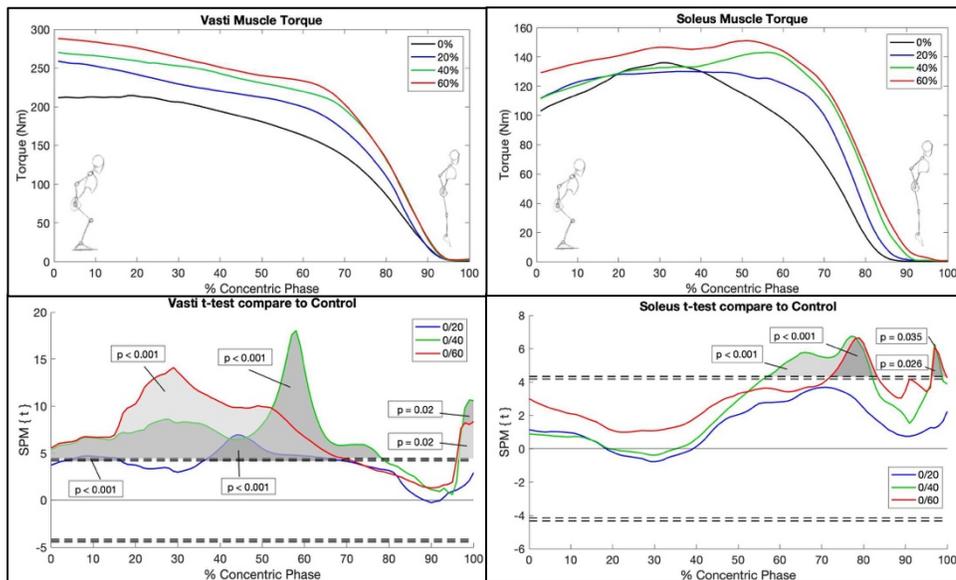
Keywords: PBMCs, Inflammation, Mitochondria, NNT, Palmitate, ROS.

# INDIVIDUAL MUSCLE TORQUES OF THE UNIARTICULAR EXTENSORS DURING LOADED VERTICAL JUMPS

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**PURPOSE:** The purpose of this study was to evaluate the effect of load on individual muscle torques during the concentric phase of loaded hexagonal barbell (HB) vertical jumps. **METHODS:** 10 males ( $20.4 \pm 2.4$  y;  $108.8 \pm 14.0$  kg) performed 5 maximal HB jumps at 0% (control), 20%, 40% and 60% of their HB 1-repetition maximum ( $216.6 \pm 10.9$  kg). Ground reaction forces and 3D lower extremity marker trajectories were input into a 23 DOF musculoskeletal model and muscle torques (Nm) for the gluteus maximus (GMAX), vastus intermedius (VASTI), and soleus (SOL) were calculated. Torques were calculated as the product of muscle moment arm and muscle force as estimated via static optimization. Changes in torque values over the concentric phase (0-100%) were analyzed using statistical parametric mapping (SPM)/RMANOVA with paired-t post-hocs. **RESULTS:** SPM paired-t noted increases in VASTI torque for the 20% load during 3-15% and during 35-70% of the phase (Figure 1, left). Increases in VASTI torque were also noted from 0-70% and 95-100% of the phase for both the 40% and 60% loads. SPM paired-t noted no difference in SOL torque at any timepoint for the control vs 20% load (Figure 1, right); however, increases in SOL torque were noted from 60-90% of the phase for 40% load, 70-83% of the phase for 60% load, and 96-99% of the phase for both. No differences were noted for GMAX (all  $p > 0.05$ ). **CONCLUSION:** Muscle torque was increased above that of the control condition for the vastus intermedius and the soleus during hexbar jumping with external loads. Loaded hexbar jumping may be beneficial in training as a means of increasing muscular torque of the uniarticular knee and ankle extensors but may not be as effective at increasing output from the uniarticular hip extensors.



**Figure 1.** Top Row: Mean VASTI (Left) and SOL (Right) muscle torques for control (0%) and 20%, 40%, 60% loads. Bottom Row: SPM paired-t post hocs between control and each condition for VASTI (Left) and SOL (Right). Dashed black lines depict upper/lower t-score significance thresholds on the Y-axis (SPM{t}).

## EXERCISE-RELATED DIFFERENCES IN PTSD SYMPTOMS, DISTRESS, CHRONIC PAIN, AND SLEEP QUALITY IN TRAUMA EXPOSED ADULTS

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Psychological trauma can lead to posttraumatic stress disorder (PTSD), which is associated with numerous negative health outcomes. Exercise (e.g., aerobic or resistance) has beneficial effects on PTSD, including a reduction in symptom severity, psychological distress, chronic pain, and poor sleep. However, the dose (i.e., amount) of exercise that is associated with a reduction in these negative outcomes is not currently known. **PURPOSE:** To explore differences in exercise participation and PTSD symptom severity, psychological distress, chronic pain, and sleep quality in a cross-sectional sample of trauma-exposed adults. **METHODS:** 474 participants completed an electronic survey. PTSD symptom severity, psychological distress, chronic pain, and sleep quality were examined as a function of self-reported exercise level (i.e., no exercise = inactive, 1-149 min/wk of exercise = moderately active, and  $\geq 150$  min/wk of exercise = active) using MANOVA. Pairwise comparisons of exercise level for each dependent variable were conducted with Bonferroni correction. Preliminary analyses determined age as a significant confound and it was controlled for in all subsequent analyses. **RESULTS:** Participants' mean age was  $34.7 \pm 12.8$ , and 70.2% identified as female. The overall multivariate model for exercise was significant,  $F(8, 934) = 3.28, p = .001$ ; Wilk's  $\lambda = 0.946$ , partial  $\eta^2 = .027$ . Pairwise comparisons revealed that active participants reported lower PTSD symptom severity ( $p = .001$ ), psychological distress ( $p = .002$ ), chronic pain ( $p = .022$ ), and better sleep quality ( $p < .001$ ) relative to those who were inactive. Moderately active participants reported better sleep quality than inactive participants ( $p = .002$ ); however, these groups did not significantly differ for PTSD symptom severity ( $p = .053$ ), psychological distress ( $p = .437$ ) or chronic pain ( $p = .439$ ). There were no significant differences between active and moderately active participants on any of the dependent variables ( $p$ 's  $> .05$ ). **CONCLUSIONS:** Physically active trauma-exposed individuals experience lower PTSD symptom severity, less psychological distress, less chronic pain, and better sleep quality than their physically inactive counterparts. This suggests that any amount of exercise may be beneficial for this population. Longitudinal research is needed to confirm these initial cross-sectional findings.

## **EFFECT OF MODERATE- AND VIGOROUS-INTENSITY AEROBIC AND ANAEROBIC EXERCISE TESTING ON A WOMAN WITH POST-COVID-19 SYNDROME**

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Individuals with post-COVID-19 syndrome (long COVID) are subject to a variety of persistent symptoms including sporadic bouts of dyspnea. Both aerobic and anaerobic exercise modalities are highly effective treatments for the management of other chronic respiratory diseases, but exercise tolerance or benefits in long COVID patients are unclear. **PURPOSE:** The purpose of this case study was to determine if exercise of various intensities and modalities triggered dyspneic episodes in a person with long COVID. **METHODS:** A woman (44 yrs; mass 73 kg; BMI 24.4 kg·m<sup>2</sup>; resting peripheral blood oxygen saturation 98%) who was infected with COVID-19 in November 2020 and had persistent and unpredictable bouts of significant dyspnea was tested 8 months post-infection. She performed a graded exercise treadmill test (GXT) at habitual walking speed (3.0 mi·hr<sup>-1</sup>) with increasing grade of 2% per minute, 6-min treadmill walking tests at 60% and 80% peak heart rate (HR), one repetition maximum (1RM) leg press strength test, and 8-repetition leg press sets at 50%, 60%, 70%, and 80% 1RM. All tests were performed on the same day. The order of testing (post-test rest period) were: GXT (10 min); 60% walking (10 min); 80% walking (10 min); 1RM determination (3 min); 50% 1RM, 60% 1RM, 70% 1RM, 80% 1RM (3 min between sets). Oxygen saturation was captured via fingertip pulse oximeter, dyspnea was assessed by the Modified Borg Dyspnea Scale (Borg), and HR was captured using a chest-strapped HR monitor. **RESULTS:** During all aerobic tests she maintained normal oxygen saturation (range: 94-98%) and did not reach 5 (severe dyspnea) on Borg (range: 0.5-4, highest rating at peak GXT). Similar results were seen during anaerobic testing (oxygen saturation range 98-99%, Borg range 0.5-3, highest rating post-80% 1RM set). **CONCLUSION:** Acute bouts of moderate- and vigorous-intensity aerobic or anaerobic exercise testing sessions did not trigger severe dyspnea in a long COVID patient prone to episodes of breathlessness. These results suggest that research using moderate or vigorous aerobic or strength training may be feasible in long COVID patients to determine whether training adaptation can be safely induced, as seen in other cohorts with chronic respiratory disease.

## **PSYCHOLOGICAL BENEFITS OF EXERCISE IN CHRONIC PAIN AND PTSD: A PROOF OF CONCEPT STUDY**

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Chronic pain and posttraumatic stress disorder (PTSD) are national priorities for the Veterans Health Administration, as steep increases in the prevalence of these conditions among returning OEF/OIF/OND Veterans continue. Exercise is an important chronic pain (CP) management tool and there is growing support for the use of exercise in PTSD treatment. **PURPOSE:** To examine the effects of a 12-week progressive aerobic exercise program on PTSD symptoms among veterans and civilians with CP+PTSD. **METHODS:** Participants had CP+PTSD ( $n=10$ ), 50% were female, 60% were Veterans with a mean age of  $39.6\pm 9.81$  years. At screening, a clinician administered PTSD Scale (CAPS-5) was used to confirm PTSD diagnosis. At baseline, the self-reported PTSD checklist (PCL-5) was used to assess PTSD severity, and a cardiopulmonary exercise test (CPET) was conducted to measure baseline fitness ( $\text{peakVO}_2$ ) and heart rate at peak exercise. A 12-week (3 x 30 minute sessions/week) progressive moderate-to-vigorous intensity aerobic exercise program was developed using each individual's CPET data. The CAPS-5, PCL-5 and CPET were repeated at follow up. Pre-post differences in PTSD symptoms were explored with repeated-measures ANOVA. **RESULTS:** CAPS-5 scores improved across exercise training, with a near significant effect ( $p=.06$ ) in the 10 participants with CP/PTSD: Screening  $\text{CAPS}_{\text{baseline}}=27.7\pm 9.8$ ;  $\text{CAPS}_{\text{post-training}}=14.2\pm 10.35$ , partial  $n^2=.26$ . Self-rated PTSD Check List (PCL-5) scores did not improve significantly, but there was a medium effect size:  $\text{PCL}_{\text{baseline}}=28.22\pm 12.37$ ;  $\text{PCL}_{\text{post-training}}=18.11\pm 11.01$ , partial  $n^2=.10$ . **CONCLUSION:** Three months of progressive moderate-to-vigorous aerobic exercise is associated with improved PTSD symptoms from baseline to post-training in CP+PTSD participants. Larger studies of this nature are needed to replicate and generalize the findings. Our next study will allow us to broaden the study eligibility criteria and further delineate the impact of progressive exercise on PTSD, chronic pain and depression, among other important secondary outcomes shared between CP+PTSD.

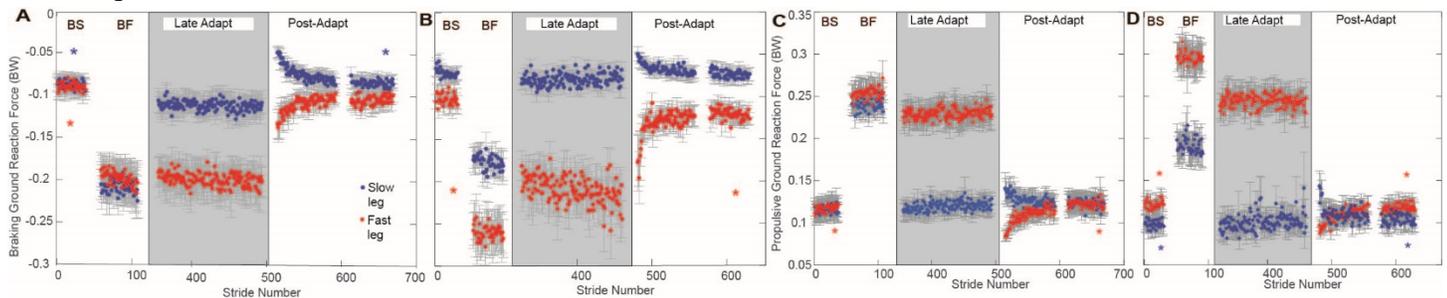
# ADAPTATION OF LEG FORCES DUE TO GRADUALLY INTRODUCED SPLIT-BELT WALKING IN PEOPLE WITH TRANS-TIBIAL AMPUTATION

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Amputees exhibit asymmetric step lengths and ground reaction forces during walking, which could contribute to increased overuse injuries on the intact leg. Split-belt walking with side-by-side treadmill belts moving at different speeds can correct baseline step length asymmetries through error augmentation paradigms, in which the split-belt condition exacerbates the baseline asymmetry. When the split-belt condition is removed (i.e. the belts return to the same speed), symmetry improves. **PURPOSE:** We used an error augmentation, split-belt paradigm to induce adaptation of ground reaction forces (GRFs) in trans-tibial amputees. Prior work shows aftereffects in braking, but not propulsive GRF. We hypothesized that people with amputation and controls would exhibit aftereffects in braking GRF, but propulsive GRF would return immediately to baseline when the split-belt condition was removed. **METHODS:** Eight trans-tibial amputees and eight matched controls first completed a fast baseline trial with both belts at 150% of preferred walking speed (PWS) and 2 slow baseline trials with both belts moving at 75%PWS. In the adaptation, the fast belt gradually accelerated to 150%PWS. Then belt speeds remained constant for 3 minutes. The prosthetic leg was on the slow belt. Next, belt speeds abruptly switched to 75%PWS. We compared the first 5 steps of this post-adaptation period to the last 5 steps of the slow baseline trial using repeated measures ANOVA followed by t-tests with Bonferroni corrections ( $\alpha=0.0167$ ). **RESULTS:** For the fast (intact) leg, amputees and controls had significantly higher peak braking force in early post-adaptation than at baseline. Both subject groups had lower fast leg peak propulsive force in early post-adaptation than at baseline or in late post-adaptation. There were also aftereffects in step length symmetry for both controls and amputees. **CONCLUSIONS:** These data indicate predictive control of both braking and propulsive forces during split-belt adaptation, and this control is unaffected by trans-tibial amputation.



**Figure:** Peak braking GRF for matched control subjects (A) and people with trans-tibial amputation (B); and, peak propulsive GRF for controls (C) and people with trans-tibial amputation (D). \* indicates a significant difference from early post-adaptation ( $p < 0.0167$ ). BS – slow baseline, BF – fast baseline

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**TITLE: SMALL INCREMENTAL ADDITIONS OF NON-FUNCTIONAL MASS ON HEART RATE AND RESPIRATORY RESPONSE IN HEALTHY UNTRAINED INDIVIDUALS.**

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Participation in regular exercise is recommended for individuals with excessive body fat or non-functional mass (NFM). However, attempting to improve fitness with excess NFM can be difficult due to additional load placed on the body. **PURPOSE:** This study examined how small increases in NFM affect changes in heart rate (HR) and VO<sub>2</sub> during walking in healthy untrained individuals. **METHODS:** Project design was approved by the Husson IRB. Eight male (N= 8) and twelve female (N= 12) subjects were recruited for the study. Subjects carried loads in increments of 1%, 2.5%, 5%, and 10% of their body weight. An initial baseline treadmill walking test with no additional load was performed by each of the subjects. There was at least one rest day between trials. Loaded trials were performed in randomized order. Subjects carried weight in a small cloth swag bag with the weight positioned between the inferior angles of the scapulae. Heart Rate and VO<sub>2</sub> were recorded using a Parvo Medics 2400 Metabolic Cart. Subjects were asked to perform a Modified Balke walking treadmill test at a standard walking speed of 3.5 mph. Treadmill grade increased 1% every minute until 80% of their predicted max heart rate. Using SPSS a one-Way ANOVA was used to compare differences across the 5 trials for both heart rate and respiratory responses. **RESULTS:** The data showed even small additions of NFM affect time to 80% MHR. There were significant difference between all workloads on HR. ( $F = 69.77, df = 4, p < .001$ ). VO<sub>2</sub> increased with each addition of weight but showed no significant difference between the 0%, 1%, 2.5%, 5% nor 10% ( $F=0.95, df=4, p=0.44$ ) **CONCLUSIONS:** With small additions of NFM there are obvious changes in work capacities. At a low workload of 3.5 mph physiological compensation appears to be cardiovascular in efforts to maintain cardiac output. Though the VO<sub>2</sub> increased with addition of load the differences did not require significant need for respiratory compensation. The conclusion of this study is that in untrained persons who are potentially gaining weight the greatest effect will be on heart function.

## **EFFECT OF RANGE OF MOTION ON KNEE EXTENSOR MUSCLE TORQUE-VELOCITY AND FATIGUE CHARACTERISTICS**

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While it is well accepted that muscle fatigue is task-specific, little information is available regarding the influence of joint range of motion (ROM) on muscle power and fatigue.

**PURPOSE:** Determine the effect of knee joint ROM on knee extensor muscle torque-velocity and fatigue characteristics. **METHODS:** Seven healthy adults (29±5 yr, 5 female) were studied after providing written informed consent. Each leg of each participant was randomly assigned to a 35 or 75 deg ROM condition. The torque-velocity protocol was performed on one leg and the fatigue protocol on the other using a Biodex System 4 Dynamometer (Biodex, Shirley, NY); these protocols were then switched for each leg at a second visit such that each leg did both protocols at one ROM. Torque-velocity protocol: 2 maximal isometric contractions followed by 6 sets of 3 maximal isokinetic contractions at 60, 120, 150, 180, 240, and 300 deg·s<sup>-1</sup>, in random order and with 2 min rest between sets. Peak torque at each velocity was used to evaluate the torque-velocity relationship. Fatigue protocol: 114 maximal contractions (1 every 2 s) at 120 deg·s<sup>-1</sup>. Fatigue: ((final concentric peak power ÷ initial peak power)\*100). Statistics: rmANOVA and t-tests, with p<0.05 indicating significance. **RESULTS:** The torque-velocity relationship did not differ between the 35 and 75 deg ROM protocols (p=0.059), indicating similar strength under both ROM conditions. The fall of peak torque (i.e., fatigue) was greater during the 75 deg ROM protocol (to 45%±15 initial) than the 35 deg ROM protocol (to 71%±14 initial, p<0.001). **CONCLUSION:** Overall, the torque-velocity data showed that muscle strength did not differ by ROM, indicating that these young adults attained peak torque within 35 deg ROM for all velocities. Greater fatigue during repeated contractions at 75 deg ROM, potentially due to the greater total work and duty cycle in this task, provide evidence that ROM is an important factor in the task specificity of fatigue.

## GAME EXPERIENCE OF ACTIVE VS. SEDENTARY VIRTUAL REALITY GAME

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Virtual reality (VR) is expanding exponentially with its growing consumer market. Researchers have been using VR to test different health interventions, including physical activity (PA) promotion. **PURPOSE:** We aimed to investigate the effect of an active vs. sedentary VR game session on game experience components. **METHODS:** Thirty-six sedentary college students (Female/Male=9/27; age=23.2±2.8 years; BMI=23.5±4.5 kg/m<sup>2</sup>) made two visits to our lab for an active and a sedentary VR session in random order. The active VR (AVR) game was rhythm-based (called Beat Saber) that required whole-body movement to cut through and avoid blocks. The sedentary VR (SVR) game, also rhythm-based (called Thumper), employs an Xbox One controller for control of a beetle-like character travelling along an obstacle filled space track. We used the HTC Vive Pro VR headset system, a lightweight device (803 grams) with a high-resolution display, attachable headphones, and a wireless adapter for untethered play. Participants were instructed to play for as long as they want up to a maximum of 60min to prevent exhaustion. PA levels were monitored by wrist-worn accelerometers (Actigraph GT9 Link). After each session, participants completed a 33-item questionnaire, measuring 7 components of the game experience. **RESULTS:** Participants played similar durations in AVR and SVR (26.3±11.6min vs. 27.1±16.9min, p=0.764). We found that AVR significantly out-elicited SVR in moderate-to-vigorous PA (MVPA) (13.1±6.5 minutes [52.4±17.8%] vs. 0.4±0.6min [1.6±1.6%], p<0.001). Questionnaire analysis showed that AVR elicited higher Competence, Flow, and Positive Affection than SVR session (all p<0.036), but Sensory and Imaginative Immersion were borderline (p=0.085), and no significant differences existed for Challenge, Tension, and Negative Affection (p > 0.05). **CONCLUSION:** Although the AVR game didn't produce a longer play duration, AVR elicited more MVPA, competence, flow, and positive affection among sedentary young adults.

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## THE IMPACT OF EXERCISE MODE ON BRAIN-DERIVED NEUROTROPHIC FACTOR AND ARTERIAL STIFFNESS IN COLLEGE STUDENTS

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Brain-derived neurotrophic factor (BDNF) has been proposed as a peripheral biomarker for exercise-induced alterations in state anxiety and cognitive function. As arterial stiffness has been associated with state anxiety and cognitive function, the acute arterial stiffness response to exercise mode was investigated using pulse wave velocity (PWV). Presently, it is poorly understood how high-intensity interval exercise (HIIE) and moderate-intensity continuous exercise (MICE) compare in terms of their acute impact on these variables within the same design. **PURPOSE:** To examine the relationship between exercise mode and brain function as it relates to BDNF, arterial stiffness, state anxiety (SAI), and working memory (DST). **METHODS:** Twenty-six healthy subjects (13 men, 13 women;  $M_{age} = 23.92 \pm 3.55$  years) completed a familiarization session followed by three randomized and counterbalanced experimental sessions: HIIE, MICE, and a control session (CON). The HIIE and MICE sessions were isocaloric. **RESULTS:** BDNF levels significantly increased at 30 minutes post-exercise (P30) following MICE ( $1560.37 \pm 940.86$  pg/mL) relative to CON ( $909.39 \pm 690.07$  pg/mL;  $p = .001$ ,  $d = .74$ ) and HIIE ( $993.23 \pm 580.47$  pg/mL;  $p < .001$ ,  $d = .69$ ). There were no gender differences in the serum BDNF response to experimental sessions ( $F = 0.41$ ,  $p = .73$ ,  $\eta_p^2 = .018$ ). The coefficients of variation (CV) concerning the low, moderate, and high controls for the BDNF enzyme immunoassay were 101.6%, 16.4%, and 17.3% respectively. The average intra-duplicate CV for all six plates was 3.85%. PWV was significantly lower immediately post-exercise (POS) following MICE ( $5.42 \pm .14$  m/s) relative to CON ( $5.67 \pm .14$  m/s;  $p = .005$ ,  $d = .36$ ) and HIIE ( $5.62 \pm .14$  m/s;  $p = .020$ ,  $d = .29$ ). No significant differences were observed in SAI or DST. **CONCLUSIONS:** MICE led to an increase in serum BDNF and a decrease in arterial stiffness post-exercise. More research is warranted to determine the relationship between these indices of neurological and cardiovascular function.

## **SEX DIFFERENCES IN PARTICIPATION TRENDS IN A LOCAL ROAD RACE RUNNING EVENTS IN CONNECTICUT**

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Female participation in road race running event has been increasing year-to-year until 2019. Majority of runners of U.S. road races from 2019 were females but only 43% of U.S. marathon finishers were women. Most data comparing sex differences in participation trends was assessed on large marathons and half-marathons or large data aggregates without considering the impact of concurrent road races offering various distances for runners. **PURPOSE:** The purpose of this study was to examine sex differences in participation in locally organized road race events offering at least three race distances. It was hypothesized that 1) overall female participation would be higher compared to male counterparts for all three events and higher than national average for marathons, 2) a lower number of women would complete with increasing age compared to men in marathon. **METHODS:** Hartford Marathon event was selected as the target road race due to historically large number of participants, local nature of the event, and three road race distances offered: 5K, half marathon, and marathon. National averages were obtained from the USA Running Trend Report 2019 and compared to participants from the Hartford Marathon events in 2019 (N=7277). Demographic data (mean and percentages) was assessed separately for 5K, half marathon, and marathon and stratified by self-identified gender based on participant's registration form and final race results. Differences in participation trends were compared between male and female runners for each distance and classified into eight age groups categorized by decades: <20, 20-29, 30-39, ... and +80. **RESULTS:** Females consisted of 60.9% all 2086 5K finishers, 54.6% of all 3697 half marathon, and 38% of 1494 marathon finishers. Female participation in half marathons and marathons was lower than national average of 60.9% for all U.S road races. Higher percent of male runners (M) were Connecticut residents compare to female runners (F) in all events: 92.6% (M) vs 91.7% (F) in 5K, 77.3% (M) vs 75.1% (F) in half marathon and 57.8% (M) vs. 52.8% (F) in marathon. For 5K, most popular age group was 30-39 (23.5% F and 20.6% M), followed by 40-49 (20.1% F and 18.8% M) and 50-59 (18.6% F and 17.7%) age groups. This trend was consistent for both sexes. For half marathon, similar trends were found for both sexes. However, most popular age group for both sexes was 40-49 for marathon (31.7% F and 29.7% M), followed by 30-39 age group. Sex differences were found in third most popular age group being 20-29 for females (23.0%) and 50-59 (18.9%) for male runners, which was consistent with the hypothesis. **CONCLUSIONS:** Although age group trends were consistent with U.S. national trends, this data demonstrates that lower percent of female runners competed in Hartford half marathon and marathon events compared to national averages. These results are practically significant to road races organizers and local organizations interested in increasing participation of females in road race events.

## **FACEMASK USE DURING EXERCISE: EFFECTS ON PHYSIOLOGIC AND PERFORMANCE PARAMETERS**

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Facemasks hinder the spread of respiratory disease, and their use often mandated during the SARS-CoV2 pandemic. Most users wear cloth or surgical-type facemasks, and the Centers for Disease Control (CDC) recommends “double facemasks” (surgical facemask over a cloth facemask) to increase filtration. Physical exertion increases the exhalation of potentially infectious particles, therefore double facemask use may be particularly important during exercise. However, facemasks are perceived as uncomfortable, especially during vigorous activity, and there is a paucity of data on the effects of facemask use on performance and physiology during exercise. **PURPOSE:** The purpose was to assess physiological and subjective measures with three facemask combinations during moderate and vigorous exercise.

**METHODS:** Recruited subjects (N=15) were healthy and participated in at least thirty minutes of endurance activity three days a week for three months (Age: 21.1±0.772 years; 53% male). VO<sub>2</sub>max testing was performed (VO<sub>2</sub>max: 46.28±11.46) and watts calculated at 40%, 60%, and 75% of VO<sub>2</sub>R. Each subject participated in three thirty-minute bicycle trials, each utilizing the following facemask configurations assigned randomly:

- #1: Surgical-grade facemask
- #2: 3-ply cotton facemask
- #3: #1 over #2

During each trial, subjects cycled for 10 minutes at 40%, 60%, and 75% of their VO<sub>2</sub>R. HR, O<sub>2</sub> saturation, respiratory rate, RPE, and dyspnea were collected at 5 and 10 minutes at each intensity. **RESULTS:** When comparing the facemasks at each exercise intensity, there were no differences in HR, O<sub>2</sub> saturation, respiratory rate, RPE and dyspnea (p>0.05). When combining facemask trials and comparing exercise intensities, all assessments increased with intensity (p<0.00), except O<sub>2</sub> saturation, where there was a decrease with intensity (40%; 96.1±.92, 60%; 95.4±1.1, 75%; 94.8±1.5, p<0.00 to 0.04). **CONCLUSION:** The results demonstrate that there were no physiological differences among the facemask combinations studied. It appears the CDC recommendations to “double facemask” is reasonable to increase filtration and reduce the risk of infection, without further stress during exercise. The drop in O<sub>2</sub> saturation with increasing intensity was observed with facemask use, suggesting the need for further research to compare facemask and no facemask conditions. Due to health safety concerns, this research could not be completed without facemasks.

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## **RUNNING HISTORY AND INJURY STATUS IN FEMALE CURRENT AND FORMER DIVISION 1 DISTANCE RUNNERS**

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Division 1 female distance runners must train at high mileage and intensities, oftentimes leading to overuse injuries. The COVID-19 pandemic likely led to altered training and injury status in this population. **PURPOSE:** To evaluate training and injury status in female current and former Division 1 distance runners and quantify the impact of the early months of the COVID-19 pandemic on training and injuries. **METHODS:** 176 current (91) and former (85) female Division 1 distance runners ( $24.9 \pm 7.9$  yr) were recruited for this study, representing all NCAA regions. Data were collected from an online survey in July 2020 asking questions pertaining to weekly mileage, training, previous injuries, and changes in training/injury during the pandemic. Data were analyzed using Chi Square tests. **RESULTS:** 33% of current and 28% of former female Division I runners reported having a current injury ( $p=0.08$ ). Current runners reported more bone stress reaction and fracture injuries while former reported more inflammation injuries. There were significant differences in average weekly mileage distribution ( $p<0.001$ ) and time at current mileage ( $p=0.04$ ) between current and former runners. Current runners ran more than former ( $>40$  miles/week versus  $<40$  miles/week) and a larger percent of current runners were at that mileage for shorter times compared to a more widespread distribution for former runners. 90% of the injured current runners and 77% of former injured runners were still running over 20 miles per week ( $p<0.001$ ). During the COVID-19 pandemic, 25% of the sample reported no change in training, while 33% decreased mileage, 29% increased mileage and 5% stopped running altogether ( $p<0.001$ ). 43% of the injured runners reported healing from previous injuries, while 18% of the uninjured developed injuries during this time. **CONCLUSION:** Female current Division 1 distance runners displayed higher weekly mileage, shorter time at mileage, and more bone stress injuries compared to former. During the early months of the pandemic, runners displayed training modifications and running status changes but no difference in injury status and mileage. Runners have been impacted by the pandemic, and the long-term implications on injury patterns and performance are unclear.

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## **Qualitative study on the perceived barriers of a physical activity program in toddlers: Classroom teacher perspective**

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Toddler children (18 months-2.8 years) spend a significant portion of their day at childcare settings, where they spend most of their time engaged in sedentary activity. Toddler classroom teachers have a considerable influence on toddlers' physical activity (PA) levels. Due to the toddler classroom environment, teachers may encounter unique age and ability related barriers to the implementation of PA programs. **PURPOSE:** The purpose of this qualitative study was to determine the perceived barriers that toddler classroom teachers may face in implementing PA programs for toddlers. **METHODS:** Toddler classroom teachers from 3 environmentally matched childcare centers from the Springfield MA area participated in this qualitative study. Focus group meetings (n=3) were conducted separately at each center. At each meeting, a semi-structured focus group format and questionnaire were used to guide the sessions. All focus groups were audio-recorded and later transcribed by primary, secondary, and tertiary trained researchers. Open coding was used by researchers to identify themes. Representative quotes were selected for each theme to demonstrate saturation of ideas. **RESULTS:** A total of 15 teachers participated in this study (age =  $38.4 \pm 12.5$ ; BMI (self-reported) =  $26.1 \pm 4.3 \text{ kg/m}^2$ ). Teachers had an average of  $9.5 \pm 8.7$  years of experience as toddler classroom teachers (ranging between 1 to 28 years). Teachers perceived barriers to PA were categorized into 3 main themes. The three main themes were 1) essential childcare needs (e.g., regular diaper changes of the toddlers, child supervision), 2) wide variation in cognitive and motor skill abilities of toddlers (e.g., differences in children that just learned to walk versus those that have been walking for an extended period, short attention span) and 3) limited resources and physical space (e.g., limited activity options, small classroom design to hold 9 toddlers). **CONCLUSION:** This qualitative study provides preliminary evidence that classroom teachers face unique perceived barriers in implementing PA for toddlers. Future research should examine how these perceived barriers can be overcome through design and implementation of PA programs developed specifically for toddlers within the childcare center.

## **CHANGES IN EXERCISE HABITS OF UNIVERSITY STUDENTS DURING THE COVID-19 LOCKDOWN**

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COVID-19 has presented a level of restrictions to our lives over the past several months. The pandemic has placed a barrier to exercise that has affected many individuals. Although restrictions have varied, the general population were forced to seek alternative exercise routines. **PURPOSE:** The purpose of this investigation was to investigate how the exercise habits of college students changed as a result of the COVID-19 pandemic lockdown. Data were collected from students at the University of Southern Maine via an online survey distributed through a university student email distribution list. **METHODS:** All university students were invited to participate in the survey starting in February 2021 through March 2021. The study included a questionnaire designed to capture exercise habits of university students three months prior to the shut-down of COVID-19 (January – March 2020) and their current exercise habits in (February - April 2021). The survey questions were based on the current American College of Sports Medicine (ACSM) physical activity (PA) guidelines which include number of days a week exercising, combination of moderate and vigorous activity, aerobic and strength activities. The survey also included changes in hours of sitting. **RESULTS:** The majority of the participants in this study were not meeting the recommended ACSM guidelines for PA prior to the lockdown. Before COVID-19, 28.12% participants met the ACSM guidelines for minutes of exercise per week. After COVID-19 lockdown, 25% met this requirement. The participants showed a decrease in PA along with an increase in weekly sitting time. Before COVID-19, 21.8% participants were sitting  $\geq 35$  hours per week. After the COVID-19 lockdown, 50.45% participants were sitting  $\geq 35$  hours per week. **CONCLUSIONS:** The results of this study could be used for further research to promote an increase in PA at home. With the uncertainty of the pandemic, motivating people to stand and walk more could be the first step in breaking the increase in sitting habits and help to increase PA. The COVID-19 pandemic has certainly imposed many restrictions on our daily routines, but it could also open up new approaches for prescribing PA in the future.

## **PREDICTING OVERALL FOOTWEAR SATISFACTION BASED ON RUNNER-SPECIFIC ATTRIBUTES AND PREFERENCES**

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**PURPOSE:** The objective of this study was to determine if overall satisfaction of a running shoe can be predicted based on runner-specific characteristics and preferences regarding fit and performance of that shoe. **METHODS:** 232 recreational runners (116 females, 116 males; age:  $32.0 \pm 9.9$ ) who ran at least 20 miles per week were selected for a crossover study. Participants were randomly sent control shoes or experimental shoes to be worn for the first four weeks of the study. At the end of week four, second shoes were sent out and participants were asked to wear them for the next four weeks. We asked participants to run a consistent mileage over the eight week period and track their mileage in weekly running logs. At the end of the fourth and eighth week, a final questionnaire was sent out for assessment of the running shoes they were currently testing. Questions regarding the fit, feel, and performance of the running shoe were asked. We asked participants to rate and describe several attributes (e.g. fit, comfort, responsiveness) using a sliding scale response system that translated to a numerical scale of 0-100. We analyzed the data through a multiple regression to evaluate the relationship between individual preferences and overall satisfaction of the experimental running shoes. **RESULTS:** We chose four variables to evaluate the relationship between runner-specific characteristics and overall satisfaction: gender, age, pace, and mileage. No statistical significant relation was observed between these specific characteristics and overall satisfaction. When looking at individual preferences of the shoes, four variables were considered: overall comfort, overall fit, responsiveness, and weight. In men and women, overall comfort, overall fit, and responsiveness significantly predict overall satisfaction ( $r^2 = 0.79$ ;  $p < 0.05$ ), but perceived weight was not related. **CONCLUSION:** The results suggest that preferences regarding physical properties and characteristics of running shoes are most predictive of overall satisfaction. By determining the properties that are most important to runners, shoes can be designed and advertised to appeal to specific populations of runners.

## **HIGH-QUALITY DIET MODIFIES PROTECTIVE EFFECTS OF PHYSICAL ACTIVITY ON MORTALITY RISK**

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Although physical activity plays an important role in overall and cardiovascular health, it is largely unknown whether a high-quality diet modifies its benefits. Studying the interaction between dietary intake and moderate-to-vigorous physical activity (MVPA) on mortality will inform public health policies. **PURPOSE:** The purpose of this study was to determine if diet modifies the relationship between MVPA and mortality risk. **METHODS:** The study population included participants from the National Health and Nutrition Examination Survey (NHANES) 2005-2006 (n=4808). Healthy Eating Index (HEI) scores based off of 24-hour recall data were used to determine diet quality. Seven-day hip accelerometer data was used to assess physical activity levels. **RESULTS:** Over a mean follow-up of  $9.2 \pm 2.3$  years, there were 227 deaths. Higher levels of MVPA were associated with a lower risk of death independent of HEI score (HR = 0.80 per ten-minute increase, 95% CI = 0.73-0.87). Effect modification analyses showed that HEI score moderated the association of MVPA with mortality risk (p-interaction = 0.009). The association of MVPA with mortality risk was stronger among participants with a healthier diet (HEI score > 50; HR = 0.69 per ten-minute increase, 95% CI = 0.59-0.80). For participants with a poorer diet, the association of MVPA with mortality risk was attenuated but still significant (HEI score < 50; HR = 0.88, 95% CI = 0.80-0.98). **CONCLUSIONS:** In a nationally represented sample, MVPA and diet were independently associated with lower risk of mortality. Increased MVPA most greatly reduced risk of death among those who had a healthy diet. Meeting both dietary and physical activity guidelines is most protective against mortality.