

### **Validation of Smartphone-Based Assessment of Sit-To-Stand Power**

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Modern smartphones are inexpensive, portable, user friendly, and contain sensitive gyroscopes. Apps can be used to sample, store, and wirelessly transmit data. Although easy to conduct, field tests of sit-to-stand (STS) power provide only a relatively crude (timed or counted) outcome measure of global performance. Expensive lab-based biomechanics equipment is required to obtain measures of leg power (LP) for individual repetitions during brief 5x STS tasks.

**PURPOSE:** To determine the ability of the iPod to detect movement speed for each rep during a 5x STS test, and make comparisons with an electrogoniometer (eGONI) and force platform.

**METHODS:** Young adults ( $22.9 \pm 2.9$  yrs, 21 men, 21 women) performed a 5x STS task as rapidly as possible with strict form. Three trials were performed. A 5<sup>th</sup> generation iPod Touch was firmly attached (Velcro) to a strap around the lower thigh. An eGONI (Biometrics) was placed laterally across the knee joint. The feet were on a force platform (AMTI Accusway) in front of the chair. Concurrently, iPod gyroscope data (rad), knee joint angle (rad), and ground reaction force (GRF, N) were sampled at 100Hz. The peak slope (0.1s time constant) of the iPod pitch signal, eGONI signal, and GRF was calculated for the rising phase of each rep. The peak GRF was also measured. The instantaneous slope was normalized to body mass to provide an index of power for each rep. For each device, the mean power of 5 reps and the maximal single rep value was calculated for the three trials. Correlations were computed between the devices across all subjects.

**RESULTS:** The mean ( $R^2=0.85$ ) and max ( $R^2=0.86$ ) iPod peak slope were highly correlated with the corresponding eGONI value. The mean ( $R^2=0.47$ ) and max ( $R^2=0.44$ ) iPod peak slope were moderately correlated with the corresponding GRF value. The mean and max values were highly correlated with each other for the iPod ( $R^2=0.99$ ), eGONI ( $R^2=0.99$ ), and GRF ( $R^2=0.98$ ). The greater rising power for men vs. women was detected similarly by the iPod (32.5%), eGONI (29.5%), and peak GRF (30.9%).

**CONCLUSION:** As measured with the iPod, mean rising power from the 5x STS is very reflective of a single maximal rep. The iPod is sufficiently sensitive to detect differences in chair rising power between sexes and can replace an electronic goniometer for assessing chair rising power.

## **Exercise and Prayer Effects on Cancer Survivor HRQOL**

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Exercise reduces cancer-related effects and improves health-related quality of life (HRQOL). Prayer contributes to enhanced HRQOL. The combined effect of exercise and prayer is less clear.

**PURPOSE:** The purpose of this study is to examine the combined effect of exercise and prayer on HRQOL among cancer survivors. **METHODS:** Oklahoma cancer survivors and caregivers will participate in an 8-week intervention program randomized into four groups: 1) Exercise only, 2) Prayer only, 3) Combination, or 4) Control. Exercise intervention involves three 30-minute walking sessions (65-85% max heart rate; one supervised, two unsupervised). Prayer intervention involves three prayer sessions (one phone call, two text messages or e-mail). FACIT-SP (v4) will measure HRQOL. **RESULTS:** ANOVA will determine group differences at  $p < .05$ . **CONCLUSION:** Exercise and/or prayer may enhance HRQOL. Further study is needed to examine the combined effect of exercise and prayer on cancer-related effects and HRQOL.

## **Extraordinary Spinal Reflex Clonicity and Hyperreflexia in College-Aged Identical Twins: A Case Control Study**

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**BACKGROUND:** Proprioceptive muscle spindle feedback excites spinal circuits and can elicit central pattern generation. Tendon vibration stimulates spindles, activates the stretch reflex circuit, and typically produces a smooth increase in muscle force (the tonic vibration reflex).

**PURPOSE:** Clonicity and hyperreflexia are often associated with neurodegeneration. Here we describe 1) extraordinarily high amplitude stretch reflexes, and 2) astonishingly robust, consistently clonic vibration reflexes in two ostensibly healthy, physically active identical twins. The purpose is to describe these truly unique reflex responses and compare them to controls.

**METHODS:** This rare phenomenon was observed by happenstance in our teaching lab. Two twins and two controls (21-22 yr-old females) underwent assessments: normal and Jendrassik-potentiated patellar tendon taps, knee extensor (KE) tonic vibration reflex (TVR, 100 Hz, 2mm patellar tendon vibration), and TVR's for elbow flexors (EF), wrist flexors (WF), and wrist extensors (WE). Tendon tap-elicited KE force pulses were recorded at rest and during a Jendrassik maneuver. Vibration-elicited KE forces were recorded during 30s and 60s TVR trials. TVR responses of the EF, WF, and WE were recorded using an app on an iPod. Mean force and standard deviation (SD) of KE TVR force was measured. The SD of acceleration of the forearm or hand segment was measured for TVR trials of the EF, WF, and WE muscles.

**RESULTS:** Tendon tap-elicited KE force pulses were 2.8 fold and 1.9 fold greater for the twins than controls. Twins vs. control TVR response: the mean KE TVR force was 22x greater for the 30s TVR (5.4% vs. 0.25% MVC) and 15x greater for the 60s TVR (6.7% vs. 0.46% MVC). The rectus femoris TVR EMG response was 10-fold greater. Reflex fluctuations in twins vs. control: the SD of KE force was 41 times greater during the 30s TVR and 44 times greater during the 60s TVR. The SD of acceleration was 12x greater for EF, 9x greater for WF, and 10x greater for the WE. KE force fluctuations and forearm/hand acceleration fluctuations were characterized by a robust 5-6 Hz clonus. During the TVR, the twin with the greatest KE force fluctuations also had greater upper limb fluctuations. **CONCLUSION:** The spinal reflex excitability exhibited by these twins is extraordinary, rare, and most likely of genetic origin.

## Effects of A Kefir Diet on Kidney Antioxidant Enzymes of Rats Treated with Doxorubicin

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Doxorubicin (DOX) is a potent chemotherapy drug whose mechanisms of action includes generation of reactive oxygen species (ROS), and as such, its use as an anticancer drug is limited by toxicities in non-cancer cells. The kidney is susceptible to oxidative stress (OS), and it has been shown previously that DOX disrupts antioxidant enzyme expression. Exogenous antioxidant administration has been shown to minimize OS associated with kidney injury, and as such, interventions to protect against DOX-induced antioxidant disruption in the kidney would be of benefit. The fermented milk product kefir (K) has antioxidant properties and acts to protect against ROS-induced cell damage, but K's effect on the DOX treated kidney has yet to be explored. **PURPOSE:** To examine the expression of catalase (CAT), glutathione peroxidase (GPx) and cytosolic superoxide dismutase (SOD1) in the kidney of rats fed K prior to and during DOX treatment. **METHODS:** Male rats were randomly assigned to one of four groups: kefir+saline (K+S), kefir+DOX (K+D), milk+saline (M+S), or milk+DOX (M+D). Rats were fed either a diet supplemented with K or a milk-based control diet for 8 weeks before and after receiving 15 mg/kg DOX or saline (SAL) as a placebo. Five days after injections, kidneys were excised and Western blotting was performed to assess CAT, GPx, and SOD-1 expression. **RESULTS:** No significant drug effect ( $p=0.11$ ), diet effect ( $p=0.08$ ), or interaction ( $p=0.76$ ) was observed for CAT, and a 26% greater CAT expression was observed in K+D when compared to M+D. With GPx expression, no significant drug effect ( $p=0.09$ ), diet effect ( $p=0.11$ ), or interaction ( $p=0.66$ ) was observed, and K+D had a 32% lower GPx expression than M+D. No significant SOD-1 drug effect ( $p=0.07$ ), diet effect ( $p=0.61$ ), or interaction ( $p=0.46$ ) was observed, and K+D had a 27% lower SOD1 expression than M+D. **CONCLUSION:** DOX did not significantly alter kidney CAT, GPx, or SOD1 expression in K or M fed animals suggesting no significant protective effect of chronic K feeding on kidney antioxidant expression versus chronic M feeding. Future work, however, should include standard chow as a control diet to better elucidate the impact DOX has on kidney as it is possible that both K and M were protective against the antioxidant changes typically observed with DOX.

## **Effects of Doxorubicin Treatment and Exercise on Skeletal Muscle Function and Myogenic Regulatory Factors**

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Doxorubicin (DOX) is used to treat a wide range of cancers, but its use is limited due to its toxicities. DOX treatment causes myotoxicity leading to skeletal muscle dysfunction and impairments in activities of daily living for cancer patients. Maintenance and repair of skeletal muscle involves myogenic regulator factor (MRF) signaling, and evidence suggests that DOX inhibits MRF expression. Exercise, however, attenuates many of the toxicities associated with DOX treatment, and including exercise with DOX treatment may have a positive effect on MRF expression. **PURPOSE:** To determine the effects of exercise and DOX treatment on skeletal muscle function and MRF expression. **METHODS:** Male rats were randomly assigned to sedentary+saline (SS), sedentary+DOX (SD), treadmill+DOX (TMD), resistance training+DOX (RSD), or combined endurance and resistance training+DOX (COMD). DOX groups received 1 mg/kg DOX daily for 12 consecutive days and SS received 0.9% NaCl at an equivalent volume as a placebo. TMD then trained on a motorized treadmill 5 days per week for 2 weeks, RSD animals were then housed in cages where food and water were progressively raised to force a bipedal stance for 2 weeks, and COMD rats were then housed in raised cages and treadmill trained for 2 weeks. Sedentary rats were restricted to normal cage activity during this time period. Twenty-four hours after the activity intervention, grip strength (GS) was measured, and the soleus was extracted and analyzed for expression of the primary MRFs MyoD and Myf5 using Western blotting. **RESULTS:** SD had a 29% lower GS than SS ( $p < 0.05$ ), but this significant GS decline was not observed in TMD, RSD, or COMD (-10%, -5%, -2% vs. SS, respectively,  $p > 0.05$ ). MyoD expression was 61% lower in SD when compared to SS, but none of the activity interventions attenuated this decline (-56%, -65%, -65% vs. SS in TMD, RSD, and COMD, respectively,  $p < 0.05$  for all comparisons). A similar Myf5 decline was observed with SD, TMD, RSD, and COMD expressing 44%, 40%, 65%, and 56% lower Myf5 than SS, respectively ( $p < 0.05$ ). **CONCLUSION:** Activity interventions protected against the DOX-induced reduction in GS, but this does not appear to be the result of changes in MRF expression suggesting that exercise-induced protection against DOX myotoxicity may not be due to mitigating decreases in primary MRF expression.

## Leg Power During Simulated Sit-to-Stand Fatigue: Smartphone Measures of Movement Speed

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Smartphones are inexpensive, portable, user friendly, and contain sensitive gyroscopes. Apps can sample, store, and wirelessly transmit data. The 30s sit-to-stand (STS) is often used to measure leg power and fatigue resistance but provides only a relatively crude count of repetitions. Typically, expensive equipment is required to measure leg power (LP) and changes in LP that would indicate fatigue.

**PURPOSE:** Determine the ability of an iPod to detect changes in chair rising speed, compared with an electrogoniometer (eGONI) and force platform.

**METHODS:** Young adults ( $22.9 \pm 2.9$  yrs,  $n = 42$ ) performed a series of 20 STS repetitions starting with five at maximal speed, followed by progressive slowing of the remaining reps. Three trials of 20 reps were performed. A 5<sup>th</sup> generation iPod Touch was attached laterally on the lower thigh. An eGONI (Biometrics) was placed laterally across the knee joint. The feet were on a force platform (AMTI) in front of the chair. Concurrently, iPod gyroscope data (rad), knee joint angle (rad), and ground reaction force (GRF, N) were sampled at 100Hz. The peak slope (0.1s time constant) of the iPod pitch signal, eGONI signal, and GRF was calculated for the rising phase of each rep, in addition to the peak GRF. The instantaneous slope was normalized to body mass to provide an index of power for each rep. For each device, the max, min, and max-min across the 20 reps were calculated. Correlations were computed between the devices for all subjects combined.

**RESULTS:** Within individual subjects, across the range of speeds, the iPod values were highly correlated with the eGONI values (all  $R^2 > 0.97$ ), and the iPod vs. GRF  $R^2$  values ranged between 0.82 and 0.95. For 3,148 trials pooled across all subjects, the  $R^2$  was 0.91 for iPod vs. GONI, 0.77 for iPod vs. GRF peak slope, and 0.72 for iPod vs. GRF peak. Across all subjects, the iPod vs. eGONI  $R^2$  values ranged between 0.80 and 0.84 for max, min, and max-min. The iPod vs. GRF peak slope  $R^2$  values ranged between 0.24 and 0.34, and between 0.38 to 0.54 for iPod vs. GRF peak.

**CONCLUSION:** A large range of chair rising speeds can be detected with the iPod. The iPod is an adequate substitute for an electronic goniometer or force platform to assess changes in leg power during an extended sit-to-stand task.

## Association between Whole-Body $VO_{2peak}$ and Skeletal Muscle Mitochondrial Respiration in Adults at Risk of Diabetes

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Whole body oxygen consumption ( $VO_{2peak}$ ) is a strong predictor of morbidity and mortality. In populations at risk for chronic disease, the relationship between skeletal muscle mitochondrial respiratory capacity and  $VO_{2peak}$  is relatively unexplored. **PURPOSE:** To identify associations between  $VO_{2peak}$  and mitochondrial respiration in adults at risk for Type 2 Diabetes (T2D). **METHODS:** We enrolled 23 older adults (63 $\pm$ 6yrs) at risk for T2D as defined by impaired fasting glucose (100-126mg/dL), HbA1c (5.7-6.4%), impaired glucose tolerance (140-200mg/dL), or a family history of T2D.  $VO_{2peak}$  was measured during a graded exercise test on a cycle ergometer while mitochondrial respiration was assessed in permeabilized skeletal muscle fibers obtained from muscle biopsy samples of the vastus lateralis. Two different substrate-uncoupler-inhibitor-titration (SUIT) protocols were implemented. SUIT1 evaluated carbohydrate supported respiration during complex I-linked leak ( $Cl_L$ ) and maximal coupled oxidative phosphorylation (OXPHOS;  $Cl_P$ ) with sequential addition of fatty acid ( $Cl\&FAO_P$ ) and complex-II linked carbohydrate substrates to determine OXPHOS ( $Cl+II\&FAO_P$ ) and uncoupled electron transport system (ETS) respiration. SUIT2 utilized an ADP titration to determine mitochondrial ADP sensitivity, as defined by apparent ADP  $K_m$ , followed by OXPHOS and ETS capacity. **RESULTS:**  $VO_{2peak}$  (ml/kg/min) correlated with  $Cl_P$  ( $r=0.687$ ,  $p=0.0003$ ) and ETS ( $r=0.454$ ,  $p=0.047$ ). When analyzing relative to  $VO_{2peak}$  expressed as fat free mass (FFM), these correlations were further strengthened ( $Cl_P$ :  $r=0.694$ ,  $p=0.0002$ ; ETS:  $r=0.547$ ,  $p=0.007$ ). **CONCLUSIONS:** Our findings demonstrate skeletal muscle mitochondrial respiratory capacity is significantly correlated to  $VO_{2peak}$  in those at risk for T2D and is strengthened when adjusted for FFM. The data may provide a mechanistic link between mitochondrial dysfunction and the predictive value of  $VO_{2peak}$  on morbidity and mortality.

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## Chronic Inflammation, Cardiorespiratory Fitness, Physical Activity, and Dietary Inflammatory Index in Cancer Survivors

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Chronic inflammation has been linked to the development and progression of cancer. Age, body composition, cardiorespiratory fitness, physical activity, and dietary factors are associated with a global marker of inflammation, c-reactive protein (CRP), in healthy populations. However, few studies have explored the relationship between these variables with physically active cancer survivors. **PURPOSE:** To examine differences in fitness, daily activity levels, and dietary characteristics of active cancer survivors when grouped according to serum CRP (Low vs. Moderate to High). **METHODS:** Cancer survivors (N = 14, mean age = 66 ± 15 years) were evaluated for body mass index (BMI), body composition, and cardiorespiratory fitness (VO<sub>2peak</sub>). Physical activity was measured via an accelerometer over a 7-day span. Diet logs (3 day) were analyzed and the dietary inflammatory index (DII) for each subject was obtained. Serum CRP was evaluated with an enzyme linked immunosorbent assay (ELISA). Subjects were assigned to one of two groups based on their serum CRP concentrations: Low CRP (≤ 1 mg/L) (LO) (N = 7) or Moderate to High (CRP > 1 mg/L) (MH) (N = 7). A t-test was used to compare LO and MH groups. Data are presented as mean ± SD. **RESULTS:** MH had significantly higher BMI (kg/m<sup>2</sup>) (MH 30 ± 5.2 vs. LO 24 ± 8.8, p = 0.02), higher body fat percentage (40.3 ± 7.77 vs. 32.4 ± 5.34, p = 0.05), and lower VO<sub>2peak</sub> values (mL/kg/min) (19.4 ± 5.54 vs. 31.8 ± 2.70, p = 0.0002). There were no significant differences between LO and MH with respect to age, physical activity levels, caloric intake, or DII. **CONCLUSION:** Cancer survivors with moderate to high serum concentrations of CRP had higher BMI, more body fat and lower cardiorespiratory fitness. However, there were no differences between the groups with respect to daily physical activity, caloric intake, or DII when compared to survivors with low serum concentrations of CRP. These data suggest that interventions aimed at reducing body fat and improving cardiorespiratory fitness may be useful in controlling chronic inflammation as defined by serum CRP concentrations in cancer survivors.

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## Acute Effects of Exercise on Fatigue and Energy Levels in Breast Cancer Patients

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*Background:* Fatigue and lack of energy are commonly reported and persistent side effects of cancer treatment. Previous research has demonstrated that chronic exercise improves fatigue and energy, but the acute effects of exercise have not been well documented. This study examined energy and fatigue levels before, and immediately after exercise sessions in breast cancer patients who were currently undergoing, or within 3 months of completing chemotherapy or radiation treatment. *Methods:* Participants were enrolled in Breast cancer patients Engaging in Activity while Undergoing Treatment (BEAUTY), a 12-week exercise program. Exercise sessions took place twice per week, were supervised, group-based, and included a combination of strength and aerobic exercises. Fatigue and energy were self-reported before and after each exercise session, on a 0-10 scale (0=low, 10=high). Only participants who attended at least one exercise session were included in the analyses. Average energy and fatigue scores for before and after each session were calculated, and differences were examined using paired samples t-tests. *Results:* Participants ( $N=106$ ) attended  $8.8 \pm 6.16$  exercise sessions, and were either undergoing (85.8%), or had completed treatment (14.2%) within  $M=2.1 \pm 0.9$  months of beginning the program. Most participants were diagnosed with stage I (24.6%), II (50%) or III (19.2%) breast cancer, and 97.4% received a combination of chemotherapy and radiation. From pre to post exercise session, energy showed a significant increase  $M\Delta=.750 \pm 1.25$ , [ $t(104) = 1.21$ ,  $p=.000$ ], and fatigue decreased ( $M\Delta=-.171 \pm .30$ ), but was not statistically significant [ $t(105) = -6.21$ ,  $p = .231$ ]. *Conclusion:* Exercise increased energy levels of breast cancer patients immediately following exercise sessions. Future studies should examine the most appropriate dose of exercise to maximize improvements in energy and fatigue levels during treatment for breast cancer.

## **Bone Quality in Weight and Non-Weight Bearing Sports in Male Collegiate Athletes**

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Bone quality has been correlated with lifetime physical activity. The accrual and maintenance of bone has been shown to be related to the type of sport, length of participation, weight bearing (WB) or non-weight bearing (NWB) activity, and the multidirectional forces applied.

**PURPOSE:** To determine if there are differences between weight bearing and non-weight bearing sports on bone quality in male collegiate athletes. **METHODS:** Ten male collegiate athletes ( $20.8 \pm 1.2$  yrs), with no history of musculoskeletal injuries within the last 12 months, were selected from each NCAA Division II men's soccer, football, cross country, swimming, and USA cycling Division I teams ( $n=50$ ). For analyses, men's soccer, football, and cross country were considered WB, and swimming and USA cycling were considered NWB. A bone-specific physical activity questionnaire (BPAQ) and a general demographic health questionnaire were collected for each athlete to determine eligibility for the study, as well as their history of physical activity and general demographic information that was relative to bone health. Using the Achilles InSight Ultrasonometer, broadband ultrasound attenuation (BUA), speed of sound (SOS), and stiffness index (SI) were measured on both heels for each athlete. The BUA, SOS, and SI were compared between sport, WB vs. NWB activities, and foot dominance using a two-way ANOVA with repeated measures. **RESULTS:** No significant differences were found between dominant and non-dominant foot for sports or WB vs. NWB activities. There were significant differences between BUA scores for sports and WB vs. NWB activities  $p=0.026$  and  $p=0.015$ , respectively. The SOS scores were significant for sports and WB vs. NWB activities ( $p<0.001$ ). SI scores were found to have a significant difference between sports type and WB vs. NWB activities ( $p<0.001$ ). **CONCLUSION:** Weight bearing vs. non-weight bearing sports have significant effects on bone health in male collegiate athletes.

## **The Effects of Graded Running on Muscle Activation of the Quadriceps and Hamstring Muscle**

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**PURPOSE:** To determine the effect of graded running on muscle activation of the quadriceps and hamstrings. **METHODS:** Four college age subjects with different athletic backgrounds were chosen for the study. Each subject participated in three running trials at 0°, +5.0° and -5.0° at a speed of 2.24m/min. All trials were completed consecutively in order to avoid removal of electromyography (EMG) electrodes. Electrodes were placed on the rectus femoris (RF), vastus medialis oblique (VMO), biceps femoris (BF), and semitendinosus (ST) muscles. Each subject completed a 5-minute warm-up on a level (0° incline) treadmill at their preferred pace. After warm-up, the treadmill was brought to 2.24 m/min and subjects were allowed to acclimate to the speed and grade for two minutes. After two minutes of acclimation, data was collected for one full gait cycle at 0° incline. Subjects rested for two minutes between trials. The treadmill position during the second and third trial was randomized to either +5.0° or -5.0° and data was collected in the same fashion as the 0°incline. Data was analyzed using a two-way ANOVA. **Results:** Each subject's VMO mean voltage changed significantly ( $p<.001$ ) from level running to inclined and declined running while RF, ST and BF showed no significant change in mean voltage between grades. Mean VMO voltage was highest during level running and lowest during declined running. **CONCLUSION:** As a group, the only trend that existed was the increase in VMO voltages when running on a level surface versus a 5° decline. This trend suggests that running downhill does not create greater muscle activation in the VMO when compared to running on a level surface. A homogenous group of subjects could show more trends within other muscle groups.

## **Validation of Wearable Heart Rate Monitors at Rest and at Increasing Intensities**

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Wearable activity trackers provide valuable information regarding heart rate (HR) throughout daily activities and during exercise. Due to the high demand for wearable devices, individuals are seeking out reliable devices to track their fitness. However, there is little information regarding the validity of wearable activity trackers in literature. **PURPOSE:** To determine the accuracy of the HR monitor in the fitbit Blaze (FB) and Garmin chest strap (GCS) at increasing intensities. **METHODS:** Four female participants ran on the treadmill at 80.5 m/min, 134.1 m/min, and 187.8 m/min after a resting phase. The subjects completed each phase one time. Each phase was a duration of five minutes. The first three minutes were used so a steady state HR was achieved and the last two minutes were used for data collection. Subjects were given two minutes between phases for a recovery period. Each subject was connected to a five-lead electrocardiogram (ECG), the FB, and the GCS. **RESULTS:** As intensity increased, the GCS and the FB produced significantly ( $p < .05$ ) different measurements in comparison to the ECG. At rest, a significant difference occurred between the ECG and the GCS in one subject. During the 80.5 m/min phase, there was a significant difference in the FB and ECG in one subject. A significant difference was seen between the ECG and GCS in two subjects during the 134.1 m/min phase; there was a significant difference between ECG and FB in one subject. During the 187.8 m/min phase, there were significant differences between both the GCS and FB when compared to the ECG in all subjects. **CONCLUSION:** When compared to a five-lead ECG, there was a decrease in the accuracy of the FB and GCS at higher intensities.

## **Attitudes toward opioid painkillers before and after an educational intervention**

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The abuse of opioid painkillers (OPK) has emerged as a major health crisis in the United States in recent years. Attitudes regarding the perceived risks of opioid painkillers can be indicative of potential for abuse. **Purpose:** The purpose of this study is to examine college-aged adults' attitudes towards OPK before and after an educational intervention, that describes the costs and dangers associated with opioid painkillers as well as alternative methods for pain relief.

**Methods:** Two hundred thirty-five participants (69 males,  $20.6 \pm 2.5y$ ) completed questionnaires related to their thoughts and feelings about OPK in an anonymous manner. First, investigators read a narrative related to becoming injured and the prescription OPKs by one's physician. Participants then rated their agreement to a series of prompts related to OPK use. After a brief educational intervention describing the risks associated with opioid painkillers as well as alternative methods to relieve pain, the participants completed the same questionnaire again. Changes between pre- and post-intervention scores were analyzed using paired sample t-test, with Bonferroni correction for multiple comparisons. **Results:** 52% of respondents had previously been prescribed OPK, and 34% knew of at least one person that had become addicted to OPKs. There were significant improvements between pre- and post-intervention for 6/10 questions related to; the concern about the risks of OPKs, medical over-prescription of OPKs, desire that physicians review risks prior to OPK prescription, favorability of state-run prescription monitoring programs, willingness to share OPKs with family members, and prospect of taking OPKs without first visiting a physician (all  $P < .005$ ). **Conclusion:** More than half of a population of college students had previously taken OPK and more than a third had been witness

to a person with addiction. An intervention aimed at sharing the risks and alternatives of OPK use successfully improved student's opinions related to the safe use of OPKs.

## Smartphone-Based Assessment of Ballistic Arm Movement

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Laboratory-grade accelerometers can be used to measure ballistic movements such as punching. Smartphones contain accelerometers that may provide similar readings to lab accelerometers. The easy accessibility and mobility of smartphones allow for the ability to collect data on ballistic movement in patients or research subjects in remote, non-laboratory environments.

**Purpose:** To determine if a smart device can be used in place of lab accelerometers to measure the speed of ballistic “air punches”.

**Methods:** These pilot data were collected from two healthy male adults (21, 24 yrs) who performed sets of 20 punches. A 5th generation iPod Touch was firmly secured to a Velcro strap around the distal forearm/wrist. A uniaxial Endevco accelerometer (10G) was secured to the iPod Touch so that the accelerometer measured along the Y-axis of the iPod. The subject was seated with the shoulder slightly abducted, the elbow flexed at 90 deg, forearm in mid-pronation, and fingers flexed into a fist. The subject was asked to perform 20 punches, with each consecutive punch performed incrementally faster. The punch was performed by flexing the shoulder and extending the elbow fully in the sagittal plane and returning to the starting position. The iPod app (SensorData) and data collection system separately sampled data at 100Hz. Brief, sharp mechanical artifacts were introduced for both the iPod and the accelerometer to synchronize the time axis. The data were merged and time-aligned into the same file. The peak acceleration from the initial outward punching phase was measured from both devices.

**Results:** The peak acceleration values tracked closely with each other across the range of very slow to maximal punch speeds. The measured peak acceleration from the iPod Touch and accelerometer was highly correlated ( $R^2$  range 0.98 to 0.995 for individual subject trials, 0.985 for all punches pooled). For sets of punches from individuals, changes in peak punching acceleration were highly correlated between devices ( $R^2$  range 0.97 to 0.99).

**Conclusion:** This pilot data indicates that the accelerometer in the iPod Touch is suitably sensitive to measure high speed, unloaded, discrete movements of the arm. It can be used as a substitute for lab accelerometers in settings where data collection cannot occur in a laboratory setting.

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## REDUCED SKELETAL MUSCLE BLOOD FLOW IN PERSONS WITH MULTIPLE SCLEROSIS EXHIBITING AUTONOMIC NERVOUS SYSTEM DYSFUNCTION

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Multiple Sclerosis (MS) is a demyelinating disease of the central nervous system characterized by a variety of symptoms including fatigue, reduced exercise capacity, and autonomic nervous system (ANS) dysfunction.

**PURPOSE:** The purpose of this study was to determine whether persons with MS (PwMS) demonstrate reduced skeletal muscle blood flow during exercise compared to age matched controls.

**METHODS:** The first analysis included 7 PwMS (age:  $52.0 \pm 9.8$ , 6 women) and 6 controls (age:  $49.2 \pm 9.8$ , 4 women). ANS function was assessed in both groups using the 31 item Composite Autonomic Symptom Score (COMPASS-31) questionnaire. A subset of 3 women with MS exhibiting ANS dysfunction (age:  $55.3 \pm 7.0$ , Patient Determined Disease Steps: 1-3) were then age, sex, and workload matched with controls (age:  $51.3 \pm 9.5$ ) for the second analysis. Mean blood velocity was measured (Doppler Ultrasound) and femoral blood flow (FBF) and conductance (FVC) were calculated during submaximal single leg knee extension with a modified cycle ergometer on the right leg at 20% and 40% of work-rate max (WRmax). FBF and FVC were normalized per 100g of thigh fat free mass. Comparisons for analysis 1 were made with unpaired 1-tailed T-Tests and comparisons for analysis 2 with paired 1-tailed T-Tests.

**RESULTS:** Analysis 1: FVC tended to be lower in the MS group at 20% WRmax ( $P = 0.13$ ) and 40% WRmax ( $P = 0.13$ ). However, there was no difference in FVC when absolute workloads were matched (MS 40% WRmax vs. Con 20% WRmax: MS:  $6.3 \pm 1.0$  watts, Con:  $5.0 \pm 0.8$  watts) between groups ( $P = 0.41$ ). Analysis 2: Absolute and relative workloads were matched for each group (20% WRmax, MS:  $4.2 \pm 0.8$  watts, Con:  $4.0 \pm 1.0$  watts; 40% WRmax, MS:  $8.3 \pm 1.7$  watts, Con  $8.0 \pm 2.0$  watts). FBF was lower at 40% WRmax ( $P = 0.05$ ), while FBF at 20% WRmax ( $P = 0.13$ ) and FVC at both workloads tended to be lower in MS (20% WRmax,  $P = 0.13$ , 40% WRmax,  $P = 0.14$ ).

**CONCLUSION:** These results suggest that PwMS exhibiting ANS dysfunction may have reduced blood flow during exercise at similar relative and absolute workloads compared to age/sex matched controls. These findings warrant further investigation into the regulation of skeletal muscle blood flow in PwMS to determine whether impaired blood flow contributes to common symptoms of MS such as reduced exercise capacity and fatigue.

## Effects of Dietary Creatine Monohydrate Supplementation on Late Onset Doxorubicin-Induced Skeletal Muscle Dysfunction

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Doxorubicin (DOX) is an effective chemotherapy drug used in treating solid and hematological cancers, but its use is limited by its toxicities that may cause debilitating side effects. One such side effect is skeletal muscle dysfunction as DOX accumulates in skeletal muscle and promotes reactive oxygen species formation ultimately reducing protein synthesis, and impairing force production. Creatine monohydrate (Cr) supplementation has been shown to decrease oxidative stress, and stimulate protein synthesis thus leading to improved skeletal muscle performance, but the effects of Cr supplementation on chronic DOX-induced myotoxicity have yet to be explored.

**PURPOSE:** To determine the effects dietary Cr supplementation on late-onset DOX myotoxicity. **METHODS:** Male Sprague-Dawley rats were randomly assigned to one of three groups: control diet+saline (CS), control diet+DOX (CD) or Cr+DOX (CRD). On day 1, CRD received a diet supplemented with 3% Cr for 40 days, and on day 14, animals received daily 1 mg/kg daily DOX injections for 12 consecutive days (12 mg/kg cumulative). CD received standard chow, and on day 14, animals received daily 1 mg/kg DOX injections for 12 consecutive days (12 mg/kg cumulative). CS received standard chow, and on day 14, animals received daily 0.9% NaCl injections for 12 consecutive days as a placebo. Forelimb grip strength was assessed at baseline and throughout the 40-day treatment period, and on day 40, the right soleus (SOL) and extensor digitorum longus (EDL) were excised for *ex vivo* function analysis. **RESULTS:** No between group differences in grip strength were observed at baseline, but on day 40, CD had significantly lower mean grip strength than CS (-21%,  $P < 0.05$ ). This significant decline in grip strength at day 40, however, was not observed in CRD (-12% vs. CS,  $P > 0.05$ ). *Ex vivo* skeletal muscle function analysis revealed no significant between group differences in relative maximal twitch force, maximal rate of force production, or maximal rate of force decline in the primarily type I SOL ( $P > 0.05$ ). In the primarily type II EDL, however, CD had significantly lower relative maximal twitch force, maximal rate of force production, and maximal rate of force decline than CS (-55%, -44%, and -42%, respectively,  $P < 0.05$ ), but these significant relative maximal twitch force, maximal rate of force production, and maximal rate of force decline differences were not observed in CRD (-36%, -35%, and -31% vs. CS, respectively,  $P > 0.05$ ). **CONCLUSION:** Dietary Cr supplementation attenuated the decrease in grip strength that accompanied DOX treatment, but this late-onset myotoxicity and Cr-induced protection was observed in the EDL but not the SOL. This suggests that Cr may be a useful intervention in managing late-onset DOX myotoxicity, but this protection may be limited to type II skeletal muscle.

## Evaluating a Second Generation Phytochemical Nrf2 Activator on Proteostasis and Cytoprotective Gene Expression In Vivo

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Aging is associated with increases in oxidative stress. Redox imbalance occurs when production of reactive oxygen species (ROS) exceeds the capacity of antioxidant enzymes to eliminate ROS. Increased levels of intracellular ROS can compromise proteostasis by causing irreversible damage to proteins. The transcription factor nuclear factor erythroid-derived 2-like 2 (Nrf2) mediates the cellular endogenous antioxidant defense system by regulating antioxidant enzymes that are cytoprotective against ROS. Nrf2 can be activated phytochemically through the supplement Protandim. Previous work from our lab has demonstrated that a phytochemical based Nrf2 activator improves proteostasis in skeletal muscle in vivo. Recently, we have begun to characterize a second generation Nrf2 activator (PB125) that has increased anti-inflammatory action in addition to anti-oxidant properties. Since inflammation can blunt protein synthetic responses, we speculated that PB125 might provide additional benefits on proteostatic processes. **PURPOSE:** The purpose of the present study was to examine in vivo the effects of three different doses (10, 100, and 300 ppm) of PB125 supplementation on Nrf2 activation and proteostasis. **METHODS:** 60 male CB6F1 mice aged 10-11 months were assigned to diets containing low, medium, or high doses of product PB125 in a 5 week feeding study. Mice were isotopically labeled with 8% deuterium oxide (D<sub>2</sub>O) to simultaneously measure protein and DNA fractional synthesis rates (FSR) in liver, heart, and skeletal muscle. Nrf2 activation was assessed through analysis of gene expression profiles via Affymetrix GeneChip microarray. **RESULTS:** Proteostatic mechanisms were increased in the liver mitochondrial fraction in the 10 ppm treatment group (18.93 vs 16.27 FSR%/day, p<0.05). However, there were no differences in proteostatic mechanisms in heart or skeletal muscle. At 100 ppm, there was up-regulation of Nrf2-dependent cytoprotective genes (Akr1d1, Gpx2, Gclm, Fthl17b, 3.82, 1.84, 1.42, 1.64-fold increase). **CONCLUSION:** From our data we were able to conclude that all three doses were safe, and that 100 ppm was effective at activating Nrf2. In addition, there was an indication of increased proteostatic processes in the liver, but not heart or skeletal muscle, perhaps due to the healthy status of the mice.

## **Title: Marijuana Use and The Health and Fitness of Physically Active Users and Non-Users**

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Although an increasing number of states are legalizing marijuana (MJ) for recreational use, research examining the chronic fitness and health related effects of MJ use in humans have been limited. **PURPOSE:** To examine the health and fitness of physically active MJ users and non-users. **METHODS:** Physically active, healthy males (N=24) were placed into groups based on MJ use: marijuana users (MU; n=12) or non-users (NU; n=12). Physical activity level and MJ use were confirmed using IPAQ-Short Format and the Marijuana Use Measure questionnaires. MU had used MJ products at least once per week for the past 6-months. NU had not used MJ within the past 12-months. Descriptive measures including age, body mass (BM), resting heart rate (RHR), body mass index (BMI), body fat (skinfold, BF) resting systolic (SBP) & resting diastolic (DBP) blood pressure were assessed. Pulmonary function was evaluated (forced expired volume in 1-second percent (FEV1%) and relative forced expired volume in 1-second (RFEV1<sub>max</sub>)) using spirometry. Cardiorespiratory fitness (VO<sub>2</sub>max), lactate threshold (LT) and onset of blood lactate accumulation (OBLA) (treadmill test with measurement of expired gasses) were assessed. Independent t-tests were used to identify differences between groups (p<.05). Data are presented as mean ± SD. **RESULTS:** MU used MJ an average of 21 times out of the last 30-days. All MU were smoking MJ in some form. All participants (MU and NU) averaged 23 yrs. ± 5 yrs. age, 80.4 ± 14.9 kg BM, 25.0 ± 3.6 kg/m<sup>2</sup> BMI, 12.0 ± 5.9 % fat, 65.8 ± 13.1 bpm RHR, 123.2 ± 8.4 mmHg SBP, and 70.3 ± 10.0 mmHg DBP. RFEV1<sub>max</sub> (54.7 ± 10.2 ml/kg/s) and FEV1% (92.9 ± 12.8 %) were not different between groups (p<0.05). VO<sub>2</sub>max was not different between groups (MU=51.1 ± 8.9; NU=53.5 ± 5.5 ml/kg/min; p=0.5.) Rate of perceived exertion at termination for MU and NU were (8.9 ± 0.9) and (9.5 ± 0.7), (p=0.1). LT and OBLA occurred at (69.3 ± 9.2 %) and (80.4 ± 11.1 %) of VO<sub>2</sub>max respectively, with no differences between the groups (p=0.3, p=0.8). **CONCLUSION:** The health and fitness of MU were not different from NU. We speculate that because all individuals in the study were physically active and had VO<sub>2</sub>max, LT and OBLA in higher fitness categories, it is possible that exercise provided protection against any marijuana related side effects in a healthy, male population.

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## The Effect of a Two-Week Sprint Interval Training Program: A Pilot Study

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**PURPOSE:** Our purpose was to determine if a two-week Sprint Interval Training (SIT) program was of sufficient duration to alter metabolic and anthropometric measurements or mood.

**METHODS:** Nine college-aged subjects of varying training experience were chosen based on guidelines provided by the American College of Sports Medicine (ACSM); subjects were young, healthy, and considered at low risk for cardiovascular disease. Each subject completed an exercise program consisting of a two-week sprint interval training regimen—a type of training characterized by short periods of maximal effort. Week 1 consisted of two training days, each with two sprints and week 2 consisted of two training days with three sprints. Each sprint lasted thirty seconds. All interval training was performed on a cycle ergometer and the resistance utilized during each sprint was individualized at 7.5% of the subject's body weight.

Measurements of maximal oxygen consumption ( $\text{VO}_2$  max), body weight, body fat percent, waist circumference, resting heart rate, and pre- and post-exercise blood lactate were taken one week prior to training and again one week following training. In addition, participants completed a Brief Mood Introspection Scale (BMIS)—a questionnaire used to rate mood—before and after each interval training session. All analyses were completed using a paired t-test. **RESULTS:** The two-week pilot study yielded significant decreases in waist circumference (-1.61 cm;  $p = 0.035$ ) and resting blood lactate (-0.656 mmol/L;  $p = 0.045$ ) from pre-training to post-training. No significant differences were found in body weight, body fat percent,  $\text{VO}_2$  max, resting heart rate, or mood. **CONCLUSION:** Two weeks of sprint interval training was of sufficient duration to demonstrate a significant decrease in waist circumference and resting blood lactate. There was no significant effect upon body weight, body fat percent, resting heart rate,  $\text{VO}_2$  max or mood.

## Hematological Changes in Elite Collegiate Cross Country Runners Residing at Moderate Altitude: A Retrospective Analysis

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**PURPOSE:** This study assessed selected seasonal hematological changes in elite male and female collegiate cross-country runners residing at a moderate altitude (1655 m). **METHODS:** Previously collected de-identified data from 29 members of the University of Colorado's cross-country team (12 males, 17 females) were analyzed for this project. The data was part of the regularly scheduled monitoring of these athletes through the CU Sports Medicine program. This program involves blood samples being taken following a rest day, after an overnight fast, at five time points across the year. The time points assessed were August, October, January, April, and August of the new season. Hematological parameters measured included red blood cell count (RBC), hemoglobin concentration (Hb), hematocrit (Hct), mean corpuscular volume (MCV), red cell distribution width (RDW) and serum ferritin. A linear mixed model was used to assess changes over time, significance set at  $p < .05$ . For variables that violated the assumptions of the linear mixed model (ferritin), non-parametric analysis was used. **RESULTS:** Males (M) and females (F) had significantly different baseline values for Hb (gm/dL) (M:  $16.3 \pm .3$  versus F:  $14.6 \pm .2$ ) and Hct (%) (M:  $46.5 \pm .8$  versus F:  $43.0 \pm .6$ ). As a percent change from baseline, both males and females demonstrated higher Hb (M = +1.8%; F = +2.7%) and Hct (M = +6.0%; F = +4.9%) at the October time point. MCV (Aug1-  $90.4 \pm .6$ , Aug2-  $92.4 \pm .6$ ) and RDW (Aug1-  $12.7 \pm .1$ , Aug2-  $12.5 \pm .1$ ) were the only two variables whose two August time points were significantly different. Serum ferritin (ng/mL) was stable over all five time points for males (average of all time points: 56.5), whereas females demonstrated significantly lower values in January (49.2). **CONCLUSION:** These results suggest seasonal hematological changes occur in elite collegiate cross-country runners. These changes could be indicative of altitude effects related to plasma volume changes and/or erythropoiesis. Future studies should directly assess the contribution of these parameters to the observed changes and determine the impact of these changes on performance.

## Maintenance of Postural Steadiness throughout Chemotherapy Treatment

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Chemotherapy negatively affects postural steadiness of cancer patients, contributing to an increased risk of falling. Physical activity improves postural steadiness, and has been shown to reduce toxic effects of chemotherapy such as peripheral neuropathy and vestibular dysfunction; two known causes of decreased postural steadiness. **PURPOSE:** To determine whether postural steadiness improves in cancer patients undergoing chemotherapy following 12-weeks of exercise. **METHODS:** Cancer survivors ( $n = 25$ ; mass =  $79.0 \pm 22.6$  kg; ht =  $1.66 \pm 0.08$  m; age =  $61.3 \pm 10.0$  yrs) receiving chemotherapy participated in this study. Postural stability was assessed prior to and following a 12-week individualized exercise intervention that included cardiovascular, muscular strength, flexibility, and balance training. In both pre- and post- measures, center of pressure (COP) data were collected (1000 Hz) for 10 seconds in four conditions: rigid surface eyes open (RSEO), rigid surface eyes closed (RSEC), compliant surface eyes open (CSEO), and compliant surface eyes closed (CSEC) using the Bertec BalanceScreener™ (Bertec Corporation, Columbus Ohio). Root-mean square (RMS), mean velocity (VEL), 95% confidence ellipse area (95CE), and mean frequency (FREQ) were investigated (Prieto et al., 1996). A MANOVA with repeated measures ( $p < 0.05$ ) was used to identify main effects between pre- and post-training assessments. **RESULTS:** From pre- to post- assessments mediolateral RMS decreased significantly for all conditions ( $p < 0.04$  across all comparisons; RSEO by 35%, RSEC by 45%, CSEO by 43%, CSEC by 43%). A significant decrease was also observed in FREQ between pre- and post- assessments ( $p < 0.044$  across all comparisons; RSEO by 29%, RSEC by 29%, CSEO by 31%, CSEC by 23%). No other variables changed significantly between pre and post assessments ( $p > 0.05$ ). **CONCLUSION:** Postural stability in the mediolateral direction was improved in cancer patients after 12-weeks of individualized exercise training. In addition, there was evidence of increased postural control based on an increased mean frequency of the COP trajectory after training. These results suggest that exercise training is beneficial to postural stability in cancer patients undergoing chemotherapy treatment.

TITLE: Six weeks of Nrf2-activator supplementation increases subcellular skeletal muscle protein and DNA synthesis.

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The age-related loss of muscle mass and function are key contributors to the decline in healthspan. Maintenance of protein homeostasis (proteostasis) is critical to maintain muscle quality and function during advancing age. We have previously shown that interventions that slow aging increase the ratio of skeletal muscle protein to DNA synthesis, which we believe are indicative of improved proteostatic mechanisms. Oxidative stress and inflammation blunt the anabolic response to protein feeding, thus supplementation with a nuclear factor, erythroid 2 like 2 (Nrf2) activator could restore the anabolic response to protein feeding in older adults. PURPOSE: To test the hypothesis that supplementing with a Nrf2 activator alongside protein feeding would increase muscle subcellular protein synthesis in skeletal muscle of older adults.

METHODS: In a 6-week double-blind study, older adults (n=46, 60-77 years old) were randomized to protein supplementation with placebo (CON) or one of the Nrf2 activators conjugated linoleic acid (CLA) or Protandim (PTD). We used deuterium-labeled water to measure DNA synthesis and protein synthesis in myofibrillar, mitochondrial, and cytosolic enriched fractions of skeletal muscle.

RESULTS: PTD maintained myofibrillar protein synthesis while mitochondrial and cytoplasmic protein synthesis decreased ( $p < 0.05$ ). There was no change in DNA synthesis with PTD or CLA supplementation compared to CON. PTD tended to increase the myofibrillar protein: DNA synthesis ratio compared to CON (PTD  $5.55 \pm 1.364$  vs CON  $4.691 \pm 0.749$ ;  $p = 0.07$ ). Increased myofibrillar protein:DNA synthesis after PTD was more apparent in men.

CONCLUSION: We report that protein supplementation with a Nrf2 activator tended to increase myofibrillar protein:DNA synthesis ratio which was more profound in men versus women. Given that protein:DNA synthesis is a measure of proteostasis, our results demonstrate that protein supplementation with a Nrf2 activator to diminish oxidative stress and inflammation improves proteostasis in older adult men. Additional studies are warranted to determine if maintaining myofibrillar proteostasis with PTD or more potent Nrf2 activators may help maintain muscle mass and function with age in both men and women.

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## **Precooling with an Ice Vest: Effect on Core Temperature While Swimming**

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Precooling has been shown to improve athletic performance by decreasing core body temperature prior to exercise, thus delaying the onset of core heating during training. Previous research has studied the effect of precooling on cyclists and runners, but very little research has been done involving core temperature (CT) in collegiate female swimmers. **PURPOSE:** To observe the effect of wearing an ice vest on core temperature prior to swimming. **METHODS:** Two female collegiate swimmers who participated in separate swimming trials, precooling and non-precooling, 45 to 60 minutes in duration. Trials were separated by one week. Each trial had a 15 minute warm up consisting of a 400yd swim, 200yd kick, and four sets of 50yd drill as well as a 200yd cool down. Core temperature monitoring was performed during a main set of 1600 yards swam at 75% of fastest mile pace broken into eight, 200yd intervals. Precooling before trials was randomized. CT, heart rate (HR), and rating of perceived exertion (RPE) were measured before and after warm-up and at 200yd intervals for the remainder of the trial. **RESULTS:** There were significant differences ( $p < 0.01$ ) between CT for precooling and non-precooling trials using single subject analysis. CT remained lower throughout the duration of exercise during precooling trials compared to non-precooling trials. RPE for subjects 1 and 2 and HR for subject 1 were not significantly different between trials; however, HR for subject 2 was significantly higher in the precooling trial ( $p < 0.01$ ). **CONCLUSION:** Precooling, using an ice vest before exercise, was shown to be significant in reducing core temperature during swimming compared to non-precooling.

## Inter-rater Reliability of 8-Point Urine Color Scale Between Expert and Novice Evaluators

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Urine color (UC) is a simple and convenient method for evaluating hydration status. However, it is a subjective measurement that could differ between trained and untrained investigators.

**Purpose:** The purpose of this study was to compare the agreement of the 8-point urine color scale between trained and untrained investigators.

**Methods:** Two hundred fifty-four samples from 35 individuals (15 males, 20 females,  $28 \pm 8$  y,  $169.2 \pm 20.0$  cm,  $77.0 \pm 23.1$  kg) who consumed a range of daily water volume, and not following exercise were analyzed for osmolality (UOsm) and specific gravity (USG). Then samples were assigned a urine color score 1-8 on the 8-point urine color scale by one investigator with 10 y experience (EI), one investigator with 2 y experience (MEI), and 3 novice investigators (NI) who had not previously used UC. First, linear regression of UOsm versus UC was performed for each investigator. Next, the co-efficient of variation (CV) for each integer was calculated based on the EIs evaluation. The mode of the absolute difference between the MEI and the NIs showed the most frequent discrepancy. Finally, the integers were grouped into three categories (hyperhydrated 1 and 2, euhydrated 3-5, and hypohydrated 6-8). The Cohen's Kappa score between each investigator and the EI determined agreement.

**Results:** Because the urine samples were collected in sedentary individuals very few samples were evaluated as an 8 and thus only colors 1-7 were evaluated. The mean UOsmo and USG were similar between the EI and others for each respective UC (all  $P > .08$ ), except for one integer between one NI and the EI. Linear regression revealed a significant relationship between UC and UOsmo for all investigators ( $R^2$  between 0.47 and 0.52). The CV for integers 1-7 were; 0.10, 0.37, 0.22, 0.17, 0.21, 0.08 and 0.03, respectively. The overall mode of MEI and NIs versus EI was 0. The Cohen's Kappa scores ranged between 0.69 and 0.77.

**Conclusion:** UC can be used by all levels of researchers after reading basic instructions with good agreement. Although higher levels of variation exist for UC 2, 3, 4, and 5 the most common difference between evaluations remained 0 for all integers. Cohen's Kappa evaluation reveals good categorical agreement (i.e.,  $> 0.60$ ) between less experienced investigators with one with more than 10 y of experience with UC evaluation.

## Relationship Between Mitochondrial Respiration and Glucose Tolerance in Individuals at Risk of Type 2 Diabetes

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The relationship between skeletal muscle mitochondrial respiration and development of chronic diseases is a highly contentious topic since assessment of mitochondrial function varies across studies. **PURPOSE:** To determine if ex-vivo mitochondrial respiration of permeabilized muscle fibers is related to postprandial glucose tolerance in individuals at risk of developing Type 2 Diabetes (T2D). **METHODS:** Participants (n=27;  $\geq 55$  yrs), with impaired fasting glucose (100-125 mg/dL), HbA1c (5.7-6.4%), impaired glucose tolerance (140-200 mg/dL) or family history of T2D twice arrived overnight fasted for an oral glucose tolerance test (OGTT) or a skeletal muscle biopsy. Glucose area under the curve (AUC) was determined after a standard 75g glucose load. Vastus lateralis skeletal muscle samples were permeabilized and evaluated by high-resolution respirometry during 2 substrate-uncoupler-inhibitor-titration (SUIT) protocols. SUIT1 evaluated NADH supported respiration during complex I-linked leak ( $Cl_L$ ) and maximal coupled oxidative phosphorylation (OXPHOS;  $Cl_P$ ) with sequential addition of fatty acid ( $Cl$ & $FAO_P$ ) and complex II-linked carbohydrate substrates to determine OXPHOS ( $Cl$ + $CII$ & $FAO_P$ ) and uncoupled electron transport system (ETS) respiration. SUIT2 used an ADP titration to determine ADP sensitivity followed by evaluation of  $Cl_P$ ,  $Cl$ + $II_P$  and ETS capacity. **RESULTS:** All p-values  $< 0.05$ . In SUIT1  $Cl_P$  ( $r = -0.45$ ),  $Cl$ + $II$  $FAO_P$  ( $r = -0.48$ ), and ETS ( $r = -0.50$ ) were negatively correlated with glucose AUC. In SUIT2,  $Cl_P$  ( $r = -0.60$ ),  $Cl$ + $II_P$  ( $r = -0.46$ ), and uncoupled maximal ETS ( $r = -0.52$ ) were all associated with glucose AUC, as well as  $Cl_P/Cl_L$  ( $r = 0.63$ ) and  $Cl$ + $CII$ & $FAO_P/Cl_L$  ( $r = 0.63$ ). **CONCLUSION:** In both SUIT protocols maximal mitochondrial OXPHOS and ETS were negatively correlated with glucose AUC in participants at risk for T2D. These data suggest that mitochondrial capacity is associated with impaired glucose tolerance and may contribute to the progression of T2D. Further studies will determine if there are defects in proteostatic mechanisms that impair mitochondrial function in these individuals.

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## Breathing Valve Resistance Alters Physiological Responses During a Graded Exercise Test

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### Fitness Assessment

Indirect calorimetry has been a valuable tool for determining energy expenditure. The technique requires the use of two-way breathing valves, which can differ in airflow resistance and potentially alter the energy expenditure measurement. **Purpose:** To determine the impact of breathing valve resistance on peak aerobic capacity ( $\dot{V}O_{2\text{peak}}$ ) and running economy (RE) in endurance trained and recreationally active individuals. **Methods:** Ten endurance trained males (ETM), 10 endurance trained females (ETF), 10 recreationally active males (RAM), and 10 recreationally active females (RAF) participated in this study. On two separate occasions, subjects performed identical graded exercise treadmill protocols using either a Rudolph 2700 (high resistance) or a Daniels' (low resistance) breathing valve. Parameters obtained from these protocols included energy expenditure (EE), ventilation ( $\dot{V}_E$ ), heart rate (HR), respiratory exchange ratio (RER), RE,  $\dot{V}O_{2\text{peak}}$ , and time to exhaustion (TTE). **Results:** When using the Daniels' valve, all groups had significantly lower EE (-2.4, -3.4, -2.7, and -2.0% for ETM, ETF, RAM, and RAF,  $p < 0.05$ ) and better RE (-2.7, -3.5, -1.9, and -1.8% for ETM, ETF, RAM and RAF,  $p < 0.05$ ) across submaximal speeds. The ET group had lower  $\dot{V}_E$  (4.6 and 3.8% for ETM and ETF,  $p < 0.05$ ) when using the Daniels' valve across submaximal speeds. TTE was significantly longer using the Daniels' valve for all groups (6.0, 10.9, 6.2 and 9.8% for ETM, ETF, RAM and RAF,  $p < 0.05$ ) but  $\dot{V}O_{2\text{peak}}$  was unaltered. **Conclusion:** Compared to the Daniels' valve, the Hans Rudolf 2700 breathing valve altered the assessment of RE, submaximal EE, and TTE regardless of fitness level, but did not change  $\dot{V}O_{2\text{peak}}$ . Therefore, airflow resistance of a breathing valve must be considered when assessing and comparing EE, RE and TTE in the applied and research settings.

**Key Words:** economy; work of breathing; time to exhaustion;  $\dot{V}O_{2\text{peak}}$ ; energy expenditure

## **Title: Kefir Alters Cardiac Function and Left Ventricular Dimensions in a Model of Doxorubicin-Induced Cardiomyopathy**

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Doxorubicin (DOX), a powerful anthracycline antibiotic commonly used to treat many different forms of cancer, is associated with the production of reactive oxygen species that cause oxidative damage resulting in cardiac dysfunction. Kefir is a naturally fermented milk product containing antioxidants, probiotic bacteria and yeast. The antioxidants contained in kefir interact with several types of reactive oxidative species, some of which act to manage oxidative stress. While recent studies suggest that consumption of kefir may have anti-tumor and antimicrobial properties, none have explored its potential for protecting against DOX-induced cardiac dysfunction. **PURPOSE:** To explore the effects of dietary kefir on DOX-induced cardiotoxicity in rats. **METHODS:** Singly housed, 10 week old, male Sprague Dawley rats were placed on 1 of 2 isocaloric diets: milk control diet (CON n=24) or kefir diet (KEF, n=23) with equivalent macronutrient profiles. After 8 weeks of dietary intervention, all animals were given either a bolus injection (15 mg/kg) of DOX (CON-DOX, n=12; KEF-DOX, n=11) or saline (CON-SAL, n=12; KEF-SAL, n=12). Cardiac geometry and cardiac function were evaluated using echocardiography 5 days post injection, and data were analyzed using a 2 X 2 ANOVA. **RESULTS:** Significant effects were observed for left ventricular dimension at systole (diet p=0.01, drug p=0.002), left ventricular dimension at diastole (diet p=0.01 and drug p <0.0001), peak mitral flow velocity (diet p=0.02 and drug p<0.001), septal wall thickness at diastole (drug p=0.0013), ejection time (drug p = 0.0039), left ventricular mass (drug p = 0.0085), relative wall thickness (drug p=0.0002), and filling time (diet p=0.0006). **CONCLUSION:** Incorporation of kefir into the diet altered DOX-induced changes in rat cardiac function and morphology. We speculate that kefir may be an alternative strategy in mitigating the deleterious cardiac side effects of anthracycline chemotherapy.

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## DEPRESSIVE SYMPTOMS AND METABOLIC SYNDROME RISK FACTORS IN MALE AND FEMALE COLORADAN FIREFIGHTERS

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Many (37%) firefighters exhibit posttraumatic stress disorder (PTSD) symptoms and are four times more likely to encounter a cardiovascular episode than the general public with cardiovascular disease responsible for 45% of deaths each year.

**PURPOSE:** The purpose of this study was to examine depressive symptoms and metabolic syndrome risk factors (MetS) among firefighters: *What are depressive symptoms and MetS risk factor profiles among firefighters? Is there an association between depressive symptoms and MetS?*

**METHODS:** The Firefighter Testing Program (FTP) (2008-2015) at Colorado State University; serves twenty fire agencies in Colorado. FTP variables included age, BMI, MetS, and depressive symptoms. Descriptive characteristics, Pearson's chi squared, and Fisher's exact tests were utilized using *R foundation*.

**RUSULTS:** Male (n=564) and female (n=36) participants had similar age, BMI, and depressive symptoms. Interestingly, 11% of females exhibited MetS with no females exceeding 3 risk factors; 19% of males exhibited MetS with 7% exceeding 3 risk factors. No significant associations between depressive symptoms and MetS were found.

**CONCLUSION:** The presence and frequency of MetS and depressive symptoms among firefighters warrants attention. Duty standards for physical and mental health should be established and implemented in fire agencies. Future research might examine, *are depressive symptoms related to change in MetS over time?*

## Effects of Endurance Exercise Training on Doxorubicin-Induced Changes in Cardiac Insulin-like Growth Factor-1 Expression

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### **Abstract:**

Doxorubicin (DOX) is a highly effective chemotherapeutic agent used in the treatment of cancer; however, its clinical use is limited due to a dose-dependent cardiotoxic side-effect. Insulin-like growth factor-1 (IGF-1) signaling regulates contractility, metabolism, hypertrophy, apoptosis, and many other process related to optimal cardiac function. DOX treatment has been shown to decrease IGF-1 expression and down-regulate other markers in the IGF-1 signaling pathway. Although exercise training has been shown to mitigate the cardiotoxic side-effects of DOX, it is unclear whether exercise may mediate its effects via IGF-1 expression. **PURPOSE:** The purpose of this study was to examine the effects of endurance exercise on DOX-induced changes in cardiac IGF-1 expression. **METHODS:** Male Sprague-Dawley rats ( $n = 12$ ) were randomly assigned to either sedentary (SED) or treadmill (TM) exercise groups. The TM protocol included 10 weeks of running, 5 days/week, with progressive increases in intensity and duration on a motorized treadmill, while SED animals were limited to normal cage activity for 10 weeks. Following the 10-week treatment period, animals were further randomized to receive saline (SAL) or a 12.5 mg/kg bolus dose of DOX. Cardiac IGF-1 was quantified in all hearts three days following injection. **RESULTS:** Cardiac IGF-1 expression decreased 22% in the SED/DOX group when compared to SED/SAL (Cohen's  $d = 0.774$ ). Results also indicate a 22% increase in IGF-1 expression in the TM/SAL group when compared to the SED/SAL group (Cohen's  $d = 0.843$ ) and a 16% increase in IGF-1 expression in the TM/DOX group when compared to SED/DOX (Cohen's  $d = 1.131$ ). **CONCLUSIONS:** These pilot studies show that the cardioprotective effects of exercise may be mediated, at least in part, through preservation of IGF-1 expression. Initial data from these studies show a large effect size across all comparisons and warrants further exploration with larger sample sizes. While several mechanisms may explain exercise-induced protection against chemotherapy cardiotoxicity, IGF-1 and IGF-1 signaling pathways may be involved.

## **The Effect of Repetitive Climbing on Heart Rate in Collegiate Male Rock Climbers**

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**PURPOSE:** To determine if there was a heart rate (HR) response to repetitive climbing by observing changes at various climbing speeds. **METHODS:** Five collegiate, male rock climbers performed 8 sessions on a bouldering route at preferred, easy, intermediate, and fast speeds. Each session consisted of a submaximal warm-up followed by 2 sets of 5 climbing trials. Climbers performed the trials at random speeds and were given a 5-10 minute break after warm-up and between sets to allow HR to return to within 10 bpm of resting. All HR measurements were obtained using a Garmin chest strap monitor; changes in HR were represented by the percent change in pre and post trial HR.

**RESULTS:** There was no statistical significance between the climbers' changes in HR during session 1 compared to session 8 ( $p = 0.13$ ). However, it was observed that every participant was able to climb at faster speeds and at lower mean changes in HR in session 8 relative to session 1. **CONCLUSION:** The results implied that there was a learning effect when climbing repetitively. Since HR is an indicator of economy, lower changes in HR during the last session suggest that repetition allowed the participants' to improve their climbing economy by learning how to proficiently perform the route movements.



## Comparison of Nutritional Characteristics of Beverage Intake from Computer-based Dietary Analysis Versus Categorical Analysis

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Entering all beverages from one 7-day fluid log into a computer-based dietary analysis program can take up to 30 minutes. For large scale investigations this time can be minimized by choosing representative beverages for a number of categories. Using this method, the data can be entered into a computerized spreadsheet in under 5 minutes.

**PURPOSE:** The purpose was to determine if calculating nutritional information using a representative beverage from each of 39 categories is comparable to that obtained through individually entering each beverage into dietary analysis software.

**METHODS:** Thirty-nine healthy adults (15 males, 24 females,  $29 \pm 9$  y,  $171.9 \pm 8.6$  cm,  $72.4 \pm 11.8$  kg) were asked to complete a fluid log by recording everything they drank for 7 d. A single technician entered each fluid log into the Nutrition Data System for Research (NDSR) dietary analysis software for analysis of the daily average intake of nutrients from beverages; water (H<sub>2</sub>O), kilocalories (KCAL), carbohydrates (CHO), fat (FAT), protein (PRO), alcohol (ALC), caffeine (CAF), and sodium (Na). Separately, a second investigator entered a representative beverage and the corresponding volume for each of the same beverages into a computerized spreadsheet (Microsoft Excel) to calculate the same nutrients. Two-sample paired t-tests and Bland-Altman analyses were used to compare the daily averages from NDSR and Excel for.

**RESULTS:** There were no significant differences between the NDSR and Excel nutrient calculations for H<sub>2</sub>O ( $-16.2 \pm 124.5$  g·d<sup>-1</sup>,  $P = 0.42$ ), KCAL ( $-1.59 \pm 111.1$  Kcal·d<sup>-1</sup>  $P = 0.96$ ), CAF ( $-27.9 \pm 98.1$  mg·d<sup>-1</sup>,  $P = 0.08$ ), or FAT ( $0.32 \pm 2.9$  g·d<sup>-1</sup>,  $P = 0.50$ ), all  $P < .05$ . Bland-Altman analysis showed no bias in regards to amount consumed. Excel on average under-estimated CHO ( $8.4 \pm 21.0$  g·d<sup>-1</sup>,  $P = 0.02$ ), PRO ( $1.0 \pm 2.6$  g·d<sup>-1</sup>,  $P = 0.02$ ), and Na ( $85.0 \pm 101.9$  mg·d<sup>-1</sup>,  $P < 0.01$ ), and over-predicted ALC ( $4.9 \pm 10.9$  g·d<sup>-1</sup>,  $P = 0.01$ ).

**CONCLUSIONS:** Spreadsheet analysis can be used reliably for beverage evaluation to estimate consumption of H<sub>2</sub>O, KCAL, CAF, and FAT. However, computer-based analysis should be used when Na, CHO, PRO, and ALC are the variables of interest.

## Effects of Creatine Supplementation on Doxorubicin-Induced Myotoxicity

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Doxorubicin (DOX) is an effective chemotherapy treatment associated with several deleterious side effects, including skeletal muscle dysfunction. Previous research from our lab has shown that *ex vivo* creatine (Cr) pretreatment, prior to DOX incubation, attenuated DOX-induced fatigue in the EDL, but not the SOL. The effects of *in vivo* supplementation on DOX myotoxicity, however, are currently unknown. **PURPOSE:** To investigate the effects of *in vivo* Cr supplementation on DOX myotoxicity. **METHODS:** Male Sprague-Dawley rats were randomly assigned to the control (CON), doxorubicin (DOX), or creatine + doxorubicin (CR+DOX) group. CR+DOX received rodent chow supplemented with 3% creatine monohydrate and the CON and DOX received standard rodent chow. After two weeks of feeding, CR+DOX and DOX groups received a bolus (15 mg/kg) intraperitoneal (i.p.) DOX injection and CON received an i.p. saline injection as a placebo. Dietary interventions then continued for 5 more days. Forelimb grip strength was then measured as an indicator of *in vivo* muscle function and muscle fatigue was analyzed *ex vivo* using a 100 second fatigue protocol. **RESULTS:** When compared to CON, a significantly lower grip strength was observed in DOX (-23%,  $p < 0.05$ ), and creatine monohydrate feeding attenuated this decrement in grip strength (-15% CR+DOX vs. CON,  $p > 0.05$ ). In isolated muscle experiments to explore fatigue, solei (primarily type I muscle) from CON produced significantly less force than baseline at 60 s ( $p < 0.05$ ) and solei from DOX produced significantly less force than baseline at 30 s ( $p < 0.05$ ); however, CR+DOX produced significantly less force than baseline at 60 s ( $p < 0.05$ ) suggesting that Cr feeding attenuated DOX-induced fatigue in type I muscle. In the primarily type II EDL, a significant decline in force production from baseline was observed at 50 s in CON and CR+DOX ( $p < 0.05$ ) and at 20 s in DOX ( $p < 0.05$ ) suggesting that Cr attenuated DOX-induced fatigue in type II muscle. **CONCLUSION:** A diet supplemented with Cr attenuated the decrease in grip strength and increase in fatigue that accompanies DOX treatment. These findings suggest that Cr supplementation may have use in managing DOX myotoxicity in cancer patients.