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ABSTRACTS

Elbow flexor fatigue modulates central excitability of the knee extensors

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The present study investigated the effects of exercise-induced upper limb fatigue on motoneuronal excitability and motor task performance of non-exercised lower limb muscles. Eleven participants attended three testing sessions: i) control, ii) fatiguing unilateral elbow flexion (UniFlex) iii) fatiguing bilateral elbow flexion (BiFlex). The non-fatigued knee extensor muscle was assessed with neuromuscular tests including thoracic motor evoked potential (TMEPs), quadriceps muscle stimulation, knee extensor maximal voluntary contractions (MVCs) and normalized electromyographic (EMG) activity before and at 30 s, 3-min and 5-min post-fatigue. BiFlex caused an 8.9% decrease in voluntary force output ($p = 0.126$, effect size = 0.93) and 18.2% decrease in normalized EMG activity ($p = 0.034$) in the knee extensors compared with Control session immediately after intervention. The TMEP.Mmax^{-1} ratio measured at vastus lateralis muscle showed a transient increase immediately following BiFlex compared with Control session ($p = 0.003$). The effects were more pronounced during the BiFlex compared to the UniFlex condition, suggesting that the observed interlimb/intersegmental effect of fatigue is muscle-volume-dependent. It is likely that the observed effects on voluntary force and EMG were centrally mediated given that there were no changes in the Mmax or evoked contractile properties, both measures of peripheral excitability.

Exercise-induced fatigue in one limb modulates responsiveness of the corticospinal pathway in non-fatigued contralateral limb

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The underlying mechanism(s) of a generalized sense of fatigue has not been fully described; however, declining neuromuscular function of non-exercised muscles in the absence of peripheral fatigue suggests a central fatigue mechanism. The aim of the present study was to investigate the effects of fatigue induced in elbow flexors and knee extensors of the dominant limbs on corticospinal excitability of the non-fatigued non-dominant elbow flexor (biceps brachii) muscle. Twelve recreationally active individuals attended 3 testing session including: i) Control (no intervention), ii) fatiguing dominant elbow flexors (EF) and iii) fatiguing dominant knee extensors (KE). The non-localized effect of fatigue was measured using transcranial magnetic stimulation (MEP), cervicomedullary motor evoked potentials (CMEP) and compound muscle action potential (M-max) on non-dominant elbow flexor muscle. The MEP, CMEP and M-max were elicited every 1.5 seconds while performing 5 second voluntary contractions at 100, 50 and 5% maximal voluntary isometric contractions (MVICs). The sequences of contractions (100%, 50%, 5%) and stimuli (MEP, CMEP, M-max) were repeated 2 times at pretest and 6 times at post-test. The fatiguing protocols were 2 trials of 100 seconds sustained MVICs performed by dominant elbow flexors or knee extensors. The MEPs and CMEPs during each contraction were normalized to M-max. Significant condition effects were observed for both MEP ($p = 0.022$) and CMEP ($p = .037$) during 100% MVC contraction. The MEP amplitude in non-exercised elbow flexor was significantly increased following both EF and KE fatiguing protocols compared to Control (all $p < 0.026$) whereas CMEP reduced significantly following EF ($p = 0.05$). Furthermore, significant condition effects were also observed for both MEP ($p = 0.022$) and CMEP ($p = .018$) during 5% MVC contractions. There was a significant decrease and increase for MEP ($p = 0.036$) and CMEP ($p = 0.060$) amplitude respectively, in non-exercised elbow flexor following KE protocol compared with Control. No statistical difference was observed at 50% MVC contractions. The results in the present study suggest that exercise-induced fatigue in contralateral homologous and heterologous muscle groups may modulate responsiveness of the corticospinal pathway that innervate muscles in unrelated non-fatigued limb. However, the alterations of responses in cortical and spinal motoneurones demonstrated different patterns during various levels of voluntary muscle activation in non-fatigued limb (e.g. 100% vs. 5% MVC).

Reduced endurance and capacity of the human neuromuscular system in severe diabetic neuropathy during sustained muscle contraction

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Diabetic neuropathy (DN) can lead to contractile slowing and unstable neuromuscular transmission contributing to weakness and disability. It is not known how these alterations in the neuromuscular system may impact fatigability and further contribute to clinical deficits. Thus our objective was to assess the response and capacity of the neuromuscular system of patients with DN when stressed with a sustained maximal voluntary contraction (MVC). Baseline dorsiflexor MVC and evoked contractile properties were assessed in 10 patients with DN and compared with 10 age (~65 y) and sex-matched (7 males) controls. Surface electromyography (EMG) recorded tibialis anterior evoked maximal compound muscle action potentials (CMAPs) and neuromuscular activity during MVCs. Participants engaged in a sustained isometric dorsiflexion MVC for which task termination was determined by the inability to sustain ≥60% MVC torque. The fatigue protocol was immediately followed by a maximal evoked twitch, with additional maximal twitches and MVCs assessed at 30-seconds and 2-minutes post-fatigue. DN patients fatigued ~21% more quickly than controls ($p<0.05$) and featured less relative EMG activity during the first third of the fatigue protocol compared to controls ($p<0.05$). Moreover, DN patients produced ~50% less angular impulse (an analogue of work) compared to controls ($p<0.05$). Immediately following fatigue, maximal twitch torque was reduced similarly (~20%) in both groups and concurrently CMAPs were reduced (~12%) in DN patients, whereas they were unaffected in controls ($p>0.05$). Twitch torque and CMAP amplitude recovered to baseline 30-seconds post-fatigue. Additionally, at 30-seconds post-fatigue, both groups had similar (~10%) reductions in MVC torque relative to baseline, and MVC strength recovered by 2-minutes post-fatigue. We conclude DN patients are more fatigable than controls, and neuromuscular transmission failure may contribute to this greater fatigability and disability. (Supported by NSERC.)

Associations between access to physical activity facilities in the workplace and physical activity levels: Results from the Canadian Community Health Survey

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Frequently cited barriers to physical activity participation include lack of time and access to physical activity resources. The purpose of this study was to therefore quantify the extent to which access to physical activity facilities (PAF) at or near the work place is associated with physical activity. Data for this study was derived from the Canadian Community Health Survey [CCHS] cycle 4.1 (2007/2008; n=62 575; 18-64 y). Respondents who were working or absent from a job or

business in the past week were asked a series of seven questions about access to PAF at or near their place of work. The questions were summed to create a composite score from which two further variables were derived, that determined both the degree and type of access. Multivariable logistic regression was used to estimate the association between access to PAF and moderate physical activity (≥1.5 kcal/kg/day), weighted to be representative of the Canadian population. Compared to those with no PAF at or near work (OR=1.00, referent), participants who had access to at least 'one or more' PAF were 84% more likely to be at least moderately active (OR=1.84, 95% CI: 1.71 – 1.97), whereas those with access to 'three or more' PAF were over twice as likely (2.16, 2.0 – 2.33). Moreover, odds of moderate activity were higher regardless of the type of PA resource available [access to 'one or more' PAF (1.59, 1.47 – 1.73), 'health program at work' (1.45, 1.08 – 1.95), or both (2.21, 2.03 – 2.39)]. Results from this analysis suggest that greater awareness and perception of PAF at or near the workplace is associated with higher odds of moderate activity, particularly when combined with a health program in the workplace. Taken together, these data highlight the potential impact of facilities both within and surrounding the workplace in the promotion of physical activity.

Independent and joint associations between sitting time and lifestyle factors on mortality in post-menopausal U.S. women

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Prolonged sitting has been linked to cardiovascular disease, diabetes, obesity, cancer and premature mortality. However, the independence of the sitting time (ST) - health relationship is not fully established, and warrants study within populations with multiple chronic conditions who are susceptible to both low levels of physical activity (PA) and high ST. Data from the Women's Health Initiative observational cohort (WHI-OS) was obtained by limited access application from the National Heart, Lung, and Blood Institute (NHLBI) and used for this analysis (n=84 865; 50-79 y). To assess this, ST was divided into quartiles (Q1: ≤5; Q2: 6-9; Q3: 10-13; Q4: 14+ hrs./day) on the basis of self-report ("During a usual day and night, about how many hours do you spend sitting?") and subsequently cross-classified with other lifestyle-related risk factors (e.g. sleep duration, psychosocial stress, cigarette smoking, PA, body mass index, and fruit and vegetable consumption). Over 15 years of follow-up there were 5458 deaths. Compared to those in the lowest quartile of ST (HR=1.00), women who sat more than 10 hours per day had a higher risk of all-cause (Q3: HR: 1.13, 95% CI: 1.04-1.22; Q4: 1.26, 1.11-1.44) and cancer-related death (Q3: 1.17, 1.04-1.31; Q4: 1.38, 1.13-1.67), even after adjusting for covariates (i.e. age, education, income, ethnicity, physical limitations and hormone use). In subsequent analyses, current smokers and inactive-sedentary women were at particularly high risk of death from any cause. These findings suggest that in older, post-menopausal women, excessive ST may act in combination with other established risk factors to increase premature mortality. Public health efforts aimed at reducing lifestyle-related health risk may therefore benefit from incremental efforts aimed at reducing total sedentary time.

Timing of left ventricular twist and carotid artery longitudinal wall motion as evidence for a structural ventricular-vascular coupling effect

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Carotid artery longitudinal motion (CALM) has been shown to be altered in individuals with cardiovascular disease; however, the factors determining both the direction and magnitude of CALM remain unknown. While the pattern of CALM varies between individuals, it is typically characterized by initial movement toward the heart (retrograde motion) in early systole, which slows and then reverses away from the heart (anterograde motion) in late systole. The purpose of this study was to evaluate the determinants of CALM with respect to the timing of retrograde and anterograde motion. We hypothesized that both left ventricular twist (LVT) and carotid artery blood velocity (CBV) may be key determinants through structural ventricular-vascular coupling and local mechanical forces, respectively. Six healthy subjects were recruited (age: 24.0±2.9 years). CALM, LVT and CBV were all collected simultaneously via ultrasound with a 13MHz linear array probe for vascular assessments and a 5MHz sector probe for cardiac assessments. All measurements were linearly interpolated to 300 discrete points per heart cycle to facilitate comparisons of timing of events between individuals, and all timing results are presented as the value of the discrete point for each measurement. The start of LVT coincided with the onset of retrograde CALM, occurring at similar discrete time points (19±12 vs 26±20, p=0.71). Also, the onset of the initial forward component of CBV coincided with the shoulder (i.e., greatest reduction in movement velocity) of retrograde CALM (42±7 vs 44±8, p=0.26). A significant correlation was observed between the discrete time at maximal LVT and peak retrograde CALM (r=0.91, p=0.01) and a trend was observed between the discrete time at end-CBV and peak retrograde CALM (r=0.80; p=0.058). These results suggest the timing of specific events during CALM can be accounted for by events linked to both cardiac twist and carotid blood flow. Our future studies will investigate the relative weights of these CALM determinants and the impact of vascular stiffness on CALM movement patterns. (Funded by NSERC.)

The effect of a minimally supervised preoperative exercise training on postoperative recovery of functional exercise capacity in elderly cancer patients

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Exercise training has been shown to positively affect the maintenance of physical capacity and recovery from surgery. The present study proposes that a supervised pre-operative exercise training program encourages patient compliance, thus maximizing the opportunity to regain functional exercise capacity post-surgery. We hypothesize that a minimally supervised exercise program (ie: 1x/week) optimizes the ability to recover functional walking capacity at four weeks post-surgical resection of colorectal cancer. In total, 28 patients (age 65 ± 13 years), referred to the hospital for surgery of malignant, non-metastasized, colorectal lesion, were recruited for this study. The treatment group (TREAT, n=14) received a home based exercise program that included 4 supervised training sessions at the hospital exercise laboratory (1 per week) during the 4 week pre-surgical period. TREAT also received daily supervised exercise during the post-surgical hospital stay. In contrast the control group (CON, n=14) received an unsupervised 4-week home-based exercise program before surgery. Post-surgical exercise was also not supervised. The exercise programs (both pre and post-surgery) included individualized aerobic, resistance and flexibility exercises. Both groups continued to exercise until 4 weeks post-surgery, after which they returned to the laboratory for evaluation. The primary outcome was functional walking capacity, as assessed by the six-minute walk test (6MWT). All patients in the TREAT group attended the weekly supervised exercise sessions and continued the home-based exercises with a 98% compliance rate. In contrast, the average compliance in the CON group was 44%. The 6MWT at baseline for the treatment group was 415 ± 117.7 meters and at four weeks after surgery increased to 428 ± 118 meters (average increase of 13 meters). In contrast, the 6MWT for the CON group at baseline was 421 ± 111 meters and decreased to 398 ± 132 meters (average decrease of 23m). Four weeks after surgery, 64.2% of the patients in the TREAT group regained baseline functional walking capacity as compared to only

43.8% of the patients in the CON group (p=0.06). The preliminary results of this cohort study demonstrate that even a minimally supervised exercise session, limited to one session a week prior to surgery and during the postsurgical follow up, has a positive impact on achieving a faster return to baseline functional capacity. This enhanced recovery period is critical for the maintenance of quality of life and diminished health care costs in this patient population.

The effects of a trimodal prehabilitation program on pre-operative physical activity levels and functional capacity in patients awaiting colorectal resection

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Poor physical function is associated with an increased risk of post-surgical complications. High complication rates following colorectal surgery render many patients unable to fully regain functional capacity, thus seriously compromising quality of life. Prehabilitation refers to the process of actively improving physical function in anticipation for an upcoming physiological stressor, such as surgery. The aim of this study was to assess the feasibility of implementing a trimodal prehabilitation program (exercise, nutritional counselling and anxiety reduction) during the 4 week pre-operative period in order to improve the functional capacity of elderly patients scheduled for colorectal cancer surgery. Patients were either assigned to a prehabilitation group (PREHAB; n=50; age 68.2±11.3 years) or a matched time control group (CON; n=49; age 67.2±9.5 years). Patients in PREHAB were prescribed an individualized home training program, received a dietary evaluation and whey protein isolate to ensure adequate protein intake, and were taught anxiety reducing techniques. This intervention was implemented for the approximate 4 week period from time of receiving surgical date to hospital admission for surgery. CON received the same program but only after surgery, as per present hospital protocols. In both PREHAB and CON, the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire was used to measure physical activity levels, while the six-minute walk test (6MWT) was used for assessment of functional exercise capacity. Baseline measurements were collected at the initial and pre-operative measurements were collected one day prior to surgery. The change in total physical activity during the pre-operative period (from baseline to pre-operative measurements) was significantly greater amongst PREHAB compared to CON (+17.97 vs. -4.26 kcal/kg/week, p=0.01). The change in levels of moderate and vigorous intensity physical activity amongst PREHAB was also significantly greater than CON (+17.52 vs. -3.09 kcal/kg/week, p<0.01). Compared to patients in the CON group, patients in PREHAB experienced a significantly greater change in 6MWT during the pre-operative period (+27.7 vs. -1.33 meters, p<0.01), thus indicating an improved functional capacity prior to surgery. These findings highlight the positive effects of a trimodal prehabilitation program on patients' physical activity levels and functional capacity, and demonstrate that improving physical function within the 4 week pre-operative period is a feasible goal. These improvements are critical for the post-surgical wellbeing of elderly cancer patients and maintenance of quality of life.

Myofibrillar protein synthesis is elevated for 2 days following acute resistance exercise and high-intensity interval training in elderly men

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Resistance exercise (RE) is commonly prescribed to older adults to promote gains in muscle mass, and aerobic exercise (AE) to promote gains in fitness. High intensity interval exercise (HIIT), a potent stimulus for aerobic fitness and potentially muscle remodelling in older persons, is less well studied. The aim of this study was to determine how each mode of exercise would affect longer-term (2d) muscle protein synthesis (MPS). We hypothesized that RE and HIIT would increase myofibrillar MPS, whereas AE and HIT would increase sarcoplasmic MPS. Sedentary men (n=22; 67 ± 4 yr; BMI: 27.0 ± 2.6 kg/m^2) were recruited and randomly assigned to RE, AE, or HIIT. One week following $\dot{V}O_{2peak}$ and 10RM testing, participants began daily consumption of a stable isotope tracer (D_2O) for 9d. Daily saliva samples were taken to measure tracer incorporation in total body water. Muscle biopsies were obtained on days 5-9 of D_2O consumption to measure tracer incorporation into muscle at rest, and 24h, as well as 48h following acute exercise. Exercise consisted of: RE (3 x 10 reps: leg extensor and press, 95% 10RM), HIIT (10 x 1 min at 90% maximal heart rate [HR_{max}]) or AE (30 minutes continuous cycling at 55-60% HR_{max}). Myofibrillar fractional synthetic rate (FSR) was elevated relative to baseline 1d and 2d following acute RE and HIIT. The increase in myofibrillar FSR was greater following RE vs. HIIT at both time-points. HIIT was the only mode of exercise to stimulate an increase in sarcoplasmic MPS 1d post-exercise (2.30 ± 0.34%d^{-1} vs. 1.83 ± 0.21%d^{-1}). This study demonstrates for the first time that HIIT is able to significantly increase myofibrillar and muscle sarcoplasmic FSR in older men. Considering that HIIT is also a potent stimulator of muscle oxidative metabolism, it may be beneficial to incorporate HIT into exercise prescriptions for older adults combined with RE to increase strength and aerobic fitness.

The influence of sex on non-invasive assessments of vascular health in young healthy participants

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Non-invasive instruments and procedures used for the assessment of arterial and venous health are ideal because they permit repeated assessments throughout exercise intervention studies. Arterial health and venous health are commonly estimated using applanation tonometry and venous function, respectively. Few studies have reported the relationship between these measures of vascular health. We assessed the reproducibility (ICC) and correlation (Pearson r) of Augmentation Index and Venous Compliance in a sample men (n=15) and women (n=10). Together, participants were healthy (SBP/DBP: 104.1±7.3/68.3±5.0mmHg, HR: 63.7±7.9bpm), young (Age: 24.7±3.2 years), and physically active (Rapid Assessment of Physical Activity: 6.2±1.0). All participants completed an initial familiarization session, followed by two identical experimental sessions where both arterial Augmentation Index (AIx) and Venous Compliance (dV/dP) were measured. AIx values were accepted only if an operator index > 90%. Reliability between days for AIx was extremely high (ICC: 0.95, p < 0.000) while dV/dP scores at 20mmHg were less reliable (ICC: 0.83, p < 0.000). There was a negative correlation between intra-individual same day AIx and dV/dP variables (r = -.56, p<0.01). There was a significant influence of sex such that males had lower AIx values (Mean±SEM) (0.17±2.50) than females (15.27±2.65) (p<0.000), and lower dV/dP values (0.10±1.25) than females (8.41±1.20) (p<0.000). Based on these results, studies of vascular health should consider the arterial distensibility measurement of AIx and the venous function measurement of dV/dP as independent reliable variables that vary greatly between the sexes. (Funding: CIHR Banting and Best CGS Doctoral Research Award.)

Adaptation of mitochondrial expression and respiration in vascular smooth muscle cells undergoing phenotype shift

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Atherosclerosis, the leading cause of morbidity and mortality in the Western world is characterized by aortic remodeling caused by sub-endothelial accumulation of fatty substances. This buildup triggers a

phenotype shift in the vascular smooth muscle cells (VSMC) from contractile to synthetic. The VSMCs subsequent migration and proliferation into the fatty layer induce irreversible plaque formation and establish them as an integral mechanism of atherosclerosis. Explaining the molecular and cellular physiological underpinnings involved in this phenotype shift is thus crucial for understanding the etiology of this disease. The VSMC phenotype shift provokes changes in expression of cytoskeletal, contractile and ion channel proteins. The synthetic phenotype is also considered to be metabolically active based on its increased synthesis and deposition of extracellular matrix as well as its ability to proliferate. With the mitochondrion being the primary site of energy production and an essential component of cellular metabolism, we hypothesize that the function, as well as the expression of pertinent proteins, will be altered in this phenotype shift. This theory is strengthened by the fact that mitochondrial DNA damage has been shown to precede plaque formation, suggesting involvement of mitochondria in early atherosclerosis. The goal of this study was to investigate the role of the mitochondria during VSMC phenotype shift. Mouse aorta was placed in serum free media for 24h, thus inducing early VSMC phenotype shift. High resolution respirometry was used to determine mitochondrial respiratory capacity. Relative changes in OXPHOS protein expression, as well the confirmation of early VSMC phenotype shift, were obtained by immunoblotting. Protein expression of known markers (i.e.: TRPC1, alpha-actin and calponin) confirmed the shift in phenotype of the VSMC. High resolution respirometry indicated a reduced mitochondrial respiration in the synthetic tissue when normalized to amount of tissue (mg) but an increased respiration when the data was normalized to either expression of voltage dependent anion channel (representing mitochondrial density) or expression of individual complexes. These results indicate a strong plasticity in the mitochondrial function and in the corresponding mitochondrial proteins following VSMC phenotype shift. In conclusion, these findings indicate that mitochondrial activity is significantly altered during early stages of VSMC phenotype shift. Future studies are required to confirm whether these observations introduce a new perspective regarding the etiology of atherosclerosis and possible novel targets for pharmacological intervention.

Anticipatory and feed-forward regulation of motor output during repeated sprints

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Factors influencing pacing or avoidance strategies have not been well examined during intermittent exercise. We previously reported the adoption of pacing strategies based on the knowledge of the number of sprints to be performed consecutively (Billaut et al. 2011, Med. Sci. Sports Exerc. 43(4):665-672). Here, we further tested the hypothesis that performance is determined by a mechanism of anticipatory regulation for the avoidance of excessive locomotor muscle fatigue. Nine participants performed four trials in random order, involving one (S1), two (S2), four (S4) or six (S6) sets of five 5-s sprints (power self-selected) with 25 and 120 s of rest between sprints and sets, respectively. Mechanical work and total electromyographic intensity (summed quadriceps electromyograms, RMS_{sum}) were calculated during every sprint. Peripheral muscle fatigue was assessed via pre- to post-exercise change in potentiated quadriceps twitch force ($\Delta Qtw,_{pot}$). Voluntary activation (VA) was used to quantify completeness of quadriceps activation. Work performed in the first sprint (7.8%) and first set (5.2%) was lower in S6, compared to S1 ($P<0.05$). Average work performed across all sets was lower in S4 (9.1%) and S6 (12.3%), compared to S1 ($P<0.05$). Work done in the last set was not different between S4 and S6 ($P=0.99$). RMS_{sum} data followed a similar pattern. Astonishingly, $\Delta Qtw,_{pot}$ was not different across the four trials (~40%, $P=0.55$). VA was more reduced in S4 (5.8%) and S6 (8.3%) than S1 ($P<0.05$). Results show that the decrease in performance during repeated sprints is not directly linked to energy stores. Rather, based on projected "finishing points" and afferent feedback, humans regulate exercise intensity and hence metabolic rate, so the organism can anticipate and avoid excessive fatigue. This supports the concept of integrative central regulation of effort.

Nitrate supplementation does not improve on-ice 1000-m time-trial performance in elite short-track speed skaters

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Nitrate supplementation can increase tolerance of high-intensity work rates. However, limited data exist on the effect of nitrate ingestion on the recovery of performance after a first maximal effort, as happens in short-track speed skating international competition. We tested whether 5 days of nitrate supplementation could improve repeated time-trial performance in international-level speed skaters. Using a double-blind, randomized, crossover design (≥ one-week washout), 9 male and female elite short-track speed skaters (21.8±2.4 yr) ingested one high (*Beet It Sport*, ~6.5 mmol nitrate; HI) or low dose (juice blend, ~1.1 mmol nitrate; LO) per day on days 1-4. After a double dose of either HI or LO on day 5, athletes performed two on-ice 1000-m time trials, separated by 35 min. Athletes were asked to replicate the activity they would normally do on race day, which involved sitting and/or biking for a few minutes. Compared with LO, HI did not improve performance in the first (90.92±4.08 vs 90.95±4.06 sec, P=0.67, ES=0.01) nor the second time trial (91.16±4.06 vs 91.55±4.40 sec, P=0.42, ES=0.09). This equates, at the average speed of 39.5 $km.h^{-1}$, to less than 1 meter and 4.6 meters slower in the first and second trials, respectively. The time decrement from the first to the second trial was not different (P=0.29) between LO (0.26±0.66%) and HI (0.68±0.63%). Plasma lactate concentration measured after the trials (LO: 14.8±1.1 mM; HI: 14.8±1.2 mM) and at the end of the recovery periods (LO: 9.8±2.1 mM; HI: 10.2±1.9 mM) did not differ (P=0.47) between treatments. Five days of nitrate supplementation did not change physiological responses and failed to improve repeated, time-trial performance in elite short-track speed skaters. These data extend previous findings by demonstrating that nitrate ingestion does not enhance recovery from supra-maximal exercise in elite athletes.

Reduced lifespan and hyperadrenergic drive in phospholamban-overexpressing mice

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Our laboratory has recently uncovered a novel model of centronuclear myopathy in mice overexpressing phospholamban (Pln^{OE}) in their slow twitch type 1 fibres. PLN is a small 51 amino acid protein that physically interacts with and inhibits the function of the sarco(endo) plasmic reticulum Ca^{2+}-ATPase (SERCA). Here, we assessed the lifespan of Pln^{OE} mice compared to wild-type (WT) littermates. Survival curve analysis revealed a significant difference between Pln^{OE} mice and WT mice (logrank test, $p = 0.05$) with a median survival of 582 and 634 days, respectively. We did not suspect that cardiac dysfunction would be a major factor contributing to this early death as Pln^{OE} mice were generated such that the *Pln* transgene was attached to the β-myosin heavy chain promoter that controls skeletal muscle specific type 1 overexpression. Correspondingly, we were not surprised to find only a 1.5-fold increase in PLN expression in left ventricles (LV) obtained from Pln^{OE} mice versus WT mice. Furthermore, although we cannot fully eliminate cardiac dysfunction as a factor contributing to the early death in these transgenic mice, LV weights were not different between WT and Pln^{OE} mice at 12 months of age (WT = 163 ± 12 versus Pln^{OE} = 166 ± 9, $p = 0.86$). We did expect that hyperadrenergic

drive would contribute to the early death in the *Pln*^{OE} mice as it is well established that β-adrenergic signaling results in phosphorylation of PLN thereby relieving its inhibition on the SERCA pumps. Specifically, we hypothesized that PLN overexpression in skeletal muscles would activate a negative feedback loop thereby increasing circulating catecholamines. Here, we found that serum norepinephrine was elevated in *Pln*^{OE} mice (29.8 ± 14 ng/ml) compared to WT mice (4.0 ± 0.7 ng/ml); however this only approached significance ($p = 0.055$). Moreover, there was a trend ($p = 0.07$) for elevated phosphorylated PLN content relative to total PLN in *Pln*^{OE} mice (2.9 ± 0.6 A.U.) compared to WT mice (1.5 ± 0.1 A.U.). These results suggest that hyperadrenergic drive may be contributing to the early death in *Pln*^{OE} mice; however, more work is required to fully establish its role. (Supported by CIHR.)

Systematic review and meta-analysis on the temporal effect of acute exercise to alter central pulse wave velocity in healthy adults

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In recent years pulse wave velocity (PWV) has been identified as an independent predictor of cardiovascular risk and it is recognized as an accurate non-invasive measure of arterial stiffness. This has led to an accumulating volume of literature concerning the effects of exercise on PWV, but the evidence base has yet to be systematically reviewed nor has meta-analysis of the results been reported. An increased understanding of the link between exercise and PWV is important to help improve methods of investigation and allow insight into the cardiovascular response to exercise. It is believed that exercise mode, duration, and intensity can differentially impact central vascular properties both acutely and chronically. We assessed the impact of an acute bout of multi-modal exercise, versus specific aerobic/resistance exercise, on central pulse wave velocity (CPWV) accounting for available post-exercise measurement time intervals. Using online databases, we sought scholarly articles noting pre and post data following acute exercise in healthy subjects. The search revealed 2,016 titles with 60 articles that fit our inclusion/exclusion criteria. Acute CPWV recorded prior to and then between 0-20min after all types of exercise (21 studies, n=526) demonstrated a mean increase in CPWV of 1.4m/s (p<0.001), while no increase or decrease was apparent in studies (10 studies, n=182) which measured CPWV 20-60min post exercise (–0.2 m/s, p=0.4). Examination of studies specific to acute aerobic exercise (10 studies, n=349) of any intensity except sprint/anaerobic, revealed CPWV to be generally increased in the 0-20min post-exercise period (1.5m/s, p=0.02), yet decreased (–0.6m/s, p<0.001) in the subacute 20-60min period (6 studies, n=96). Aerobic exercise studies which measured CPWV <20min post exercise and employed maximal aerobic exercise (supermaximal/anaerobic excluded; 5 studies, n=212) reported increases of 2.3m/s (p=0.02), which differed from submaximal protocols (5 studies, n=147) with non-significant increases of 0.2 m/s (p=0.7). A single bout of resistance training (10 studies, n=159) resulted in an elevated CPWV <20min post-exercise (1m/s, p=0.03), which was no longer elevated (0.3m/s, p=0.4) within the measurement period of 20-60min (5 studies, n=86). Following an acute bout of exercise, CPWV is generally elevated in the initial 20min period post-exercise, but may decline after the initial 20min dependent on exercise mode and intensity. More literature is required to examine the specific temporal alterations within the first 0-5, 5-10 and 10-20 min post exercise to better understand the time course of these effects.

Lifelong endurance training keeps mitochondria young

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Aging is associated with diminished cardiovascular function and sarcopenia, and loss of muscle oxidative capacity is considered a salient feature of aging. While moderate-to-high intensity training evokes mitochondrial biogenesis in skeletal muscle, it remains unclear to what extent aging in itself or rather a lower training stimulus that accompanies aging contributes to loss of skeletal muscle mitochondrial function. To address this question leg muscle mitochondrial respiratory capacity in 8 older men (65±2 yrs) who had maintained road cycling training ~200 km/week for 50 years was compared to that of 8 age-matched sedentary (UT) controls (67±1 yrs). $\dot{V}O_2$ max was measured on a bicycle ergometer and a biopsy obtained from vastus lateralis muscle was permeabilized and prepared for high resolution respirometry (Oxygraph, Oroboros, AT). $\dot{V}O_2$ max was substantially higher (p<0.05) in lifelong trained (45±2 ml/kg/min) compared to UT (27±2 ml/kg/min). Mitochondrial LEAK respiration was higher in ET, and Vmax of mitochondrial respiration (OXPHOS) with mixed substrates was ~2-fold higher in the ET (132±6 pmol/sec/mg) compared to UT (72±4 pmol/sec/mg, p<0.01). Higher fatty acid oxidation and substrate control ratios in ET indicate regulatory changes in mitochondria in addition to a larger mitochondrial volume. The findings indicate that skeletal muscle mitochondrial respiratory capacity of 'lifelong trained' older males is retained at a level comparable to young athletic individuals, and suggest that decrements in aerobic performance with age are primarily attributed to diminished cardiovascular function.

Maintained $\dot{V}O_2$ max despite substantially reduced muscle mitochondrial capacity after expedition skiing in the arctic

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Cardiovascular function and metabolic capacity of skeletal muscle respond to exercise training in a manner dependent on the loading stimulus. We recently reported that prolonged low-intensity training enhances peak arm $\dot{V}O_2$ through a higher O_2 delivery and expanded capillary volume that increased O_2 diffusion without change in mitochondrial capacity. In this study, we examined the circulatory and metabolic responses to leg exercise after a ski expedition in the arctic. In 9 healthy volunteers (7 male, 2 female), hemodynamic and metabolic responses to incremental leg cycling were measured by the Fick method and biopsy of the quadriceps muscle before and after 5 weeks of skiing for 6 hrs per day at a latitude of 80° north. Peak pulmonary $\dot{V}O_2$ during 2-leg cycling was unchanged after training (3.52±0.19 L·min^{-1} post vs. 3.52±0.18 L·min^{-1} pre), as was $\dot{V}O_2$ across the leg (3.0±0.2 post *vs.* 2.8±0.4 L·min^{-1} pre). Peak leg O_2 delivery (3.8±0.4 vs. 3.6±0.2 L·min^{-1}), O_2 extraction (83±1 *vs.* 82±1%), and muscle capillaries (612±28 *vs.* 576±17) were unchanged, however mitochondrial oxidative phosphorylation (OXPHOS) capacity was reduced (90±3 vs. 70±2 pmol·sec·mg^{-1}, P<0.05) as was citrate synthase activity (34±3 vs. 40±3 umol·g^{-1}·min^{-1}, P<0.05). A lower mitochondrial LEAK respiration following training suggests improved mitochondrial efficiency, while maintained peak leg $\dot{V}O_2$ despite a 23% lower muscle OXPHOS capacity emphasizes excess capacity of mitochondria in the O_2 cascade in humans.

Nutritional involvement, support, education, and knowledge of head athletic trainers in the Canadian Hockey League

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This study examined the role of Head Athletic Trainers (AT) of the Canadian Hockey League (CHL) in advising, supporting, and influencing hockey players regarding nutrition. The formal education and nutritional knowledge of the CHL ATs (n=26, 12 Ontario HL, 10 Quebec Major Junior HL, 4 Western HL) was also examined with a 27-question survey. The ATs (20 males, 4 females, 2 not specified) averaged 9.5 ± 7.1 (SD) years of experience and 81% had completed nutrition courses as undergraduate students. They rated their nutritional roles on the team as "very involved" (29%) or "somewhat involved" (64%) and 62% occasionally made nutrition plans for the players. The foods provided in

the change room for players before and after games and practices was mostly handled by the ATs (63%), followed by equipment managers (13%). No other nutritional support or training was provided during the hockey season to the majority of the ATs (84%). Most ATs (92%) believed that "nutrition was very important for hockey performance" and 84% "strongly agreed" with the statement, "what an athlete eats before a game or workout affects their performance". The common nutritional challenges perceived by the ATs included: financial limitations (65%), time limitations (46%) and lack of player interest (42%). ATs were knowledgeable about the main source of energy (carbohydrate) for hockey (85%). Participants had difficulty determining what foods contained carbohydrate, especially dairy products (38%) and leafy vegetables (31%), however 96% correctly identified fruits as containing carbohydrate. Their hydration knowledge was good as 96% "strongly disagreed" with the statement, "drinking fluids during a game or workout slows athletes down" and 80% "strongly disagreed" with the statement "water replaces everything lost in sweat". Many ATs in the CHL had other team roles including equipment manager and strength and training coach. The ATs were "very interested" (65%) or "interested" (31%) in additional nutritional education, training and support from their teams and the CHL. (Supported by a Mitacs Accelerate Award and PepsiCo Canada.)

The effects of concentrated beetroot juice supplementation on temperature regulation and 10-km time-trial performance in a warm environment

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Beetroot juice (BRJ) is a form of nitrate supplementation that can benefit endurance performance. Elevated nitric oxide levels that result from BRJ may cause vasodilation, and as a result, improve temperature regulation. Better temperature regulation may contribute to the improvements in performance following BRJ; however, the role of temperature regulation remains unstudied. Therefore, the purpose of this study was to determine the effects of BRJ on temperature regulation and time-trial performance in a warm environment. Using a double-blind, repeated-measures crossover design, 13 recreational male cyclists (29±8 yr, $\dot{V}O_2$peak=53.8±5 ml/kg/min, peak power output [PPO]=350±38.7 W) completed 2 testing sessions, separated by a minimum 7-day washout period. Two hours prior to testing participants ingested either 140 ml of a concentrated BRJ (~8.4 mmol of NO_3^-) or a placebo (nitrate-depleted BRJ; PLA). During testing, participants performed 30 min of submaximal cycling at 60% PPO followed by a 10-km time-trial with an average air temperature of 28°C and relative humidity of 35%. Heart rate (HR), core temperature (T_C, using an ingestible temperature sensor), and forearm skin temperature (T_{SK}) were monitored. During the 30 min of cycling, average HR (158±13 vs. 155±11 bpm), increase in T_C (1.2±0.5 vs. 1.3±0.3°C), and increase in T_{SK} (1.5 ± 0.8 vs. 1.6 ± 0.7°C) were not different between BRJ and PLA. During the 10-km time-trial, performance (1065±79 vs. 1060±87 s; average power output: 214±41 vs. 218±44 W), average HR (173±8 vs. 171±10 bpm), and increase in T_{SK} (1.1±0.4 vs. 1.0±0.4°C) were not different between BRJ and PLA. During the time-trial, the increase in T_C was significantly less following BRJ than PLA (0.3±0.1 vs. 0.4±0.2, p=0.006). Supplementation with BRJ had no effect on T_C during submaximal exercise but reduced the increase in T_C during the 10-km time-trial, suggesting the temperature regulation benefits of BRJ supplementation may be intensity dependent. The blunted increase in T_C during the 10-km time-trial associated with BRJ intake did not translate into improvements in time-trial performance.

The effects of different hydration states on shooting accuracy and reactive agility in collegiate female basketball players

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Basketball, due to the repeated bouts of high-intensity effort, puts players at risk for becoming dehydrated. In experienced male players, dehydration impaired basketball skill performance. Whether skilled female players are similarly affected by dehydration is uncertain. Thus, the purpose was to examine the effects of different hydration states on shooting accuracy and reactive agility in female basketball players. On 3 different days, 8 female basketball players (177±7 cm; 20±2 y; 74.1±10 kg) from a nationally ranked university team completed 40 min of drills designed to mimic game demands. During the 40 min, players either ingested no fluids (NFL), ingested water to match sweat losses (FL), or ingested water *ad libitum* (AD). Shooting accuracy and reactive agility were assessed at the end of each trial. Players attempted 20, 2-point jump shots after dribbling and 20 shots after receiving a pass (40 shots total). Tests to measure reactive agility were performed with and without ball handling. Repeated measures ANOVAs were performed to determine if differences between NFL, FL, and AD were significant. Effect sizes (Cohen's d) were calculated to determine the magnitude of the differences. The fluid deficit (% body mass loss) was equivalent to 0.1±0.2, 0.5±0.2, and 1.1±0.2% in FL, AD, NFL, respectively (p<0.001). There were no significant differences in 2-point shooting accuracy for all shots (NFL=22.7±6.5; FL=23.9±4.0; AD=25.0±4.8), shots after dribbling (NFL=10.4±4.2; FL=11.6±2.4; AD=13.1±2.4), or shots after receiving a pass (NFL=12.3±3.1; FL=12.3±2.8; AD=11.9±3.4). Reactive agility performance, without ball handling, was 9.5±0.4, 9.4±0.5, and 9.3±0.4 s in NFL, FL, and AD, respectively. With ball handing, players completed the agility test in 10.0±0.7 (NFL), 10.2±0.8 (FL), and 10.1±0.7 (AD). There were no differences in any of the reactive agility measures. A large effect size (0.8) was noted for the lower 2-point shooting accuracy off the dribble in NFL compared to AD. Fluid restriction resulted in a greater fluid deficit compared with AD and FL. The impairment in shooting accuracy associated with fluid restriction and the greater fluid deficit, while not statistically significant, is practically meaningful as indicated by the large effect size.

Determinants of liver fat and insulin resistance

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The accumulation of liver fat (intrahepatic triglyceride; IHTG), termed non-alcoholic fatty liver disease (NAFLD) is directly involved in the pathogenesis of insulin resistance. Determinants of IHTG include diet and physical activity (PA); however their independent contributions are unclear. Additionally, whether diet and PA behaviours are associated with IHTG independent of abdominal obesity, in particular visceral fat (VAT), is also unclear. The purpose of this cross-sectional study was to first determine the association between diet, PA, and IHTG, and secondly, to determine the associations between abdominal obesity, IHTG, and insulin resistance. Participants included sedentary, abdominally obese men and women (N=23). Diet quantity and composition was measured using 7-day dietary records and diet quality was measured using the Alternate Healthy Eating Index. PA variables (sedentary time, light PA, moderate PA, vigorous PA) were measured using the accelerometer, worn for 7 days. IHTG was measured using ^{1}H-magnetic resonance spectroscopy, abdominal adiposity by magnetic resonance imaging, and insulin resistance by HOMA-IR. Linear regression revealed that none of the diet and PA variables were significantly associated with IHTG (p>0.05). VAT (R^2=0.36) and waist circumference (R^2=0.19) were significantly associated with IHTG (p<0.05). Both VAT (HOMA-IR, R^2=0.37; fasting insulin, R^2=0.29) and

IHTG (HOMA-IR, R^2=0.51; fasting insulin, R^2=0.53) were significantly associated with HOMA-IR and fasting insulin (p<0.05); however, after controlling for each other, VAT was no longer associated with insulin resistance whereas IHTG remained a significant correlate. Our findings suggest that 1 week of dietary and PA measures are unrelated to liver fat. That liver fat remained an independent predictor of insulin resistance after controlling for VAT reinforces the importance of liver fat as a predictor of cardiometabolic risk.

Associations between objectively measured physical activity, pre-pregnancy body mass index and gestational weight gain

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Physical activity (PA) during pregnancy may help women meet the gestational weight gain (GWG) guidelines. We examined the relationship between objectively measured PA during pregnancy and the likelihood of meeting GWG guidelines. Relationships between maternal pre-gravid body mass index (BMI), PA and GWG were also explored. Data was collected from women (n=48) participating in the Maternal Obesity Management (MOM) trial. PA was measured using Actical accelerometers (valid day = 10+ hours; 4-7 valid days; adjusted for wear time) in the beginning (V1: weeks 12-20), middle (V2: weeks 26-28) and end (V3: weeks 36-40) of pregnancy. Daily minutes of light, moderate, and vigorous PA, as well as sedentary time, were determined. Women were classified as 'active' or 'non-active' according to two different guidelines: CSEP's PA guidelines for adults (150 minutes moderate-to-vigorous PA (MVPA)/week in bouts of 10+ minutes) and the joint CSEP/SOGC PARmed-X for pregnancy (120 minutes MVPA/week). GWG was categorized as 'excess' or 'not excess' based on exceeding the upper limit of appropriate GWG relative to pre-gravid BMI. PA, BMI and GWG were examined as continuous and categorical variables. Spearman and Pearson correlations and Chi-square tests tested the relationships between the variables. The likelihood of meeting specific PA guidelines (CSEP vs. PARmed-X) differed considerably at each time and decreased over pregnancy (V1: 15% vs. 38%; V2: 5% vs. 26%; and V3: 0% vs. 14%). Moderate PA at V1 was weakly correlated with exceeding GWG guidelines (r=0.382, p=0.015). Meeting PA guidelines and exceeding GWG recommendations were not related. Pre-gravid overweight/obesity was related to exceeding GWG guidelines ($X^2_{(1,\ n=48)}$=5.107, p=0.024), but not related to PA guideline adherence. BMI was negatively correlated with vigorous PA at V1 (r=–0.434, p=0.005), and at V3 it was positively correlated with light PA (r=0.520; p=0.005) and negatively correlated with sedentary time (r=–0.442; p=0.018). Adherence to PA guidelines was poor and was not associated with GWG. Overweight/obesity was a better predictor of excess GWG.

Self-report questionnaire overestimates physical activity in pregnancy

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Physical activity (PA) is important for a healthy pregnancy. Most pregnancy research relies on subjective measures of PA (e.g. questionnaires, recalls) which may be less accurate. We compared results from the Pregnancy Physical Activity Questionnaire (PPAQ) to directly measured PA from Actical accelerometers (valid day = 10+ hours wear time, 4-7 valid days; adjusted for wear time). Healthy women (n=29; BMI=24±5 kg/m^2) completed both measures of PA in the second trimester of pregnancy. PPAQ activity variables were calculated in two ways: using all questions, and only considering the leisure time PA section. Women were classified as 'active' or 'non-active' using CSEP's PA guidelines for adults (150 minutes of moderate-to-vigorous (MVPA)/week, in bouts of 10+ minutes). Data are presented as mean ± standard deviation. Spearman and Pearson correlations tested potential relationships between daily minutes of light, moderate, and vigorous PA, MVPA, and sedentary time, from the two methods. Paired samples t-tests and Wilcoxon signed-rank tests compared PA variables between the two methods. The PPAQ overestimated MVPA by 17±16 hours/week in the combined sample [large effect size (r=–0.63), p=0.00], and a significant effect size remained when investigating the non-active [overestimate=14±12 hours/week, very large effect size (r=0.76), p=0.00] and the active women [overestimate=22±21 hours/week; large effect size (r=–0.63), p=0.005], separately. The PPAQ variables did not correlate with their respective Actical measures for sedentary time, moderate PA, or MVPA (p>0.05). Only PPAQ-measured light and vigorous PA were positively correlated with Actical-measured minutes of light PA (r=0.382, p=0.041) and vigorous PA (r=0.441, p=0.017), respectively. The PPAQ overestimated light PA by 15±19 hours/week in the combined sample [large effect size (r=–0.54), p=0.00], and when investigated separately the effect size was larger in active women [overestimate=19±16 hours/week, very large effect size (r=0.78), p=0.005], than the non-active women [overestimate=12±21 hours/week, large effect size (r=–0.49), p=0.003]. Using only the leisure time PA questions, the PPAQ continued to overestimate MVPA by 2±3 hours/week [moderate effect size (r=–0.41), p=0.002], with significant positive correlations noted between PPAQ-measured leisure time MVPA (r=0.514, p=0.004), moderate PA (r=0.409, p=0.028), and vigorous PA (r=0.577, p=0.001) and the corresponding Actical-measured variables. The PPAQ does not provide a reliable estimate of PA in pregnant women as it drastically overestimates MVPA. Although PPAQ leisure time questions may help to distinguish trends in activity patterns in pregnant women, data from subjective questionnaires may result in misinterpretation of relationships with health outcomes.

Does high fat diet induces loss of reciprocal changes in the generation of G3P from glucose and from glyceroneogenesis in white adipose tissue?

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Triglyceride synthesis in mammalian tissues requires glycerol-3-phosphate (G3P) as the source of triglyceride-glycerol (TAG-glycerol). There are three pathways of G3P synthesis, and previous data support the concept that a reciprocal control of G3P generation exists between glyceroneogenesis and glycolysis. The pathways of G3P generation were examined in retroperitoneal (RWAT) and epididymal (EWAT) adipose tissues from mouse fed a high-fat (HF) diet for 8 wk. After this period we evaluate the *in vitro* rates of 2-deoxy-[14C]glucose uptake and incorporation of 1-[14C]pyruvate or U-[14C]glycerol into TAG-glycerol in isolated adipocytes, and the glycerol kinase (GyK) and P-enolpyruvate carboxykinase (PEPCK) activity in supernatants obtained after tissue homogenization. Protein content was evaluated by western blot. The plasma glucose concentration was determined enzymatically and plasma insulin was measured with ELISA kit. The HF diet induced marked increases in body fat mass and in the plasma levels of glucose and insulin. HF diet feeding induced a marked increase in RWAT and EWAT GyK activity (3,4X and 2,5X) and protein content (42% and 87%) from HF diet–fed mouse, and also a higher

TAG-glycerol synthesis from glycerol in EWAT (47%). In contrast, there was a decrease in G3P generation via glycolysis in RWAT (71%) and EWAT (39%) which was evidenced by the rates of glucose uptake. In the glyceroneogenesis pathway, HF diet feeding reduced TAG-glycerol synthesis from pyruvate (72 and 75%, respectively) but did not affect activity or protein content of PEPCK in both tissues. Based on the findings high levels of plasma insulin and reduced utilization of glucose by WAT, the both inhibition of glyceroneogenesis and glycolysis, shows that the insulin resistance caused by the HF diet could contribute to the loss of known reciprocal changes in these generation pathway of G3P. In addition, contrary to the idea that the activity of GyK is negligible or nonexistent in WAT, our data show that this could be the main source of G3P in WAT.

Effect of different caffeine dosages on aging muscle performance

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The age-related loss in muscle performance decreases the ability to perform tasks of daily living. Caffeine has been shown to improve muscle performance in young adults. However, the effects of caffeine on muscle performance in aging adults is relatively unknown. Using a repeated measures, cross-over design, healthy males (N=8, 55.7±3.2 yrs; 90.6±10.4 kg; 181.3±6.2 cm) were randomized to consume caffeine (3mg/kg, 5mg/kg) and placebo, on 3 separate occasions (4 days apart), 60 minutes prior to performing leg press and chest press repetitions to volitional fatigue (3 sets at 70% 1-repetition maximum; 1 minute rest between sets). There was a set main effect ($p<0.05$) for the leg press and chest press with the number of repetitions performed decreasing equally for caffeine and placebo. Caffeine had no effect on the total number of repetitions performed across sets (3mg caffeine: Leg press 80.3±35.5, Chest press 30.2±6.4; 5mg caffeine: 87.7±19.7, Chest press 28.5±5.6; Placebo: Leg press 75.8±23.6, Chest press 28.7±8.0). Pre-exercise caffeine ingestion has no effect on muscle performance in healthy aging men.

Effect of pre-exercise creatine ingestion on muscle performance in healthy aging males

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Bolus ingestion of creatine (20 grams), 3 hours prior to resistance training, may increase plasma creatine concentrations which could facilitate creatine uptake into skeletal muscle leading to greater muscle performance. Using a repeated measures, cross-over design, healthy males (N=9, 54.9±4.3 yrs; 92.9±11.6 kg; 179.2±7.1 cm) were randomized to consume creatine (20 grams) and placebo (20 grams maltodextrin), on 2 separate occasions (7 days apart), 3 hours prior to performing leg press and chest press repetitions to volitional fatigue (3 sets at 70% 1-repetition maximum; 1 minute rest between sets). There was a set main effect ($p<0.05$) for the leg press and chest press with the number of repetitions performed decreasing equally for creatine and placebo. Creatine had no effect on the total number of repetitions performed across sets (Creatine: Leg press 63.1±34.1, Chest press 25.5±7.6; Placebo: Leg press 63.1±46.4, Chest press 25.1±4.4). Pre-exercise creatine ingestion has no effect on muscle performance in healthy aging males.

Evaluating the feasibility and efficacy of a community exercise intervention for adults with multiple sclerosis: "MACcess"

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Multiple Sclerosis (MS) is a degenerative disease of the spinal cord that affects many Canadians. There is no cure for the disease therefore efforts toward managing symptoms, improving quality of life (QoL) and everyday function are key to treatment. Evidence suggests that participating in physical activity is one of the ways individuals can help battle the disabling symptoms of MS. New physical activity guidelines for individuals with MS recommend participating in at least 30 minutes of moderate intensity aerobic activity 2 times per week and participating in strength training exercises for major muscle groups at least 2 times per week. The MS population is plagued by high physical inactivity rates and it may be a challenge for these individuals to participate in the recommended amounts of twice weekly exercise. Therefore the goal of this study was to determine the feasibility and efficacy of participating in a once-weekly group exercise program ("MACcess"). A sample of 11 adults living with MS (61.4 ± 7.8 years of age, 21.1 ± 10.7 years since diagnosis) were recruited from MACcess at McMaster University in Hamilton, Ontario. Before and after the 4-month study period, participants were asked to perform a series of peak muscle strength tests using wheelchair accessible weight training systems and unilateral pulleys. The maximum weight that could be lifted in one repetition (1RM) was assessed in the elbow flexors, elbow extensors, shoulder flexors, shoulder extensors, leg flexors and leg extensors. Participants also completed the MS Quality of Life-54 (MSQoL-54) questionnaire. Attendance at the weekly exercise classes over the 4 months was 73.3 ± 0.8%. Significant improvements were seen in all upper and lower body strength measures. Specifically, elbow flexors ($p = 0.046$), elbow extensors ($p = 0.028$), shoulder flexors ($p = 0.013$), shoulder extensors ($p = 0.001$), leg flexors ($p = 0.004$) and leg extensors ($p = 0.007$). For QoL, mental health-related QoL significantly improved from baseline ($p = 0.024$) however physical health-related QoL did not ($p = 0.195$). The results from this study suggest that adherence to a weekly group exercise program for adults with MS is very good and that significant gains in strength and mental QoL can result after a 4-month period. Once-weekly exercise could serve as an effective stepping stone to incorporating more regular physical activity into the daily life of adults living with MS.

Hemodynamic and autonomic responses of conventional and pyramid methods of strength training in non-practitioners elderly

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The pyramid strength training is widely employed to increase strength and hypertrophy. However, little is known about this method in hemodynamic and autonomic outcomes. The aim of this study was to evaluate the hemodynamic and autonomic response of conventional and pyramid methods of strength training in non-practitioners elderly women. For all, 24 elderly women (67±5 y, 27.7±4.7 kg/m^2), were randomized (crossover method) for engaged into two groups- an conventional group (CG, n=12) and an pyramid group (PG, n=12) for eight weeks. In the transition period, the volunteers were detraining for 12 weeks for the additional eight weeks of strength training in a contralateral arm of the study. The PG was composed by 3 sets of 12, 10 and 8 maximal repetitions with overload during the sets. The CG was composed by 3 sets of 10 to 15 repetitions with fixed load. In the both methods there was until 2 minutes of interval between the sets and the exercises. Blood pressure (BP) and heart rate (HR) was measured before and after the interventions with automatic and oscilometric device of blood pressure (Omron HEM-7421NT), in order to attend the Guidelines of rest BP measurements. The heart rate variability was measurement by a portable frequencimeter (RS800 - Polar® Team System). It was employed the Shapiro-Wilk, ANOVA two-way for repeated measures, following the Newman-Keuls Post-Hoc, $p<0.05$. The variance coefficient was 4.0 and 2.4 mmHg for the systolic (SBP) and diastolic (DBP) blood pressure, respectively. SBP reduction only in GP

(pre=120±13 vs. post=115±11 mmHg, p=0.02), without changes in GC (pre=118±12 mmHg vs. post=119, p>0.05). No significant differences were found for DBP in GP (pre=69±9 vs. post=67±7 mmHg, p>0.05) and CG (pre=68±8 vs post=68±9 mmHg, p>0.05), as well as the HR values in the GP (pre=71±12 *vs.* post=73±12 bpm, p>0.05) and CG (pre=70±11 *vs.* post=68±11 bpm, p>0.05). There was a similar and significant reduction in the RR interval in both groups (pre=855±165 ms *vs.* post=807±175 ms; p=0,02); HFnu (pre=61±17 *vs.* post=55±22, p<0,001). The RMSSD, LFnu, and LF/HF ratio values did not change between the two methods (p>0.05). In conclusion, pyramidal method of strength training is able to promote a more marked resting SBP reduced than conventional method, but no difference was observed in the cardiac autonomic modulation between the both methods.

Does a history of shift work impact cardiovascular reactivity to an acute mental stress task?

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In Canada, approximately 25% of the workforce is employed in shift working positions and there is evidence that it is associated with an increased risk of cardiovascular disease. High cardiovascular reactivity to stressful tasks is a known predictor of increased future cardiovascular risk and it may play a causal role in disease progression. No studies to date have investigated the impact of a history of shift work on cardiovascular reactivity to an acute stressor. The purpose of this study was to compare the stress reactivity of healthy female shift workers (SW) and non-shift workers (NSW) in response to a laboratory mental stress task. Heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured in 19 SW (40.5 ± 11.3 years) and 18 NSW (42.6 ± 10.9 years) at rest, and during a speech and mental arithmetic stress task. HR, SBP and DBP were monitored continuously using a 3-lead electrocardiogram and finger photoplethysmography. All values are means ± SD. The speech and mental arithmetic tasks were successful in eliciting an increase in subjective stress rating that was not significantly different between groups (p=0.23) (Increase in Subjective Stress Rating out of 10: ΔSW 4.76± 1.76, ΔNSW 4.00 ± 2.08). HR (p=0.67) and SBP and DBP reactivity to stress were also not significantly different between SW and NSW (SBP: ΔSW: 20.93 ± 10.72 mmHg, ΔNSW: 19.57 ± 11.92 mmHg, p=0.52; DBP: ΔSW: 14.27 ± 6.58 mmHg, ΔNSW: 11.20 ± 6.28 mmHg, p=0.15). Although it did not reach significance in the current sample, the magnitude of difference in DBP reactivity between groups (3.07 mmHg) is a moderate effect size (d = 0.5), and a previous report suggests that in men a 1 mmHg increase in DBP reactivity is associated with a 2-7% increase in the risk of future hypertension. In conclusion, these preliminary data suggest that a history of shift work may modestly increase cardiovascular stress reactivity. Further research is necessary to fully characterize and explore the importance of cardiovascular stress reactivity in this population.

Is PGC-1α transcription activated by exercise in aged muscle?

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The transcriptional coactivator PGC-1α is responsible for the expression of genes encoding mitochondrial proteins in skeletal muscle. With aging, PGC-1α expression declines, correlating with the reduction of mitochondria in skeletal muscles. Acute exercise is a potent stimulus for PGC-1α transcriptional activation in young muscle. With successive exercise bouts, this culminates in mitochondrial biogenesis. Previous work comparing adaptations between young and aged muscle has documented that mitochondrial adaptations are blunted in aged muscle after exercise. This tempered response may be due to transcriptional insufficiency, as signaling kinases important for transcription are less responsive. Whether contractile activity activates PGC-1α transcription in aged animals to the same degree as in their younger counterparts has not been determined. Thus, we investigated PGC-1α transcription following acute contractile activity in young and aged muscle. The tibialis anterior (TA) muscles of 6 and 35 month old Fischer 344 BN rats were electrotransfected with a 1.5kb rat PGC-1α promoter construct upstream of a luciferase reporter. One week later, the left TA was subjected to 15 mins of contractions (5 min, 1Hz; 10 min, 10Hz) followed by 1 hour of recovery. In the aged animals, mitochondrial content and muscle mass were reduced by 28% and 40%, respectively. This reduction in mitochondria likely contributed the greater rate of muscle fatigue in aged animals during 1 and 10Hz contractions. PGC-1α transcription in resting muscle of aged animals was 64% of that found in young animals. In response to contractile activity, PGC-1α transcription was increased by 2.3-fold in young animals. Interestingly, the transcription of PGC-1α was suppressed by 6.7-fold following contractions in aged animals. These data suggest that the reduced level of PGC-1α in aged muscle is mediated by transcriptional deficits, and that these are exacerbated in response to contractile activity. This may be a result of altered signaling directed toward the PGC-1α promoter, or a markedly divergent time course of transcriptional activation in response to exercise, compared to younger counterparts.

Characterization of bilateral arm muscle activity during arm cycling at various relative workloads

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Studies utilizing isometric contractions to assess the neuromuscular system typically require participants to contract at an intensity made relative to their maximal voluntary contraction (MVC). During arm cycling, however, an absolute workload is normally used. This could significantly affect various neurophysiological outcome measures due to participants cycling at different relative intensities. The objective of this study was to characterize the activity of various muscles at different intensities of arm cycling based on peak power output (PPO) determined from a 10-second maximal intensity arm ergometry sprint. Electromyography (EMG) was recorded from 6 muscles bilaterally (i.e. biceps brachii, triceps brachii, anterior deltoid, brachioradialis, flexor carpi radialis and extensor carpi radialis). Subsequent cycling trials ranged from 5-50% (5% increments) of the PPO achieved from the 10-second sprint with EMG recordings (root mean square amplitude) made relative to those obtained during the 10-second sprint. Linear regression analysis revealed that increasing workloads from 5% to 35% lead to linear increases in muscle activation (biceps [right], r = 0.9603; biceps [left], r = 0.9935; triceps [right], r = 0.9723; and triceps [left], r = 0.9885). This relationship was not as strong for workloads between 40 – 50% of PPO [(biceps [right], r = 0.4788; biceps [left], r = 0.5629; triceps [right], r = 0.6342; and triceps [left], r = 0.1184)]. These preliminary data (n = 3) indicate that standardizing the intensity of arm cycling based on PPO arising from a 10-s Wingate may be useful for intensities below 40% of PPO. Further data collection and analysis is required before a conclusion can be made with certainty.

PINK1 import in skeletal muscle mitochondria

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Mitochondria function as important regulators of skeletal muscle mass. When energetic demand is elevated, the synthesis of mitochondria is induced. Mitochondria that are unable to sustain cellular requirements are targeted for degradation, a process termed mitophagy. The balance between synthesis and mitophagy is critical in maintaining energetic homeostasis. Recently, a protein kinase (PINK1)

has been implicated in mitophagy as a sensor of mitochondrial dysfunction. Under healthy conditions, PINK1 is translocated into mitochondria by the protein import machinery (PIM) and proteolytically processed by the protease PARL. When mitochondria become dysfunctional, the dissipation of the membrane potential prevents the import and processing of PINK1 resulting in its accumulation on the outer membrane. Once on the outer membrane, PINK1 activates Parkin-mediated ubiquitination leading to the degradation of damaged mitochondria. However, the mechanisms of PINK1 import and its role in muscle remain unclear. In this study we examined PINK1 import into mitochondria isolated from mouse muscles. A rapid increase in PINK1 insertion into the outer membrane (59 ± 6.9%) and processing (56 ± 7.3%) was observed by 15 minutes of incubation with mitochondria. When an uncoupler (CCCP) was supplemented, PINK1 import was arrested by 50%, confirming that complete PINK1 import is membrane potential-dependent. Profiling of PIM revealed a 1.5 to 2-fold greater abundance of Parkin and Tom70 respectively relative to VDAC, corroborating previous research suggesting that Tom70 is indispensable for PINK1 import. PARL levels were only 50% of either VDAC, Tom40 and Tom22 levels, suggesting a limiting role for PARL in the import process. Rates of PINK1 import (5.0%/min) were similar to Bcl-2 (5.9%/min), but greater than that of Tom40 (2.7%/min) and OCT import into the matrix (1.5%/min). This implies that rates of import into the matrix and outer membrane are divergent. Our findings suggest that PINK1 import is regulated by the mitochondrial PIM, but that the relationship of PINK1 import to Parkin and PARL remain to be determined. (Supported by NSERC.)

Effect of Gross Motor Skills programs in children: ongoing study

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Increasingly, there is evidence showing that children have significantly reduced physical activity time and gross motor (GM) skills. Participation in physical activity (PA), sports and free play could be hampered by GM problems and they are rarely reported in the primary diagnosis. Moreover, very few researches did look at the psychological and neuropsychological impacts of GM intervention programs. The purpose of this study is to describe the GM, psychological and neuropsychological profile of infants and measure the impact of three GM intervention program's on these variables. 59 children, 26 boys and 34 girls (mean age=7.4±0.6; BMI=14.02±2.25), completed the 12 weeks GM program. Participants followed one of the three intervention programs (12w/1 session of 60 minutes per week): Physical Education (N=22), Aucouturier Psychomotricity (N=19) and GM training program (N=19). GM performance was evaluated with the UQAC-UQAM GM skills test battery comprising 12 items that assess 5 GM qualities: Simple Reaction Time; Limb Speed; Agility; Coordination and Balance. Results were compared between groups. Psychological tests were evaluated using the PRESS questionnaires and included psychological distress, and neuropsychological tests were evaluated using CPT test including impulsivity and attention. Results showed from the three interventions program only the GM training program reach significant results between pre-post tests. However, the intervention programs did not have an impact on psychological distress, which stayed at a relatively low level at pre-post tests. In the same way, attention was improved marginally but not significantly for all groups and impulsivity also get slightly better but only for the Aucouturier and physical education programs, although not significantly. Overall, results of this current ongoing study indicate the importance of physical activity at a young age to develop GM skills. More research is needed to better understand the possible link between gross motor skill, impulsivity and attention.

Standardization of ultrasound-determined muscle thickness in anatomically distinct muscles with force strain-gauge sensors

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Hypertrophy can be measured using a variety of methods, but the use of ultrasound is becoming increasingly prevalent due to its low cost and non-invasive nature. In order to be useful ultrasound-determined changes in muscle in response to, for example, resistance training would be desirable. We aimed to develop a robust method for determining muscle thickness at distinct anatomical sites – biceps and vastus lateralis – using methods to increase the validity and reliability of the measures. Research has shown strong correlations between ultrasound-determined measurements and MRI-measured muscle thickness in human cadaver specimens. However, with the ultrasound technique, human muscle may be susceptible to significant changes in thickness from external force and there is currently no objective method to control for probe 'hold-down' pressure. The lack of a standardized method to control for probe pressures can result in measurement errors and impact reliability and validity. In addition, post image acquisition analysis is also currently poorly described and could also have substantial impact on reliability and validity. The purpose of the current study was to examine the differences in ultrasound muscle thickness with increasing probe pressures as well as to develop a standardized method for determination of thickness using edge-detection software. While supine, longitudinal long axis sonographic images were taken of the biceps (60% distal of the acromial process to the lateral epicondyle of the humerus) and vastus lateralis (60% distal of the greater trochanter to the lateral condyle of the femur) in young men (n=15, 21.69±2.85 yrs). The ultrasound probe was secured to a digital strain gauge, which provided simultaneous force readings of the probe pressure and repeat images of each muscle were taken with increasing pressures of 0.2, 0.5, 0.7, and 1.0 N. A custom semi-automated edge tracking software was used for image and data analysis. Analysis showed that with each increasing level of hold-down pressure, regardless of anatomical location, muscle thickness measurements were reduced showing a strong dependence of muscle thickness measurement on hold-down pressure. These preliminary findings indicate that increases with probe pressure may significantly alter muscle thickness measurements. (Funded by NSERC.)

Conscious perceptual cues and inhibitory afferent feedback may have little influence on altering an anticipatory pacing strategy during repeated short duration cycling sprints

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Sub-optimal motor drive to the active muscles has been shown to contribute to fatigue during maximal exercise tasks. The purpose of the present study was to use hypoxia to exacerbate physiological perturbations and perceptual cues and explore the subsequent regulation of neural drive during short duration all-out cycling sprints. On separate days, 9 healthy men performed a repeated sprint bout (RSB) consisting of 10 x 4 s all-out cycling sprints (30 s of passive rest between sets) under normoxia (NM: fraction of inspired O_2 0.21), and severe normobaric hypoxia (SH:0.13). Peak power (W) and muscle activation (RMS/M-wave) were obtained during each sprint, while heart rate (HR), and perceptual scores; perceived difficulty breathing, perceived limb discomfort, and overall perceived discomfort were recorded immediately following each sprint. Blood lactate (BLa) was taken 30 s following the finally sprint. HR, BLa and all perceptual scores increased across time ($p<.05$) and were greater under SH ($p<.05$). There was a main effect of time and condition ($p<.05$) on peak power output dur-

ing the RSB with greater reductions under SH ($p<.05$). Muscle activation decreased in both conditions ($p<.05$) with no difference across conditions ($p>.05$). In conclusion, despite SH exacerbating both physiological and perceptual responses in accordance with greater performance loss during a bout of repeated short-duration all-out cycling sprints, the regulation of neural drive was no different across conditions. During very short duration all-out exercise tasks, physiological and perceptual feedback may play little role in regulating neural drive or adjusting a pre-exercise anticipatory pacing strategy.

Sedentary time in working and non-working older Canadian men and women

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Although current sedentary behaviour guidelines focus on children and youth, the potential health consequences of prolonged sedentary time (ST) for aging Canadians are significant. Despite this, the prevalence of ST among older adults is not well described. The purpose of the present study was to investigate ST among Canadians ≥ 60 years, including associations with sex, working status, self-perceived health, waist circumference, and physical activity levels. Data from 1,729 adults (898 women) between 60-79 years of age were obtained from cycles 1 and 2 of the Canadian Health Measures Survey. 539 (32.2%) individuals reported they were currently working. Total ST was measured using an Actical accelerometer worn for between 4 and 7 days. Estimated leisure time ST (including activities such as screen time and reading) were obtained via self-report. According to the measured data, 93.6% of participants accumulated ≥ 8 hours per day of ST: men were sedentary for an average of 594±5 minutes/day while women were sedentary for 606±4 minutes/day (NS). Self-reported leisure ST was similar in men and women (228±6 vs. 229±4 minutes/day, respectively). There was no difference in measured ST between working (598±5 min/day) and non-working older adults (601±3 min/day), although individuals who were working reported less leisure ST (204±7 min/day) than those who were not working (240±5 min/day) ($p<0.05$). Multivariate linear regression models indicated that measured ST (adjusted for accelerometer wear-time) was associated with not meeting physical activity guidelines ($\beta = 37.8$; $p<0.001$), high-risk waist circumference ($\beta = 9.5$; $p<0.05$), and fair/poor self-perceived health ($\beta = 30.7$; $p<0.01$), while self-reported ST was only associated with not working ($\beta = 31.6$; $p<0.001$). These data suggest that objective measurements may provide more meaningful insight into ST. Older Canadians accumulate high amounts of ST, regardless of their sex or working status, and ST is highest among those who perceive their health to be fair/poor, have a high-risk waist circumference, and do not meet current physical activity guidelines.

Sedentary time in women: association with muscular strength and postural stability

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Sedentary behaviour is associated with increased risk of metabolic disease independent of physical activity, but there is limited evidence of its effects on musculoskeletal or functional outcomes. Further study is warranted, especially among women as they are at increased risk for falls and diminished strength as they age. Thus, the purpose of this study was to examine the association between sedentary time, muscular strength, and postural stability in older women. Fifty women (age: 56.7 ± 4.1yrs, BMI: 27.0 ± 5.3 kg·m-2) wore an Actigraph GT3X accelerometer for 7 days to measure sedentary time. Peak torque of the knee extensors and flexors was assessed using an isokinetic dynamometer and postural stability was assessed using computerized dynamic posturography to calculate a composite balance score. Participants were sedentary for an average of 559 ± 86 minutes per day, or 65% of total wear time, and 352 of those minutes were spent in bouts of sedentary time longer than 10 minutes. The balance score was inversely correlated to age ($r = -.33$, $p<0.05$) and to the proportion of time spent sedentary ($r = -0.41$, $p<0.01$), and was positively correlated to the peak torque of the knee extensors at 60 °/s ($r = 0.39$, $p<0.01$). Percent of time spent sedentary was inversely correlated to peak torque of the knee flexors ($p<0.05$). Multiple linear regression analyses showed that 17.7% (adjusted R2) of the variance in balance scores was explained by the variables age and sedentary time while the same model explained 15.6% of the variance in peak torque of the knee flexors. Proportion of time spent sedentary was negatively associated with balance scores ($\beta = -.341$, $p<0.05$) and peak torque of the knee flexors ($\beta = -.285$, $p<0.05$). These results suggest prolonged sedentary time could have a negative impact on strength and balance. In addition to promoting physical activity, women should be encouraged to minimize sedentary time to help preserve function as they age.

Premovement changes in corticospinal excitability of the biceps brachii are not different between arm cycling and an intensity-matched tonic contraction

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Premovement changes in corticospinal excitability have mainly been studied using tonic contractions. Relatively little is known about corticospinal excitability changes prior to rhythmic and alternating movements, such as arm cycling. Studies using animal models have shown that pre-motor modulation of spinal motoneurone excitability is different prior to a rhythmic and alternating movement compared to an isometric contraction. Therefore, the purpose of the current study was to assess corticospinal excitability using transcranial magnetic stimulation to elicit motor evoked potentials (MEPs) and spinal motoneurone excitability using transmastoid electrical stimulation to elicit cervicomedullary motor evoked potentials (CMEPs), prior to arm cycling and an intensity-matched tonic contraction. MEPs and CMEPs were recorded using surface EMG from the relaxed biceps brachii prior to arm cycling, tonic contraction and at rest with no intent of movement, then normalized to Mmax elicited through brachial plexus stimulation. The MEP amplitudes were larger prior to arm cycling (4.37 ± 0.58% of Mmax; $P = 0.02$) and tonic contraction (4.32 ± 0.91% of Mmax; $P = 0.02$) compared to control (2.32 ± 0.78% of Mmax), but showed no difference between contraction types. MEP onset latencies were also shorter prior to cycling (14.05 ± 0.24ms; $P = 0.03$) and tonic contraction (14.24 ± 0.14ms; $P = 0.03$) compared to control (15.61 ± 0.55ms). Compared to rest CMEP amplitude remained unchanged prior to arm cycling and tonic contraction. We conclude that premovement enhancement of corticospinal excitability is due to an increase in supraspinal but not spinal motoneurone excitability, independent of the forthcoming motor output.

A one year follow-up of fitness levels in elite youth ice hockey players

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The longitudinal development of fitness in elite youth ice hockey players has not been elucidated. The objective of this research was to compare the fitness levels of athletes who reported to a pre-season fitness combine in 2012 (T1) and 2013 (T2). It was hypothesised that with increased age an improved fitness level would be observed. One hundred and thirty nine athletes, between the ages of 12 and 16 years at T1, reported to the same pre-season fitness combine prior to two consecutive hockey seasons. Anthropometric, anaerobic fitness, musculoskeletal fitness, and agility were assessed. All data is represented as mean±SD (T1 vs T2) and was compared with a paired t-test ($p<.05$). With an increase in age of one year, height (172.18 ± 7.53 cm vs 179.95 ±

6.27 cm; p<0.001), body mass (64.92 ± 10.97 kg vs 71.71 ± 10.04 kg; p<.001) and body fat (9.38 ± 3.50% vs 11.00 ± 3.53%; p<.001) all increased. Improvements were observed in absolute peak power output (PO_{peak}) (719.10 ± 156.92 W vs 829.60 ± 156.55 W; p<.001), relative PO_{peak} (10.92 ± 1.18 $W \cdot kg^{-1}$ vs 11.53 ± 1.21 $W \cdot kg^{-1}$; p<.001), absolute mean power output (PO_{mean}) (555.21 ± 114.38 W vs 636.61 ± 110.92 W; p<.001), and relative PO_{mean} (8.44 ± 0.75 $W \cdot kg^{-1}$ vs 8.82 ± 0.78 $W \cdot kg^{-1}$; p<.001). However, there was no change in fatigue index (48.04 ± 7.57% vs 49.41 ± 7.9%; p=.103). Musculoskeletal fitness also showed improvement over a one year span with push-ups (20.98 ± 12.12 reps vs 30.90 ± 10.1 reps; p<.001), left (44.03 ± 9.53 kg vs 52.28 ± 8.21 kg; p<.001) and right (45.94 ± 9.90 kg vs 54.31 ± 8.89 kg; p<.001) hand grip strength, left (15.72 ± 3.69 kg vs 19.57 ± 4.74 kg; p<.001) and right (15.94 ± 3.99 kg vs 19.72 ± 4.71 kg; p<.001) hip adduction strength and left (15.65 ± 3.25 kg vs 18.83 ± 4.04 kg; p<.001) and right (15.64 ± 3.46 kg vs 19.25 ± 4.33 kg; p<.001) hip abduction strength all increasing. There was no change in duration of static prone elbow plank (114.57 ± 15.37 s vs 114.89 ± 14.31 s; p=.812). Leg power assessed with a standing long jump improved over a period of a year (216.65 ± 20.65 cm vs 232.62 ± 33.96 cm; p<.001) along with agility as determined by a 5-10-5 yard shuttle run (5.22 ± 0.85 s vs 4.52 ± 0.60; p<.001). Over the course of one year, elite youth ice hockey players experienced positive changes in anthropometric measures along with improved anaerobic and musculoskeletal fitness, and agility probably as a result of their natural growth and development during this period.

Strength development in elite youth ice hockey players

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The sport of ice-hockey requires high levels of muscular strength. The objective was to retrospectively review anthropometric, musculoskeletal fitness and agility characteristics of elite youth ice hockey players. We hypothesized that natural growth with age would be associated with a bigger, stronger and more agile athlete. Data was retrieved for 260 male (13yrs, n=75; 14yrs, n=70; 15yrs, n=58; 16yrs, n=57 (which includes 11 players who turned 17)), AAA ice hockey players. All data was collected during a pre-season off-ice testing combine. Tests performed included height, weight, skinfolds, grip strength push-ups (13 and 14yrs), bench press (15 and 16yrs), hip adduction, hip abduction, supine rows, abdominal plank, vertical and broad jump, and 5-10-5 yard shuttle run. One-way ANOVAs and Tukeys post-hoc tests determined changes successive age groups (p<.05). Weight increased between all age groups (p<.05), while height increased from 13 to 14yrs (167.6±8.4cm vs 175.0±6.1cm respectively; p<.001). Grip strength increased between all age groups (p<.05), bench press increased from 15yrs to 16yrs (9.78±5.8reps vs 17.0±7.8reps respectively; p=.001) and left and right hip abduction strength improved from 14 to 15yrs (left, 15.3±2.4kg vs 16.9±3.2kg respectively; p=.02: right, 15.5±2.7kg ± 17.0±3.7 respectively; p=.03) and 15 to 16yrs (left, 16.9±3.2kg vs 19.0±3.3kg respectively; p=.001: right, 17.0±3.7 vs 19.5±2.9 respectively; p<.001). Hip adduction only improved in the left leg from the age of 15 to 16yrs (16.6±3.3 vs 19.2±3.4 respectively; p<.001). Leg power assessed by vertical (13yrs, 43.9±7.9cm vs 14yrs, 47.5±6.1cm (p=.004) vs 15yrs, 52.8±8.9cm; p=.001) and broad jump (13yrs, 204.3±15.2cm vs 14yrs, 217.2±17.9cm (p<.001) vs 15yrs, 233.4±19.1cm; p<.001), and agility (5-10-5 shuttle test) (13yrs, 5.5±0.3s vs 14yrs 5.3±0.2s (p<.001) vs 15yrs, 5.2±0.2s; p=.006) improved from 13 to 14yrs and 14 to 15yrs. No changes were observed in body fat percentage, push-ups (between the ages of 13 and 14yrs), abdominal plank endurance or number of supine rows completed. Anthropometric, muscular strength, power, endurance and agility variables changed between some but not all successive age groups. Monitoring these variables and developing sport specific, individual based training programs could help maximize an athlete's fitness testing scores.

Acute brachial artery endothelial responses to both moderate continuous and high-intensity interval exercise in young healthy males

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Aerobic exercise training improves vascular function, particularly in those with baseline endothelial dysfunction; however, the acute vascular response to exercise is poorly understood. Research suggests high–intensity interval exercise (HIIT) training may provide similar and potentially even greater improvements in cardiovascular function compared to moderate-intensity continuous exercise (CON). The purpose of this study was to compare the time course of acute changes in vascular function following two different exercise protocols; CON vs. HIIT. Ten young healthy untrained males (23 ± 2 yrs) completed one bout of CON (30 mins at 55% peak power) or HIIT cycling (10 one-minute intervals at 80% peak power) on different days in random order. Endothelial function was assessed using brachial artery flow-mediated dilation (baFMD) at baseline, and immediately, 1 hour and 24 hours post-exercise. Brachial artery vascular smooth muscle function was assessed by examining the dilation in response to a dose of sublingual nitroglycerin (NTG) at all time points, except 1-hour post-exercise. There were no differences in baFMD between CON and HIIT at any time point. Immediately post-exercise baFMD values were unchanged from baseline. However, 1 and 24 hours post-exercise, baFMD values were attenuated compared to all other time points for both HIIT (baseline: 6.2 ± 2.6%; immediately post-exercise: 8.4 ± 2.2%; 1 hour post-exercise: 2.6 ± 2.6%; 24 hours post-exercise: 4.2 ± 2.6) and CON (baseline: 6.3 ± 2.2%; immediately post-exercise: 7.1 ± 2.2%; 1 hour post-exercise: 3.5 ± 2.9%; 24 hours post-exercise: 4.6 ± 2.2%). NTG mediated brachial artery dilatory responses were not changed at any time point for either exercise condition. The intermittent rest periods involved in the HIIT exercise protocol may provide time for recovery of nitric oxide mediated dilatory capacity such that the post-exercise vascular function was similar between HIIT and CON in healthy young men. Regardless of the protocol, immediately post-exercise, endothelial function is maintained and becomes reduced 1 and 24 hours following exercise cessation. (Funded by Natural Sciences and Engineering Research Council of Canada.)

Time course of changes in middle cerebral artery and internal carotid artery cross-sectional area and blood flow during hypercapnia and hypocapnia.

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We have previously shown that middle cerebral artery (MCA) cross-sectional area (CSA) changes during hypercapnia (HC) and hypocapnia (HO) with 3T MRI. The purpose of this study was to examine the time course of these changes during 5 minutes of HC and HO and to compare these changes in MCA CSA and flow (Q_{MCA}) to changes in the internal carotid artery (ICA CSA and Q_{ICA}). End-tidal partial pressure of carbon dioxide ($ETCO_2$) values were manipulated by breathing 6% CO_2 for 5 minutes (HC) and by increasing breathing rate to 30 breaths per minute, also for 5 minutes (HO). Measures of MCA CSA were made at baseline and every minute during HC and HO with 3T MRI. On a separate day MCA cerebral blood flow velocity was collected during the same protocols with transcranial Doppler ultrasound and ICA diameters and flow velocity were collected with duplex ultrasound. Fourteen subjects (23 ± 3 years, 7 females) participated in the study and we had complete data for 11 subjects during HC and 9 subjects

during HO. During HC, MCA CSA was significantly increased at each time point while the maximum percent change of 14 ± 8% occurred at minute 4. During HC, $ETCO_2$ increased from 37 ± 3 mmHg to an average of 52 ± 2 mmHg. During HO there was a significant decrease in MCA CSA at minute 4 and 5 with the greatest percent change of 6 ± 6% at minute 5. During HO, $ETCO_2$ decreased from 37 ± 4 to an average of 24 ± 6 mmHg. In contrast, when ICA CSA was calculated from ICA diameter there were no significant changes during HC or HO. There was a trend for absolute Q_{ICA} to be greater than Q_{MCA} during HC (p=0.067) and Q_{ICA} was greater than Q_{MCA} during HO (p=0.006). However, when expressed as percent change from baseline Q_{ICA} and Q_{MCA} were not different during HC or HO. Therefore, changes in CSA during HC and HO are different between the ICA and the MCA but flow is not when expressed as the percent change from baseline. (Supported by CIHR.)

Relationship of muscle mitochondrial content and the Keap1-Nrf2 pathway

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The Keap1-Nrf2 pathway is the major regulator of an elaborate network of cytoprotective proteins, conferring cellular protection by augmenting its expression in response to disturbances in oxidative stress, such as the production of reactive oxygen species (ROS). However, little is known about the expression and function of this system in skeletal muscle. Since mitochondria are one of the major sources of ROS within the cell, we hypothesized that the expression of the Keap1-Nrf2 pathway would be proportional to muscle mitochondrial content. Thus, we assessed Nrf2 and Keap1 protein content in fast-twitch white (FTW), fast-twitch red (FTR), slow-twitch red (STR) and the heart (HRT). Interestingly, the ratio of Keap1:Nrf2 protein was highest in the most oxidative muscle types, suggesting that the pathway is relatively inactive when mitochondrial content is high. The opposite ratio was observed in the low oxidative FTW muscle. We also evaluated Nrf2 and Keap1 in response to unilateral rat muscle denervation (3 and 7 days), since this model of muscle disuse is known to increase ROS production. Denervation induced 30% and 38% (n=3) reductions in Nrf2 by 3 and 7 days, respectively, along with a 35% decrease in mitochondrial content. Conversely, the expression of Keap1 protein was increased by 47% and 72% following 3 and 7 days of denervation (n=3). In KO mice, the absence of Nrf2 led to a 20% reduction in mitochondrial content (n=5-6), and this was reflected in reduced endurance performance, as assessed using an *in situ* gastrocnemius contraction model in WT and KO mice (n=3).Thus, our findings suggest that Nrf2 is a partial regulator of muscle mitochondrial content, which has implications for the quality of skeletal muscle and its ability to maintain force. Future studies will be designed to determine the localization of Nrf2 within the cell to gain further insight into its role under conditions of exercise and muscle disuse.

Comprehensive assessment of brachial artery endothelial function across a spectrum of health and disease

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Endothelial dysfunction is associated with an increased risk of cardiovascular disease morbidity and mortality. Traditionally, endothelial function is assessed using flow-mediated dilation (FMD), which represents an index of endothelial "reactivity". Low-flow mediated constriction (L-FMC) has been proposed to represent a measure of basal endothelial function, and has recently gained attention as a complementary assessment of endothelial function. The purpose of this study was to characterize and compare the measures of FMD and L-FMC in the brachial artery across a spectrum of health and disease. Brachial artery diameters and blood velocities were collected using Duplex ultrasound at baseline for 30-seconds, following which a pneumatic cuff on the forearm was inflated above systolic blood pressure to induce a 5-minute period of ischemia. Measurements were repeated for 30-seconds at 4-minutes of ischemia and for 3-minutes following cuff deflation for the calculation of L-FMC and FMD, respectively. Participants included 9 young healthy individuals (YH, 20 ± 2 years), 18 old healthy individuals (OH, 70 ± 4 years), 11 stroke patients (S, 65 ± 9 years), and 26 patients with coronary artery disease (CAD, 64 ± 9 years). There was no difference in FMD between groups (YH: 7.0 ± 3.4%; OH: 4.5 ± 2.6%; S: 6.0 ± 4.0%; CAD: 4.5 ± 2.8%, p=0.135), while L-FMC was lower in the CAD group (0.9 ± 1.3%) compared to the YH (-3.2 ± 3.4%) and OH (-1.2 ± 2.1%) groups (p≤0.001). Findings from this study confirm brachial artery L-FMC is present in healthy individuals and absent in clinical patients, indicating impaired basal endothelial function. In contrast to the literature, while FMD appears to be similar in health and disease in the current sample, patients included in this study were stable and receiving medical management. The discrepancy in observations between measurements and groups highlights the necessity to perform both L-FMC and FMD measurements for a comprehensive assessment of endothelial function. (Funding: Natural Sciences and Engineering Research Council of Canada.)

Inactivity-induced reductions in muscle protein synthesis and muscle mass are attenuated by low load resistance exercise but not citrulline supplementation in older men

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Short-term periods of relative muscle disuse occur with increasing frequency with age and may accelerate sarcopenic muscle loss. We have previously shown that 14d of reduced ambulation in older adults induced anabolic resistance as evidenced by reductions in postprandial muscle protein synthesis (MPS), which we hypothesized might be related to reductions in microvascular flow. The purpose of this trial was to determine if chronic citrulline (CIT) supplementation (5g/d) could attenuate muscle loss and enhance the MPS response in a step-reduced (SR) or step-reduced and resistance trained (SR+RT) leg in older men. Healthy, older men (70 ± 1 yr) underwent 14 d of SR (<1500 steps/d) and were randomized to supplementation with citrulline (CIT) or placebo (PLA). In addition, subjects reported to the laboratory for thrice weekly unilateral RT (leg press, knee extension, 30% 1-RM, 3 sets to failure). On the morning of day 15 subjects underwent primed constant infusion of L-[ring-$^{13}C_6$]phenylalanine with serial muscle biopsies from the SR and SR+RT legs and MPS was assessed in the postabsorptive and postprandial states following ingestion of: 20g whey protein + 5g CIT or 20g whey protein + 15g glycine (PLA). Steps were reduced (P<0.001) by 78 ± 4% and 81 ± 2% throughout the intervention in the CIT and PLA groups. There was no effect of CIT on leg lean mass in the SR or SR+RT leg; however, the change in lean mass in the SR+RT leg (+201 ± 75g) differed from that of the SR leg (-60 ± 82, P = 0.01). MPS was lower in the SR as compared with SR+RT legs in both the postabsorptive (SR: 0.025 ± 0.001%/h vs SR+RT: 0.044 ± 0.001%/h) and postprandial (SR: 0.053 ± 0.002%/h vs SR+RT: 0.116 ± 0.004%/h) states with no effect of CIT. Six sessions of low-load, high volume RT attenuated the deleterious effects of reduced activity on muscle mass and alleviated the decline in MPS. These phenotypic changes align with higher rates of postabsorptive and postprandial MPS in the SR+RT versus SR leg. These findings show that low-load RT, but not CIT supplementation, can attenuate the deleterious effects of reduced activity that occur with aging.

A novel method of torque-onset determination and its differential effect on torque kinetics and electro-mechanical delay in men and boys

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Torque (Tq) onset (TO) is often determined from the torque-time trace, as the time at which the trace emerges above a threshold (THR) of a given Tq value, percentage of peak Tq (Tq_{pk}), or a set number of standard deviations above baseline 'noise'. These methods provide only estimates which are invariably later than actual TO. This consequently affects calculations of Electro-Mechanical Delay (EMD), time to Peak Rate of Tq Development ($tRTD_{pk}$), and the Tq kinetics curve. When comparing similar cohorts, or in pre–post experimental designs, these effects are also similar and hence can often be disregarded. However, when dissimilar groups are compared, *e.g.*, children *vs.* adults, these effects can be dissimilar and could thus become highly consequential. To address this issue we developed a retrograde (RET) TO-determination algorithm, which tracks the Tq trace back to its baseline's mean value. We analyzed Tq-time traces of maximal, explosive, isometric knee-extensions (Biodex dynamometer), using both the THR (2–4Nm, depending on noise) and RET methods, in 12 men and 13 boys, 21.6±1.6 & 8.7±0.6 years, respectively. Corresponding Tq_{pk} values were 248.3±89.9 & 78.6±30.1Nm. Compared with THR, RET resulted in shorter EMD (by 26.5±9.9 & 29.7±11.4ms in men and boys, respectively; THR–RET p=0.0002), and correspondingly longer $tRTD_{pk}$ (by 34.2±12.8 & 35.5±31.7ms, respectively; THR–RET p<0.0001). The corresponding time-shifts in Tq kinetics were even larger. For example, time to 30%Tq_{pk} increased from 65.5±12.8 in THR to 99.7±17.7ms in RET, (Δ=34.2ms, p<0.0001) in the men, and from 60.2±14.2 to 107.7±22.4ms, respectively (Δ=47.5ms, p<0.0001) in the boys. Notably, the choice of TO-determination method fundamentally affected the boys–men Tq-kinetics differences. Using THR, boys reached 30%Tq_{pk} 5.3ms/8% faster than men, while using RET, they were 8.0ms/8% slower ((Δ=13.3ms/16%, p<0.04). These findings suggest that choice of TO-determination method can have profound effects on key muscle-functional parameters to the extent that men's greater ability to rapidly develop Tq, compared with boys, might go undetected using a traditional THR method. (Funded by CIHR.)

A cross-sectional survey investigating coaches' and parents' expectations and beliefs of an entry-level alpine youth race program

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Coaches plays a pivotal role in skill development of entry-level athletes and subsequently the athlete's parents assist in this outcome by communicating their expectations around their athletes' skill progression. The purpose of this study was to assess expectations and beliefs regarding the outcomes and benefits of an entry-level alpine youth race program comparing coaches (C) and parents (P) living in Southern Alberta. A cross-sectional survey design was employed and a 13-question face validated survey with Likert scale questions was administered on iPads. The main outcomes were to identify the perceptions and expectations that coaches and parents have for their athletes/children specifically regarding goals, expectations, and to identify an appropriate age for competition. Inclusion criteria required the C and P to be coaching or had a child in a race program 7 years old or younger within the last 5 years. A 186 participants from six ski clubs completed the survey (36 C (19.4%), 145 P, and 5 parent/ski coaches (CP)) and their characteristics were: 52% male (M/F, 97/89); 47.8% (n=89) had completed an undergrad degree, 24.7% (n=46) held a master's or professional degree; 76.3% of the participants had experience in alpine skiing (n=142) at least at the recreational level, 30.1% (n=56) at the club level, and 2.2%% (n=4) provincially. Most participants self-reported they had good to excellent knowledge of alpine skiing (n=145, 78%). Frequencies and Fisher Exact Test were used to compare the responses. C, P and CP were in agreement that fun and learning lifelong skills were very important for their children/athletes. There was a difference however in belief between the C and P about how important achieving athlete goals (p=0.001) and improving skills (p=0.007) were. There was also a discrepancy among all of the participants about an exact age that a child should be exposed to competition. Questions regarding the expectations and role of the parents also showed significant differences between the P and C regarding the volunteering commitment of parents (p=0.028) and whether parents should interfere minimally with the coaches (p=0.015). In summary some similarities and differences in beliefs and expectations for coaches and parents of alpine youth race programs have been identified. Further research is needed to create strategies to ensure these expectations can be aligned between the participants so as to ensure the athletes have the best possible environment for training in. (Funding Acknowledgements: Sport Science Association of Alberta.)

CIS athletes' influenza a vaccination knowledge, attitude and practice in Calgary, Alberta

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Athletes may be an increased risk for transmission and contraction of influenza due to their more frequent air travel than non athlete students, increased close contact with others through sport and are more likely to share surfaces such as workout equipment which can act as disease vectors. The influenza vaccine is considered an important method of prevention and due to the increased risk of contraction it is recommended that athletes receive the vaccine. Therefore the study purpose was to assess the knowledge, attitude and practice (KAP) of Canadian Interuniversity Sport (CIS) athletes regarding influenza A vaccination. A cross-sectional survey design was employed and the framework for the survey questionnaire was based on the behavioral theory of the Integrative Model of Behavioral Prediction (IBM). The emailed survey was distributed using SurveyMonkey (SurveyMonkey.com) during January and February of 2014 at the University of Calgary in Alberta. The CIS athletes (N=450, mean age 20.4 ± 2.2 years) response rate was 39.3% (n=177) and a group of non-athlete kinesiology students (21.06 ± 2.7 years of age) were recruited for comparison (n=34) with a response rate of 100% (n=34). A frequency analysis was employed to describe the dependent variables (knowledge, attitude and practice), and athlete and non-athlete student responses were compared through a χ^2 test statistic and Kruskal-Wallis analysis. Respondents were dropped from analysis of questions left blank (Athletes n=8, Non-athletes n=1). Over half of CIS athletes were aware of the safety, effectiveness and side effects of the influenza A vaccination. Non-athlete students had a significantly more positive attitude towards the effects of the vaccine compared to athletes (p<0.05). Athletes were significantly more concerned of contracting the virus due to potential consequences associated with an interruption in training and infection of teammates (p<0.05). Nearly one third (29.2%) of athletes participate in vaccination behaviours. In summary, the vaccination participation of CIS athletes is low when requirements for herd immunity are considered. The findings from this study may inform future intervention strategies required to enhance the knowledge, attitude and engagement of athletes in influenza vaccination behaviours.

Effect of exercise and post-exercise on hepatic insulin signaling

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Exercise induces increased insulin sensitivity in muscles and adipose tissues but its effect on liver insulin signaling still remains unexplained. The objective of this project was to describe hepatic insulin pathway during swimming exercise and post-exercise. Specifically, we characterized the insulin signaling pathway in total liver homogenates by Western Blot. Healthy male Sprague-Dawley rats fed *ad libitum* were randomly divided in the following groups: rest, 90 and 180 minutes exercise and 1, 3, 12 and 24 hours post 180 minutes exercise before animals sacrificed. Rats were accustomed to swimming the week prior to the experiment, to three exercise sessions (15, 30 and 45 min) at one-day intervals. Plasma insulin, glucose and glucagon were measured in blood samples. Liver insulin receptor (IR), insulin receptor substrate 1 (IRS 1), protein kinase B (AKT), protein kinase C (PKC), glycogen synthase kinase 3 (GSK3) and glycogen synthase (GS) were investigated using commercial antibodies. No change was observed in plasma glucose concentration. Insulin concentration was decreased during exercise and returned to baseline in the recovery period. Glucagon concentration was increased with exercise and decreased in the recovery period to return to resting level within 24 hours. During both 90 and 180 minutes of exercise, activation of all analyzed proteins (IR, IRS, AKT, GSK3, GS) was reduced. During recovery, as soon as one hour post-exercise, the inhibition of exercise was relieved. As for PKC, a reduced expression was observed with exercise and was restored during post-exercise. Every measured protein returned to their activated resting levels 24 hours post-exercise. In conclusion, these data suggest that hepatic insulin pathway is shut down during exercise and restore rapidly in post-exercise to achieve resting values within 24 hours. Compared to muscle, insulin sensitivity in liver is not potentiated, but is only restored after an exercise session.

Relationship between academic performance with physical, psychosocial, lifestyle and sociodemographic factors in female undergraduate students

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The purpose of this study was to investigate the relationship between physical, psychosocial, lifestyle and sociodemographic factors with academic performance in female undergraduate students. One hundred undergraduate female students from the Faculty of Science at the University of Quebec at Montreal (UQAM) participated in this study (mean age = 24.4 ± 4.6 years old). All participants provided their university transcript and had to complete at least 45 course credits from their bachelor degree. Body composition (DXA), handgrip strength, maximal oxygen consumption ($\dot{V}O_2$ max) (Bruce Protocol) and blood pressure were measured. Participants also completed a questionnaire on their psychosocial, academic motivation, lifestyle and sociodemographic profile. Participants were then divided into two equal groups (n = 50) based on their grade point average (GPA). The lower 50th percentile represented the lower-GPA group and the top 50th percentile represented the higher-GPA group. Significantly higher handgrip strength, $\dot{V}O_2$ max, social functioning, intrinsic motivation to know values ($p<0.05$) and significantly lower extrinsic identified regulation values ($p<0.05$) were observed in the Higher-GPA group compared to the Lower-GPA group. In addition, a lower tendency for fat mass was noted in the higher-GPA group. Moreover, eating breakfast every morning and being an atheist was positively associated with academic performance ($p<0.05$). A higher tendency for eating 3 or more fruits and vegetables was also observed in the Higher-GPA group. Finally, a stepwise linear regression analysis showed that eating a daily breakfast and $\dot{V}O_2$ max levels explained 15.0% of the variation in the GPA in our cohort. In conclusion, results of the present study indicate that eating a daily breakfast and $\dot{V}O_2$ max levels may predict academic performance in female undergraduate students.

Forearm muscle area and biceps curl strength as related to pQCT derived bone strength of the radius in older women

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To determine whether muscle area and biceps curl strength predict peripheral quantitative computed tomography (pQCT)-derived measures of bone strength in older women. Muscle size is a predictor of radius bone strength; the role of muscle strength is less investigated. We chose biceps curl as the elbow flexors have insertions on the radius, yet have not been studied in relation to bone strength at the clinically relevant radius. Distal (4% of radius length) and shaft (66%) sites of non-dominant arms of 85 postmenopausal women (64.6 ± 4.4y) were scanned using pQCT for determination of forearm muscle area and bone strength indices of BSIc (distal) and SSIp (shaft). Biceps curl predicted 1-repetition maximum (mean ± SD, 8.6 ± 1.5kg) was used to assess biceps strength. We used hierarchical linear regression to assess if adding biceps strength to a base model (height, age and forearm muscle area) would improve prediction of bone strength. The base model predicted 24% and 43% of variance in BSIc and SSIp respectively. Including biceps curl strength did not improve the predictive ability (25% and 43%, $p>0.05$). In our models, standardized β-coefficients were highest for muscle area when predicting BSIc (0.49) and SSIp (0.53). Forearm muscle area is predictive of bone strength at distal and shaft sites of the radius in older women. Interventions aimed at increasing bone strength at the fracture prone forearm in older women should focus on exercises that increase forearm muscle area. (Intervention funded by CIHR.)

Preseason Functional Movement Screen™ score predicts risk of time-loss injury in experienced male rugby union athletes

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The purpose of this study was to determine the relationship between composite Functional Movement Screen™ (FMS) score and the incidence of time-loss injury in experienced rugby union athletes. Preseason FMS scores were collected from 76 male club- and international-level rugby union athletes (21.6±2.7 years) prior to two consecutive competitive 4-month seasons, separated by six weeks. Rugby-related injury data, including mechanism of injury and severity (time lost between injury and return to play) were prospectively collected over the two seasons. A receiver-operator characteristic curve (ROC) was created for each 4-month season to identify FMS cut-off scores associated with incidence of injury. Odds ratios, positive and negative likelihood ratios (+LR, -LR), sensitivity and specificity were determined for both seasons to assess the efficacy of FMS as a predictor of injury risk. Mean FMS scores for the two competitive seasons were not significantly different. Overall mean FMS score for both seasons was 15.3±1.98. A total of 79 and 59 time-loss injuries were sustained in Season One and Two, respectively. In both seasons, mean FMS scores did not differ between injured and uninjured players; however, ROC curves indicated that FMS scores below 15 were significantly associated with injury ($p<0.05$). Odds ratio analyses revealed that when compared to those scoring at least 15, players with FMS scores below 15 were 10.42 times more likely to have sustained injury (+LR =7.08, -LR=0.72, specificity=0.95, sensitivity=0.35) in Season One and 4.97 more likely in Season Two (+LR=3.56, -LR=0.71 specificity=0.90, sensitivity=0.36). The results suggest that experienced male rugby union athletes with preseason FMS scores below 15 are

5-10 times more likely to sustain one or more time-loss injuries in a competitive season when compared to athletes with FMS scores of at least 15. The findings indicate that the quality of fundamental movement, as assessed by the FMS, is predictive of time-loss injury risk in experienced rugby union athletes and should be considered an important preseason player assessment tool.

The metabolic effects of regular exercise in a rodent model of hyperglucocorticoidemia. A comparison with the angiogenic agent prazosin

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Glucocorticoids (GCs) are the most commonly prescribed medications for auto-immune and inflammatory diseases. High dose or chronic usage of GCs can induce severe side effects such as hyperglycemia, skeletal muscle atrophy, reduced muscle capillarization, and intramuscular fat accumulation. Identification of new treatment modalities to target skeletal muscle atrophy and reduced blood supply is imperative in keeping this patient population healthy and active. In healthy rodents, chronic administration of prazosin hydrochloride, an alpha-1 adrenergic receptor antagonist, increases skeletal muscle capillarization, while volitional exercise improves skeletal muscle atrophy and has the added effects of improving glucose tolerance and decreasing skeletal muscle fat deposition. Our lab has developed a rodent model of elevated corticosterone (cort), the main GC in rodents, through the implantation of cort (400mg/rat) or wax pellets in young male Sprague-Dawley rats. To compare the positive effects of both treatments, rats were either provided with voluntary running wheels or given prazosin (50mg/L) in their drinking water for 14-days (n=5-10 per group). Animals assigned running wheels were given one week of wheel acclimation before pellet surgery, while prazosin was administered two days post pellet implantation. Prazosin decreased insulin values after a glucose load by ~43% ($p<0.01$) while exercise improved glucose tolerance by ~30% ($p<0.05$). Skeletal muscle atrophy induced by cort-treatment, as measured by reduced cross-sectional area of type IIb/x fibers within the tibialis anterior muscle, was abrogated with volitional exercise ($p<0.01$) but not with prazosin treatment. Exercise also normalized oxidative capacity in cort-treated animals, as measured by succinate dehydrogenase content ($p<0.05$), which did not occur with prazosin treatment. Conversely, prazosin treatment was able to ameliorate hepatic steatosis induced with cort administration, while exercise did not. This study shows that regular exercise and prazosin ameliorate different deleterious effects of high GCs and suggests that combining exercise and prazosin may be a viable therapeutic option to investigate.

Health and wellness demographics of Newfoundland and Labrador offshore oil and gas workers

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The Canada-Newfoundland and Labrador Offshore Petroleum Board has proposed that fitness goals should be set for offshore workers in acknowledgement of important role that physical fitness plays in their health and safety. Currently, however, the physical fitness of Newfoundland and Labrador offshore oil and gas workers is unknown. The purpose of this ongoing study is therefore to provide baseline measures of the health and well being of the offshore oil and gas workers. Measurements thus far include anthropometrics (height and weight), body composition (body mass index (BMI), waist circumference, and skinfolds) and sit-and-reach. Preliminary data was collected on 47 men with a mean age of 40.9 ± 8.0 years, weight 93.9 ± 13.9 kg, height 174.8 ±26.5 cm, waist circumference 97.1 ± 11.3 cm, body fat percentage 24.9 ± 5.8%, sit-and-reach 24.9 ±11.1 cm and BMI 29.6 ± 4.1. Based on the BMI and waist circumference, the data suggests that the healthy body composition health benefit rating is very good. The Canadian Physical Activity, Fitness and Lifestyle Approach Manual ranks the sit-and-reach data with a mean age of 40 as being good. Positive and significant correlations were found between BMI and weight ($r = .853$, $p < 0.01$), waist circumference ($r = .803$, $p < .01$), and body fat percentage ($r = .779$, $p < 0.01$). There was also a negative and significant correlation between sit-and-reach and waist circumference ($r = -.479$, $p < .05$). Additional measures will include: push-ups, grip strength, partial curl-ups, aerobic fitness (YMCA submaximal cycle ergometer or modified Canadian aerobic fitness test) and behavioural lifestyle assessments (demographics, lifestyle, stress and quality of life). Once the health and well-being of the offshore workers are characterized, programs can be implemented and/or improved to enhance the worker health and reduce the risk of injury.

Nutritional involvement, support, education, and knowledge of head and assistant athletic trainers in the National Hockey League

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This study examined the role of Athletic Trainers (AT) working in the National Hockey League (NHL) in advising, supporting, and influencing hockey players regarding nutrition. ATs (n = 51, all male, 26 head ATs, 25 assistant ATs) from 28 NHL teams completed a 27-question survey over a 20-30 min time period in a meeting setting. Most head ATs surveyed (72%) had over 15 yr of AT experience, while most assistant trainers (75%) had less than 15 yr of experience. Head ATs reported that they played either no role (26%) in team nutrition (handled by strength and conditioning coach (SCC) or registered dietician (RD)), played a secondary role (53%), or worked with the SCC/RD (31%). The assistant trainers were even less involved with team nutrition, as 69% had no involvement, 9% were secondary advisors and 22% worked with the SCC/RD. This was confirmed in a following question where most trainers (70%) indicated that the bulk of nutritional information or advice received by the players came from either a staff SCC or RD. The trainer's nutritional knowledge was strong, with 80% indicating that carbohydrates were the most important fuel source during hockey. Also, 88% of head ATs and 92% of assistant ATs "strongly disagreed" with the statement that, "fluids drank during a game will slow a player down", and 84% of head ATs and 68% of assistant ATs "strongly disagreed" with the statement, "water replaces everything a player loses while sweating". Therefore, although the majority of trainers (88%) reported that nutrition was very important for ice-hockey performance, their involvement was mainly as a secondary advisor, working with or supporting the team's SCC/RD. As most team RDs work on a part-time basis and all teams appeared to have full-time SCC, a nutritional survey is needed with the SC coaches to gain an accurate assessment of their nutritional education, knowledge and interaction with NHL hockey players. (Supported by a Mitacs Accelerate Award and PepsiCo Canada.)

Assessment of SERCA function, muscle contractility, and muscle remodeling in the diaphragm muscles of phospholamban overexpressing mice

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Recent findings from our laboratory revealed that the soleus and gluteus minimus muscles from phospholamban overexpressing mice (Pln^{OE}) accurately recapitulate human autosomal dominant centronuclear myopathy (CNM). Importantly, while diaphragm measures have been studied in murine models of muscular dystrophy and other

neuromuscular models, similar studies have not been conducted in animal models of CNM. Therefore, in this study, we assessed the diaphragm muscles from the *Pln*^{OE} mice with respect to sarco(endo) plasmic reticulum Ca^{2+}-ATPase (SERCA) pump function, muscle contractility, muscle histology, and fibre type distribution and area. To this end, we used 9 male *Pln*^{OE} mice and compared them to 7 male wild-type (WT) littermates. Compared with WT, Ca^{2+}-uptake was reduced (WT = 24.9 ± 1.6 μmol/g protein/min versus *Pln*^{OE} 17.7 ± 2.4 μmol/g protein/min, $p = 0.03$) and there was a trend towards lower maximal SERCA pump activity (WT = 414.6 ± 17.7 μmol/g protein/min versus *Pln*^{OE} 356.5 ± 24.7 μmol/g protein/min, $p = 0.09$) in diaphragm homogenates obtained from *Pln*^{OE} mice. Despite these differences in SERCA function, maximal rates of relaxation at submaximal and maximal frequencies were similar in WT and *Pln*^{OE} mice. Surprisingly, we found that diaphragm muscles from *Pln*^{OE} mice tended ($p = 0.13$) to generate greater force across submaximal and maximal frequencies compared to WT mice. In addition but in contrast to soleus and gluteus minimus muscles, centrally located nuclei were not present in diaphragm cryosections stained with H&E nor was there evidence of type I fibre predominance, which is often observed in CNM. In fact, we observed a shift towards a faster fibre redistribution which when combined with a trend towards type IIA ($p = 0.13$) and type IIX ($p = 0.08$) fibre hypertrophy in the diaphragm muscles from *Pln*^{OE} mice, these findings may partly explain the greater force generating capacity observed in the diaphragms of these mice. In conclusion, our analyses of the diaphragm muscles from *Pln*^{OE} mice provide no indication of respiratory insufficiency, which is consistent with most cases of human autosomal dominant CNM where respiratory function is normal. Future studies will investigate mechanisms leading to these responses in diaphragm muscles from *Pln*^{OE} mice. (Supported by CIHR.)

Association between resting heart rate and clustered cardiovascular risk factors in adolescents

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Resting heart rate (RHR) has been proposed as a simple measure that reflects the integrity of the autonomic nervous system, emerging as an independent predictor of cardiovascular disease and mortality in different cohorts. However, whether the cluster of cardiovascular risk factors is associated with elevated RHR is unknown. The aim of this study was to analyze association between elevated RHR and the clustering of risk factors for cardiovascular disease in a large cohort of adolescents. This cross-sectional study included 4619 adolescents (1830 boys and 2789 girls, aged 14 to 19 years old). RHR and blood pressure was measured using an oscillometric monitor. Overweight was obtained by body mass index. Physical activity level, sedentary behavior and sleep quality were obtained using a questionnaire. The sum of these risk factors was used to analyze the cluster of risk factors. A binary logistic regression modeling was used to analyze association between elevated RHR and cluster of risk factors adjusted for sex and age. Adolescents with overweight (79.4 ± 12.2 vs. 77.3 ± 12.7 beats-1min), high sedentary behavior (78.3 ± 12.4 vs. 77.0 ± 12.8 beats-1min), insufficient physical activity levels (78.3 ± 12.6 vs. 76.3 ± 12.5 beats-1min) and high blood pressure (81.4 ± 15.5 vs. 76.9 ± 11.8 beats-1min) have a higher RHR ($P<0.05$ for all). A significant association between RHR and clustering of cardiovascular risk factors indicated that adolescents with five cardiovascular risk factors aggregated were approximately seven times more likely to have elevated RHR (OR=6.65; IC95%: 2.82-15.69). Elevated RHR was associated with overweight, elevated blood pressure, low physical activity levels and high sedentary behavior. The clustering of these risk factors was associated with more likely to have elevated RHR.

Clamping end-tidal carbon dioxide during graded exercise: a pilot study

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Exercise-induced hyperventilation decreases the partial pressure of end-tidal carbon dioxide (PET_{CO2}), which may decrease cerebral blood flow (CBF) and oxygenation below a critical level that is required to maintain motor output. Therefore, the ability to clamp PET_{CO2} can be beneficial during various experimental exercise paradigms within the areas of neuromuscular, respiratory, and cardiovascular physiology. Although sequential gas delivery (SGD) circuits have been used in the past to clamp PET_{CO2} levels at rest, their design does not allow them to be used during exercise, as they cannot accommodate higher rates of ventilation. With incremental load exercise, PET_{CO2} will tend to decrease in a curvilinear fashion. Our laboratory has constructed a SGD circuit that can maintain PET_{CO2} constant during graded exercise. Subjects completed three 5 min bouts of graded exercise on a cycle ergometer (142 ± 14, 167 ± 14, 192 ± 14 W) while rebreathing through a SGD circuit. Minute ventilation ($\dot{V}_E$) was measured breath-by-breath using a pneumotach connected to the expired limb of the SGD manifold. PET_{CO2} was continuously measured at the mouth at rest and during exercise. At rest PET_{CO2} was 40.7 ± 0.6 mmHg. During the final minute of each exercise bout, $\dot{V}_E$ was 75.3 ± 9.0, 80.5 ± 8.6, 100.4 ± 17.0 L/min while PET_{CO2} was 52.7 ± 1.4, 53.0 ± 1.0, and 51.3 ± 1.5 mmHg respectively. The results of this pilot study indicate that SGD can be used to maintain isocapania with increasing work rates.

The reproducibility and measurement error of isokinetic cycling exercise at a constant rating of perceived exertion

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Exercise at a constant rating of perceived exertion (RPE) has been recently gaining popularity in intervention studies. However, the extent to which measurement error can influence the measurement itself and the interpretation of the data has received little attention, as has the reproducibility of isokinetic cycle exercise at a constant RPE. Therefore the purpose of this study was to determine the technical error of measurement (TEM) associated with constant RPE exercise on an isokinetic ergometer. Following a familiarization session, eight participants performed one 30 min bout of exercise on two separate days. Subjects exercised on an isokinetic cycle ergometer while freely adjusting their power output (PO) to maintain RPE at 5 on Borg's 10-point scale. PO was continuously recorded during each session. The TEM for the initial PO chosen by the subjects, the rate of change in PO over the 30 min and the average PO during the session were 6 W, 0.4 W/min, and 7 W, respectively. In conclusion, with sufficient subject familiarization, the measurement error associated with constant RPE exercise can be minimized to an acceptable level. These findings support the use of this exercise modality in future intervention studies.

Associations between objectively measured physical activity, sedentary time and maternal social support and depression indices

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Adequate social support and mental health are integral components of a healthy pregnancy. We examined the relationships between objectively measured physical activity (PA) in the second trimester and social support and depression scores using the Maternal Social Support Index

(MSSI) and Edinburgh Postnatal Depression Scale (EPDS), respectively. Data was collected from 55 women age 32.51 ± 4.19 years, (Body Mass Index 28.80 ± 6.45 kg/m2) participating in the Maternal Obesity Management (MOM) trial. PA was measured using Actical accelerometers (valid day = 10+ hours wear time, with 4-7 valid days) between weeks 26-28 of pregnancy. Daily minutes of light, moderate, and vigorous PA, as well as sedentary time, were determined and adjusted for variations in wear time. The MSSI and EPDS were administered at the same time point. Spearman and Pearson correlations tested the relationships between PA, MSSI, and EPDS. With respect to MSSI, as social support scores increased, total vigorous physical activity increased (r=0.391, p=0.01). Conversely, as depression scores increased total moderate-to-vigorous PA (MVPA) (r=–0.297, p=0.060) and total MVPA accumulated in 10-min bouts (r=–0.329, p=0.035) decreased. Similarly, as depression scores increased, total sedentary time increased (r=0.476, p=0.002) and total step counts decreased (r=–0.315, p=0.045). Overall, a healthy lifestyle that meets physical activity recommendations during pregnancy was inversely related to an index of poor mental health and positively related to maternal social support. Future research should examine factors that encourage a supportive prenatal environment which removes barriers for PA participation in pregnancy.

Theoretical considerations for muscle energy-savings during distance running

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We have recently demonstrated that the triceps surae muscles energy cost (EC_{TS}) represents a substantial portion of the total metabolic cost of running. EC_{TS} is predictable based on the muscle's force-length-velocity relationships. Therefore, it seems most relevant to evaluate the factors which dictate EC_{TS}, since it is likely these factors which dictate the energy cost of running. This theoretical consideration has not been explored to date. The energy cost of running and medial gastrocnemius morphological (fascicle length) and AT mechanical properties (moment arm, stiffness) were obtained in 46 trained and elite male and female distance runners using ultrasonography and dynamometry. EC_{TS} (kJ·stride^{-1}) at the speed of lactate threshold (sLT) was estimated from AT force, cross-bridge mechanics and energetics and running kinematics and kinetics. To estimate the relative impact of these factors which dictate EC_{TS}, mean values for running speed, body mass, resting fascicle length (L_f), Achilles tendon stiffness and moment arm and maximum isometric plantarflexion torque were obtained. EC_{TS} was calculated across a range (mean ± 1 sd) of values for each independent variable obtained from our subjects. Average sLT was 233 m·min^{-1}. At this speed, EC_{TS} was 219 kJ·stride^{-1}. Fascicle shortening velocity was 0.08 V_{max}. Assessed over the range of speeds and body masses, EC_{TS} varied by a factor of 1.6 and 1.7 for speed and body mass, respectively. The greatest impact on EC_{TS} was AT stiffness, which resulted in a 2.5-fold range in EC_{TS}. Increases in AT stiffness were associated with an increase in fascicle shortening velocity (3.8-fold, from 0.05 to 0.19 V_{max}) and muscle activation (1.4-fold). AT moment arm had a small (1.1-fold) impact on EC_{TS}. While L_f and MVC torque themselves did not dictate EC_{TS} directly, increases in both factors were associated with a reduction in the required level of muscle activationto run a given speed. These results further support the notion that high AT stiffness helps to reduce the energy cost of running by reducing EC_{TS}. EC_{TS} is minimal when the amount and velocity of muscle shortening is reduced, minimizing the required level of muscle activation. (Supported by NSERC.)

Supraspinal and spinal contributions to biceps brachii activity during arm cycling are cadence and phase-dependent

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The purpose of this study was to examine the influence of increasing workloads and pedalling frequencies on corticospinal excitability of the biceps brachii during arm cycling. Ten male volunteers (24.3 ± 5.4 years of age, 177.8 ± 5.73cm, 81.7 ± 7.3kg) partook in this experiment. Participants were seated in front of an arm cycle ergometer and held securely in place by shoulder straps. Surface EMG was recorded from the biceps brachii, triceps brachii, anterior deltoid and the brachioradialis. To assess changes in corticospinal excitability, motor evoked potentials (MEPs) were elicited via transcranial magnetic stimulation (TMS) of the motor cortex. To measure changes in spinal excitability, cervicomedullary evoked potentials (CMEPs) were elicited via transmastoid electrical stimulation (TMES) of the descending corticospinal tract. Responses were evoked at two crank positions; 6 and 12 o'clock, relative to a clock face of the dominant arm. Each position was assessed during three velocity trials (30, 60 and 90RPM at 20W) and four workload trials (10, 20, 30 and 40W at 60RPM). MEPs significantly increased with increasing velocity and workload at both crank positions. CMEPs significantly increased at the 6 o'clock crank position with increasing velocity, but significantly decreased at the 12 o'clock position. CMEPs showed no change with varying workloads. This data indicates that supraspinal excitability increases as an effect of cycling velocity and workload while changes in spinal excitability with different velocities appear to be phase-dependent. Previous findings suggest that this may be due to velocity-dependent reciprocal inhibition.

The skeletal muscle metaboreflex in ischaemic heart disease and the role of cardiac rehabilitation: preliminary findings

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Sympathetic overactivation exerts pathological pleiotropic effects in many chronic conditions including ischaemic heart disease (IHD) and heart failure (HF). In HF, the presence and contribution of the skeletal muscle metaboreflex to sympathetic overactivity has been documented. However, the presence and magnitude of the skeletal muscle metaboreflex in individuals with IHD but without HF is unknown. Furthermore, the effects of traditional exercise-based cardiac rehabilitation (CR) on this muscle metaboreflex are unknown. The purpose of the current study was to test the hypotheses that individuals with IHD have an overactive metaboreflex in comparison to age-matched healthy controls and that cardiac rehabilitation alters this response. Blood pressure (BP) and heart rate (HR) responses to a 2-minute 30% isometric handgrip (IHG) exercise followed by 2-minutes of post-handgrip occlusion (PHGO) were recorded in all participants at baseline, and following 6-months of cardiac rehabilitation in individuals with IHD. Our preliminary findings suggest that in comparison to an age-matched control (61 years), individuals with IHD (n = 6; 62.8 ± 10.1 years) exhibit augmented BP and HR increases in response to both IHG (Δmean arterial pressure (MAP): 14 ± 11 mmHg vs. 4 mmHg; ΔHR: 9 ± 9 bpm vs. 4 bpm) and PHGO (ΔMAP: 9 ± 6 mmHg vs. 2 mmHg; ΔHR: 2 ± 2 bpm vs. 1 bpm), highlighting a possibly overactive metaboreflex in IHD. In the 3 individuals with IHD who have completed the CR program, all BP and HR responses to IHG and PHGO were unchanged (all $P > 0.05$). This pilot data suggests that individuals with IHD without HF may have an overactive metaboreflex response to IHG exercise, and that 6-months of CR appears to have no effect on the metaboreflex. Further research examining the contribution of the metaboreflex to sympathetic overactivity in IHD is warranted.

Resveratrol and metformin combination therapy in high fat diet-induced insulin resistant mice

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Resveratrol (RSV), a polyphenol found in the skin of red grapes, has recently attracted attention due to proposed beneficial effects on insulin sensitivity. Previous work in our lab has identified protective effects of RSV against the development of type 2 diabetes in rats, in a manner

analogous to the anti-diabetic medication thiazolidinediones (TZDs). TZDs are normally prescribed in combination with another anti-diabetic drug, metformin (MET). Therefore, we sought to examine the combined effects of RSV and MET in treating insulin resistance. C57BL6 mice were fed a low (10% Kcals) or high fat diet (HFD; 60% Kcals from fat) for 8-9 weeks, at which point the HFD group had become glucose and insulin intolerant. HFD mice were separated into control (HFD), MET (~230 mg/kg BW/day), RSV (~100 mg/kg BW/day), or combined (COMB; MET ~230 mg/kg BW/day + RSV ~100 mg/kg BW/day) groups. With the exception of the low fat diet group ($p<0.01$ compared to all groups), no differences were observed in daily food consumption or body weight between groups ($p>0.05$). 4 weeks post-drug, glucose tolerance was improved in MET and trended towards improvement in COMB when compared to the HFD group ($p<0.05$ and $p=0.07$ respectively). Likewise, insulin tolerance was improved significantly in the MET and COMB groups compared to the HFD ($p<0.01$). RSV did not appear to have a beneficial effect on either glucose or insulin tolerance when given separately or in conjunction with MET. In contrast to previous evidence that RSV protects against the development of insulin resistance, our results suggest that RSV does not provide a treatment effect after insulin resistance has already been established. Moreover, RSV does not appear to provide an additive beneficial effect when given in conjunction with MET in a mouse model of insulin resistance.

Dual ablation of phospholamban and sarcolipin enhance skeletal muscle contractility

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The functionally homologous proteins phospholamban (PLN) and sarcolipin (SLN) are each capable of binding to the sarco(endo)plasmic reticulum Ca^{2+}-ATPase (SERCA) pump to regulate its activity, reducing SERCA's apparent Ca^{2+} affinity and the rate of Ca^{2+} uptake. Single gene knock out (KO) models for these proteins have demonstrated their inhibitory function reduces contractility of striated muscle. Given that the presence of both PLN and SLN results in super-inhibition of SERCA and that co-expression of PLN and SLN in human skeletal muscle fibers occurs, it was of interest to characterize the skeletal muscle contractile phenotype in their complete absence. Soleus (SOL) and extensor digitorum longus (EDL) muscles were excised from male (n = 8/group) double KO (DKO: $Pln^{-/-}Sln^{-/-}$) and wild-type (WT: $Pln^{+/+}Sln^{+/+}$) mice and mounted on a force transducer for the measurement of isometric twitch properties and force-frequency curves. Within the SOL, the maximal rate of twitch force decline (i.e. −dF/dt) was ~1.3X faster ($P < 0.05$) in DKO animals, while the maximal rate of twitch force production (i.e. +dF/dt) remained unchanged. Within the EDL, −dF/dt tended ($P = 0.07$) to be faster, while +dF/dt was ~1.2X faster ($P < 005$) in DKO mice. Additionally, tetanic force production was greater ($P < 0.05$) in the SOL of DKO animals at high stimulation frequencies (100-150 Hz), and in the EDL across most stimulation frequencies (20-150 Hz), which is consistent with greater SOL ($P < 0.005$) and EDL ($P < 0.01$) fiber cross sectional area in these animals. These findings suggest that improvement of SERCA function through removal of dual PLN/SLN-induced inhibition enhances isometric force properties within slow- and fast-twitch skeletal muscle and results in muscle remodeling.

The effects of exercising in diesel exhaust on endothelin-1, P-selectin, and E-selectin

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Outdoor exercisers are frequently exposed to air pollution. The effects of exercising in air pollution on markers of vascular health and how these effects are modulated by exercise intensity, is poorly understood. The purpose of this study was to determine the effects of low- and high-intensity cycling with diesel exhaust (DE) exposure on circulating endothelin-1, P-selectin, and E-selectin. Eighteen males aged 24.5±6.2 yrs performed 30- minute bouts of rest, low-intensity (30% of power at $\dot{V}O_2$peak) and high-intensity (60% of power at $\dot{V}O_2$peak) cycling. For each subject, each trial was performed once while breathing filtered air (FA) and once while breathing DE (300ug/m3 of PM2.5). Blood was sampled pre-exercise and immediately, 1 hour and 2 hours post-exercise. Data were analyzed as the percentage change from baseline (deltapre-post, deltapre-1h, deltapre-2h) using repeated-measures ANOVA. There was an exposure-by-intensity-by-time interaction for P-selectin and E-selectin; however, for P-selectin post hoc analysis did not reveal significant differences. *Post hoc* analysis revealed that on resting days, the changes in Eselectin were significantly different between DE and FA (deltapre-post -5.6% vs. +8.5%, p=0.001; deltapre-1h -6.6% vs. +3.8%, p=0.009, for DE and FA respectively). This effect did not occur during high- or low-intensity cycling. The increase in endothelin-1 at 2 hours post-exercise in DE was significantly less than in FA (exposure-by-time interaction: 16.6% vs. 26.6%; p=0.035). These data suggest that exposure to DE may alter the typical response of endothelin-1 and E-selectin. A reduction in the amount of circulating E-selectin and endothelin-1 may suggest that more of the markers are adhering to the vascular wall, and thus could be playing a role in vasoconstriction and inflammation. These data do not support the hypothesis that exercise intensity will exacerbate the physiological reponse to air pollution.

The pulmonary and systemic inflammatory responses to low- and high-intensity cycling in diesel exhaust

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Outdoor exercisers are frequently exposed to air pollution. The effects of combined exercise and air pollution on pulmonary and systemic inflammation and how these effects are modulated by exercise intensity, is poorly understood. The purpose of this study was to determine the effects to low-intensity and high-intensity cycling with diesel exhaust (DE) exposure on pulmonary and systemic inflammation. Eighteen males aged 24.5±6.2 yrs performed 30-minute trials of low (30% of power at $\dot{V}O_2$peak) and high-intensity (60% of power at $\dot{V}O_2$peak) cycling along with a resting control condition. For each subject, each trial was performed once breathing filtered air (FA) and once breathing DE (300ug/m3 of PM2.5) for a total of six trials. Prior to, immediately following, and 1 hour, and 2 hours post-exposure, complete blood count and fraction of exhaled nitric oxide (FeNO) were measured. Data were analyzed using repeated-measures ANOVA. There was an exposure-by-intensity-by-time interaction for FeNO, which showed that following high-intensity cycling FeNO significantly increased (FA: 19.9 vs. 22.7 ppb for pre and post exercise, p=0.048; DE: 19.3 vs. 21.9 ppb for pre and 1 h post exercise, p=0.024); however, this response was not different between DE and FA. There were no main effects of exposure on complete blood count; however, there was a trend towards an increase in platelets in DE compared to FA (210 vs. 206 giga·L-1, p=0.086). There was a significant intensity-by-time interaction for white blood cells, neutrophils and monocytes ($p<0.005$), which increased over time and this increase was intensity-dependent with greater increases over time seen with high-intensity exercise. Exposure to DE did not modify this response. These data suggest the typical pulmonary and systemic inflammatory responses to exercise are not modified by DE, and that exercise intensity does not potentiate the effects of DE on pulmonary and systemic inflammation.

Performance at a fixed mechanical or metabolic power during near maximal exercise to exhaustion: comparison of the ventilatory response

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The mechanical power output (PO) eliciting maximal oxygen consumption ($\dot{V}O_2$max) can be sustained ~6-7 min. However, because of $\dot{V}O_2$ drift at high PO, $\dot{V}O_2$max or near $\dot{V}O_2$max can be sustained much longer if PO is progressively reduced until exhaustion. This probably mimics the pacing strategy in competitive events lasting ~10-30 min. The purpose of the present study was to compare the ventilatory response during exercise at constant PO (CPO) corresponding to $\dot{V}O_2$max with that elicited by exercise to exhaustion at progressively decreasing PO (DPO). $\dot{V}O_2$max and the corresponding PO (POmax) were determined (58.7±5.2 mL·kg^{-1}·min^{-1} and 340±32 W) in 8 healthy active male cyclists (30.3±7.1 years; 73.2±5.4 kg). POmax was sustained until exhaustion for CPO, while in DPO, subjects started cycling at POmax until they reached $\dot{V}O_2$max (~3 min). PO was then progressively decreased in order to maintain $\dot{V}O_2$ near $\dot{V}O_2$max until exhaustion (95.3±3.3%$\dot{V}O_2$max). Time to exhaustion (900±384 vs 454±100 s), work completed (278±109 vs 155±38 kJ) and total O_2 consumption (60.5±25.5 vs 30.7±7.5 L) were higher in DPO (p<0.01). Minute ventilation increased until the end of CPO (155±21 L·min^{-1}), while it first increased and thereafter stabilized at a lower (p<0.01) end-value during DPO (141±21 L·min^{-1}). Breathing frequency continuously increased up to the end of both DPO and CPO (49.0±9 vs 50.1±10 breath·min^{-1}, respectively) while tidal volume increased at the beginning of both DPO and CPO, and thereafter decreased until the end of exercise (2.92±0.36 vs 3.16±0.41 L, in DPO and CPO respectively, p<0.05). The shallower breathing pattern observed at the end of DPO could be related to a greater respiratory muscle fatigue. In both DPO and CPO, the respiratory exchange ratio increased until about 150s, and thereafter decreased until the end of the tests, being significantly lower in DPO than in CPO (1.00±0.03 vs 1.09±0.03, respectively, p<0.001) indicating a compensatory ventilation of metabolic acidosis and a depletion of the bicarbonate pool, which is greater with the longer duration of DPO.

Investigating the effects of dual-task gait training and aerobic exercise on cognition and vascular health in older adults with cognitive impairment, no dementia (CIND)

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Cognitive impairment, no dementia (CIND) is an increasingly prevalent transitional stage between normal cognition and dementia. A substantial modifiable risk factor for cognitive decline is cardiovascular disease; atherosclerosis and hypertension are strongly associated with the risk of cognitive impairment. Current treatment recommendations for cardiovascular disease include aerobic exercise prescription. The association between cardiovascular health and cognitive health suggests that exercise might also serve as an effective method to abate cognitive decline in aging. Although exercise and cognitive training can benefit cognition in older adults with and without CIND, a specific modality has yet to be endorsed. This non-blinded experimental case series investigated the impact of dual-task gait training and aerobic exercise (DAE) on cognition and vascular health in older adults with CIND. Thirty-three participants (72 ± 7 years, mean ± SD; 48% female) with CIND (Montreal Cognitive Assessment score 24 ± 2.2, Mini-Mental State Examination score 28 ± 1) were recruited to a laboratory-based DAE program, which consisted of 15 minutes of dual-task gait training and 15 minutes of moderate intensity aerobic exercise, 3 times/week for 24-weeks. Participants were assessed at baseline (V0), interim (V1: 12-weeks), and intervention endpoint (V2: 24-weeks). Outcomes included 1) cognition: executive function [Trail-Making Tests (TMT) Part A & B]; attention [Digit-Symbol Coding (DSC) task]; memory (Auditory Verbal Learning Test), and 2) vascular health: carotid arterial compliance (B-mode ultrasonography); 24-hour ambulatory blood pressure (ABP). Repeated-measures ANOVA and post hoc tests (or Friedman test and Wilcoxon-ranked sign tests with Bonferroni corrections) revealed significant improvements following exercise training in 1) attention: DSC (V0: 53 ± 14 vs. V2: 56 ± 15, p=.03) and 2) memory: specifically, AVLT immediate recall [V0: 6.0 (4-10) vs. V2: 9 (6-13), p<.001; median (Interquartile range)], delayed recall (V0: 7 ± 3 vs. V2: 9 ± 4, p<.001), and total learning (V0: 39 ± 8 vs. V2: 50 ± 11, p<.001). Changes in carotid arterial compliance and 24-hour ABP remained non-significant (all p>.05). These observations suggest that 24-weeks of DAE can significantly improve attention and memory in older adults with CIND. However, these improvements were not accompanied by significant improvements in executive functioning, or reductions in ABP and arterial stiffness. Further investigations that include a larger sample and a cognitively-healthy control group may be required to determine whether DAE can improve executive function and vascular health in this population. (Supported by CIHR Grant #130474 and a Fellowship from the St. Joseph's Health Care Foundation.)

Unilateral isometric muscle fatigue decreases force production and activation of contralateral knee extensors but not elbow flexors

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Non-local muscle fatigue occurs when fatiguing one muscle alters performance of another rested muscle. The purpose of the study was to investigate if fatiguing 2 separate muscles would affect the same rested muscle, and if fatiguing the same muscle would affect 2 separate muscles. Twenty-one trained males participated in two studies (n=11; n=10). Subjects performed 2 pre-test maximum voluntary contractions (MVC) with the non-dominant knee-extensors. Thereafter they performed two 100s MVCs with their dominant knee-extensors, elbow flexors, or rested. Between and after the sets, a single MVC with the non-dominant rested knee-extensors was performed. Consequently, 12 non-dominant knee extensors repeated MVCs were completed. Force, quadriceps voluntary activation (VA) and electromyography (EMG) were measured. The same protocol was employed in study 2 except the non-dominant elbow-flexors were tested. *Study 1* = Compared to control conditions, a significant decrease in non-dominant knee-extensors force, EMG, and VA was found under both fatiguing conditions (P ≤ 0.05; ES= 0.55-1.2; 4-9%). Additionally, decrements in all variables were found from the first post intervention MVC to the last (P ≤ 0.05; ES= 0.82-2.4; 9-20%). *Study 2*= No differences were found between conditions for all variables (P ≥ 0.33; ES ≤ 0.2; ≤ 3%). However, all variables decreased from the first post intervention MVC to the last (P ≤ 0.05; ES= 0.4-3; 7.2-19.7%). Whereas the rested knee-extensors demonstrated non-local effects regardless of the muscle being fatigued, the elbow-flexors remained unaffected. This suggests that non-local effects are muscle specific, which may hold functional implications for training and performance.

Obesity alters plantar sole sensitivity

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Obesity is associated with reduced balance control. One of the mechanisms thought responsible for this reduced balance control is of a sensorimotor nature. The sensorimotor hypothesis proposes that the increased body mass of obesity impacts the sensitivity of the plantar sole (due to increased pressure) and this change in sensitivity reduces sensory feedback which results in reduced balance control. The objective of this cross-sectional study was to verify the plantar sole sensi-

tivity in lighter weight individuals and obese individuals during upright standing and also to verify how varying postures influences the plantar sole sensitivity. Our general hypothesis is increased pressure on the plantar sole will reduce plantar sole sensitivity. In order to test our hypothesis, we recruited fifteen lighter weight males (height 177±5cm, weight 79.9±6.9kg, BMI 25.5±2.0 kg/m^2, age 23.0±3.6 years) and seven obese males (height 180±3cm, weight 105.2±17.6kg, BMI 32.4±4.8 kg/m^2, age 26.7±3.3 years). Plantar sole sensitivity was determined via a psychophysical approach which was an adaptation of the Bekesy 'yes-no' method of limits (reverse staircase). A custom designed experimental force platform was used to measure plantar sole sensitivity. Participants in both groups performed three different body postures (normal, backward and forward). Plantar sole pressure was tested under the heel. All conditions were randomly presented for all subjects in both groups. Repeated measure analysis was performed ("group"(2) x "body postures"(3)) with the dependent variable being plantar sole sensitivity. A log transformation was performed on the data due to non-normality. Results indicate a significant main effect of "group" ($F(1,20)=4.96$, $p=0.037$) and "body postures" ($F(2,40)= 12.00$, $p=0.00008$). The main results in this analysis indicate that increased pressure on the plantar sole affects the sensitivity. Furthermore, there is a significant difference between lighter weight individuals and obese individuals in plantar sole sensitivity and between different postures. These preliminary data potentially identify an underlying sensorimotor mechanism that partially explains the observed association that increased body weight is a factor that influences balance control.

The mechanism underlying the hypotensive effect of isometric handgrip training: is it cardiac output mediated?

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Isometric handgrip (IHG) training lowers blood pressure (BP) in normotensive individuals yet the mechanisms remain equivocal, and some evidence suggests that men and women respond differently to training. To date, non-sex specific mechanisms influencing total peripheral resistance, either in response to a single IHG bout or with training, have been a primary research focus, and the effects of acute and chronic IHG on cardiac output (Q) in either sex are underexplored. The purpose of the current study was two-fold: 1) to investigate the effects of IHG training (4, 2-minute sustained bilateral isometric contractions at 30% of maximal contraction, 1-minute rest between, 3X/week for 10 weeks) on resting Q, and 2) to examine the Q response to an IHG bout, and the effects of training on this response. Resting BP (Dinamap Carescape v100, Critikon) was measured after 10 minutes of seated rest in twenty-two normotensive participants (10 women; mean age=24 ± 5.0 years). To assess Q, aortic root diameter (ARD; 3S-RS probe; Vivid I, GE Healthcare), velocity-timed integral (VTI; P2D probe; Vivid I), and HR (Dinamap) were measured pre- and post- an IHG bout. Both variables were re-assessed post-training. Reductions in resting systolic BP of a similar magnitude ($p>0.05$) were observed in both men (2.4 ± 6.2 mmHg) and women (2.9 ± 4.6 mmHg) following 10 weeks of training ($p=0.04$). This was accompanied by reductions in resting Q ($p=0.007$) in both men (6.6 ± 2.2 to 6.3 ± 1.8 L/min) and women (5.8 ± 0.7 to 5.1 ± 0.8 L/min) and reductions in HR ($p=0.036$), both of which were similar between sexes (all $p>0.05$). In both groups, no changes in Q were observed in response to an IHG bout, and this response was similar pre- and post- training (all $p>0.05$). In conclusion, resting Q is reduced with training, potentially implicating it as a mechanism of post-training BP reductions. The acute response to an IHG bout remains unchanged with training.

Do outdoor daycares increase physical activity?

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More than half of Canadian preschool age children between the ages of 6 months and 5 years spend considerable time in non-parental care, averaging 29 hours/week. The daycare environment could thus be an optimal environment for promoting physical activity (PA). Recently, a new form of daycare environment has evolved that is entirely outdoors in contrast to traditional, indoor based care. The purpose of this pilot analysis was to examine the physical activity behaviours in traditional and outdoor style of daycare. Two traditional, indoor based daycare centres were used as a comparison against a non-traditional, entirely outdoor centre. Analyses included 44 children (24 male, 20 female) ranging from 3 to 6 years of age. PA behaviour was captured using Actical™ accelerometers. Valid days were classified as those with a minimum of 5 hrs/day and were included in the analysis if the participant had a minimum of 3 valid days/week. Daily step counts, light PA (LPA), moderate-to-vigorous PA (MVPA) and sedentary behaviour (SED), all in min/day, were evaluated. Potential differences were evaluated using an analysis of covariance (ANCOVA) to account for participant wear time. Preliminary findings showed no significant differences in LPA or MVPA. Children at the indoor centres averaged 68.37 ± 23.72 min/d MVPA, while the outdoor group averaged 68.63 ± 23.65 min/d of MVPA. Step counts were also similar between centres with the indoor centres averaging 9539.91 ± 4105.76 steps/d while the outdoor centre averaged 10295.71 ± 4083.92. There were also no differences in sedentary behaviour between centres with 408.21 ± 33.97 min/d vs. indoor centre at 412.05 ± 34.07 min/d for the outdoor and indoor centre respectively. While no differences were found between PA behaviours in children enrolled in indoor-based vs. outdoor-based daycare centres, the study was limited by the fact that the children attending the outdoor centre did so on a part-time basis with the balance of their PA being collected external to the outdoor daycare. Further analysis of outdoor based centres with greater wear time in the outdoor environment is warranted.

Whey protein supplementation preserves postprandial muscle protein synthesis during short term energy restriction in overweight/obese adults

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Increased protein intake during diet-induced weight loss results in improved lean mass retention and fat mass loss. The physiological mechanism for this effect and the impact of protein quality on body composition during weight loss are uninvestigated. The aim of this study was to assess the mechanisms by which different quality proteins (whey or soy) affect muscle protein synthesis (MPS), whole-body lipolysis and body composition during a short term hypoenergetic diet. Forty adult men and women (35-65 years, BMI 28-50) completed a 14-d hypoenergetic diet while being supplemented twice daily with whey or soy protein, or carbohydrate control. Before and after the dietary intervention participants completed an infusion trial with a primed continuous infusion of L-[*ring*-$^{13}C_6$] phenylalanine and [$^2H_5$]-glycerol to measure postabsorptive and postprandial (following whey, soy or carbohydrate ingestion) rates of MPS and whole body lipolysis. Changes in fat and lean mass were measured by DXA. Before weight loss, postprandial MPS rates were stimulated to a greater extent following ingestion of whey protein than soy and carbohydrate. Following the 14-d weight loss, the postabsorptive rates of MPS decreased by 15±13% in the whey group, 26±13% in soy and 19.6±13% in the carbohydrate groups $P>0.05$. Postprandial rates of MPS were reduced by 8.6±0.7% in the whey

group, which was significantly less than the reduction in soy (28±5%) and carbohydrate groups (31±5%, P=0.013) following the 14-day weight loss. Whole body lipolysis was suppressed with feeding, but responded to whey and soy supplementation in the same manner before and after the 14-day intervention. Total weight loss (-2.29±0.18 kg), fat mass loss (-1.19±0.16 kg) and lean mass loss (-0.81±0.24 kg) did not differ between groups. These results demonstrate the impact of protein quality on MPS during energy restriction, and may be of importance in the development of nutritional strategies to promote lean mass retention during weight loss.

Sedentary behaviour in adults across Canada: a descriptive analysis

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While cross-Canada variations in both physical activity and weight status have been illustrated, less knowledge exists regarding the sedentary behaviour of Canadians. The aim was to describe sedentary behaviours and their correlates among adults across Canada. Cross-sectional data from the 2011-2012 Canadian Community Health Survey included >75,000 participants aged 18-64 years, representative of >20M Canadian adults. TV/video, computer, video game and reading time were self-reported. Associations with geographic, demographic and individual health characteristics were examined. About 52% of Canadian men and 48% of women reported >2 hrs/day screen time, while women reported more time spent reading ($p < 0.05$). Higher total screen time was reported by individuals from the provinces of NS, BC and YK/NW/YT, and who were younger, single, obese, inactive, less educated, recent immigrants, and employed in sales/services occupations (all $p < 0.05$). High levels of screen time were also associated with consuming fewer fruits and vegetables, having a recent injury (past 12 mos), and lower perceived life stress (all $p < 0.05$). Lower screen time was reported by individuals residing in the provinces of QC, MB and SK and those perceiving their weight to be "about right" (all $p < 0.05$). Active individuals reported lower TV time ($p < 0.05$) but no difference in computer time compared to inactive individuals. Recent immigrants (0-9 yrs) reported lower TV time but higher computer time than longer term immigrants ($p < 0.05$). Higher reading time was reported by individuals who were older, married, active, employed in "white collar" jobs, and who consumed more fruits and vegetables, while lower reading time was reported by individuals residing in the provinces of NF, NB and QC and who were inactive (all $p < 0.05$). Sedentary behaviours in Canada are variously associated with age, sex, province of residence, marital status, weight status, physical activity, nutrition habits, employment, life stress and immigrant status. These findings suggest that public health interventions targeting sedentary behaviours should be tailored to meet the needs of the specific population of interest.

Using mathematical modelling to identify the upper and lower boundaries of the severe exercise intensity domain

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The purpose of this study was to use mathematical modelling to identify the range of speeds over which $\dot{V}O_{2max}$ can be elicited, i.e., the upper and lower boundaries of the severe-intensity domain. Twenty-five university students (mean ± SD: age, 24 ± 2 yr) performed five exhaustive treadmill tests at various speeds, with no test lasting less than 2½ min and none lasting longer than 16 min. Modelling the individual two-parameter hyperbolic relationships between speed and time to exhaustion generated values for critical speed (CS), which is widely-accepted (albeit based on little research evidence) to be the threshold intensity above which $\dot{V}O_{2max}$ can be elicited, i.e., to demarcate the heavy- and severe-intensity domains. Modelling the individual three-parameter hyperbolic relationships between speed and time to achieve $\dot{V}O_{2max}$ generated values for CS′, which by definition is the threshold intensity above which $\dot{V}O_{2max}$ can be elicited. The values for CS (180 ± 23 m·min^{-1}) and CS′ (180 ± 22 m·min^{-1}) were not statistically different and were highly correlated ($r = 0.97$, $P < 0.01$). The two relationships were solved to calculate the highest speed at which $\dot{V}O_{2max}$ can be elicited, i.e., the upper boundary of the severe-intensity domain. This highest speed (304 ± 46 m·min^{-1}) was associated with an exercise duration of 100 ± 9 s, which was verified by solving the linear relationships between time to exhaustion and time to $\dot{V}O_{2max}$. These results demonstrate that the range of speeds over which $\dot{V}O_{2max}$ can be elicited can be identified using the results of a series of exhaustive running tests.

An examination of an alternate method of stimulus delivery when performing interpolated twitch to estimate muscle voluntary activation

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The interpolated twitch technique is a widely used method of assessing muscle voluntary activation. The approach involves delivering an electrical stimulus while a maximal voluntary contraction (MVC) is performed. If the muscle is not fully activated when stimulated then additional force will be generated. The magnitude of this force increase is used to quantify the degree of voluntary activation (%VA). Typically the stimulus is delivered either when force level plateaus or a set time period post onset of muscle contraction. This study examined an approach for interpolated twitch that has recently been suggested to improve precision of the technique. For this method, stimuli were delivered once force produced by participants reached 97% of their previously recorded MVC force. The purpose of the study was to determine whether this automatic force based triggering method improved the stimulus delivery precision and also to determine its effect on calculated %VA. The %VA of the quadriceps was determined in 15 male volunteers using two different methods. One method was the force triggered approach which had the stimulus being automatically triggered when participant's knee extension force reached 97% of their MVC force. For the second the stimuli were delivered when knee extension force level plateaued. The %VA for both methods, as well as the precision of stimulus delivery (i.e. how close the force at stimulus delivery was to the participants previously recorded MVC), were determined and compared using paired t-tests. Results indicated that the force based trigger method resulted in stimuli being delivered within 1% of the participants MVC, while for the force plateau method the force at which the stimulus was delivered was 94% of MVC. This difference was statistically significant. Similarly, %VA was an average of 3% greater when the force triggered approach was used –again this difference was significant. Although %VA increases were relatively small, it is important to note that in several subjects the activations determined with the two methods differed by upwards of 5%. These results suggest that using a force triggered method to deliver stimuli when using interpolated twitch will improve the precision of the approach and therefore may help reduce some of the variability associated with using the experimental approach.

Trunk extensor fatigue decreases jump height similarly under stable and unstable conditions with experienced jumpers

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The purpose of this study was to investigate the effects of back extensor fatigue on performance measures and electromyographic (EMG) activity of leg and trunk muscles during jumping on stable and unsta-

ble surfaces. Before and after a modified Beiring-Sorensen fatigue protocol for the back extensors, countermovement (CMJ) and lateral jumps (LJ) were performed on a force plate under stable and unstable (balance pad on the force plate) conditions. Performance measures for LJ (contact time) and CMJ height and leg and trunk muscles EMG activity were tested in 14 male experienced jumpers during 2 time intervals for CMJ (braking phase, push-off phase) and 5 intervals for LJ (-30-0, 0–30, 30-60, 60-90, and 90-120 ms) in non-fatigued and fatigued conditions. A significant main effect of test (fatigue) (p=.007, f=0.57) was observed for CMJ height. EMG analysis showed a significant fatigue-induced decrease in biceps femoris and gastrocnemius activity with CMJ (p=.008, f=0.58 & p=.04, f=0.422; respectively). LJ contact time was not affected by fatigue or surface interaction. EMG activity was significantly lower in the tibialis anterior with LJ following fatigue (p=.05, f=.405). A test x surface (p=.04, f=.438) interaction revealed that the non-fatigued unstable CMJ gastrocnemius EMG activity was lower than the non-fatigued stable condition during the onset of force phase. The findings revealed that fatiguing the trunk negatively impacts CMJ height and muscle activity during the performance of CMJs. However, skilled jumpers are not additionally affected by a moderately unstable surface as compared to a stable surface.

Muscle activity and physical activity responses during functional tasks in non-frail, pre-frail, and frail older adults

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Identifying the progression of frailty is essential to mitigate physical impairments associated with aging. The purpose of this study was to evaluate differences in electromyography (EMG) and physical activity (PA) between middle-aged, non-frail, pre-frail, and frail older adults during a set of progressive functional tasks, synonymous with activities of daily living (ADL). Fifteen middle-aged (49 ± 5 years), and seventy-six older adults (77 ± 8 years) participated in this study. Older adults were categorized as non-frail (n=49), pre-frail (n=20) and frail (n=7) based-upon gait speed and modified frailty index score. EMG bursts and gaps were measured in the biceps *brachii*, triceps *brachii*, *vastus lateralis*, and biceps *femoris* bilaterally as participants completed each functional task. Nine functional tasks were performed in order of difficulty from easiest, to more challenging, to most difficult and included: (1) Standing-up from a chair; (2) Rising from a toilet; (3) Standing up from the floor; (4) Dressing and undressing a buttoned shirt; (5) Transferring a load of laundry between front loading washing machine and dryer; (6) Carrying a load of laundry up a set of stairs; (7) Eating a bowl of soup; (8) Preparing a light meal; and (9) Loading, carrying and unloading groceries onto a shelf. Increases in burst activity and decreases in gaps occurred with each progression of the functional task ($p < 0.001$) and as the participant transitioned from non-frail to frail ($p < 0.001$). Physical activity counts increased as the task became more challenging ($p < 0.001$), and PA counts were less in frail than non-frail older adults ($p < 0.05$). Results corroborate previous investigations reporting that burst activity increased and gaps decreased as person's transitioned from non-frail to frail. However, this is the first study to assess EMG and PA across progressive functional tasks, where EMG burst activity increased and gaps decreased as tasks became more challenging. The differences seen in PA, burst activity, and gaps were able to successfully discriminate stages of frailty in older adults.

Muscle oxygenation and aerobic metabolism during HIIT bodyweight squat exercise in comparison to continuous cycling

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The purpose of this study was to evaluate muscle oxygenation, cardiorespiratory, and blood lactate responses to an acute bout of a novel high intensity interval training (HIIT) bodyweight squat protocol in comparison to moderate intensity cycling exercise (MOD). On separate days, within a two week period, 15 recreationally active males (28 ± 4.6 years) performed: 1) incremental test to exhaustion on a cycle ergometer, 2) 30-minutes of moderate intensity cycling (MOD; 65% $\dot{V}O_2$max), and 3) HIIT consisting of 8 x 20 seconds of bodyweight squats performed at maximal cadence with 10-s rest intervals. During each exercise condition, oxygen consumption ($\dot{V}O_2$) and heart rate were monitored continuously and muscle oxygenation (tissue saturation index, TSI) at the left vastus lateralis muscle was measured for 2 minutes pre-, throughout, and for 5 minutes post-exercise using Near Infrared Spectroscopy (NIRS; Portalite, Artinis Medical Systems, Netherlands). Blood lactate was measured at pre- and 1, 3, and 5 minutes post-exercise. Mean and peak changes in TSI were similar in both HIIT (mean = -14.6 ± 5.3%, peak = -19.7 ± 5.2%; $p > 0.05$) and MOD (mean = -13.2 ± 5.6%, peak = -18.2 ± 7.6%; $p > 0.05$) with peak changes in TSI occurring faster in HIIT (71.2 ± 95.2 seconds after onset of exercise) than in MOD (1452.9 ± 647.8 seconds). The half time of TSI recovery post-HIIT ($T_{1/2TSI}$ = 25 ± 7.9s) was not significantly different post-MOD (25 ± 9.6s). Mean $\dot{V}O_2$ during HIIT (31.48 ± 4.58 ml·kg^{-1}·min^{-1}) was similar to MOD (33.76 ± 5.71 ml·kg^{-1}·min^{-1}), however minute ventilation ($\dot{V}_E$), respiratory exchange ratio (RER) and all post-exercise blood lactate concentrations were significantly higher in HIIT compared to MOD ($p < 0.05$). Despite the different durations of HIIT and MOD, mean and peak changes in aerobic metabolism during and after exercise were similar. Results provide evidence of both aerobic and anaerobic contributions to energy metabolism in response to HIIT, and highlight possible mechanisms for the commonly reported improvements in aerobic power following chronic HIIT.

Effect of exercise and glycemic index of carbohydrate feeding on postprandial triglycerides, insulin, and substrate oxidation

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Elevated postprandial triglyceride level is a risk factor for cardiovascular disease. Triglyceride appearance in the blood is less after a meal if endurance exercise is performed shortly before (i.e. within half a day of) the meal. This benefit of exercise is unfortunately negated if the after-exercise food choice to replace the calories expended during exercise is one containing high-glycemic index (HGI) carbohydrates. We determined the effect of consuming low-glycemic index (LGI) carbohydrates after an exercise session on the triglyceride response to a subsequent high fat meal. Using a randomized, counter-balanced cross-over design, 14 individuals (BMI>25 kg/m2) performed: 1) Walking exercise (90min) at 6pm followed by no meal (EX); 2) Exercise followed by LGI carbohydrates (i.e. lentils, EX-LGI); 3) Exercise followed by HGI carbohydrates (i.e. potatoes, EX-HGI); 4) A control condition with no exercise or meal (CNT). In all conditions, after a 10 hour fast, participants were given a standardized high fat meal. Blood triglycerides and insulin, and respiratory exchange ratio (RER) were assessed before, and for 6h after the meal. There was a condition main effect for triglycerides with EX-LGI (1.74±0.75 mmol/L) < EX-HGI (2.45±1.38 mmol/L, $p<0.05$) and CNT (2.93±2.20 mmol/L, $p<0.01$), and EX (1.97±0.90 mmol/L) < CNT ($p<0.01$). There was a condition x time interaction for insulin (n=11) with EX-LGI at 30 min (164±134 pmol/L) and 60 min (238±120 pmol/L) < CNT (413 ±419 and 405±255 pmol/L) and EX-HGI (398±337 and 398±136 pmol/L, $p<0.01$); and EX (164±66 pmol/L) < EX-HGI and CNT at 30 min ($p<0.01$). There was a condition main effect for RER with EX (0.74±0.03) < HGI-EX (0.75±0.03) and CNT (0.76±0.03) ($p<0.05$), and LGI-EX (0.74±0.03) < CNT ($p<0.05$). An evening exercise session followed by a meal containing LGI carbohydrates is beneficial for attenuating the increase in triglycerides and insulin, and enhancing fat oxidation after a high-fat breakfast the next morning. (Supported by the Heart and Stroke Foundation of Canada.)

The action of L-Arginin on oxidative - nitrosative stress induced by acute exercise in rats

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The aim of the present investigation was to evaluate the effect of L- Arginine supplements on the oxidative and nitrosative stress induced in skeletal muscle, liver and serum of acutely exercised rats. Thirty male Vistar rats were randomly divided into four groups: sedentary control (SC); sedentary control with L-Arg treatment (SC + Arg); exhaustive exercise (E); and exhaustive exercise with L-Arg treatment (E + Arg). E and E+Arg groups performed a 1 hour acute running test, or until exhaustion on a treadmill (16-26 m/min) and Arg and E+Arg groups treated orally with the L-Arg (2% diet, for 30 days). Sampling was performed 1 hour after exercise. Serum creatine kinase (CPK) activity was determined by an enzymatic method. Nitric oxide production was evaluated by measuring nitrite formation, using Griess reagent. Antioxidant-oxidant's balance was measured as H2O2 / TAC levels. CPK increased in (E), (SC + Arg) and (E+Arg) groups compared with control group (SC) (all $p < 0.05$). Acute exercise also decreased the antioxidant-oxidant's balance of H2O2 / TAC into gastrocnemius muscle and liver in (E) group than the control groups (SC) ($p = 0.021$); however, this decrease was not significant in liver. There was no significant change in serum antioxidant-oxidant's balance. In addition, supplementation of L-Arginine didn't cause significant change in antioxidant-oxidant's balance in (SC + Arg) groups. There was no significant change in nitric oxide level with supplementation of L-Argininen and acute exercise in muscle, liver and serum. The results of the present study didn't show existence of oxidative-nitrosative stress and supplementation effect in muscle, liver and serum, 1 h after acute exercise.

Pre-habilitation program for elective coronary artery bypass graft surgery patients: a pilot project

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Although exercise therapy plus education classes after surgery improve patient health outcomes, patients are not referred to an intervention until after surgery. Therefore, the purpose of our randomized controlled trial was to determine the feasibility and efficacy of exercise therapy plus cardiovascular health education programming prior to elective coronary artery bypass graft (CABG) surgery for cardiac "pre-habilitation" (Prehab) compared to standard care (StanC). Seventeen elective CABG patients were randomized StanC (n=9) or Prehab (n=8). Data was collected at baseline, 1-2 weeks pre-operatively (Preop), and three months post-operatively. Walking distance and walking speed were assessed by a 6-minute walking test and a 5-meter gait speed test, respectively. Physical activity was assessed by accelerometry. Fifteen patients completed the study (StanC, n=7; Prehab, n=8). Walking distance remained unchanged in StanC whereas Prehab patients walked +132 and +145 meters at Preop and three months post-operatively, as compared to baseline ($p<0.05$). Gait speed was unchanged in StanC; however, Prehab improved gait speed by 27% and 33% at Preop and three months post-operatively, respectively ($p<0.05$). No differences were found between StanC and Prehab for physical activity at any intensity. Complete data from 4 patients in Prehab show a 284% increase in moderate-vigorous physical activity from baseline ($p<0.05$). Enrollment in cardiac rehabilitation three months post-operatively was 43% in StanC and 100% in Prehab ($p<0.05$). Our novel data demonstrate the feasibility of utilizing a Prehab exercise and education intervention to improve functional walking ability of patients waiting elective CABG surgery.

The effect of hyperventilation-induced hypocapnic alkalosis on the slowing of $\dot{V}O_{2p}$ kinetics in acute hypoxia

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Exercise performed in hypoxia compared to normoxia is associated with hyperventilation, hypocapnic alkalosis, and a slower rate of adjustment of pulmonary O_2 uptake ($\dot{V}O_{2p}$) (i.e., greater $\dot{V}O_{2p}$ time constant, $\tau\dot{V}O_{2p}$) during transitions into the moderate-intensity exercise domain. However, a hyperventilation manoeuvre performed in normoxia also is associated with a slowing of $\dot{V}O_{2p}$ kinetics of similar magnitude. The purpose of this study was to examine whether the slower $\dot{V}O_{2p}$ kinetics in hypoxia is a consequence of: a) hypoxia alone (i.e., lowered arterial O_2 pressure [P_aO_2]), b) hyperventilation-induced hypocapnic alkalosis (i.e., lowered arterial CO_2 pressure [P_aCO_2]), or c) a combination of both (i.e., lowered P_aO_2 and P_aCO_2). We hypothesized that slower $\dot{V}O_{2p}$ kinetics in hypoxia would be related to the reduction in P_aCO_2, in addition to a lower inspired O_2 (and reduced O_2 delivery). Eleven young men performed 3-5 repetitions of step-changes in WR from a 20W baseline to 85% of their estimated lactate threshold on a cycle ergometer in the following conditions: i) normoxia (CON; normal end-tidal O_2 pressure [$P_{ET}O_2$] and end-tidal CO_2 pressure [$P_{ET}CO_2$]); ii) hypoxia (HX, inspired O_2 = 12%; lowered $P_{ET}O_2$ and $P_{ET}CO_2$); iii) hyperventilation (HV; increased $P_{ET}O_2$ and lowered $P_{ET}CO_2$); and iv) normocapnic hypoxia (Nc-HX; lowered $P_{ET}O_2$ and normal $P_{ET}CO_2$). Ventilation (and thus work of breathing) was increased (relative to CON) and matched between HX, HV, and Nc-HX conditions. During each condition $\dot{V}O_{2p}$ was measured breath-by-breath by mass spectrometry and volume turbine, and phase II $\dot{V}O_{2p}$ kinetics were fit with a mono-exponential function. The $\tau\dot{V}O_{2p}$ was different ($p<0.05$) amongst all conditions: CON, 26±11s; HV, 34±14s; HX, 45±15s; and Nc-HX, 52±14s. Therefore, prevention of hyperventilation-induced hypocapnic alkalosis, through the addition of inspired CO_2 during hypoxic exercise, caused a further slowing of $\dot{V}O_{2p}$ kinetics suggesting: a) the slower $\dot{V}O_{2p}$ kinetics observed in HX, are independent of hyperventilation-induced hypocapnic alkalosis; and b) hypocapnic alkalosis may prevent a greater slowing of $\dot{V}O_{2p}$ kinetics during hypoxic exercise. (Supported by NSERC.)

Skeletal muscle vasodilation during exercise in human obesity: contributions of nitric oxide and prostaglandins

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Obesity has profound implications for quality of life and public health care costs as more obese young adults establish cardiovascular risks earlier in life. Exercise elicits a robust local vasodilation, offering an excellent model to examine if obesity alters dynamic vascular control in younger adults. Our aim was to determine whether exercise vasodilation is reduced in young obese adults, and whether the contributions of nitric oxide (NO) and prostaglandins (PG) to exercise vasodilation are altered by obesity. Forty younger adults (27 ± 1yrs, Lean = 20, Obese = 20) completed two 10-min bouts of dynamic forearm exercise at 15% effort, separated by 20 min rest. After 5 min of control exercise, NO synthase was inhibited during the final 5 min of exercise by intra-arterial infusion of L-NMMA. During the second exercise bout, L-NMMA was infused prior to and throughout exercise ($L\text{-}NMMA_{@\ onset}$). During 5-10 min of the second bout, ketorolac was infused to inhibit cyclooxygenase and achieve double blockade (DB). Forearm blood flow (FBF; echo and Doppler ultrasound), arterial pres-

sure (brachial catheter), and forearm lean mass (DEXA) were measured to calculate relative forearm vascular conductance (FVC) = FBF/100mmHg/100g lean mass. Results are mean ± SE. Exercise vasodilation did not differ between groups in control exercise (Δ FVC, Lean: 15±1.5 vs. Obese: 13.7±1.3, p=0.5). L-NMMA reduced FVC ($p < 0.001$) similarly between groups (Lean: Δ -3.1±0.7 vs. Obese: Δ -4.0±0.9, p=0.34). L-NMMA$_{@\ onset}$ and DB had no effect on FVC during exercise (p=0.13 and p=0.65, respectively) and did not differ between groups. (L-NMMA$_{@\ onset}$, Δ FVC Lean: 13±1.1 vs. Obese: 13.2±1.0, p =0.16; DB, Lean: 14.6±1.8 vs. Obese: 15.6±1.4, p=0.41). These data indicate that obesity does not alter exercise vascular conductance during mild/moderate intensity exercise, nor does obesity alter mechanistic roles of NO and PG's in younger "metabolically healthy" adults.

Effects of self-talk on autonomic regulation of cardiovascular function during endurance exercise

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Literature examining the interaction between central command and cortical integration regulating the cardiovascular function during exercise suggests that anticipatory inputs influence cardiovascular drive. Motivational self-talk is an effective psychological strategy to improve physical performance but debate still remains as to whether these anticipatory inputs regulate autonomic function during endurance exercise. The study, therefore, aimed to determine the effect of self-talk on autonomic regulation of cardiovascular function during endurance exercise. Twenty-nine well-trained male runners [38±13 yrs., 177±7 cm and 73 ± 7 kg] volunteered to participate in a randomized-group design study that included a negative self-talk (NST), a positive self-talk (PST), and a control group (CG). First, participants underwent an incremental running test on the treadmill to determine the maximal oxygen uptake ($\dot{V}O_2$max). Next, participants received a mental training session on self-talk and created three positive and three negative self-talk statements. Finally, participants underwent the 60-min steady-state running exercise at 70% of $\dot{V}O_2$max during which they were cued at 20, 35 and 50-min with their personal self-created positive or negative self- talk statements while the CG listened to a documentary. Cardiorespiratory variables were acquired breath-by-breath using indirect calorimetry system. Salivary cortisol samples were obtained at waking and after treatment. Rate of perceived exertion (RPE) was recorded every 5-min throughout 60-min endurance exercise. No significant difference between groups was detected on $\dot{V}O_2$, $\dot{V}CO_2$, RER, $\dot{V}E$, Bf, and HR during the incremental test confirming groups' homogeneity. Although $\dot{V}O_2$, $\dot{V}CO_2$, RER, and HR significantly changed over time, during the 60-min running exercise, no main significant effect of treatment was found. However, RPE scores, $\dot{V}E$, Bf, and salivary cortisol were significantly higher in the NST group compared to the two other groups. These data suggest that NST [emotion-induced stress, as reflected by elevated cortisol] altered the Bf response. This cortical cardiovascular response correlates with perception of effort that might represent an altered central command. In conclusion, manipulating anticipatory inputs (i.e., self talk) alters hormonal response pattern, modulates cardiovascular function, and influences perceived exertion.

Oral L-glutamine supplementation on muscle recovery following eccentric exercise: are there sex differences?

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L-Glutamine has become an increasingly popular supplement among athletes because of its alleged benefits of promoting muscle recovery following exercise. This study aimed to examine the effects that oral L-glutamine supplementation has on quadriceps muscle strength and soreness ratings following eccentric exercise. It was hypothesized that L-glutamine ingestion would quicken the recovery rate of peak force production (back to pre-exercise values) and decrease muscle soreness ratings over a 96-hour recovery period. Ten healthy participants (5 females; age: 21±0.3 years; height: 174±9 cm; weight: 74±8 kg) volunteered in a double blind, randomized, placebo-controlled crossover study. Supplement conditions consisted of isocaloric placebo (maltodextrin, 0.6 g/kg/day) and micronized L-glutamine (0.3 g/kg/day-1 0.3 g/kg/day maltodextrin) ingestion over a 72-hour period. Knee extensor peak torque at 0, 30, and 180 deg/sec (Cybex® Isokinetic Dynamometer) and muscle soreness (7-point Likert scale) were measured before, immediately following, 24, 48, 72, and 96 hours after a bout of eccentric exercise. The eccentric exercise bout consisted of 8 sets (10 repetition per set) of unilateral knee extension at 125% maximum concentric force with 2-minute rest intervals between sets. L-Glutamine supplementation resulted in greater overall (main effect, $p < 0.01$) post-exercise peak torque values at 180 deg/sec and 30 deg/sec. Peak torque produced at 180 deg/sec was higher ($p < 0.05$) in the L-glutamine condition immediately following, 72 and 96 hours post-exercise. However, these effects were greater in men versus women. L-Glutamine resulted in lower ($p < 0.05$) muscle soreness ratings 24, 48, and 72, 96 hours post-exercise. Oral L-glutamine supplementation resulted in a faster recovery of dynamic peak torque and diminished muscle soreness following eccentric knee extension exercise. Greater effects of oral L-glutamine supplementation on muscle recovery were observed in men versus women.

Effects of "Home-based Exercise" intervention for the fall prevention in community dwelling elderly people

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Recent research has shown that older people who perform poorly on standardized tests of lower extremity strength and balance are at a higher risk of developing disabilities. Regularly performed physical activity is extremely important for elderly people to maintain their health status. However, falls must be prevented, because they are prone to losing their balance during physical activities. This study investigated the circumstances of falls experienced and the effectiveness of home-based exercise intervention for fall and fracture prevention in eighty-six community-dwelling elderly people. By dividing the subjects into two groups: fallers and non-fallers, the data on the circumstances of falls, fall anxieties, number of fall risks, falls assessment, 15-item version of the Geriatric Depression Scale (GDS-15), Tokyo Metropolitan Institute of Gerontology Index (TMIGI), grip strength, one-leg standing time, sit-to-stand, Functional Reach Test (FR), walking ability (speed, steps) were obtained and compared. Home-based exercise included stretching (major muscle), squat (15 reps., two times a day) and balance (one min. for each leg, two times a day) and trained for six months. Other programs, such as mini-lecture, hand book and so on, tailored for groups in falls prevention. Before intervention, fallers showed lower TMIGI (11 vs. 12 pts., $p<0.05$), higher falls assessment (4 vs. 2 pts., $p<0.05$) and GDS-15 (5 vs. 4 pts., $p<0.05$) than in non-fallers. After the intervention, it was found that the frequency of falls (0.8 to 0.3 times, $p<0.05$), the number of fall assessment (3.9 to 2.8 #, $p<0.05$), one-leg standing with eyes open (25 to 31 sec, $p<0.05$), FR (26 to 30 cm, $p<0.05$) and sit-to-stand (9 to 8 sec, $p<0.05$) were improved in fallers. On the other side, non-fallers improved only in FR (26 to 31 cm, $p<0.05$) and sit-to-stand (9 to 7 sec, $p<0.05$). These findings revealed that the home-based exercise seemed to be effective, along with fall-related information, in falls prevention for community-dwelling elderly people.

Plantar flexion exercise creates a sustained elevation in shear stress and stimulates FMD in the superficial femoral artery

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In the brachial artery, both transient (via release of temporary forearm cuff occlusion) and sustained (via handgrip exercise) increases in shear stress have been used to illicit flow-mediated dilation (FMD). Greater FMD may support perfusion and indicate better vascular health. The arteries in the legs and arms experience different patterns of shear stress during normal activity, and leg arteries are more vulnerable to atherosclerosis (e.g. peripheral artery disease). Therefore, development of protocols for assessing FMD in the legs is important. The purpose of the present study was to determine the feasibility of using plantar flexion exercise (LEX) to create a sustained increase in superficial femoral artery (SFA) shear stress for SFA FMD assessment. Six participants (3 females) (age: 24 ± 2.4yr) performed 4 trials of dynamic LEX in a specially designed machine (trial values were averaged to generate a single response for each participant). SFA blood velocity and artery diameter were assessed continuously via echo and Doppler ultrasound. Trials consisted of a 1 minute baseline, 6 minutes of rhythmic LEX (4 s of relaxation: 2 s of contraction), and 3 minutes of recovery. Shear stress was estimated as shear rate (SR=velocity/diameter). Values are mean ± SD. LEX created a sustained SR stimulus in the SFA (baseline: 8.0 ± 2.2s^{-1}; minute one: 50.6 ± 12.3s^{-1}; two: 59.1 ± 15.4s^{-1}; three: 59.4 ± 14.5s^{-1}; four: 59.2 ± 13.8s^{-1}; five: 59.8 ± 15.1s^{-1}; six: 57.5 ± 14.9s^{-1}; last five minutes (steady state) p=0.4). FMD assessed during the last minute of LEX was 4.1 ± 1.9%. Peak FMD during LEX was 7.0 ± 3.3%. This study was the first to assess FMD in the SFA throughout a bout of small muscle mass exercise, and suggests that the assessment of FMD in the SFA using LEX is feasible. The FMD resulting from this sustained stimulus may permit further insight into endothelial function in a vessel that is prone to peripheral artery disease. (Funded by *NSERC.*)

Introducing CAN-flip: a gymnastics intervention program for children with Cerebral Palsy

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Among children with Cerebral Palsy (CP) physical activity (PA) levels are alarmingly low and decline, along with physical ability, as they age. These low PA levels stem from both a lack of available exercise programs and a low motivation to participate. It seems, therefore, essential to develop exercise programs for children with CP that provide them with fun and enjoyment to ensure continued participation. This pilot study examined whether participation in an artistic gymnastics program could improve motor skills and physical self-perception in children with CP. Four girls and one boy (9.8±1.3 years) with hemiplegic CP participated in this crossover trial of a 6-week gymnastics and a six-week normal activity period, randomly assigned. All participants were tested at baseline, prior to crossover, and at the conclusion of the study. Muscle strength, gait kinematics, quality of movement, range of motion, and dynamic balance were measured. The training program was comprised of two, 1-hour gymnastics classes weekly. Classes were designed to fit the individual capabilities and needs of each participant, and were coached on a one-on-one basis. Results showed no changes after the 6-week normal activity period whereas the 6-week gymnastics intervention resulted in clinically relevant (10-25%), although statistically non-significant (p>0.05), improvements in range of motion, neuromuscular activation, muscle strength, functional motor performance, balance and gait. With respect to gymnastics skill development, each participant benefited from the therapy in different ways. This was not surprising since the five participants had varying locomotor capabilities pre-intervention so their gymnastics sessions were different and tailored to the specific needs of each child. The CAN-flip study is the first to use gymnastics as a form of exercise for children with CP. These preliminary results show the potential of artistic gymnastics training for children with CP as a feasible, safe and beneficial form of exercise therapy for these children. (Funded by Ontario Foundation of Cerebral Palsy.)

Training adaptations in response to intensity-matched concentric only, eccentric only or dually emphasized concentric / eccentric training performed to volitional fatigue

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Eccentric (ECC) contractions produce greater force than concentric (CON) contractions. Traditionally, isoinertial (free weight) training is prescribed and ultimately limited by CON strength, leaving the ECC portion under-loaded. Isolated ECC training is effective for increasing muscle hypertrophy but may be less beneficial for increasing CON 1RM strength. The purpose of this study was to compare intensity-matched isoinertial CON only, ECC only or CON/ECC emphasized training performed until volitional fatigue. Forty-seven young adults (28 males) were randomized into one of 4 groups: 1) ECC80 performed ECC only contractions at 80% of CON 1RM; 2) CON80 performed isolated CON training at 80% of CON 1RM; 3) CON/ECC80 performed standard CON contractions each immediately coupled with a 3 second ECC contraction at 80% of CON 1RM; 4) a control group. Training progressed from 3 to 6 sets of unilateral elbow flexion concentration curls over 8 weeks. Each training set was performed until volitional fatigue; this required each group to perform a varying number of repetitions but aimed to standardize the complete recruitment and exhaustion of type I and type II muscle fibers associated with training to failure. Concentration curl 1RM and elbow flexors muscle thickness (via ultrasound) were assessed pre- and post-training. ANCOVA was used to adjust for baseline differences between groups (pre-training scores as covariates). After adjustment, ECC80 (+0.19 cm) and CON/ECC80 (+0.15 cm) were more effective at inducing hypertrophy than CON80 (-0.01 cm) ($p<0.05$) and control (-0.02 cm) ($p<0.05$), with no difference between ECC80 and CON/ECC80. CON80 (+2.57 kg) showed a greater post-training increase in strength compared to ECC80 (+1.29 kg) ($p<0.01$) and control (+0.03 kg) ($p<0.01$), but was not different than CON/ECC80 (+2.07 kg). Together these results suggest that training utilizing repetitions emphasizing both concentric and eccentric loading may be most effective for simultaneously optimizing strength and muscle hypertrophy. Emphasizing the eccentric portion of the lift during isoinertial training may be necessary for optimizing muscle hypertrophy.

Active transportation and adults' health: the Canadian Health Measures Survey

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Using data from the nationally-representative 2007-2009 Canadian Health Measures Survey, the present study examined the relationships among active transportation (AT; e.g., walking and cycling for utilitarian purposes), physical activity (PA), and health-related outcomes in Canadian adults aged 20-79 years. Participants (N=3,507) reported the weekly time that they typically spend engaging in utilitarian walking and cycling and wore an Actical accelerometer for 7 consecutive days. They underwent a series of physical tests (including measures of fitness, body composition, blood pressure and blood sampling) following standardized protocols. Differences in PA and health-related outcomes across levels of walking and cycling were assessed with ANCOVA analyses controlling for age, gender, education, household income, usual daily PA and the complex survey design. Associations were considered significant if $p \leq 0.016$ given the multiple

comparisons of the 3 levels of walking (<1 hour/week, 1-5 hours/week, >5 hours/week) and cycling (no cycling, <1 hour/week, ≥1 hour/week). Compared to adults reporting walking <1 hour/week, those reporting 1-5 hours/week had higher moderate-to-vigorous PA (MVPA) (+4.3 min/day); those reporting >5 hours/week had higher MVPA (+11.5 min/day) and lower glycohemoglobin (-0.1%), LDL cholesterol (-0.3 mmol), and apolipoprotein B (-0.1 g/L). Additionally, adults reporting >5 hours/week had higher MVPA (+7.3 min/day) and lower skinfold thickness (-4.2 mm) and triglycerides (-0.2 mmol/L) than those reporting 1-5 hours/week. Compared to adults reporting no cycling, those reporting ≥1 hour/week had greater MVPA (+11.0 min/day) and aerobic fitness (+3.0 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$), and lower BMI (-2.3 kg/m^2), waist circumference (-7.2 cm), triglycerides (-0.3 mmol/L), and fasting insulin (-27.8 pmol/L). In addition, adults reporting cycling ≥1 hour/week had lower BMI (-2.7 kg/m^2), waist circumference (-8.4 cm) and skinfold thickness (-8.9 mm) compared to adults reporting <1 hour/week. While the cross-sectional design of this survey precludes causal inferences, the present findings indicate several associations between AT, objectively-measured PA and important cardiovascular disease risk factors at the population level. The implementation and evaluation of interventions and policies to support AT are warranted.

Knowledge, awareness, and uptake of Canadian physical activity and sedentary behaviour guidelines

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In 2006, the Canadian Society for Exercise Physiology (CSEP) launched the Physical Activity Measurement and Guideline Project with the goal of providing age-, gender-, and ability-specific guidelines to promote fitness, performance, or health. In 2011, this resulted in the launch of evidence-based physical activity (PA) guidelines for children and youth (5-17 years), adults (18-64 years), and older adults (≥65 years) as well as sedentary behavior (SB) guidelines for children and youth. The following year, CSEP released PA and SB guidelines for the early years (0-4 years). Since the release of the new guidelines, little work has been done to gauge awareness or uptake among the general population. The aim of this review was to understand how, where, and who are using the guidelines across Canada. Content experts, key organizations, journal websites, and service organizations were consulted. MEDLINE and Embase were searched for additional peer-reviewed publications pertaining to the guidelines. Three scientific publications explored uptake and/or awareness of the guidelines were included, all of which focused on the guidelines for those <18 years. Publications, as well as information from ParticipACTION and the Canadian Fitness and Lifestyle Institute reported that awareness of guidelines is low (on average, <10% of survey responders), especially with respect to the SB guidelines (on average, <5% of survey responders). When surveying 159 public health unit, and CSEP partner websites, it was reported that information on the guidelines was available only 51% of the time. Finally, online metrics (e.g., downloads, site accessions) from CSEP and journal websites showed that electronic uptake of guidelines was high (e.g., all "highly accessed" on journal websites). All levels of governments should collaborate in creating sustained and well-resourced communication plans to reach whole populations to raise awareness of PA and SB guidelines and implement programs to facilitate uptake.

National representativeness of the International Study of Childhood Obesity Lifestyle and the Environment

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The International Study of Childhood Obesity, Lifestyle, and the Environment (ISCOLE) provides robust, multi-national information on physical activity, diet and weight status in 10-year old children around the world. The purpose of this manuscript was to understand the similarities and differences between data collected in ISCOLE and data from nationally representative surveys in all ISCOLE data collection sites (Australia, Brazil, Canada, China, Colombia, Finland, Kenya, India, Portugal, South Africa, United Kingdom, United States). Variables included in the analysis were sex, body mass index (BMI), socioeconomic status (household income), physical activity (accelerometer derived moderate- to vigorous- physical activity (MVPA)), and screen time (child-report). Distributions of characteristics were assessed within each ISCOLE country-level database, as well as using published data from national surveys. Almost half of ISCOLE countries (5/12) could not provide any comparable data from their country. Of 12 countries, four provided data on objectively measured physical activity, four provided data on self-reported sedentary behaviour, seven provided data on weight status, and five provided data on household income. The five ISCOLE countries that were part of the Health Behaviours in School-aged Children survey also provided comparable data for self-reported physical activity. When data were available, ISCOLE study sites appeared to be relatively representative of their country as a whole; however, this varied with data availability. Few countries used the same cut-points, or measurement tools when analysing participant characteristics. The ISCOLE data were re-analysed to match other country-level data, but this limited comparisons across countries. This work highlights the need for standardized measurement tools around the world while account for cultural specific characteristics, and the need for collaboration across study centres and research groups.

Does an acute bout of aerobic exercise enhance motor learning?

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Motor learning is essential to the acquisition of new skills as well as to movement rehabilitation in clinical populations, such as persons with stroke. Evidence is emerging that high-intensity aerobic exercise enhances motor learning in healthy individuals. When a single bout of high-intensity intermittent cycling immediately precedes or follows practice of a continuous tracking task (CTT), individuals show improved learning of the task. However, for translation of this work to clinical populations, the effect of lower-intensity exercise must be examined. The present ongoing work aims to investigate how a 20-minute continuous low- to moderate-intensity cycling bout influences motor learning. Four participants (2 female; age, 23.3±2.9 years; $\dot{V}O_2$peak, 45.6±mL·min^{-1}·kg^{-1}; HRpeak, 188±5 b·min^{-1}; Wpeak, 240±37 W) completed a maximal exercise test followed 48 hours later by two randomized conditions immediately

followed by CTT practice: 1) a 20-minute seated rest period immediately followed by CTT practice; and 2) a 20-minute continuous cycling bout (50% HR reserve, 132±15 b·min^{-1}; PO, 215±17 W; RPE6-20, 10±1). Practice under each condition was followed by a 24-hour no-exercise retention test and conditions were separated by a 2-week washout period. CTT practice involved 20×30-second trials of tracking via non-dominant thumb joystick manipulation. The CTT included a repeated sequence to evaluate sequence-specific implicit motor learning. Time lag and shifted root-mean-square error (shRMSE) measured temporal and spatial performance, respectively. Preliminary data show a trend towards greater temporal performance (time lag) on the repeated sequence after exercise, during practice (Exercise, 26.7±15.3 msec; Rest, 96.7±15.2 msec) and at retention (Exercise, 20.0±17.3 msec; Rest, 100.0±40.0 msec). Spatial performance (shRMSE) followed a similar trend at both practice (Exercise, 5.4±0.5; Rest, 6.1±0.5) and retention (Exercise, 4.5±0.2; Rest, 5.0±0.5). Preliminary results suggest that a single bout of low- to moderate-intensity continuous cycling can enhance implicit sequence-specific motor learning, similar to effects reported after high-intensity exercise. These data provide an important first step towards translation of exercise-induced increases in motor learning to clinical populations.

Short-term omega-3 supplementation alters neuromuscular function and some performance measures in male athletes

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The use of omega-3 fatty acid supplementation (omega-3s) to alter post-exercise inflammation and to support training adaptations has been examined. It is unknown if omega-3 supplementation can enhance neuromuscular function or exercise performance. We tested the effect of short-term (21 days) of mammalian omega-3 supplementation (5000mg, 375mg EPA, 230mg DPA, 450 DHA) compared to olive oil placebo (5000mg) on neuromuscular function and performance measures in elite male athletes using a double-blinded randomized placebo controlled design. At least 48 hours after familiarization, participants reported back to the laboratory for Visit 1, including a resting blood sample to measure plasma omega-3 concentration and complete the testing protocol. The testing protocol included maximal isometric voluntary force (MVC), vertical jumps, maximum push-ups, maximum squats at 10 repetition maximum (RM) weight, a Wingate test, 10km cycling time trial and post-testing MVC. All tests were repeated on Visit 2, after 21 days of supplementation. Changes in MVC force and performance measures were compared from Visit 1 to Visit 2 and analyzed using magnitude-based inferences. Changes in omega-3 concentration were analyzed using ANOVA. From Visit 1 to Visit 2, the omega-3 group showed a likely beneficial increase in quadriceps MVC force (mean ± SD) (4.2% ± 11.3%) compared to placebo. The difference in 10RM squat repetitions was unclear between groups (omega-3 20.6% ± 29.3%, placebo 25.6% ± 34.6%). The change in Wingate fatigue index was possibly different (-12% ± 7.2%) compared to placebo. The decrease in 10km cycling time trial time was likely beneficial (-3% ± 5.7%) compared to placebo. Plasma omega-3 concentrations were different from baseline compared to placebo, EPA (p=0.004), DPA (p=0.087) and DHA (p=0.058). Our findings indicate short-term omega-3 supplementation may enhance neuromuscular function in trained athletes and attenuate fatigue during sprint and time trial cycling.

Strength and power asymmetries in the proximal and distal muscle groups of the lower limbs

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Limb asymmetries are known to increase the risk of injury and are important for rehabilitation. The purpose was to identify strength and power asymmetries in the upper and lower leg muscles, and the connection to limb dominance. Asymmetries were predicted to be greater for power than strength and for distal compared to proximal muscle groups. Ten right-footed participants (5 male; 5 female) were recruited. Muscle thickness (MT) was measured using β-mode ultrasound on the vastus lateralis (VL), biceps femoris (BF), tibialis anterior (TA) and soleus (SOL) of both legs. Maximal voluntary isometric (MVC) strength and velocity dependent contractions (power) were completed on a Humac NORM dynamometer for four movement tasks: knee flexion (KF), knee extension (KE), ankle plantar flexion (PF) and dorsiflexion (DF). Electromyography (EMG) recordings were acquired from the VL, BF, TA and SOL, and normalized to MVC. Asymmetry scores were calculated using the equation: (dominant leg – nondominant leg/stronger leg) x 100, with the absolute score serving as the absolute asymmetry. Results showed no significant difference in MT between legs ($p>0.05$). Absolute asymmetries were significantly different than zero for all tasks ($p<0.05$) for strength (range:7.0±5.4 to13.0±7.1%) and power (range:8.9±10.7 to 24.2±16.1%); whereas asymmetries related to limb dominance were only significant for PF strength and KE power ($p<0.05$). Power asymmetries (14.8±5.7%) were greater than strength (10.6±2.9%) averaged across all tasks ($p<0.05$), with no difference between the upper and lower legs. However, in the lower leg DF had greater power asymmetry than PF ($p<0.05$). Agonist EMG activation in PF was greater than DF, and KE was greater than DF ($p<0.05$). KE had greater antagonist activation than all other tasks ($p<0.05$). Analyzing absolute asymmetries revealed substantially larger strength and power asymmetries compared to asymmetries factoring in dominance. Overall there was greater power than strength asymmetry in the legs but no differences between proximal and distal muscle groups. These findings suggest substantial leg asymmetries exist but do not necessarily favour the dominant leg.

Does a prior heat stress protect rat skeletal muscle force during lengthening contractions?

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An elevated Heat Shock Protein (HSPs) content has been shown to provide protection to cells and tissues, including skeletal muscles, from various stressors. The purpose of this study was to determine whether a prior heat stress and the subsequent increase in HSP content provided protection to skeletal muscles during lengthening contractions (LCs). To do this, male Sprague-Dawley rats (n=5/group) had one hindlimb subjected to heat stress (15 min 42C), 24 hours prior to subjecting both tibialis anterior (TA) muscles to either 20 or 60 LCs via electrical stimulation. When non-heat stressed muscles were subjected to 20 or 60 LCs, peak muscle tension was reduced by 26% and 79%, respectively. Similarly, heat stressed muscle subjected to 20 or 60 LCs showed a reduction in peak muscle tension of 27% and 75%, respectively. Twenty-four hours after the last LC both TA muscles were removed and assessed for muscle damage and HSP analyses. As expected HSP25 and HSP72 content was significantly increased by the prior heat stress and also after 20 or 60 LCs. These data suggest a prior heat stress and perhaps an increased HSP content does not protect muscles during lengthening contractions.

4 minutes of in-class high intensity interval activity improves selective attention in 9-11 year olds

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With the rise in youth physical inactivity rates, there is a need to demonstrate the necessity of physical activity inclusion within school

curricula. It has been established that there is a positive relationship between physical activity and academic performance; however, there is a knowledge gap concerning the mechanisms underlying this relationship. FUNtervals are 4-minute high intensity interval activities that use whole body actions to complement story lines that have been shown to improve classroom behaviour; one proposed mechanism for physical activity induced improvements in academic achievement. The purpose of this study was to explore whether FUNtervals can also improve selective attention, an executive function posited to be essential for learning and academic success. Over a 3-week period 7 grade 3-5 classes (n=88) were exposed to a single group, repeated cross-over design where each student's selective attention on no-activity (NA) days was compared to FUNtervals (FUN). In week 1, students were familiarized with the d2 test of attention and the FUNterval activities. In both week 2 and week 3 students completed the d2 test of attention following either a FUNterval break or a no-activity break. The order of these breaks was randomized in week 2 and then repeated in the opposite order in week 3. Although students processed 2.6% more characters during the d2 test following no activity (MFUN=361.7±8.2 vs. MNA=370.15±9.0, p=0.04, ES=0.11), students made fewer errors (% Error; MFUN=3.4±0.3% vs. MNA=4.4%±0.5%, p=0.001, ES=0.26) following FUNtervals. Specifically, they made both fewer errors of omission (MFUN=5.9±0.6 vs. MNA=8.7±1.2, p=0.012, ES=0.26) and commission (MFUN=5.9±0.6 vs. MNA=8.7±1.2, p=0.012, ES=0.16). These data demonstrate that FUNtervals, a time efficient and easily implemented physical activity break, can improve selective attention through improved accuracy, quality of work and a higher degree of carefulness in elementary school children.

High fat diet induced adipose tissue insulin resistance is recovered with an acute bout of exercise independent of adipose tissue inflammation

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Adipose tissue (AT) insulin action is impaired in obesity and is associated with chronic adipose tissue inflammation and macrophage polarization. In obese, insulin resistant mice, a single bout of exercise increases adipose tissue insulin action, however the mechanisms remain unclear. The purpose of this study was to investigate the acute effects of exercise on adipose tissue inflammation, macrophage polarization, and insulin action in obese, insulin resistant mice. Male C57BL6 mice were fed a low (10% Kcals) or a high fat diet (HFD; 60% Kcals from lard) for 8 weeks. HFD mice were assigned to one of three groups: sedentary or acute exercise (treadmill running for 120 min at 15 m/min, 5% incline) followed by 2 or 4 hours of recovery. The HFD resulted in increased body mass, glucose intolerance, and decreased insulin induced Akt Thr308 phosphorylation in both epididymal (eWAT) and subcutaneous (SQ) AT. This impaired insulin signaling was accompanied by increased JNK1 phosphorylation, indicative of inflammation. Exercise resulted in the recovery of insulin induced Akt Th308 phosphorylation at 2 and 4h post exercise. This was accompanied by an up-regulation of inflammatory genes: TNFα and SOCS3 4h post exercise in eWAT and IL-6 and SOCS3 at 2 and 4h in SQ, with no change in JNK1 phosphorylation status. Further, HFD resulted in an up-regulation of MCP1, IL-10, and Arg1 in eWAT, indicating macrophage infiltration and M2 polarization. The HFD did not alter MCP1, IL-10, or Arg1 in SQ, however acute exercise increased both MCP1and IL-10 expression in recovery. Together these results indicate a depot-specific effect of a HFD and exercise on markers of AT inflammation and macrophage infiltration. Further, these results demonstrate that a decline in AT inflammation is not required for improved AT insulin action.

Lower limb and trunk muscle activation with back squats and weighted sled apparatus

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The back squat is a traditional resistance training exercise whereas the resisted sled exercise is a relatively new resistance exercise. However as there are no studies comparing muscle activation between the exercises, the objective of this study was to examine activity of leg and trunk muscles for the two exercises. Ten healthy resistance trained males participated in a randomized cross-over design study consisting of two preparation sessions and two testing sessions. Electromyographic (EMG) activity of the rectus femoris, biceps femoris, gastrocnemius, lower erector spinae and the transversus abdominus/internal obliques (TrA/IO) were monitored during a twenty step maximum (20SM) push with the weighted sled apparatus and a 10 repetition maximum (10RM) with a bilateral back squat. There were non-significant trends for the rectus femoris (p=0.092: 8.6%-16.7%) and biceps femoris (p=0.09: 10.5%-32.8%) to demonstrate higher activity with the sled and squat exercises respectively. There were main effects for condition with 61.2% greater gastrocnemius EMG with the sled exercise (p=0.01) and 74.5% greater erector spinae EMG activity with the squat (p=0.002). There were no significant differences between the exercises for the TrA/IO. In summary the sled and squat exercises provided similar EMG activity for the quadriceps, hamstrings and TrA/IO. The squat provided higher lower erector spinae activation, while the sled had superior gastrocnemius activation. Dependent upon the movement training specificity of the sport, either exercise may be employed in a training program while acknowledging the differences in gastrocnemius and erector spinae activity.

Benefits of prazosin in ameliorating the effects of pathophysiological levels of glucocorticoids

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Prolonged exogenous glucocorticoid (GC) administration, while beneficial in treating a variety of inflammatory conditions, causes hyperglycemia, hyperinsulinemia and visceral fat accumulation. Pathophysiological levels of corticosterone (cort), the main GC in rats, exert angiostatic effects on the vasculature of the skeletal muscle, which may promote muscle ischemia, decrease exercise ability and alter muscle glucose handling. In rodents, chronic administration of prazosin hydrochloride, an alpha-1 adrenergic receptor antagonist, increases skeletal muscle capillarization. We hypothesized that prazosin administration would improve the cort-induced reduction in skeletal muscle capillarization. Cort (400mg/rat) or wax pellets were implanted in young male Sprague-Dawley rats. Two days post pellet implantation, prazosin (50mg/L in drinking water) or water alone was given ad-libitum for 7 or 14 days. 9-days after pellet implantation, mRNA levels of vascular endothelial growth factor (VEGF), a potent angiogenic factor, and thrombospondin-1 (TSP-1), an angiostatic factor, were assessed. There was a trend for a decrease in VEGF mRNA and a significant decrease in TSP-1 mRNA in response to cort-treatment ($p<0.05$, n=5). However, there was a significant increase in the expression of VEGF relative to TSP1 with prazosin treatment, even in the presence of cort, suggesting that prazosin promotes a pro-angiogenic environment. This was expected in the placebo-prazosin group; however this is a novel finding in the cort-prazosin animals. The induction of a pro-angiogenic environment was confirmed by the capillary-to-fiber (CF) ratio, an indicator of skeletal muscle angiogenesis, within the tibialis anterior. Although CF ratio was unaffected by 9-days of cort-treatment, it was significantly reduced after 16-days ($p<0.001$, n=3-8). As hypothesized, CF ratio was restored with 14-days of prazosin co-administration. Prazosin co-administration did not improve glucose tolerance; however, prazosin did improve fasted insulin and in-

sulin throughout the oral glucose tolerance test (p<0.01, n=5-9). This study demonstrates a novel use for prazosin in counteracting the angiostatic and altered metabolic effects caused by prolonged elevation in GCs.

The cross-over effect and time course following unilateral plantar flexors static-stretching on single-leg jump performance and gastrocnemius muscle activity

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The aim of this study was to evaluate the acute effects of unilateral ankle plantar flexors static-stretching (SS) on cross-over effect of the sEMG and jump performance measures on non-stretched lower limbs during single-leg bounce drop jump (SBDJ), and time course and extent of sEMG, passive range of movement (ROM) and jump performance measures of the stretched lower limb. Seventeen young individuals performed SBDJ before and after (stretched limb: immediately post-stretch, 10 and 20 minutes and non-stretched limb: immediately post-stretch) a unilateral ankle plantar flexor SS (6 sets of 45s/15s, 70-90% point of discomfort). For the performance we calculated the jump height, impulse, time to reach peak force and contact time. Surface EMG (EMG integral [IEMG]) was used to describe the muscular activity of gastrocnemius lateralis, and the muscular pre-activation ($IEMG_{pre\text{-}activation}$). Ankle dorsiflexion passive range of motion increased in the stretched limb before and after the SS (pre-test: 21°±4 and post-test: 26.5°±5, p < 0.001). We observed a decrease of peak of force (P=0.029), and $IEMG_{pre\text{-}activation}$ (P=0.015) in the stretched limb; and for impulse (P=0.03), and jump height (P=0.032) in the non-stretch limb between pre-stretching and immediately post-stretching. In conclusion, our SS effectively increased passive ankle ROM of the stretched limb, and it might appears to decrease the muscle peak force and pre-activation; however these finding were only a transient effect (less than 10 minutes). The decrease of jump height and impulse for the non-stretched limb may suggest a central nervous system inhibitory mechanism from SS.

Hindlimb unloading accelerates disease progression in the SOD1 mouse model of amyotrophic lateral sclerosis

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Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by progressive motoneuron loss resulting in skeletal muscle denervation, atrophy and weakness. Motoneurons innervating fast-fatigable muscles (i.e. fast-fatigable motor units) are especially vulnerable, whereas motoneurons innervating slow fatigue-resistant muscles (i.e. fatigue-resistant motor units) show resistance to the disease. Our purpose was to determine if conversion of motor units towards a faster-fatigable phenotype accelerates disease progression. Forty-day-old wild type (n=11) and SOD1 (n=15) mice received 20 days of hindlimb suspension (HS), an unloading model that causes slower-to-faster phenotypic transformations, muscle atrophy, and weakness. Age-matched wild type (n=11) and SOD1 (n=9) untreated mice were controls. HS induced muscle atrophy and weakness in soleus (SOL) and medial gastrocnemius (MG), measured by decreased muscle weight (mean±SEM; SOL: 6.7±0.4 vs 2.7±0.3mg, MG: 42.9±1.8 vs 30.8±1.6mg, p<0.001) and force (SOL: 0.13±0.01 vs 0.07±0.008N, MG: 1.7±0.07 vs 1.1±0.07N, p<0.001). Immunohistochemical and physiological analyses revealed HS caused transformation towards a faster-fatigable phenotype in SOL (type I→IIA→IID→IIB transformation, fatigue index: 0.6±0.02 vs 0.3±0.02, p<0.001). Similarly, fiber type transformation occurred in the IIA→IID→IIB direction in MG (p<0.01). Results confirm HS was an effective intervention. The number of denervated muscle fibers, measured immunohistochemically by neural cell adhesion molecule (NCAM) expression, and number of intact motor units, measured physiologically by motor unit number estimation, were the primary outcomes for assessing disease acceleration. HS induced an increased proportion of NCAM positive fibers (SOL: 1.8±0.5 vs 4.4±0.4%, MG: 2.8±0.7 vs 4.9±0.6%, p<0.05). Notably, in MG, HS induced a 45% motor unit loss in 60-day-old SOD1 (p<0.001) that was equivalent to the loss observed in 120-day-old untreated SOD1; while the number of motor units in 120-day-old untreated SOD1 SOL were preserved, HS induced a 40% motor unit loss in 60-day-old SOD1 (p<0.05). We conclude that HS accelerates the progression of motor unit loss in the SOD1 mouse model of ALS. Therefore, people living with ALS should not be encouraged to reduce weight bearing activities. (Funding: CIHR-NRP.)

The anorexigenic effect of exercise to limit ad libitum energy intake in a school-based setting

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Laboratory experiments reveal that exercise can reduce energy intake, with an advantage for moderate-to-vigorous physical activity (MVPA). The current project aims to identify if, in very young children and in a natural setting, a change in the structure of the lunch period can results in a reduced energy intake. To do so, nine experimental visits were performed. Three conditions were tested, on three occasions each –1) Meal at the beginning of the lunch period followed by a 40-minute MVPA session: Meal_MVPA; 2) A 40-minute light intensity physical activity (LPA) session followed by lunch: LPA_meal; 3) A 40-minute MVPA session followed by lunch: MVPA_meal. Children were instructed to eat their ad libitum lunch box (8-9 items) to reach 4/5 on the satiety visual analogue scale. Twenty-one participants (8 boys; 13 girls) aged 5.6 ± 0.5 years took part in this school-based project. Eighty percent of students were normal weight, with only one underweight, two overweight and one obese children. The MVPA interventions led to significantly higher step counts than LPA sessions (LPA_meal: 2,706 ± 803 vs. MVPA_meal: 3,295 ± 744 and Meal_MVPA: 3,468 ± 1177 steps). Energy intake at lunch was 445 ± 128 kcal for Meal_MVPA, 510 ± 149 kcal for LPA_meal and 428 ± 129 kcal for MVPA_meal, with a significant difference between LPA_meal and MVPA_meal. The relative contribution of lipids to the meal was significantly higher for the LPA_meal condition than for the Meal_MVPA condition: 30 vs. 27%. Overall, this study showed that 1) The anorexigenic effect of MVPA is present in very young children and can be obtained outside the laboratory; 2) It is possible to delay the meal without increasing energy intake if MVPA is done during the delay period; 3) The introduction of a delay increases lipid consumption when LPA_meal but not MVPA_meal is performed during that delay.

A pulse-based diet and exercise training in women with polycystic ovarian syndrome: effects on body composition, bone mineral properties and reproductive measures

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Polycystic ovarian syndrome (PCOS) is an endocrine disorder that predisposes women to increased risk of heart disease, diabetes, infertility

and endometrial cancer, affecting an estimated 500,000 women in Canada. We hypothesized a pulse-based diet (e.g. beans, lentils) would have a positive effect on body composition and reproductive measures. Thirty-one women with PCOS aged 18-35y with a mean body mass index of 33 were randomly assigned to groups receiving a pulse-based diet (n=17) or the National Cholesterol Education Program (NCEP) therapeutic lifestyle changes (TLC) diet (n=14) for 16 wks while participating in an aerobics-based exercise program involving 45 minute sessions 5 times per week. Dual energy X-ray absorptiometry (DXA) was used to assess body composition, including bone mineral density (BMD) and hip geometry (hip structural analysis) to predict bone strength. During the intervention, both groups lost body mass ($p<0.001$; Pulse -3.6 vs TLC -3.0 kg), percent fat mass ($p=0.0013$; Pulse -1.0 vs TLC -1.5%), trunk fat mass ($p<0.001$ Pulse -1.0 vs TLC -1.5 kg) as well as lean body mass ($p<0.05$; Pulse -1.3 vs TLC -0.4 kg). Both dietary interventions combined with exercise training led to higher lumbar spine BMD ($p=0.014$; Pulse and TLC +5.3%) with no effect on total hip BMD. Both groups had higher narrow neck cross-sectional moment of inertia (i.e. a predictor of bone strength at the narrowest part of the femoral neck; $p<0.05$ Pulse +0.18 vs TLC +0.09 cm^4) following the intervention. Both diets also led to more women exhibiting regular menstrual patterns ($p<0.01$). Although the dietary interventions reduced body mass, lumbar spine BMD and femoral neck predicted strength were improved, likely because of concurrent participation in an exercise program and a more favorable hormonal milieu (leading to improved menstrual cyclicity). (Supported by Agriculture and Agri-Food Canada and the Saskatchewan Pulse Growers.)

Comparing neuromuscular function in healthy older and young adults

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The reduced number of functioning motor units (MU) in a given muscle and the associated loss of muscle mass and strength (termed sarcopenia) is a hallmark of typical human aging. The loss of muscle mass/strength results in decreased functional mobility, which could mean the loss of independence in older adults. This study investigated the relationship between MU properties and the strength and power of two lower limb muscles in healthy young and old adults. Twelve older adults (six male, six female; mean age, 77 ± 5 yrs) and twelve young adults (six male, six female; mean age, 24 ± 3 yrs) were studied. MU properties of the tibalis anterior (TA) and vastus medialis (VM) muscles were determined using decomposition-enhanced spike-triggered averaging (DE-STA). The maximal strength and peak power output of these two muscles were also measured using the Biodex System 3 dynamometer. Motor unit number estimates (MUNE) of the TA were significantly reduced ($p>0.05$) in older adults (102 ± 76) compared to young adults (234 ± 109), primarily as a result of significantly larger surface-detected motor unit potentials (S-MUP) in older adults (63 ± 29 μV) compared to young subjects (28 ± 14 μV). Although VM S-MUP values were larger in older adults (60 ± 31 μV) compared to young (48 ±42), the difference was not significant. Maximal strength and power were normalized to subject's body weight and were significantly larger in both the TA and knee extensors of young adults compared to old. Maximal power output displayed greater deficits than isometric strength in both lower limb muscles of older adults. Results from this study indicate that changes in MU properties of the TA and VM occur with ageing, and this effect may be greater in the TA muscle. Further, power, especially in the knee extensors, may be a more sensitive measure of neuromuscular health than isometric strength, and should be the focus of exercise programs in elderly subjects. (This study was supported by the Ontario Graduate Scholarship (OGS).)

Can NIRS derived measures of oxygen saturation differentiate vascular responsiveness in young and older adults?

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Flow-mediated dilation (FMD) is a commonly used non-invasive technique to assess vascular endothelial function, although the technique has shown poor repeatability. Recently, near-infrared spectroscopy (NIRS) measures of tissue oxygen saturation (StO_2) during vascular occlusion have been used to characterize the dynamic response of local tissue perfusion in response to a brief period of ischemia. The purpose of the present study was to establish age-associated changes in FMD, and subsequently identify which StO_2 parameters reflected these group changes. Ultrasound-derived FMD was quantified by a 10 MHz linear-array transducer following 5 minutes of distal cuff occlusion of the popliteal artery in 16 healthy young (Y; 27 ± 4 yrs) and 16 older adult (O; 74 ± 7 yrs) males. Triplicate measures of end-diastolic arterial diameter were taken every 15 seconds following cuff release and FMD response was calculated as the greatest percent change in diameter from baseline (%FMD). StO_2 was measured using NIRS throughout the duration of each test. Two consecutive FMD tests were performed by the same investigator, separated by 30 minutes of rest in the supine position. The two tests were averaged for %FMD and all StO_2 parameters for each participant. %FMD was significantly greater in Y (6.1 ± 2.9%) compared to O (4.4 ± 1.7%). There was a significant difference between groups for StO_2 peak undershoot (Y 38.1 ± 9.8%; O 45.5 ± 8.4%), slope 1 (Y -0.09 ± 0.02; O -0.07 ± 0.02) and peak overshoot (Y 77.5 ± 4.4%; O 82.3 ± 1.8%). Additionally, the StO_2 at the time of average peak dilation was also significantly lower in O compared to Y (71.0 ± 3.9% and 75.1 ± 2.9%, respectively). Although there were no strong correlations between %FMD and the NIRS parameters, likely due to the poor reliability of the FMD measure itself, the dynamic changes in StO_2 were able to track the differences in O and Y that were highlighted with the FMD measure. (Supported by NSERC.)

Relationships between motor classification, physical activity and cardiovascular health in adults with cerebral palsy

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Cerebral palsy (CP) is a disability that impacts a person throughout their lifespan. We sought to determine whether physical activity (PA) levels, assessed using accelerometers, predicted structural and functional indices of vascular health in adults with CP across the Gross Motor Function Classification System (GMFCS). We hypothesized that adults with CP who were community ambulant (GMFCS I-II) would have increased levels of PA, increased endothelial function, decreased arterial stiffness and decreased cardiometabolic risk compared to those who were non-ambulatory (GMFCS III-V). Forty adults with CP were recruited for the study (33.7 ± 12.7) (14 ambulant) (26 non-ambulant). Central (cPWV), upper (uPWV) and lower (lPWV) pulse wave velocities were measured using simultaneous applanation tonometry. Absolute and relative flow-mediated dilation (FMD) of the brachial artery was measured on the dominant arm of the participant. Carotid intima-media thickness and distensibility were measured

with B-mode ultrasound in the right common carotid artery. Cardiometabolic markers of fasting interleukin-6, insulin, glucose, and a lipid panel were analyzed from serum. The non-ambulant group had an increased uPWV (10.2 m/s ± 1.9) compared to the ambulant group (8.28 m/s ± 1.6) ($p<0.01$) despite no differences in cPWV or lPWV. No group differences were seen in terms of the FMD assessment suggesting that endothelial function is preserved in the non-ambulant group. Moderate-to-vigorous PA (MVPA) levels were greater in the ambulant group (2.4 mins ± 2.1 per hour) compared to the non-ambulant group (0.3 mins ± 0.6 per hour) ($p<0.01$). Furthermore, sedentary time was greater in the non-ambulant group (57.8 mins ± 1.9 per hour) compared to the ambulant group (51.6 mins ± 4.7 per hour) ($p<0.01$). Despite differences in PA levels, MVPA was not a significant independent predictor of vascular or metabolic health however, GMFCS level was predictive of upper limb PWV and resting heart rate in this cohort of adults with CP. (Funding Sources: The Ontario Federation for Cerebral Palsy (OFCP) and Natural Sciences and Engineering Research Council of Canada (NSERC).)

The role of the unfolded protein response in muscle contractile activity-induced adaptations

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Mitochondrial biogenesis (MB) is a process whereby the organelle reticulum expands in order to meet the increasing needs of the cell in response to various stressors, such as exercise. To achieve this expansion, there is a rapid increase in the transcription and translation of nuclear genes encoding mitochondrial proteins (NuGEMPS), under the influence of PGC-1α. The immediate surge of newly translated proteins has the potential to overload the protein handling machinery of the cell, and may induce an unfolded protein response (UPR) within both the mitochondria (UPR^{mt}) and endoplasmic reticulum (UPR^{ER}). Little work has been done examining the role of the UPR in skeletal muscle, particularly with respect to exercise-mediated adaptations. To study this, rats were subjected to 3 hours of muscle contraction, followed by recovery (3 hrs), over the course of 1, 2, 3, 5 or 7 days, to examine the chronology of activation of MB, the UPR^{mt}, and the UPR^{ER}. We observed a 20% increase in COX activity, along with a 270% rise in PGC-1α mRNA expression between 2-7 days of stimulation, signifying increased mitochondrial content. Concomitantly, the mRNA expression of the critical UPR transcription factor CHOP was enhanced by 89% following contraction between 2-5 days. This was paralleled by a 70% increase in CHOP protein at 2-3 days, relative to control. Conversely, ATF4 mRNA expression was reduced 23% following a single bout of contractile activity, but returned to control levels between 2-7 days. The mRNA expression of LonP, an upstream activator of the UPR^{mt}, increased 25% following a single bout of muscle contraction, however it was reduced by 18% between 3-7 days. Similarly, mtHSP70 mRNA increased by 31% within 1-2 days of contractile activity, indicating UPR^{mt} induction. These data suggest that the beneficial adaptations associated with exercise in improving muscle health and function are preceded by rapid alterations in UPR^{mt} and UPR^{ER} proteins, suggesting a role for these pathways in muscle adaptations.

Estimates of persistent inward current in human soleus motor units decline during fatigue

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Persistent inward current (PIC) is an intrinsic property of motoneurons that allows for increased motoneuron output in response to synaptic input. PIC acts a gain modulator and varies with joint angle, type of movement, arousal state, and may change with fatigue. Fatigue is defined as the inability to produce optimal levels of force. A possible contributor to neuromuscular fatigue is a reduction in PIC. It was hypothesized that PIC would decrease as fatigue increases in response to either decreased monoaminergic drive or increased inhibitory input. This investigation examined the relationship between PIC and reciprocal inhibition and its contribution to fatigue. Single motor unit recordings were made from low threshold motor units of the soleus. PIC was estimated using the paired motor unit technique. This approach uses the difference (ΔF) between the firing rate of a low threshold control unit and the recruitment and decruitment of a higher threshold test unit as an estimate of persistent inward current. PIC was estimated before, between, and after sets of fatiguing plantarflexion contractions. Fatiguing contractions were made until maximal force declined to 70% of the initial value. Significant decreases in estimates of PIC occurred at 50% time to exhaustion (tlim) ($p<0.05$), 75% tlim ($p<0.05$), and 100% tlim ($p<0.01$). Estimates of PIC returned to baseline after a recovery period ($p=1.00$). No significant changes occurred in estimates of PIC during a control day in absence of fatiguing contractions. If fatigue-associated changes in ΔF were due primarily to PIC, then we would expect ΔF values to be higher and unchanged across the fatigue protocol when stimulation of the nerve to the antagonist was applied to "turn PIC off" via reciprocal inhibition. No significant change in PIC was seen with reciprocal inhibition before and after fatigue. These findings suggest that a reduction in PIC is a possible contributor to neuromuscular fatigue.

Is there an anorexigenic effect of physical activity in children outside the laboratory?

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It is interesting to note in the context of body weight regulation that physical activity (PA) increases energy expenditure, but that it also helps decrease energy intake. In laboratory settings, energy intake can vary, with a higher anorexigenic effect seen with more intense exercise sessions and with differences among various sub-groups (e.g. gender and body weight status). In the current study, the goal was to examine in real-life settings the association between PA intensity and energy intake in children. Data from wave one of the Quebec Adipose and Lifestyle Investigation in Youth (QUALITY) cohort were used. Children aged 8–10 years with at least one obese biological parent were categorized as underweight/normal weight (BMI < 85^{th} percentile), overweight (85^{th} ≤ BMI < 95^{th} percentile) or obese (BMI ≥ 95^{th} percentile). Practice of PA was monitored for seven consecutive days using accelerometers. Energy intake was assessed from three 24-h diet recalls. Five hundred thirty-three children [54% boys (20% overweight and 20% obese) and 46% girls (17% overweight and 23% obese)] were included in the present study. A multiple linear regression was used and a correction for the overall PA level (daily counts per minute; CPM) was applied. The practice of low intensity PA was negatively associated with energy intake ($R^2=0.06$; $p<0.001$). Indeed, a daily increase of one hour of low intensity PA was associated with a decrease of 39 kilocalories [$p=0.055$]. This effect was the same among sex and body weight status categories. Sedentary and moderate-to-vigorous PA were not associated with energy intake. Also, time spent in the various intensity levels had no effect on the macronutrient consumption. In conclusion, for the same overall PA level, a high practice of low intensity PA is associated with a decreased energy intake. This suggests that optimal intensity for PA to influence energy intake might differ between laboratory and real-life settings.

Physical activity profile of type 1 diabetic children: To pump or not to pump?

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Treatment for Type 1 diabetes (T1D) recently evolved drastically with the use of the insulin pump. In children, the device is prescribed more and more but its impact on physical activity patterns is scarce. To date, only one Norwegian study investigated this issue and it revealed that the use of the pump over multiple insulin injections did not influence patients' physical activity levels. The goal of the current study is thus to reveal the complete physical activity profile, including exercise barriers, of Canadian children with T1D according to their insulin treatment. The study was performed at the CHU Sainte-Justine's diabetes clinic, Montreal, Canada. A self-administered questionnaire had been completed by 188 patients with T1D (6-17 y). The patients were either under insulin injections treatment (no distinction was done between multiple daily injection and more conventional forms of insulin injection treatment) or insulin pump. Mean duration of diabetes was 5.3 years (SD 3.6), 56% of children were boys and 60% used the insulin pump. The risk of hypoglycaemia during exercise was seen as a barrier to practice physical activity for 33% of respondents on insulin injections treatment and for 21% of respondents on the pump ($p=0.089$). In children (< 12 years old), 47% of those on insulin injections treatment reported doing ≥ 60 minutes of moderate-to-vigorous physical activity (MVPA) ≥ 4 days/week, while the proportion was 40% for those using the insulin pump ($p=0.832$). In teenagers, 11% who were not on the pump and 19% who were using it did at least 60 minutes of MVPA on average per day ($p=0.327$). This study suggests that while the insulin pump tends to be associated with less perceived barriers that prevent patients with T1D from doing regular physical activity, this does not translate into higher levels of physical activity in pump users.

Comparison of neuromuscular fatigues induced by prolonged exercise in normoxia and hypoxia

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It has been previously demonstrated that a prolonged cycling exercise in normoxia (N) induces fatigue due to both peripheral and central alterations. It has also been reported that cerebral perturbations are greater during short-duration exercise in hypoxia (H) compared to N but no studies have considered the effects of prolonged cycling exercise at the same percentage of $\dot{V}O_2$max measured in N and H. The purpose of this study was to test the hypothesis that central alterations are accentuated in H compared to N during prolonged whole-body exercise at the same relative intensity. Ten subjects performed two sessions consisting of 3 bouts of 80 min cycling at 45% of their relative maximal aerobic power in N and H (F_IO_2 = 12%, mean SpO_2 during cycling exercise = 77 ± 8%). Before exercise and after each bout, transcranial magnetic stimulation (TMS) was used to assess corticospinal excitability (motor-evoked potential; MEP) of knee extensor muscles. Femoral nerve electrical stimulation was used to measure changes in muscle contractile properties. Voluntary activation was also assessed with both types of stimulation. A significant and similar torque reduction (25 ± 11% and 20 ± 12% in N and H, respectively) was measured at the end of exercise in both environmental conditions. A significant time effect was observed for all parameters. The reduction of peak twitch torque was significantly lower in H than in N (15 ± 19% and 28 ± 15%, respectively). No other significant differences were observed between N and H. In particular, the reduction in voluntary activation measured with TMS and electrical stimulation (~8% and ~13%, respectively) and MEP did not differ between environmental conditions. It is concluded that when prolonged exercise is performed at the same relative intensity, fatigue is similar between N and H. Even if the brain is affected by hypoxia, F_IO_2 as low as 12% does not appear to affect functional capacity or motor cortical excitability during cycling.

Modulation of supraspinal and spinal excitability following an upper-body Wingate Test

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The objective of this study was to characterize the effect of an upper-body Wingate test on supraspinal and spinal motoneurone excitability. Twelve recreationally active males (age, 22.4 ± 2.4 years; weight, 82.1 ± 10.4 kg) participated in the study. Motor evoked potentials (MEPs) elicited by transcranial magnetic stimulation (TMS) of the motor cortex and cervicomedullary MEPs (CMEPs) elicited by transmastoid electrical stimulation of the corticospinal tract provided assessments of corticospinal and spinal motoneurone excitability, respectfully. Electromyographic (EMG) recordings were made from the relaxed biceps brachii muscle prior to and post (immediate post, 3, 6 and 9 min) upper-body Wingate. Each time point represents the beginning of a two-minute recording window from which averaged responses were taken. The 30s Wingate test was performed against a resistance equal to 3.5% of the participant's body weight. The amplitude of the MEPs was significantly decreased ($p<0.05$) at time points 3 and 6 minutes (pre, 6.85% ± 3.88%; post 3 minutes, 3.46% ± 2.91%; post 6 minutes, 3.69% ± 2.82% of M-wave) and CMEP amplitudes were significantly increased ($p<0.05$) at time points 3, 6, and 9 minutes (pre, 9.9% ± 13.9%; post 3 minutes, 35.4% ± 9.28%; post 6 minutes, 39.6% ± 20.6%; post 9 minutes, 35.1% ± 12.7% of M-wave) when compared to pre-Wingate test measures. The changes in MEPs and CMEPs in the present study resemble those previously reported following fatiguing exercise of the biceps brachii using isometric contractions. This suggests that acute corticospinal adaptations following short bouts of maximal exercise may not be motor output-dependent.

A new spin on muscle quality: magnetization transfer imaging of the tibialis anterior in human diabetic neuropathy

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Magnetization transfer (MT) imaging has been frequently used to study pathological changes in the human central nervous system, and the technique has been applied to evaluate limb skeletal muscle quality in very few studies related to natural adult aging, and in clinical populations. Based on the transfer of spin from protein-bound protons to mobile water protons, a measure of protein content can be obtained using magnetic resonance imaging procedures. A peripheral neuropathy due to diabetes (DN) is related to a loss of strength, motor axon loss, muscle denervation and subsequent atrophy of skeletal muscle. The purpose here was to assess whether people with DN have a reduced muscle protein quality in comparison to age-matched control subjects. Using a 3T magnetic resonance scanner, MT and T2-weighted multi-echo cross-sectional images of the tibialis anterior (TA) muscle were recorded from 9 individuals (5 men) with DN (~65y) and 7 (4 men) age and sex-matched controls. Using OsiriX imaging

software (version 5.8.5), a magnetization transfer ratio (MTR) was calculated offline from pairs of images with (M_T) and without (M_0) an off-resonance prepulse as: $[(M_0-M_T)/M_0]$. T2 relaxation times of the TA were also calculated. Outside the magnet, maximal dorsiflexion strength (MVC) and voluntary activation were assessed using an ankle joint dynamometer. Despite equal activation abilities, the DN group was ~30% weaker than controls with a significantly lower proportion (~5%) of contractile tissue and lower MTR (0.28±0.03 vs. 0.32±0.02 percent units). T2 relaxation time was significantly longer in the DN group (77±16 ms) compared to control (63±6 ms). In addition to some loss of contractile mass, these findings indicate a reduction in the structural integrity and myocellular protein density found within the TA. Thus, for those with DN the loss of strength is likely due to both a loss of muscle mass and a reduction in contractile quality. (Supported by NSERC.)

The effect of 15 minutes of passive rest on SCAT3 scores following maximal aerobic exercise

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The Sport Concussion Assessment Tool – 3rd Edition (SCAT3) has been created to help assess the occurrence of a concussion in athletes. It is recommended that subjects rest for an arbitrary period of 10-15 minutes following injury in order to alleviate the effects of fatigue prior to SCAT3 assessment. The purpose of this study was to determine whether a 15-minute rest period following maximal aerobic exercise is an adequate amount of time for SCAT3 scores to return to baseline. Twenty six healthy, active volunteers participated. Each participant was assessed using the SCAT3 to obtain baseline measures, followed by a graded exercise test (GXT). Participants were then given 15 minutes of passive rest and re-assessed using the SCAT3. Paired t-tests were used to detect differences in SCAT3 scores, using a significance level of $p < 0.05$. The mean age, height and mass of participants were 27.0 ± 4.0 yr, 176 ± 11 cm and 80.3 ± 14.0 kg, respectively. The number of symptoms increased from 1.7 ± 1.5 to 5.0 ± 3.6 during pre- and post-$\dot{V}O_{2max}$ SCAT3 assessment, respectively ($p < 0.05$). Symptom severity scores also increased from pre- to post-$\dot{V}O_{2max}$ SCAT3 assessment (2.2 ± 2.1 vs. 7.0 ± 5.2, respectively; $p < 0.05$). The number of errors committed during tandem stance decreased from pre- (0.77 ± 1.18) to post-exercise (0.27 ± 0.45; $p < 0.05$), while time to complete tandem gait decreased from pre- to post-$\dot{V}O_{2max}$ assessment (14.9 ± 3.0 s vs. 13.5 ± 3.4 s, respectively; $p < 0.05$). Our data suggests that 15 minutes of passive rest following maximal aerobic exercise may not be enough time to allow the number of symptoms and symptom severity scores to return to baseline in SCAT3 assessment. While symptom scores are subjective, it remains possible that the observed differences may be due to the effects of exercise. This study is one of the first to critically evaluate the newly implemented SCAT3 that many health practitioners use for concussion evaluation.

Self-myofascial release is no more effective than stretching in improving functional outcomes in men with 'tight' hamstrings

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Self-myofascial release (SMR), specifically via foam-rolling, has grown substantially in popularity in recent years and is now commonly found in most gyms, clinics, and high performance centers despite a dearth of scientific evidence for its use. There have been reports of acute effects of SMR using foam-rolling to decrease the magnitude of delayed onset of muscle soreness symptoms, increase range of motion (ROM) similar to stretching, and to increase performance measures. The proposed mechanisms remain unclear and to date, no long-term studies have been published; however, if proven effective SMR would be an economical and practical substitute for traditional therapist-administered myofascial release. The aim of this study was to determine the effects of SMR paired with stretching (SMR+stretch) to stretching (stretch) alone over a 4-week intervention in 19 young men (21.7±2.9 yr; 24.7±3.9 kg/m^2) who reported bilateral 'tightness' (reduced ROM) in their hamstrings. One of the subjects' legs was assigned to stretch and the other to SMR+stretch. We hypothesized that SMR+stretch would be more effective than stretch alone. Passive ROM, compliance, rate of force development (RFD), and maximum voluntary contraction (MVC) were all measured via a Biodex dynamometer. Subjects underwent a familiarization session 1 week prior to commencing the protocol and measures were taken at baseline and at 4 wk. The SMR protocol was 4 repetitions of 60 s of foam rolling oscillating from the ischial tuberosity down to the back of the knee. The stretching protocol was 4 repetitions of a 45 s specific static hamstring stretch. Between repetitions subjects rested for 15-30 s. Each participant performed the intervention to the corresponding leg twice per day for 4 wk. The results showed that passive ROM was significantly increased in both the SMR+stretch and stretch legs, however, there was no significant difference between treatments. Compliance, peak torque at end-ROM, RFD, and MVC were unchanged as a result of training and showed no differences between groups. The lack of changes in tissue compliance suggests that there was likely no change in hamstring tissue. Nonetheless, an interesting finding is that despite the increase in end ROM, peak torque at the end-ROM did not change. These data allude to the potential of a change in tissue 'quality', though it may be specific towards the end-ROM. Our data show that there appears to be little benefit of combining foam-rolling with traditional stretching alone for the alleviation of self-perceived limitations in hamstring ROM.

Ginseng supplementation restores vascular responsiveness in type I diabetic rats

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Vascular responsiveness is impaired in diabetic and sedentary populations. Natural alternatives to prescribed drugs, such as ginseng supplementation and exercise, might help restore vasoresponsiveness. This study examined the effects of 12 weeks of North-American aqueous ginseng supplementation, exercise training, and sedentary behavior on vascular responses in type I diabetic rats. Rats were assigned to a non-diabetic sedentary control (C_S; n=7), sedentary diabetic (D_S; n=7), sedentary diabetic with ginseng supplementation (250 mg·kg^{-1}/day ginseng) (D_S+GS; n=8), sedentary diabetic with ginseng supplementation and endurance exercise (5x week,1 hour/day at 21 m·min^{-1}) (D+GS+Ex; n=8), and a control group not exposed to sedentary behavior (C; n=8). Diabetes was induced by streptozotocin. Femoral, iliac, and aorta arteries were excised, cleaned of connective tissue and rings of ~2 mm length were mounted onto a myography system. Percent vasorelaxation responses to cumulative doses of acetylcholine (Ach) were calculated. The overall % vasorelaxation (10^{-8} M ACh to 10^{-4} M ACh) of the carotid artery was similar in C_S (57.1±30.9%), C (66.2±35.1%), D_S (57.8±35.6%), D+GS+Ex (70.8±37.1%), and G_S+GS (63.5±36.8%). The overall % vasorelaxation in the aorta artery was smaller in C_S (22.7±17.0%) compared to C (46.1±35.3%), D_S (60.0±40.2%), D+GS+Ex (64.0±40.2%), and D_S+GS (55.7±38.7%) ($p< 0.05$). Additionally, the overall % vasorelaxation was smaller in C compared to D+GS+Ex. In the femoral, the overall % vasorelaxation was reduced in D_S (17.6±15.9%) compared to all other conditions (C_S, 42.8±21.6%; C, 79.1±27.9%; D+GS+Ex, 55.3±26.6%; D_S+GS, 44.5±25.8%) ($p< 0.05$), and C displayed a larger % vasorelaxation compared to the other conditions. The main findings were that: 1) although the sensitivity to ACh of the femoral artery was severely affected by diabetes, this condition did not affect

the carotid artery; 2) ginseng supplementation restored the loss of sensitivity in the femoral artery, whereas exercise training did not add further vascular protection; 3) control sedentary rats showed a depressed sensitivity to ACh compared to control animals not exposed to 12 weeks of sedentary lifestyle. (Supported by: CIHR, Ontario Ministry of Research and Innovation.)

Energy restriction-induced reductions in myofibrillar protein synthesis are rescued by resistance training and balanced daily protein ingestion in older men

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In overweight/obese older adults weight loss has numerous clinical benefits but may accelerate sarcopenic muscle loss; thus, strategies to enhance weight loss with a high fat-to-lean ratio are paramount. We examined the impact of dietary protein distribution on the synthesis of specific muscle protein fractions before and during periods of energy restriction (ER), with and without resistance training (RT) in twenty overweight/obese older men (66 ± 4 yr, 31 ± 5 kg·m^{-2}). A 4wk long hypocaloric (-300 kcal·d^{-1}), higher protein (1.3 g·kg^{-1}·d^{-1}) diet consisting of 4 daily meals was provided to participants who were randomized to a balanced (BAL: ~25% of total protein intake per meal) or skewed (SKEW: ~72% of total protein intake at evening dinner meal) pattern throughout the day (n=10 per group). In wk 0-2 (Phase 1:ER) participants continued their habitual physical activity and in wk 3-4 (Phase 2:ER+RT) participants performed whole body, progressive RT (3 d·wk^{-1}). A 13-h primed continuous infusion of L-[ring-$^{13}C_6$] phenylalanine with muscle biopsies was used to measure fasted (0-2 h) and fed-state (2-13 h) myofibrillar and sarcoplasmic protein synthesis in response to a BAL or SKEW pattern of protein intake in: energy balance (EB), at the end of Phase 1 (ER), and at the end of Phase 2 (ER+RT). In the fed state, myofibrillar fractional synthetic rate (FSR) was lower in ER than EB in both groups (P=0.000), but was ~19% higher in BAL than SKEW (P=0.014). In ER+RT, fed-state myofibrillar FSR increased above ER in both groups and in BAL was not different from EB (P=0.903). In contrast, in SKEW myofibrillar FSR remained ~14% lower than EB (P=0.002) and ~16% lower than BAL (P=0.006). Fed-state sarcoplasmic FSR was reduced to a similar extent (~19%) in ER and ER+RT compared to EB (P<0.01), with no difference between groups. During ER in older men a balanced distribution of daily protein stimulated the synthesis of muscle contractile proteins more effectively than a skewed protein intake with consumption of the majority of protein in the evening meal. Combining resistance training with a balanced protein distribution 'rescued' rates of myofibrillar protein synthesis during ER and may represent an effective strategy to facilitate muscle mass retention during ER in overweight/obese older adults.

The effect of a fast start versus constant power pacing strategy on performance and the utilization of energy above critical power in a 6 min performance

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The purpose of this study was to compare two different pacing strategies during a 6 min cycle performance test on average power output, utilization of W' (energy available above critical power (CP)) and capillary blood lactate concentration. It was hypothesized that a constant power strategy performed at the power output of fatigue threshold (FT) would elicit a superior performance compared to a sprint start strategy followed by constant power cycling at FT minus 5% (5%<FT). This strategy is similar to that employed by elite rowers during a 2 km race (~6min). Eight healthy, male subjects (age 24±3) completed a cycle ramp test to fatigue ($\dot{V}O_2$max 4.32±0.76 L·min^{-1}; peak aerobic power 373±49 W) and a 3-min all-out ride to determine CP and the FT. The FT work rate was calculated as (CP (W) + (W'J/ 360 s) and performed for the initial 270 s of the FT ride. The 5%<FT began with a 12 s sprint, followed by 248 s paced at a 5%< FT pace. The final 90 s of both strategies incorporated an increase in effort, in 30 s periods, such that effort was maximal over the last 30 s. The FT strategy yielded a higher average work rate compared to 5%<FT over the 6 min (304±37 W vs 292±39 W, p<0.05). W' utilized was lower over the initial 12 s of FT (504±84 J vs 4687±1060 J, p<0.05), and higher from 13-270 s and 271-360 s compared to 5%<FT (10571±1650 J vs 5518±2266 J, p<0.05 and 6369±4271 J vs 3296±3086 J, p<0.05). Total utilization of W' was higher during the FT vs 5%<FT (17444±5439 J vs 13502±3543 J). No difference in post-exercise blood lactate concentration was observed between pacing strategies (FT,14.2±3.2 mmol vs 5%<FT,14.7±2.9 mmol). In conclusion, the FT strategy resulted in a superior performance, while facilitating a greater utilization of W', compared to the elite rowing stratagem during a 6 min performance.

Diagnosing physical inactivity and referring patients to exercise professionals: the way of the future

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An integrated system-wide coordinated approach to health care will require the engagement of all health care providers, patients and the community at large. Patient-centered care in chronic disease management should revolve around disease-specific education and professional partnerships that can provide support for patients in lifestyle management. It remains unclear how often or comfortable physicians are in counseling and referring patients to other health care providers that specialize in physical activity and exercise prescription. The purpose of this study was to conduct a scoping review of physician's approaches to physical activity counseling and exercise referral in chronic disease management. SportDiscus, Medline (OVID), Web of Science and PubMed databases were searched using common terms ("prescribing exercise and health care", "clinician exercise interventions", "public health and exercise", "public health, exercise medicine and chronic disease", and "inactivity, economic analysis and exercise') and bibliographies of selected studies were searched. Peer-reviewed and grey literature articles were reviewed (N=96) and reduced to 33 based on overall relevance to the stated purpose. The inclusion criteria (1) pertained to physician counseling and exercise referral; (2) focused on physician experience or current reported trends; and (3) involved chronic disease prevention or management as an outcome or topic of discussion. Studies extracted were tabulated with common descriptive headings. Results were grouped loosely into themes and included: 1) several studies identified physician-based contribution to PA and/or programs (advice during visits, Green Prescription, referral to community programs), 2) physician's belief in exercise for their patients was constrained by barriers they were experiencing (no time, not a priority, isolation from PA agencies, lack confidence in the services to which they are referring, apprehensive about using exercise as a treatment for medical conditions, a referral pathway is unknown, concerns over the quality of the services providing exercise-based therapy) and 3) cost effectiveness approach was questioned. In summary physicians have the potential to contribute to lifestyle-related chronic disease management, but face multiple barriers that limit them from prescribing exercise to their patients. A more feasible approach would be to diagnose physical inactivity and refer patients to exercise professionals (certified exercise physiologists (CEPs) or degreed exercise professionals), whose scope of practice and professional responsibility fit this niche. Educating physicians on the exercise professional's scope of practice is necessary but it is unknown whether this will be sufficient for physicians to begin prescribing exercise for patients.

Impact of long-term marathon running on age-related lateral ventricle expansion

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Enlargement of the lateral ventricles in the brain occurs with age and generally reflects brain atrophy. Conversely, physical activity may ameliorate age-related brain volume loss in older adults. At present, the impact of long-term aerobic training on brain structure and function remains unknown. The purpose of this retrospective cross-sectional study was to determine if endurance running may delay age-related changes in lateral ventricle volume. Fifteen masters athletes (MA, 59±4 years, endurance training > 10 years), and 15 sedentary but otherwise healthy older adults (OA, 62±3 years) participated. Using 3T magnetic resonance imaging, T1-weighted high-resolution (1.0x1.0x1.0mm) images were acquired. Images were analyzed using a partially automated segmentation tool developed in-house specifically for volumetric assessment of the lateral ventricles. An overall effect of age on lateral ventricular volume was observed (r^2=0.07, slope=0.95cm^3/year, $p<0.05$). Abdominal girth was smaller for MA (80.9±8.8cm) as compared to OA controls (88.8±10.4cm, $p<0.05$). MA had a larger left cardiac ventricular mass (163±35) and $\dot{V}O_2$ max (50±7ml/kg/min) as compared with OA controls (123±38, 37±8 ml/kg/min respectively, $p<0.01$). However, no difference in lateral ventricle volume was observed between MA (17±12cm^3) and OA controls (16±12cm^3, $p=0.93$) and the data were marked by high variability. These preliminary results suggest that long-term endurance running has minimal effect on age-related expansion of lateral ventricles in the brains of healthy middle-aged individuals. (Supported by CIHR.)

A Phase II RCT and economic analysis of three exercise delivery methods in men with prostate cancer on ADT

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In Canada the most common type male cancer is prostate cancer; one common treatment is androgen deprivation therapy (ADT), but its side effects can lead to decreased physical functioning and well-being. Previous research indicates that resistance and aerobic training provide multiple health benefits; however few studies have directly compared exercise modalities. Additionally, understanding the role of adherence to exercise is important for long-term benefits. The primary aim of this phase II non-inferiority RCT is to determine whether three exercise delivery models are equivalent in terms of benefits in health and well-being in this population. Secondary aims include longer-term adherence and cost-effectiveness. Men diagnosed with prostate cancer who are currently on ADT (or are castrate-resistant for 6 months), fluent in English, and living close to study center are eligible. They are screened through the Physical Activity Readiness questionnaire or receive physician approval. Participants complete five assessments, which are conducted by a Certified Exercise Physiologist. They may consist of socio-demographic and clinical data collection, physical fitness testing, self-report questionnaires, BMD, and blood work. Objective measures include; body composition, fitness testing, quality of life and fatigue, biological outcomes, and adherence. Participants are randomized in a 1:1:1 fashion. Each participant will receive a detailed exercise manual and are asked to complete 4 - 5 exercise sessions per week incorporating aerobic, resistance and flexibility training. Statistical analysis will be conducted on feasibility, efficacy outcomes, and adherence. The goals of this study are to gain a better understanding of health benefits provided through the delivery models, the cost-effectiveness of running these programs and an increased understanding of adherence to exercise.

Effects of combined aerobic and resistance exercise on quality of life and fitness of individuals who are post cancer treatment

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The number of individuals living with cancer is growing. Cancer survivors can experience numerous, debilitating and long lasting side effects. What can be implemented following treatments to reduce side effects? One option is exercise. This study evaluated the effects of an eight-week individualized aerobic and resistance exercise program on physical functioning and quality of life (QOL) in individuals post treatment from breast, colon and adenoid cystic cancer. Participants were recruited through a local non-profit cancer support centre. Eight participants met the inclusion criteria and were approved to participate by physicians through a Physical Activity Readiness medical questionnaire (PARmed-X). All participants completed four assessments surrounding an eight-week exercise program. Pre-, post- and three month follow-up assessments consisted of an interview, related QOL questionnaires, as well as body composition, cardiovascular and musculoskeletal testing. An additional questionnaire-only assessment was also administered at the 4-week point of the exercise program. The individualized exercises prescribed were based on results from the pre-assessment. Participants attended exercise training sessions bi-weekly for eight weeks. Training included a warm-up, prescribed cardiovascular and resistance training, and stretching. Through this study, trends of improvements in muscular strength, endurance, reduction in fatigue levels and perceived QOL were identified. These outcomes further support current literature that a comprehensive physical fitness program is important for this population in assisting them with reduction in their cancer related side effects. Additionally participant perceived improvements were seen throughout the 8-week exercise program and at post-test. This research helped provide evidence-based knowledge on the effects of exercise on individuals that are 2 – 12 months post treatment. Future research should focus on the benefits of individualized exercise programs at any stage of cancer including improvements in QOL, fatigue and physical functioning.

Physical adaption during an expedition in Antarctica

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Antarctica is a non-human land that challenges the human body whenever someone ventures there. A group of 6 explorers (3 women and 3 men; 25 ± 4 years old) participated in an expedition in complete autonomy for 27 days in Antarctica. The objective was to observe the physiological adaptation of the explorers in this extreme environment following physical preparation, high calorie input nutrition, and mineral supplements. Anthropometric measures (DXA) and a specific aerobic and endurance tests were conducted before and after the expedition in the laboratory at UQAM. Furthermore, the grip strength of the explorers was taken in Antarctica before and after the expedition. Pre- and post- expedition measurements were not significantly different for %body fat (14.5 ± 7.2 VS 11.8 ± 5.9 and 26.5 ± 7.8 VS 25.1 ± 7.8% fat for men and women, respectively), for lean mass (70.3 ± 5.4 VS 69.0 ± 3.3 and 46.5 ± 5.6 and 48.3 ± 4.9 kg for men and women, respectively) and for the specific $\dot{V}O_2$peak test (48.3 ± 2.9 VS 62.0 ± 7.9 ml/kg/min for men and 39.5 ± 2.1 VS 42.0 ± 7.7 ml/kg/min for women).

The grip strength did not change significantly and was 106.3 ± 12.6 VS 107.3 ± 15.0 kg for men and 78 ± 12 VS 76 ± 12 kg for women before and after the expedition, respectively. The nutrition and the physical preparation appear to be key aspects during an expedition in an extreme environment to countermeasure weight lost and physical ability decay.

ER stress-altered sarcoplasmic reticulum-mitochondria interaction in skeletal muscle: potential involvment in Duchenne Muscular Dystrophy

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Patients with Duchenne Muscular Dystrophy (DMD) present a major muscle weakness leading to respiratory failure and dilated cardiomyopathy. Altered muscle function has been attributed to mitochondrial dysfunction, cell death and altered calcium handling. Besides its role in calcium homeostasis, the sarco-endoplamic reticulum (SR/ER) controls protein folding and, under pathophysiological conditions, may activate the unfolded protein response (UPR) to limit ER stress, or the activation of cell death pathway. In the present study, we aimed to determine whether ER stress and UPR are enhanced in mdx mice, an animal model of DMD. In the diaphragm of 4, 10, and 26 week old mdx mice, we found a significant increase in the expression of UPR proteins such as GRP78, IRE1a, p-eif2a compared to Wild-Type mice (between 1.2 and 3.2 fold increase in mdx *vs* WT). In addition, ER stress is associated with a disruption in SR-mitochondria interaction, charaterized by a decreased association between the SR/ER IP3 receptor (IP3R) and VDAC, the porine of the mitochondrial outer membrane. Similarly, 8 hours after injection of the ER stress activator in WT mice (1μg/g of tunicamycin, i.p.), the UPR response was activated and the IP3R-VDAC interaction significantly decreased. Although the force generating capacity of the diaphrgam measured *ex vivo* was not significantly affected by tunicamycin, the EDL maximal force-generating capacity dropped significantly (-21% compared to WT). Altogether, these results demonstrate that activation of UPR pathway altered SR/ER mitochodria interaction and muscle contractility, which may contribute to muscle weakness in DMD.

Central and peripheral mediated neuromuscular fatigue of 10 maximal intensity lower body intermittent sprints on a cycle ergometer

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Little is known about neuromuscular fatigue (NMF) that likely occurs during maximal intensity intermittent-sprint (IS, defined as ≤10s sprints interspersed with ≤60s of recovery) cycling. The purpose of this study was to determine 1) if IS cycling causes NMF and 2) the time course and origin (peripheral or central) of NMF during IS cycling. We hypothesized that IS would induce NMF leading to reductions in power and force similar to that reported for RS cycling and 2) NMF during IS would predominantly be peripheral fatigue early in the session (i.e. the first 5 sprints) and central fatigue would become more prevalent towards the end of the session (i.e. the last 5 sprints). Eight highly motivated, recreationally trained, male athletes completed two separate sessions of 10, 10s sprints interspersed with 180s of recovery on a cycle ergometer. The power outputs were recorded for each sprint and knee extensor maximum voluntary contraction (MVC) force, voluntary activation and evoked contractile properties, along with blood lactate, were recorded pre-sprint, post-sprint 5 and post-sprint 10. Total work over the 10 sprints significantly decreased by 8.5% and could be described by two linear relationships from sprints 1-5 (5.2%) compared to sprints 6-10 (3.3%). MVC force significantly decreased by 16.6% and a further 7.1% after sprint 5 and 10, respectively, compared to pre-sprint. Voluntary activation was unchanged after sprint 5, however, significantly decreased by 6.5% after sprint 10. Potentiated twitch forces decreased by 24.4% and 6% following sprint 5 and 10, respectively, compared to pre-sprint. Thus, these results show that IS did induce NMF, similar to reported NMF due to RS. Novel findings of the study showed that the NMF during the first 5 sprints was mainly peripheral whereas in the last 5 sprints it was both peripheral and central. It appears that central motor drive is reduced at the latter end of the exercise protocol where peripheral fatigue may be at its limit.

Simulated ship motion results in compromised simple reaction time and visuomotor accuracy tracking tasks but not maximal voluntary force or activation of the elbow flexors

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Moving environments such as space flight, increased and decreased gravity, vibration and short duration (<10 minutes) ship motion exposure compromises the performance of motor tasks. Although some longer duration studies have examined altered gravity, the effects of longer duration ship motion exposure on motor tasks and recovery is unknown. The purpose of this study was to determine; 1) how simulated ship motion affects reaction time, visuomotor accuracy tracking, force output and biceps brachii muscle activation over an hour of motion exposure and 2) if there is a residual effect of simulated motion and the time course of recovery from any decrements in the aforementioned performance measures. Sixteen participants randomly performed two experimental testing conditions; 1) motion exposure (MO) and 2) control (CO). The dependent variables were reaction time, visuomotor accuracy tracking, and maximal voluntary contractions of the elbow flexors and were measured pre-, 1, 10, 20, 30 and 58 minutes during, and 1 and 15 minutes post-condition. A two-way (condition x time) repeated measures ANOVA revealed that 1) reaction times were significantly ($p < 0.007$) slowed at all time points in MO but unchanged during CO, 2) error rates of the visuomotor accuracy tracking task were significantly ($p < 0.007$) increased 1 and 10 minutes into MO, and 3) maximal force, voluntary activation and rmsEMG responses of the biceps brachii were not different between MO and CO. We conclude that motion causes an increase in attention demands, which cause deficits in motor tasks, and more specifically, effect to a greater extent fine tasks (reaction time and visuomotor tracing) than gross tasks (maximal force).

The effects of heavy load carriage on cardiopulmonary responses to graded exercise

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Many emergency response occupations (e.g., infantry, wildland firefighting, search and rescue) require heavy load carriage with backpacks. Tests of aerobic fitness for duty may or may not simulate the type of load carriage encountered during work, leading to questions of test validity. The purpose of this experiment was to study the effects of heavy load carriage on cardiopulmonary responses during graded exercise. Forty-two males (age: 28 ± 6 yr, height: 182.7 ± 6.4 cm, mass: 86.9 ± 13.6 kg) provided written informed consent before completing two randomly ordered graded exercise tests (GXT) to measure ventilatory threshold (T_V) and peak oxygen consumption ($\dot{V}O_{2peak}$). Test conditions were loaded (L) and unloaded (U). During L, each subject carried a correctly sized and properly fitted 80 L backpack weighing 25 kg.

Pack volume and load distribution were consistent between all packs used in the study. Modified Balke treadmill tests were completed at 91 m·min^{-1} with stage increases of 2% grade until exhaustion. Paired-t analysis revealed a small but significant decrease in $\dot{V}O_{2peak}$ (2.6%) which may have been secondary to a similar decrease in peak minute ventilation ($\dot{V}_E$). At peak exercise, breathing frequency (B_F) was significantly increased (2.4%) and tidal volume (V_T) was decreased (4.8%) however there was no difference in respiratory exchange ratio. At T_V (n=39) $\dot{V}O_2$ was decreased by 4% (p<.05) however $\%\dot{V}O_{2peak}$ was the same between U and L conditions (71 and 70%, respectively). Minute ventilation at T_V was the same between U and L despite significantly increased B_F (9%) and decreased V_T (9%) in L. These results suggest that heavy load carriage with a properly fitted backpack has a significant effect on both T_V and $\dot{V}O_{2peak}$ during graded exercise tests. During L, alterations in breathing pattern were sufficient to maintain $\dot{V}_E$ at T_V but not at peak exercise. These findings have implications for evaluation of fitness for duty in occupations where heavy load carriage is a requirement.

Ventilatory responses to prolonged exercise with heavy load carriage

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The purpose of this experiment was to study breathing pattern, operational lung volume and respiratory muscle strength during 45 minutes of exercise with a heavy backpack (25 kg). Fifteen males completed randomly ordered graded exercise tests on a treadmill with (L) and without (U) a correctly sized and fitted 80 L pack weighing 25 kg. Subsequently, each subject completed two exercise challenges (L and U conditions, in random order) that consisted of 45 minutes of treadmill walking at 67 ± 4% $\dot{V}O_{2peak}$. Maximal inspiratory and expiratory pressures (MIP and MEP) were measured before and immediately following exercise. During exercise, ventilatory and gas-exchange data were recorded every five minutes. Perceptual responses were recorded in the first five-minute measurement cycle and were repeated every ten minutes during exercise. During loaded exercise, breathing frequency (B_F) and ventilation ($\dot{V}_E$) increased by 21.7 and 15.1% (P<0.05), respectively, while tidal volume (V_T) and end-inspiratory lung volume (EILV) reduced by 6.3 and 6.4% (P<0.05), respectively. Following exercise in the loaded condition, MIP was decreased by 6.7% (P<0.05) with no change in MEP. No reduction in maximal inspiratory or expiratory pressures were observed following exercise in the unloaded condition. Although aerobic demand was matched between conditions, exercise stress, leg fatigue and breathing stress were always perceived to be higher (P<0.05) in the loaded condition. In summary, the mechanical disadvantage placed on the respiratory system during prolonged exercise with a heavy pack suggests that work of breathing (WOB) was increased and this resulted in a progressive alteration in ventilatory mechanics. The decrease in maximal inspiratory pressure and compensatory changes in breathing pattern and EILV are indicative of respiratory muscle fatigue. We suggest that in an attempt to minimize the WOB, subjects adopted a shallow and frequent breathing pattern; however, this breathing pattern increased dead space and minute ventilation, leading to greater perceived exercise stress and breathing discomfort.

Resistance training but not arm dominance affects the corticospinal excitability of the biceps brachii

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The effects of resistance training on the corticospinal excitability (CE) of the dominant and non-dominant limb have not been studied. Therefore, the purpose of the current study was to determine how chronic resistance training (i.e. greater than two years of resistance training experience) affects CE in the dominant and non-dominant biceps brachii (BB). Fourteen male participants were split into two groups: 1) chronic resistance trained (RT, n = 7) and 2) non-resistance trained (NRT, n=7). Both groups performed 4 sets of 5s pseudo-randomized contraction intensities of the dominant and non-dominant elbow flexors at 25, 50, 75, 90, and 100% of MVC. During each contraction, subjects received transcranial magnetic stimulation, transmastoid electrical stimulation and Erb's point electrical stimulation to determine the amplitudes of motor evoked potentials (MEP), cervicomedullary evoked potentials (CMEP) and maximal muscle compound potentials (M-max), respectively in the biceps brahii. All MEP and CMEP amplitudes were normalized to M_{max}. Training or BB dominance did not affect ($p > 0.14$) MEP amplitudes across all contraction intensities. CMEP amplitudes were significantly decreased in the non-dominant BB of the NRT group at 50% and 75% MVC by 38% ($p = 0.23$) and 24.6% ($p = 0.049$), respectively compared to the RT group. There was a trend for CMEP amplitude to decrease in the non-dominant BB of the NRT group at 25%, 90% and 100% MVC by 7% ($p = 0.055$), 36% ($p = 0.077$) and 35% ($p = 0.078$), respectively compared to the RT group. CMEP amplitudes in the dominant BB were significantly decreased in the NRT group at 50% MVC by 50% ($p = 0.031$) and there was a trend for the CMEP to decrease at 75% MVC by 44% ($p = 0.059$). In conclusion, regardless of training, corticospinal excitability was not different between the dominant and non-dominant BB. However, spinal, but not supraspinal excitability of both dominant and non-dominant BB is increased in chronic resistance trained individuals.

The impact of acute phosphate supplementation on endothelium-dependent dilation

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Elevated serum phosphate levels are indicative of cardiovascular morbidity and mortality in patients with coronary artery disease. However, the mechanisms through which phosphate may be detrimental to vascular health in both healthy and disease populations remain unclear. The purpose of this study was to investigate the effects of acute phosphate supplementation on endothelial-dependent dilation (EDD) in healthy subjects. A within-subjects, counterbalanced and double-blinded design was used such that over two visits, 16 healthy male participants (22.9 ±3.07) were exposed to phosphate and placebo conditions (one each visit). A supplement (Phoslax Oral Solution) containing 1200 mg of phosphorus or a placebo was consumed orally. Tests of EDD were performed pre- and 120 min post-supplement or placebo ingestion using a standard brachial artery reactive hyperemia flow-mediated dilation test (RH-FMD). RH-FMD was calculated as the percent increase in brachial artery diameter from baseline to the peak diameter during hyperemia post-forearm occlusion cuff release. The %RH-FMD in the phosphate supplementation condition was not significantly different from the placebo condition (main effect of condition P = 0.306; condition x time interaction P=0.193) with an average post-phosphate RH-FMD of 6.8± 3.1% and a post-placebo RH-FMD of 6.7 ± 2.9%. These findings suggest that ingestion of a large phosphate supplement has no acute impact on endothelial function in healthy young men. These findings conflict with a previous study that reported an acute decline in EDD at 120 minutes following ingestion of 1200 mg of phosphate with a meal. Further research is needed to better understand the relationship between dietary phosphate and cardiovascular disease. (Funded by NSERC.)

HSP content following lengthening muscle contractions

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Lengthening muscle contractions (LCs) are known to cause muscle damage and result in an elevated HSP content. To date, most studies

have inflicted significant amounts of injury using excessive contraction protocols to elevate HSP content, while few have investigated the heat shock response following mild or moderate contraction protocols. The purpose of this study was to assess the relationship between sets of LCs and HSP content. Male Sprague-Dawley rats were anaesthetized and one tibialis anterior (TA) muscle subjected to 20, 40, or 60 LCs (sets of 20 contractions, 5 minutes rest between sets) by electrical stimulation and lengthened by a servomotor. The non-stimulated contralateral TA served as a control. Twenty-four hours after the last LC, animals were anaesthetized and TA muscles from both limbs were removed, weighed and snap frozen in liquid nitrogen and later assessed for Hsp72 content by western blotting. Peak muscle torque between the first and last (20, 40 or 60) LC showed significant ($p<0.05$) decreases of 27%, 52% and 57% following 20, 40 and 60 LCs, respectively. Western blot analyses showed a progressive elevation in Hsp72 content following 20, 40 or 60 LCs. These results suggest that one set of LCs activates the heat shock response and can elevate Hsp72 content.

The effects of post-stroke aerobic exercise on cognition and behavioural recovery: a systematic review of animal and clinical studies

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Most people admitted to hospital with stroke continue to have enduring motor and cognitive deficits that interfere with their previous roles and quality of life. Aerobic exercise (AE) improves cognitive performance in healthy humans and animals however findings in stroke are inconclusive. We undertook this study to consolidate potentially important findings in animal models and preliminary clinical trials in order to gain methodological insights for future studies. Using predetermined criteria and keywords we searched PubMed, CINAHL, PsycInfo, the Cochrane Library and the Central Register of Controlled Clinical Trials for human and animal studies that measured at least one domain of cognition or behaviour before and after an exercise intervention. Titles, abstracts and manuscripts were screened by two researchers and data consolidated into spreadsheets. A total of 4250 titles were returned from the literature search, 31 articles were included in the final review. Our research resulted in only nine human trials with the vast majority of research being undertaken in animal models (n=22). All animal studies employed exercise within days after stroke however only one clinical study examined AE during the post-acute rehabilitative phase (<6months) post stroke. Results of this synthesis showed that AE does not improve upper extremity tasks. In terms of effect of AE on cognitive domains, AE improves processing speed, learning, and spatial memory but not tests of executive function. Our synthesized findings suggest that AE affects very specific cognitive domains. The disparity between animal model methodology (time post stroke, severity) and clinical trials make knowledge translation difficult.

Determinants of arterial stiffness in preschool-aged children

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Arterial stiffness is an independent risk factor of poor cardiovascular outcomes in adults. Body composition, aerobic fitness, and physical activity (PA) have been found to be predictive of arterial stiffness in school-aged children and adults; however, it is unknown if there are similar relationships in younger children. Therefore, the purpose of this study was to examine the relationships between arterial stiffness (measured by pulse wave velocity, PWV) and body composition, aerobic fitness, and PA in preschool-aged children. Four hundred and fourteen 3-to 5-year-olds participated (206 girls; age: 4.5 ± 0.9 years, BMI percentile: 52.3 ± 28.5). Resting arterial stiffness was assessed using whole-body PWV from the time of ventricular depolarization to the arrival of the pulse wave at the dorsalis pedis artery. Percent body fat and lean body mass were calculated using bioelectrical impedance analysis and time to exhaustion on a maximal treadmill test (Bruce Protocol) and heart rate recovery 1- and 2- min following the test were used as indicators of aerobic fitness. PA was assessed over 7-days using accelerometers, which were analyzed in 3-sec epochs to determine light PA (LPA) and moderate-to-vigorous PA (MVPA). Variables predicting PWV were analyzed using multiple linear regression modeling. In addition to body composition, aerobic fitness and PA; age, sex, height z-score, and BMI z-score were also included in the model as independent predictors. Regression analyses determined that only age, LPA, height z-score, and time to exhaustion on the treadmill were significant predictors of PWV ($R^2 = 0.143$, $p<0.001$). Sex, percent body fat, lean body mass, BMI z-score, MVPA, and heart rate recovery did not statistically account for the variance in PWV over and above the aforementioned predictors. The results suggest that preschool-aged children who are more fit and who engage in more LPA have more favourable arterial stiffness. Body composition was not associated with arterial stiffness in this sample of preschoolers. (Supported by the Canadian Institutes of Health Research (CIHR).)

Changes in rat skeletal muscle mitochondrial PLIN3 and PLIN5 protein content following 8-weeks of endurance training and acute electrically stimulated contraction

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In skeletal muscle, fatty acids hydrolyzed from lipid droplets are directed to mitochondria for oxidation or re-esterified. Lipid droplet-associating proteins PLIN3 and PLIN5 have been implicated in skeletal muscle lipolysis. Recently, our laboratory reported increased PLIN5 mitochondrial enrichment and no net change in mitochondrial PLIN3 protein in rat muscle following acute contraction. Communication between the release of the newly hydrolyzed fatty acids and the mitochondria may be an important point of control potentially mediated by PLIN proteins. To determine whether PLIN3 and PLIN5 enrichment in the mitochondria is different between sedentary and endurance-trained rats we conducted an 8-week progressive treadmill running protocol (25m/min, 10% incline, 60min) with male Sprague Dawley rats (n=9, age=51-53 days, weight=562±18g). Plantaris muscles were mounted for lipid analysis (oil red-O) and red gastrocnemius muscles were collected for primarily subsarcolemmal (SS) mitochondrial isolation. A two-way ANOVA analyzed acute contraction in sedentary and endurance-trained rats. Total mitochondrial PLIN3 protein was ~1.5-fold higher in endurance-trained rats when compared to sedentary (main effect, $P<0.01$), corresponding to increased intramuscular lipid storage (main effect, $P<0.001$), with mitochondrial PLIN5 content unchanged following endurance training. Acute lipolytic contraction in sedentary and endurance-trained rats resulted in no net change in PLIN3 mitochondrial content. Mitochondrial PLIN5 enrichment increased following acute lipolytic contraction (main effect, $P<0.01$) corresponding to the degree of decreased intramuscular lipid content in sedentary and endurance-trained rats (main effects, $P<0.001$). While PLIN5 seems to have an acute role during muscle contraction, PLIN3 may not. However, PLIN3 may still have a role in the mitochondria with chronic adaptations. We can speculate that PLIN5 may be involved in regulating the flux of fatty acids to the mitochondria during contraction-induced lipolysis because the degree of acute

mitochondrial PLIN5 enrichment during contraction is similar in sedentary (~1.6-fold) and endurance-trained (~1.7-fold) groups, corresponding to statistically similar decreases in sedentary and endurance-trained intramuscular lipids in this model. (Supported by NSERC, Canada.)

Estimated voluntary activation via twitch interpolation of the elbow flexors during a maximum voluntary contraction is dependent on stimulation type not training status

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The interpolated twitch technique (ITT) via nerve stimulation and transcranial magnetic stimulation (TMS) has been used to estimate percent voluntary activation (VA) of various muscles in humans. However, a detailed comparison between these techniques for estimating %VA has not been performed. Twenty-four male participants were split into three groups: 1) chronic resistance trained with ITT experience (CRT, n = 9), 2) chronic RT without ITT experience (NRT, n=8) and non-RT without ITT experience (non-NRT, n=7). Each group completed five stimulation conditions of the right elbow flexors during four randomized contraction intensities (25%, 50%, 75% and 100% MVC). The five stimulation conditions were 1) single nerve stimuli used to evoke maximal compound action potential (Mmax) in the biceps brachii (BB), 2) 20% increase in the single nerve stimuli amperage used in stimulation condition 1, 3) a doublet at the same amperage used in stimulation condition 2, 4) TMS at a maximum stimulator output (MSO) that elicited a large motor evoked potential (MEP) that was ~50% of Mmax in the BB and 5) 25% increase in the TMS MSO used in stimulation condition 4. Stimulation type ($p < 0.03$) but not training ($p > 0.06$) had an affect on estimated %VA of the elbow flexors during MVC. When using evoked potentiated twitch forces to estimate %VA, stimulation conditions 1, 2, and 3 produced 91.9, 92.7 and 97.5%VA, respectively, which were all significantly ($p < 0.01$) higher than stimulation conditions 4 (81.6%) and 5 (86.2%). When using estimated resting twitches forces to estimate %VA, stimulation conditions 1, 2 and 3 produced 82.2, 85.0 and 89.5%VA, respectively, which were not significantly ($p > 0.15$) higher than stimulation conditions 4 and 5. In conclusion, estimated %VA of the elbow flexors during 100% MVC is dependent on stimulation type not training status. Furthermore, the use of predicted resting twitch forces compared to potentiated twitch forces leads to decreases in estimated %VA.

Effects of supra maximal high intensity interval training vs. continuous training in well-trained rowers on peak power, aerobic power, critical power and energy available above critical power

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The purpose of this investigation was to compare the outcomes of a novel high intensity interval training (HIIT) program with a continuous training program (CONT) on well-trained rowers. We hypothesized that six HIIT sessions would elicit superior adaptations in power than CONT. After six weeks of training, 16 rowers (21.6±6yrs; 6 Females: Peak Aerobic Power (PAP) 293W; 10 Males: PAP 419W) were randomized into two groups and completed a ramp test (Females: 25 W/min; Males: 30 W/min) to determine PAP, and a 3-min critical power test (CP) pre- and post- training. The HIIT completed 6 HIIT sessions within their 13 training sessions over 14 days. HIIT consisted of 10 cycles of 10 s work (140% of PAP) followed by a 5 s recovery period, then followed by 8 min of active recovery and completed 6 times per session. The CONT group continued with the National Rowing coach prescribed, moderate intensity, predominantly continuous training over 14 days. Total training duration, including warm up and cool down, was similar between groups. All testing and training was performed on Dynamic Concept II and standard Concept II rowing ergometers respectively. No differences occurred pre- to post-training between groups in PAP (HIIT: 394±58-404±70W; CONT: 350±83-355±86W; *p>0.05),* and 10s Power (HIIT: 594±193-681±218W; CONT: 581±224-571±235W; *p>0.05*), whereas 60 s performance decreased pre- to post- in CONT only (510±167–489±171W; *p=0.02*). CP increased pre- to post- in both groups (HIIT: 336±59-360±59W; CONT: 290±73-316±74W; *p≤0.05*). Energy available above CP (W') decreased pre- to post- CONT (14256±7022-11303±7360J; *p=0.009*) but not in HIIT (13747±5517-11497±8323J; *p>0.05*). Collective power output measures (including: 10s Power, 60s Power, CP, and PAP) showed an improvement for HIIT pre- to post-training (464±158-496±184W; *p=0.014*) vs CONT (433±186-433±181W; *p>0.05*). In conclusion, when all power measures are integrated, HIIT results in superior power numbers compared to CONT training, while preserving W'.

Effects of 12 weeks of strength training on 24-hour blood pressure in individuals with intermittent claudication

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Intermittent claudication (IC) is characterized by the peripheral circulation dysfunction, mainly caused by atherosclerotic process of lower limbs. IC patients have 74-92% prevalence of hypertension which contributes to their higher rates of cardiovascular events. Strength training reduces blood pressure in IC patients, but the effects of such intervention on 24-hour blood pressure behavior during everyday activities have not been established yet. The objective of this study was to analyze the effects of 12 weeks of strength training on 24-hour blood pressure in individuals with IC. In this randomized controlled trial 33 patients with IC symptoms were randomized into two groups: strength training group (STG) and control (CG). Both groups performed 12 weeks of intervention. The STG performed eight exercises consisting of three sets of 10 repetitions with workload corresponding to a rate between 5 and 7 of the OMNI *Resistance Exercise Scale* and with interval of two minutes between sets, in two weekly sessions. The CG performed stretches in two weekly sessions. Before and after the intervention the patients used ambulatory blood pressure monitor for obtaining systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR) and rate-pressure product (RPP) in 24-hour periods, awake and asleep. In addition, the morning surge, blood pressure load and nocturnal blood pressure fall, were obtained. A variance two-way analysis (ANOVA) was used for data analysis. When necessary, we employed the post-hoc Newman-Keuls test. For all analysis, P<0.05 was accepted as statistically significant. Twenty-one patients (11 STG and 10 CG) completed the interventions. Systolic arterial blood pressure (STG = 125 ± 19 vs. 113 ± 16 mmHg and CG = 131 ± 16 vs. 133 ± 17 mmHg, P = 0.013) and mean arterial pressure (STG = 86 ± 10 vs. 79 ± 9 mmHg and CG = 88 ± 8 vs. 88 ± 8 mmHg, p = 0.022) at rest decreased only in STG group (p<0.05).Throughout the 24-hour period the SBP (STG = 112 ± 7 mmHg vs. 112 ± 11 mmHg and CG = 121 ± 12 mmHg vs. 121 ± 14 mmHg, P = 0.866), DBP (STG = 70 ± 7 mmHg vs. 69 ± 5 mmHg and CG = 70 ± 6 mm Hg vs. 70 ± 9 mmHg, p = 0.586), HR (STG = 81 ± 10 bpm vs. 76 ± 11 bpm and CG = 83 ± 17 bpm vs. 80 ± 16 bpm, p = 0.572) and RPP (STG = 9059 ± 1081 mmHg * bpm vs. 8547 ± 1045 mmHg * bpm and CG = 10077 ± 2485 mmHg * bpm vs. 9748 ± 2420 mmHg * bpm, p=0.714) showed similar changes between the groups (p>0.05).These results were also observed when analyzed these variables in the awake and asleep periods (p>0.05). The morning surge, the blood pressure load and nocturnal blood pressure fall of the SBP also showed similar responses between groups (p>0.05). In conclusion, the results of this study indicate that 12 weeks of strength training reduces SBP at rest, but does not alter blood pressure over 24 hours in subjects with IC.

Effects of ankle compression sleeve on fatigue and performance

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The aim of this study was to examine the effects of graduated ankle compression sleeve (CS) on jumping performance and physiological variables associated with recovery. Fifteen healthy, active participants (age: 22.47 ± 3.42 years; body mass: 72.8 ± 13.70 kg; height: 175 ± 8 cm) were selected for this study. The study used a randomized, counterbalanced design with 2 conditions: CS and control. Both conditions included a fatigue protocol, which consisted of continuous drop jumps from a 30cm platform until a predetermined jump height was no longer maintained. 24-48 hours later, participants repeated the fatigue protocol, but switched conditions. Dependent variables for both conditions were time to fatigue (TTF), drop jump performance (20cm, 35cm and 50cm box heights), blood lactate concentration, muscle activation (EMG), evoked muscle twitch properties, maximal voluntary contraction (MVC) force and skin temperature. Muscle activation levels and MVC force dropped from pre-condition to post-condition ($p < 0.05$), and were not different between conditions ($p > 0.05$). There were no significant differences between conditions for evoked muscle twitch properties. There were also no significant differences in the time to fatigue ($p = 0.475$), or post-fatigue blood lactate values (CS = 8.61 ± 3.44 mmol · L^{-1}, non -CS = 8.10 ± 2.50 mmol · L^{-1}, p = 0.892). Force plate data for drop jumps showed that there were no significant differences between conditions for jump height, contact time and take-off velocity ($p > 0.05$), however subjects showed lower ground reaction forces for 50 cm drop jumps pre-CS (CS = 4270.81 ± 972.14 N, non-CS = 3686.79 ± 954.02, p = 0.044). Skin temperature was higher in CS condition compared to non-CS (p = 0.001). Results of this study suggest that CS does not improve performance or aid in recovery, however CS might contribute to impact-related injury prevention by reducing ground contact forces from greater heights.

Comparing the relative sensitivity of reactive hyperemia and exercise induced flow-mediated dilation in detecting endothelial dysfunction in obese young men

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Flow-mediated dilation (FMD) stimulated by reactive hyperemia (RH) is a standard index of endothelial function in humans (RH-FMD) and several studies have identified that obesity is associated with impaired brachial artery RH-FMD. RH is induced via the release of a temporary forearm occlusion and causes a transient increase in brachial artery shear stress. In contrast, handgrip exercise (HGEX) creates a prolonged increase in brachial artery shear stress, which can also be used for FMD assessment (HGEX-FMD). The purpose of this study was to determine whether the association between obesity and FMD depends on the nature of the shear stress profile used for assessment. Brachial artery RH-FMD and HGEX-FMD were measured in 8 obese male participants (27 ± 6 years; waist circumference 116.2 ± 12.1 cm) and 12 healthy male controls (22 ± 3 years; waist circumference 76.8 ± 6.1 cm). Brachial artery diameter and blood velocity were assessed using echo and Doppler ultrasound, respectively. Blood velocity was used in estimating shear stress. Participants performed two standard 5-minute occlusion RH trials, two 10-minute HGEX trials, and one 15-minute occlusion RH trial. FMD was calculated as the % increase from baseline diameter to the peak diameter post occlusion release (RH-FMD) or to the average diameter during the last minute of exercise (HGEX-FMD). Results are mean ± SD. The 5-minute and 15-minute RH-FMD was not significantly different between groups (5-minute RH-FMD: obese: 6.8 ± 2.3%, control: 7.0 ± 2.9%, p = 0.836; 15-minute RH-FMD: obese: 14.4 ± 4.1%, control: 14.9 ± 5.0%, p = 0.830). However, HGEX-FMD was significantly impaired in obese participants (HGEX-FMD: obese: 5.4 ± 3.1%; control: 10.0 ± 3.6%, p = 0.008; HGEX shear stress p = 0.725 obese vs. control). In conclusion, assessment of HGEX-FMD, but not RH-FMD, detected endothelial dysfunction in obese participants. These preliminary findings suggest that brachial artery HGEX-FMD may be a sensitive detector of obesity-related impairments in endothelial function. (Funded by NSERC.)

Submaximal heart rate recovery does not predict maximal heart rate recovery for arm cranking exercise in clinical and healthy populations

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In able-bodied individuals (AB), heart rate recovery (HRR) following exercise is indicative of the integrity of the autonomic system, a marker of cardiovascular health. Furthermore, it can be measured following either submaximal or maximal exercise, as it is independent of exercise capacity or peak heart rate achieved. In persons with spinal cord injury (SCI), HRR following maximal upper-limb exercise (HRR_{max}) provides some information on autonomic function; however, it has been found to be related to heart rate reserve. It remains unclear if HRR following submaximal upper-limb exercise (HRR_{submax}) is predictive of HRR_{max}, and thus a suitable surrogate for use. This study examined the predictive capacity of HRR_{submax} in thirty-four persons with SCI (31M, 3F; age = 40 ± 11 years) and in twenty AB persons (15M, 5F; age = 35 ± 13 years). All participants completed maximal arm cranking exercise to volitional exhaustion ($\dot{V}O_2$max; SCI = 16.7 ± 6.7 mL/kg/min; AB = 29.1 ± 5.2 mL/kg/min) and submaximal arm cranking exercise at a pre-determined power output ($\dot{V}O_{2max}$; SCI = 11.3 ± 4.7 mL/kg/min; AB = 18.0 ± 3.1 mL/kg/min). HRR at 1 min (HRR1) reflecting parasympathetic activity, and HRR at 2 min (HRR2) reflecting sympathetic activity were calculated for both exercises. Linear regression analyses were used to determine predictive equations for HRR1 and HRR2. For each participant, predicted HRR_{max} was estimated from HRR_{submax}. Bland-Altman plots were then used to evaluate the agreement between predicted and observed HRR_{max} values and the limits of agreement (LOA) for both groups. HRR1 plots revealed a mean difference (bias ± SD) of 0 ± 9 bpm (95% LOA, -17 and 17 bpm) for SCI, and 1 ± 6 bpm (95% LOA, -11 and 12 bpm) for AB. HRR2 plots revealed a mean difference (bias ± SD) of 0 ± 12 bpm (95% LOA, -23 and 23 bpm) for SCI, and 0 ± 7 bpm (95% LAO, -13 and 13 bpm) for AB. Despite negligible biases, all Bland-Altman plots revealed an overestimation of low HRR_{max} values and an underestimation of high HRR_{max} values. Along with wide 95% LOA, these results suggest that for arm exercise HRR_{submax} is a poor predictor of HRR_{max}. (Supported by: ONF, OGS, NSERC.)

Adult women's perceived facilitators, barriers, and health benefits of sustaining a membership in a commercial fitness facility

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The purpose of this study was to gain in depth knowledge on the perceived facilitators, barriers, and health benefits of sustaining a membership in a commercial fitness facility (CFF) amongst active and less active adult women between the ages 35 – 55. This qualitative focus group study segmented participants into those who met Canada's physical activity (PA) guidelines of 150 minutes of moderate to vigorous PA and those who do not. Inductive analysis of the focus group data was carried out after deductively creating codes. Measures were incorporated throughout the study to ensure data trustworthiness. The analysis led to the creation of themes related to the research questions. The CFF environment needs to be more supportive, welcoming, and friendly in order to minimize barriers and facilitate membership for the less active women in this study. Active women had one less barrier to sustaining a membership in a CFF than the less active women in this study. Less active women perceived there was a lack of support and programs for their current ability level, and active participants seldom mentioned this barrier. Both groups shared sim-

ilar perceived health benefits to sustaining a membership in a CFF in comparison to other forms of exercise and venues for PA, and the active women cited one additional health benefit than did the less active women. Achieving physical and mental health goals were important facilitators and benefits to using a CFF membership for the women of this study. A less intimidating environment and more access to formal support from certified fitness professionals without an additional cost would make the CFF space more favourable for the women in this study. Recommendations from the findings of the current study are presented and directions for further research are provided.

Recovery effect of ischemia and reperfusion on exercise performance after induced muscle soreness: a pilot study

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Ischemia and reperfusion, key components in many CV diseases and their treatment, can result in tissue damage and subsequent inflammation. The cyclic inflation and deflation of a standard blood pressure cuff is an effective mechanism that has been demonstrated to protect tissues against ischemia-reperfusion injury. Intense exercise can also lead to muscle damage and an inflammatory cascade. Given that intense, muscle damaging exercise shares a number of physiological traits with ischemic injury, we examined the potential of ischemic/reperfusion cycles to alter the recovery of muscle tissue following exercise-induced muscular insult. The aim of this study was to evaluate the recovery effect of local ischemia/reperfusion cycling on exercise performance after induced muscle soreness, and against other recovery methods. Recreational cyclists and triathletes (19-45yr, $\dot{V}O_2$ max 35.4-63.9 ml.kg^{-1}.min^{-1}, 11males; 10 females) were randomized to one of four recovery groups: ischemia/reperfusion only (four cycles of 5min arm ischemia/3min reperfusion), electrical muscle stimulation (STIM) only (30min/maximally tolerable), ischemia/reperfusion and STIM combined, or a control. To test baseline performance, subjects completed a standard Wingate test and a 10km time trial on the on an electromagnetically braked cycle ergometer. The following day, muscle soreness (evaluated by a 10cm visual analog scale) was induced by use of a 30min downhill run on the treadmill (60% $\dot{V}O_2$max, -12%). Recovery methods were used immediately following the downhill run, at 24 and 48hr post exercise. Testing concluded with each subject completing the performance tests again at 48hr. As expected, the subjects that responded with the greatest increase in muscle soreness also had the greatest decrements in cycling performance, thus suggesting this as an effective experimental model. As pain increased, average speed decreased (r=-0.48, p=0.03), and total time increased (r=0.47, p=0.04) for the 10km time trail, but no associations existed with anaerobic power. We did not observe an increase in recovery (pain or performance) in the group that performed ischemic/reperfusion recovery techniques, or any other recovery method, despite strong participant suggestions of a perceived effect. The absence of significant findings likely relates to the large inter-individual variability in response, which is perhaps suggestive of responders and non-responders to the various stimuli. Future studies should consider a greater volume of recovery method exposure and larger subject numbers to overcome these potential limitations.

Systematic review and meta-analysis of the efficacy of blood flow restricted exercise for stimulating adaptions in strength and hypertrophy

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The growing evidence-base for blood flow restriction (BFR) exercise training has yet to be systematically reviewed and analyzed using meta-analytic techniques. A greater understanding of the effects of blood flow restriction on training outcomes such as muscle strength and hypertrophic adaptation is required to formulate novel research questions and advance training methods for persons in both health and disease. To date a number of varied training methodologies have been employed and study designs have differed, making direct comparison of BFR outcomes challenging. Therefore, our objectives were: 1) to systematically gather and assess studies that have combined blood flow restriction with exercise 2) to perform a meta-analysis to quantify the effectiveness of BFR exercise on muscle strength and hypertrophy 3) identify which BFR training methods result in the greatest strength and muscle hypertrophy outcomes. A computer assisted database search was conducted for articles investigating the effect of exercise combined with BFR on muscle hypertrophy and strength. A total of 660 hits were screened based on title, abstract, and full article, resulting in 35 articles that fit the review criteria. A total of 329 participants were included from 19 different studies measuring muscle strength increases when exercise is combined with BFR. Exercise was separated into aerobic and resistance modalities. Resulting from BFR aerobic exercise, there was a mean difference of 0.37 Nm between the BFR group and non-BFR control group; while BFR resistance exercise resulted in a mean increase of 0.27 kg versus controls. A total of 264 participants were included in 14 studies measuring muscle size increase (cross sectional area) when exercise is combined with BFR. The mean difference in muscle size between the experimental group and the control group was 0.444 cm2. Taken on whole, current research suggests that the addition of BFR to dynamic exercise training is effective for augmenting changes in both muscle strength and size, and the magnitude of these changes are noteworthy when considering the average length of intervention. This effect was true for both resistance training exercises and aerobically based exercise, although the effect sizes varied.

Postactivation potentiation and corticospinal inhibition following both voluntary and involuntary conditioning contractions

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Following a conditioning contraction (CC), postactivation potentiation (PAP) is observed as a large (2- to 3-fold) increase in evoked twitch torque and rate of torque development (RTD). However, this remarkable enhancement has not been observed during potentiated voluntary contractions. The purpose of this study was to determine whether central inhibition may develop during the conditioning contraction to explain the small or absent voluntary potentiation. 10 male volunteers completed voluntary and evoked contractions of the first dorsal interosseous (FDI) and motor evoked potentials (MEP) of the motor cortex. Central inhibition was assessed by measuring the silent period following the MEP, which reflects corticospinal inhibition. The FDI was potentiated via 10 s conditioning contractions at ~60% of maximal strength, both voluntary and evoked tetanus. Immediately following CC, transcutaneous electrical twitches and transcranial motor potentials were evoked. Following both voluntary and tetanic CC, twitch torque and RTD were increased (~200% and 160% respectively). Concurrently, silent period following MEP was elongated by ~10% following both voluntary and tetanic CC. These results indicate that corticospinal inhibition does occur following CC, but that it is unrelated to the voluntary activation during the CC. These results also show that following a conditioning contraction, the positive contractile effects at the muscle are accompanied by inhibitory effects at the corticospinal level.

Estimation of the phosphocreatine contribution in severe-intensity running

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The phosphocreatine contribution during a bout of exercise may be estimated by the area under the fast phase of the post-exercise $\dot{V}O_2$

curve. However, several characteristics of exercise, perhaps unrelated to the amount of phosphocreatine that has been utilised, may influence features of the $\dot{V}O_2$ profile in recovery after exercise. The purpose of this study was to test the robustness of the area under the fast phase of the post-exercise $\dot{V}O_2$ curve. Five university students (mean ± SD: age, 24 ± 1 yr; $\dot{V}O_{2max}$, 43 ± 8 mL·kg^{-1}·min^{-1}) performed six severe-intensity treadmill runs at speeds (202 ± 36 m·min^{-1}) that were individually selected to elicit exhaustion after ~10 min. Two tests were terminated after 2.5 min, two after 5.0 min, and two after 7.5 min, and data from the tests at each speed were combined for analysis. The $\dot{V}O_2$ response profile in recovery was mathematically described using a model that incorporated fast and slow components, with a common delay. The end-exercise values for $\dot{V}O_2$, rating of perceived exertion, and heart rate, as well as post-exercise values for blood lactate concentration, were higher in the longer runs than in the shorter runs. Although values of some parameters of the $\dot{V}O_2$ response profile in recovery did differ as a function of exercise duration, values for the area under the fast phase of the response (i.e., the estimates of the phosphocreatine contribution) were consistent across the three runs (2.5 min, 17 ± 4 mL·kg^{-1}; 5.0 min, 17 ± 5 mL·kg^{-1}; 7.5 min, 17 ± 4 mL·kg^{-1}). These results indicate that this estimate of phosphocreatine contribution during severe-intensity running exercise is robust in the face of differences in exercise duration.

Can blood pressure reactivity to a 2-minute isometric handgrip task predict reductions in ambulatory blood pressure?

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Cardiovascular disease (CVD) is currently the leading cause of death in Canada and the world. Hypertension has been identified as a leading modifiable risk factor for CVD development. Isometric handgrip (IHG) training is an efficacious method of lowering blood pressure (BP) and appears particularly effective in older, postmenopausal women. Responsiveness to IHG training can be predicted by pre-training systolic BP (SBP) reactivity to an IHG task (2-minute sustained contraction at 30% maximal voluntary contraction, MVC) in both hypertensive and normotensive men and women. Ambulatory BP, a less studied measure, provides insight into 24 hour fluctuations in BP and is a more accurate predictor of CVD risk, however, it is unknown whether SBP reactivity to an IHG task can predict post-training reductions in ambulatory BP or if sex differences exist. Consequently, to test the hypothesis that SBP reactivity to an IHG task will predict post-IHG training ambulatory BP-lowering in young individuals of both sexes, resting (Dinamap Carescape v100, Critikon) and ambulatory (SpaceLabs 90207 Ambulatory Blood Pressure Monitor, SpaceLabs Inc.) BP were measured prior to and following 10 weeks of IHG training (4, 2-minute IHG contractions at 30% MVC, using alternating hands, 1-minute rest periods, 3X/week) in young (mean age: 24 ± 5.2 years) normotensive women (n=9) and men (n=12). SBP reactivity to an IHG task (2-minute sustained contraction at 30% maximal voluntary contraction, MVC) was measured at baseline, whereby BP reactivity was derived by calculating the difference between peak stress BP and mean baseline resting BP. Significant training induced reductions in mean 24-hour ambulatory systolic BP of a similar magnitude (p=0.79) were observed in men (3.5 ± 3.9 mmHg) and women (4.0 ± 4mmHg; p<0.0001), but were not correlated with SBP reactivity to the IHG task (r=0.088, p=0.78). These novel findings validate the use of IHG training as an effective tool in lowering ambulatory BP, however, BP reductions cannot be predicted by SBP reactivity to an IHG task.

Effects of band loops on lower limb electromyography during barbell-back squats in resistance trained individuals

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It has been demonstrated the use of a band placed across the distal thighs acts as a proprioceptive aid for trainees to active lower body muscles in the posterior chain. The effect of using a loop band to increase barbell-back squatting performance and muscle activation in a trained population has not been investigated. We hypothesize that: 1) the use of the loop band will increase muscle activity in the hip musculature (gluteus maximus and gluteus medius) and 2) The number of repetitions performed at 60% of a participants 1 repetition max (1 RM), will increase. Fifteen resistance-trained males (23.6±3.5yrs) performed 5 repetitions of a barbell back squat at 80% of their 1 RM and repetitions to failure at 60% of their 1RM. Electromyography (EMG) was collected from 4 muscles during both exercise sets. No differences were found in the number of repetitions to failure test between conditions (P=0.171; Control-day: 20.4±4.7, bandloop day: 21.4±6). Similarly, no differences were found between conditions in EMG activity of the quadriceps and hamstrings during the 5RM test, as well as the repetitions to failure testin the concentric and eccentric contractions (P≥0.210; ES=0.03-0.43; 0-11% percent differences). In contrast, the gluteus medius demonstrated greater EMG activity in the band loopdayduring the 5RM test, but not repetitions to failure test in the concentric and eccentric contractions (P≤0.046; ES=0.31-0.67; 6-17%). Likewise, the gluteus maximums showed higher EMG activity in the band loop day during the 5RM and the repetitions to failure tests in the concentric and eccentric contractions (P≤0.037; ES=0.38-1.44; 6-31%). While the band around the knees did not affect the number of repetitions performed, it did increase the EMG activity of the gluteus muscles. Placing a band around the knees may be a used as a strategy to increase the contribution of these muscles during medium and heavy squat training among trained individuals.

Cerebrovascular reactivity during pregnancy: a case study

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Pregnancy is associated with profound cardiovascular adaptations including a rapid 50% increase in blood volume, 40% increase in cardiac output and 15% increase in heart rate. However, the longitudinal adaptations of the cerebrovascular circulation during gestation are poorly understood. To further understand the influence of pregnancy on cerebrovascular function, we conducted a longitudinal assessment of middle cerebral artery reactivity to a hyperoxic, CO2 re-breathing protocol in a 36 year old woman during her second pregnancy. Pre-pregnant values were assessed during the early follicular phase of the menstrual cycle in the month prior to conception and on 17 subsequent occasions up until the end of the 2nd trimester. Beat-by-beat mean arterial pressure (MAP) was derived using photoplethysmography (Finometer), middle cerebral artery blood flow velocity (MCAVP) was measured using transcranial Doppler ultrasound (Multigon), End-tidal PCO2 and PO2 were derived using real-time gas analysis (ADInstruments). From conception to 28 weeks of gestation, there was a progressive decrease in resting PetCO2 (35 Torr to 28 Torr) despite no appreciable change in resting MCAVP (62 vs. 65 cm/s). Throughout gestation MAP also remained stable. Conversely, cerebral reactivity to CO2 increased 116% from pre-pregnancy to the 27th week of gestation (0.9 cm/s/Torr to 1.9 cm/s/Torr respectively). These longitudinal data suggest that while resting blood flow in the middle cerebral artery is unchanged, cerebrovascular reactivity to CO2 increases with gestation during healthy pregnancy. (Funded by the President's Grant for the Creative and Performing Arts - Human Performance Scholarship Fund.)

Influence of motor cortical stimulus intensity on assessment of exercise-induced supraspinal fatigue and corticospinal adaptations

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There are numerous discrepancies in the literature related to the characteristics of exercise-induced corticospinal changes. Recent studies have observed different changes or magnitudes of change during and/or after exercise at two different transcranial magnetic stimulation (TMS) intensities, suggesting that the discrepancies in the current body of knowledge may at least partially arise from differences in the TMS intensity employed. Therefore, we performed neuromuscular assessments using different TMS intensities before, during and after an exhausting single-joint exercise bout. Eleven subjects performed sets of 10 submaximal isometric quadriceps contractions (5 s on/5 s off) until task failure. The first 4 sets were performed at 40% maximal voluntary contraction (MVC) force and then target force increased by 5% MVC every 4 sets. We assessed superimposed twitch (SIT) and motor-evoked potential (MEP) amplitudes and cortical silent period (CSP) duration elicited by TMS at intensities eliciting 50, 75 and 100% of maximal MEP amplitude ($I_{50,}$ I_{75} and I_{100} corresponding to 40 ± 9, 46 ± 10 and 65 ± 15% of maximal stimulator output, respectively) at constant (40% of baseline MVC, 40% MVC_B) and relative (50-75-100% MVC, I_{75} and I_{100} only) force levels. At 40% MVC_B, a low stimulus intensity (I_{50}) induced larger MEP increases. CSPs at I_{50} and I_{75} were unchanged in contrast to increased CSP at I_{100}. The magnitude of SIT decrease during exercise was larger at higher TMS intensities. At relative force levels of 50-75-100% MVC, similar responses to CSP, MEP and SIT were observed at I_{75} and I_{100} and both TMS intensities indicated similar changes in cortical voluntary activation. The present results demonstrate that TMS intensity impacts measured changes in corticospinal excitability and inhibition and that observed differences may depend on both TMS intensity and voluntary contraction force level. Interestingly, large differences in TMS intensity led to similar assessment of cortical voluntary activation. Further studies must be conducted to confirm these results and investigate underlying mechanisms.

Self-reported and objectively measured physical activity and sedentary time yield similar associations with metabolic health

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Physical activity (PA) and sedentary time have distinct physiologic and metabolic effects. Data from 2 cycles (2007-2009; 2009-2011) of the Canadian Health Measures Survey including all adults (≥18yr) with valid accelerometry (≥4 valid days) measures was used (n=5950) to i) examine the independent and joint association between the active / sedentary, active / non-sedentary, inactive / sedentary, and inactive / non-sedentary phenotypes on obesity and metabolic health, and ii) compare these relationships when using subjective or objective measures. Objectively measured physical activity (OMPA) groups were made by cross classifying "active" (A) (≥150 min/wk MVPA in bouts of 10 minutes or more), "inactive" (IA) (<150 min/wk MVPA in bouts of 10 minutes or more), "sedentary" (S) (≥480 min/day of sedentary activity) and "non-sedentary" (NS) (<480 min/day of sedentary activity) participants into 4 groups (A/NS; A/S; IA/NS; IA/S). Analogous self-reported physical activity (SRPA) groups were also made, using self-reported time in sedentary activity. Weighted associations between PA groups and metabolic syndrome (MetS), individual MetS components, 1+ condition (1 or more of diabetes, myocardial infarction, stroke, cardiovascular disease) and obesity (BMI≥30kg/m.) were estimated by logistic regression. Overall, the prevalence of MetS and 1+condition were systematically higher across SRPA groups vs OMPA groups. After adjustments for age, sex, ethnicity, income, education, accelerometer wear time and BMI, the odds (OR, 95% CI) of 1+ condition (OR=3.05, 1.47-6.34) and abdominal obesity (OR=2.75, 1.16-6.55) were higher in the IA/S group vs the A/NS group (OR=1.00) within OMPA. Within SRPA groups, higher odds were observed for the IA/S group for MetS, obesity, abdominal obesity and elevated triglycerides relative to the A/NS group. Although IA/S groups have the highest odds of 1+ condition, MetS, obesity, elevated triglycerides and abdominal obesity by either OMPA or SRPA, the finding of similar protective effects of A/S and IA/NS is novel. Given that SRPA appears to provide a stronger association with metabolic health, the value of complementary objective and subjective assessment of PA and sedentary time warrants further scrutiny.

The optimal warrior – what separates the best from the rest?

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The impact of combined physiological and morphological characteristics on sports performance has attracted much attention over the last decades. However, no information is currently available on the effects of these parameters on performance during occupational military tasks. Members of the Canadian Armed Forces (CAF) face several highly demanding tasks during their service, which requires higher than average physical capabilities. The combined physiological and morphological characteristics required to be a top performer on these specific military tasks are unclear at best. Therefore, the purpose of this study was to identify the physiological and morphological factors separating top and bottom performers on six military tasks. The data was acquired from CAF members during the development of the new Physical Employment Standard for the CAF. The top and bottom male and female (age 19-29 years) performers on the six military specific tasks; sandbag fortification (SBF), escape to cover (E2C), picking and digging (P&D), pickets and wire carry (P&W), stretcher carry (ST) and vehicle extrication (VE), were extracted from the database and compared for differences in physiological (upper body strength, aerobic capacity) and morphological (height, weight etc.) parameters to determine the optimal body features for being highly successful on each task and/or on all tasks combined. Results showed that beneficial body features seemed to exist for each single task, but due to the large variety in the nature of the tasks, no optimal body type for overall performance could be determined. Even though there were large difference in morphology between top and bottom performers, morphology was not predictive of performance. Multiple regression analysis showed that top performance predictors in both the male and the female group were upper body strength and aerobic capacity. These results suggest that performance on the six military tasks are dependent on the trainable features upper body strength and aerobic capacity and performance is not discriminated by body type.

Effects of ovariectomy in rats submitted or not to a 12-week resistance training programme on hepatic GLUT2 gene expression

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Estrogens withdrawal in rats, through ovariectomy (Ovx), has been repeatedly associated with disturbances in lipid metabolism. Among

them, peripheral and liver fat accumulation are well substantiated. Liver fat accumulation in Ovx animals has been associated with several perturbations of lipid metabolism, including an increased *de novo* lipogenesis. On the other hand, there is few information on how liver fat in Ovx rats may affect glucose metabolism in liver. Resistance training in rat is an exercise training model that has received little attention but that has been shown to result in metabolic adaptations in Ovx rats as well as in post-menopausal women. The purpose of the study was to investigate the effects of Ovx and a 12 weeks resistance training (RT) programme on gene expression of GLUT2 the main glucose transporter in liver. Holztman rats (n = 42) were divided into 7 groups (Sham-sedentary (Sed), Sham-RT, Ovx-Sed, Ovx-RT, Ovx-placebo, Ovx-hormone replacement therapy (HRT), and Ovx-HTR-RT). The RT protocol consisted of training sessions held every 72 h for 12 weeks, during which the animals performed from 4 to 9 vertical climbs (1.1 m) with progressive weights (up to 30 g) tied to the tail at 2 min intervals. GLUT2 transcripts in Ovx and in Ovx-placebo as compared to Sham-Sed animals were increased ($p < 0.05$), suggesting an increased hepatic glucose uptake under oestrogens withdrawal. Resistance training as well as oestrogens replacement in Ovx decreased the GLUT2 gene expression to the level of Sham-Sed animals. Adding HRT to RT in Ovx rats did not further decreased GLUT2 gene expression. The present results suggest that an increased hepatic glucose uptake in Ovx rats might contribute to the increased *de novo* lipogenesis. RT appears to be an appropriate exercise model to circumvent these effects. (Supported by CAPES and FAPESP.)

Left ventricular modulation of post-exercise oxygen uptake kinetics: effects of chronic biventricular pacing

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The relation between chronic biventricular pacing (BiVP) mediated changes in in left ventricular function and post-exercise oxygen uptake ($\dot{V}O_2$) kinetics in individuals with heart failure is not well understood. We evaluated the effects of 6 mo of BiVP on 1) reserve and peak exercise cardiac output, 2) the relation between peak $\dot{V}O_2$ cardiac output reserve, 3) gas exchange and ventilation during the recovery from peak exercise, and 4) the relation between post-exercise $\dot{V}O_2$ and peak $\dot{V}O_2$ in 12 subjects with heart failure (age: 56 ± 15 yrs; peak $\dot{V}O_2$: 12.9 ± 3.2 ml/kg/min; ejection fraction: 19 ± 4%). Cardiac output reserve measured by contrast enhanced echocardiography increased from 2.8 l/min pre-BiVP to 4.2 l/min post- BiVP, and was 22% higher at peak exercise post-BiVP (both $P < 0.05$). The increase in cardiac output was due to both a significant increase in peak and reserve stroke volume and to a salutary (non-significant) increase in heart rate reserve. The increase in stroke volume was modulated by a greater non-significant increase in end-systolic volume reserve and greater preservation in end-diastolic volume reserve. Cardiac output reserve was related to peak $\dot{V}O_2$ ($r = 0.48$, $P < 0.05$). The post-exercise recovery time constant (tau) for $\dot{V}O_2$ was faster post-BiVP (67 ± 14 s) compared to pre-BiVP (83 ± 22 s; $P < 0.05$). Similarly, the recovery of carbon dioxide output ($\dot{V}CO_2$; pre-BiVP: 140 ± 40 s vrs post-BiVP: 119 ± 44 s; $P < 0.05$) and minute ventilation (VE; pre-BiVP: 127 ± 27 s vrs post-BiVP: 108 ± 41 s; $P < 0.05$) was faster post-BiVP. The increase in peak $\dot{V}O_2$ was related to a faster recovery in post-exercise $\dot{V}O_2$ ($r = -0.46$, $P < 0.05$). In conclusion, the BiVP mediated increase in cardiac output at peak exercise likely increases O2 availability and the maximal rate of oxidative metabolism measured as an increase in peak $\dot{V}O_2$ and faster postexercise $\dot{V}O_2$ kinetics.

4-Hydroxy-2-nonenal is a novel regulator of skeletal muscle SERCA function

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4-Hydroxy-2-nonenal (4-HNE) is an α,β-unsaturated hydroxyalkenal produced through lipid peroxidation of the n-6 polyunsaturated fatty acids (PUFAs). 4-HNE is a strong electrophilic aldehyde and displays potent biological activity, capable of adducting to histidine, lysine, and cysteine residues of various proteins including the insulin receptor substrate-1 and the Na^+/K^+-ATPase pump. Importantly, 4-HNE adduction to these proteins has been shown to impair insulin signaling and inhibit the functionality of the Na^+/K^+ pump. In a previous study using rat cardiac tissue, exogenous 4-HNE treatment was found to reduce the Ca^{2+}uptake activity of the sarco(endo)plasmic reticulum Ca^{2+}-ATPase (SERCA) pump. Since SERCA2a is the predominant isoform found in cardiac tissue, we questioned whether exogenous 4-HNE treatment would also impair the activity of SERCA1a. To this end, white gastrocnemius (WG) muscles obtained from C57BL/6 mice were homogenized, and homogenates were incubated at 37°C for 1 hour with a range of 4-HNE concentrations (0, 0.25, 0.5, 1.0, 2.5, 5.0, 10 mM). Western blotting demonstrated progressive exogenous adduction of 4-HNE following incubation with increasing concentrations of 4-HNE. After the 1 hour incubation protocol, SERCA activity assays were performed on the control and 4-HNE treated WG homogenates. Preliminary analysis demonstrates that the effect of 4-HNE on SERCA activity may fit a Gaussian function since lower concentrations (0.25, 0.5, 1mM) progressively stimulated SERCA activity ($P = 0.37$, $n = 1$), whereas higher concentrations (2.5, 5, 10mM) progressively reduced SERCA activity ($P = 0.0017$, $n = 2$). Our preliminary findings indicated that 4-HNE may act as a signaling molecule capable of regulating SERCA function. Future efforts from our laboratory will attempt to identify the mechanism of 4-HNE regulated SERCA function and to assess 4-HNE's physiological and pathophysiological role as an active SERCA regulating molecule.

Comparison of child physical literacy scores between Canada and Kenya

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The Canadian Assessment of Physical Literacy (CAPL) is a new, comprehensive test battery that assesses and quantifies a child's capacity for, and commitment to, a physically active lifestyle. To better understand the global physical activity (PA) transition this study used the CAPL to compare the physical literacy of a convenience sample of children from Canada (developed country) to Kenya (developing country). Children were recruited from Ottawa, Canada (n = 223, 61.9% female, mean age 10.0±0.3) and Nairobi, Kenya (n = 180, 53.9% female, mean age 9.8±0.7). CAPL measures included assessments of four domains: Physical Competence (motor skill obstacle course, aerobic fitness, grip strength, plank endurance hold, sit-and-reach flexibility, height, weight, waist circumference), Daily Behaviour (7-day pedometer measures, self-reported screen-time, self-reported PA), PA Motivation and PA Knowledge. Aggregate scores for each domain and overall physical literacy scores were calculated. Results demonstrated that Canadian children had significantly higher total physical literacy scores (61.5±8.3) than Kenyan children (59.0±7.7) ($t = 2.3$, $p = 0.02$). Canadian children also had higher Physical Competence Domain scores (20.6±3.6 vs. 19.2±3.1; $t = 3.9$, $p < 0.001$), PA Motivation Domain scores (12.6±2.2 vs. 11.6±2.0; $t = 4.4$, $p < 0.001$) and PA Knowledge Domain scores (12.6±2.4 vs. 10.6±2.9; $t = 6.8$, $p < 0.001$). However,

Kenyan children performed better than Canadian children in the Daily Behaviour Domain (17.1±5.7 vs. 15.5±5.1; t = 2.9, p = 0.004). In conclusion, this study identified notable differences in physical literacy domain scores between samples in Canada and Kenya. Kenyan children were more active, yet demonstrated poorer physical competence, PA motivation and PA knowledge. Future research needs to explore whether lower scores in Kenya represent a true disadvantage in physical literacy or are because of cultural differences in the validity of the CAPL within varying cultural milieu.

Mitochondrial transcription factor A regulation in response to rat skeletal muscle denervation

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The aim of this study was to examine how the expression of mitochondrial transcription factor A (Tfam), a vital protein which coordinates mitochondrial content by controlling the transcription and replication of mitochondrial DNA (mtDNA), is regulated during muscle disuse. We measured Tfam expression at multiple levels following unilateral denervation for 8 hours, 16 hours, 24 hours, 3 days or 7 days, and hypothesized that decreases in Tfam expression would precede reductions in mitochondrial content. Muscle mass was lowered by 13% and 38% at 3 and 7 days post-denervation, while COX activity fell by 33 and 39% at the same time points. Activation of the Tfam promoter *in vivo* was reduced by 30-65% between 8h and 3 days of denervation. Assessment of the Tfam transcript stability revealed that it was stabilized during short-term denervation, as its half-life was enhanced following 8-24 hours of denervation. Protein expression of RNA-binding proteins which promote mRNA decay in skeletal muscle (KSRP and CUGBP1) was elevated at 3 and 7 days of denervation. Tfam localization within subsarcolemmal mitochondria was reduced after 3 and 7 days of denervation, and this was associated with the suppression of a mtDNA-encoded gene, COX I. This suggests that denervation impairs both mitochondrial Tfam import and function. Finally, AMPK phosphorylation increased 16 hours after denervation (p=0.06), and was suppressed after 7 days of denervation, providing support for an early pro-autophagy signal, but an anti-mitochondrial biogenesis signal with more prolonged denervation. These data suggest that putative signals regulate the Tfam promoter during the earliest stages following denervation, but that these are counteracted by increases in the stability of the Tfam transcript. Import of Tfam into the mitochondrion seems to be the most critical point of regulation of this protein during denervation, an impairment which is crucial for the loss of mitochondria brought about by muscle disuse.

Using a modified critical power model to differentiate athletic types

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A well-established model, Critical Power, has been extensively used in numerous endurance sports to characterize an individual's work performance; anaerobic work capacity (AWC) and critical power (CP). The model makes an assumption that all types of athlete have the same pattern of responses when it comes to power and time to fatigue, however in a recent study, Bundle showed different observation. Previously, we proposed a modified CP model, Power = AWC / time^n + CP, that showed a significant difference in power-time relationship, *n*, between junior rowers and well-trained senior rowers due to physiological changes from rowing specific training. In this follow-up study, we further investigated this relationship in different types of athletes (sprint and endurance athletes). Twelve participants (5 sprint cyclists, 7 endurance cyclists; age 35.42 ± 10.58yrs) completed 5 testing sessions over 2 weeks. First, participant's AWC_3 and CP_3 were determined. Then, subjects were randomly assigned to complete 4 power outputs producing exhaustion in 2-10min followed by a non-disclosed duration all-out effort to produce multiple estimates of AWC_n and CP_n. The power-time relationship, *n*, is estimated by fitting a nonlinear model and type III test shows the significant difference between the types of athlete. There was a weak difference (p=0.68) between the power-time relationship constant, *n*, between the sprinter (n=1.07±0.84) and the endurance athletes (n=0.21±0.31). There seemed to be a weak trend showing a difference in the power-time relationship constant, *n*, between the different types of athlete. This trend may be strengthened with having more participants. The experiment is currently ongoing and we hypothesized a significant difference will be apparent with the number of participants is over 10 in each group.

Fibre type specific increase in the lipolytic inhibitor G0S2 following 8 weeks of endurance training in rat skeletal muscle

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Lipolysis is a series of cascading catalyzed reactions during which a triglyceride is hydrolyzed to free fatty acids for energy provision. Adipose triglyceride lipase (ATGL) is the first, and rate limiting lipase of lipolysis. It is co-activated by comparative gene identification-58 (CGI-58), and inhibited by the G(0)/G(1) switch gene-2 (G0S2) protein. Following endurance training, there is an increased reliance in intracellular fat breakdown for energy production in skeletal muscle. In keeping with this, it is known that ATGL content increases in human skeletal muscle with endurance training, with no changes in CGI-58. However, nothing is known about muscle G0S2 protein content following endurance training. Therefore, the purpose of this study was to assess the total content of skeletal muscle G0S2 following endurance training compared to sedentary rats. We expected that with endurance training, G0S2 protein content would decrease to facilitate intramuscular fat breakdown. Adult male Sprague-Dawley rats (n = 10, age=51-53 days) were treadmill trained 8-weeks, increasing intensity from running 18m/min for 30 minutes in week-1 to 25m/min for 60 minutes by week-8 (all at a 10% incline). Under isoflurane-induced anesthesia, the type I soleus, largely fast twitch oxidative red (RG) and glycolytic white gastrocnemius (WG) were removed. In all three muscle types, we saw an expected increase in ATGL protein ($p < 0.05$) with the WG having the greatest relative increase in ATGL protein content (~2-fold), yet no change in CGI-58 protein expression across any of the tissues. Contrary to our hypothesis, G0S2 protein content increased in both the oxidative SOL and RG, but was unaltered in the WG. It is unclear as to why G0S2 increases following endurance training, however it is possible that increased G0S2 content is required in oxidative muscle to increase potential for regulation of triglyceride breakdown. Alternatively, it is not total content of G0S2 that is important, but post-translational modification/association of this protein that regulates lipolysis. (Supported by NSERC Canada.)

Impact of PGC-1α on exercise-induced mitochondrial remodelling

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Chronic physical activity leads to improved oxidative potential and fatigue resistance, which is beneficial to muscle health. These benefits require the regular renovation of cellular energy resources, mainly the mitochondria. The pathway responsible for the renovation of long-lived organelles consists of a specialized type of autophagy, known as mitophagy, in which dysfunctional portions of the mitochondrial reticulum are segregated and degraded. Recent studies indicate that autophagy is activated following an acute bout of exercise, however, the mechanisms leading to the activation of mitophagy during exercise have not been fully established. PGC-1α, a transcription co-activator notorious for its involvement in mitochondrial biogenesis, has also been implicated in stress-induced autophagy. However,

the interplay between autophagy and PGC-1α during exercise has yet to be evaluated. Thus, we investigated autophagic induction and gene expression after an acute bout of exercise in wild type (WT) and in PGC-1α knockout animals (KO). Mice from each genotype were subjected to an exhaustive bout of exercise. Autophagy flux as well as signaling were evaluated either immediately post exercise (Ex), or after a recovery period of 90 min (ExR). Deletion of PGC-1α resulted in a 40% decrease in mitochondrial content, as well as a 25% decline in running performance. Ex induced a 2-3-fold increase in gene transcripts of various mitochondrial (e.g COXIV, Tfam) and autophagy-related genes (e.g. p62, LC3) only in WT, but not in KO animals. Exercise also resulted in enhanced targeting of mitochondria for fragmentation, as measure by Fis1 presence on the organelle, which was 44% higher in WT compared to KO animals. Mitochondrial targeting for autophagic removal, as measured by the presence of p62 in the mitochondrial subfraction, was enhanced by 22% during Ex and was further increased during the recovery period (46% in ExR). This effect was not observed in KO animals. These results suggest that mitochondrial turnover is increased following exercise, and that this effect is at least in part co-ordinated by PGC-1α.

A scoping review comparing field test predictors of lower body muscular explosive strength in adolescent youth

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The importance of assessing lower body muscular explosive strength (LBMES) in adolescent youth is a necessary component of fitness test batteries for health indicators, and athlete assessment for strength indicators. LBMES has a protective effect against injury when incorporated into neuromuscular training programs, and can also act as an assessment tool for injury risk. Appropriate field tests are needed to measure LBMES in large populations, yet there is currently no single established gold standard field-test. The vertical jump (VJ) and standing long jump (SLJ) are well known and acceptable measures for lower body assessment due to their low-cost, easy administration, and because they reflect natural movements. Therefore, the purpose of this scoping review was to determine which one of the following two tests (SLJ and VJ) was the best predicator in a field setting of LBMES in adolescent youth. The databases used were SportDISCUS, MEDLINE, and PubMed as well as Google Scholar and Google search. The reference lists in relevant articles were also searched in order to identify any studies that were missed in the database searches. A total of 16 relevant articles (N=20) were analyzed and selected; 4 reviews and 12 studies. Based on reliability and validity, 3 of 7 articles that assessed both tests concluded that the SLJ was a better predictor; one article was inconclusive, and 3 determined VJ was a better predictor of LBMES. Most studies focused on assessing the SLJ (n=6) versus the VJ (n=3). In summary, the SLJ is more widely used in school fitness testing batteries, while the VJ is utilized with adolescent athletes. The reliability of these tests is more commonly assessed than the validity. A limitation of some of the studies (n=9) was that they did not control for body mass. Criterion-referenced cut points representative of health status in the VJ and SLJ test have not been determined for the Canadian adolescent youth population. Overall, the evidence is insufficient and perhaps more research is needed to establish a standardized indicator for both health status and performance in adolescent youth in a field setting.

Is cognitive function impaired while working in 35°C and wearing personal protective clothing and self-contained breathing apparatus in fire fighters?

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Firefighting requires adequate levels of mental function and acuity requiring the firefighter to be alert, make critical decisions, and be aware of their surroundings while working under life-threatening conditions. To date, the few studies which have examined cognitive function during exertional heat stress in firefighters have utilized simple mental performance tasks, such as reaction time, to determine any changes during situations of increasing core temperature. The purpose of this study was to examine the effects of thermal strain on various aspects of cognitive function during low-intensity treadmill walking. Ten firefighters were tested at 0800 hours and nine were tested at 1200 hours to balance the effects of circadian rhythm. Core temperature, skin temperature, and heart rate were continuously monitored and 5 mL·kg^{-1} of water was provided throughout the protocol. Firefighters walked on a motorized treadmill at 4.5 km·h^{-1} and 2.5% grade, in a climate chamber controlled at 35 °C and 50% relative humidity for 85.2 ± 16.7 min. Cognitive function was tested using the CANTABeclipse battery (spatial working memory - SWM, reaction time - RTI, rapid visual information processing - RVP, spatial span - SSP, and paired associates learning - PAL) at baseline, immediately following completion of exercise, and after attaining an active recovery core temperature of 37.8 °C, while SSP and PAL were also evaluated during exercise when core temperatures of 37.8, 38.5, and 39.0 °C were attained. Compared to baseline, SWM search time was longer at post-test along with five choice RTI, whereas simple RTI was faster. At increasing core temperatures, errors at the final level of the PAL test significantly increased at a 38.5 °C, while performance on the SSP test declined at 38.5 and 39.0 °C compared to baseline. Taken together, it appears that certain aspects of cognitive function start to decline at a core temperature of 38.5 °C when the average increase in core temperature is occurring at a rate of 1.40 ± 0.33 °C·h^{-1}.

Muscle activation of the lower limbs in minor hockey referees during elite level Midget AAA games

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The biomechanical and physiological characteristics of ice hockey skating have been extensively examined to improve performance for amateur and professional players. However, there has been little research in relation to on-ice officials. While skating technique (and muscle activity patterns) should be similar across players and officials, the physiological demands during a game are very different. Officials must maintain a high level of continuous activity throughout a game. The purpose of this study is to evaluate the muscular demands of ice hockey officials during Midget AAA hockey games. Three Hockey Canada certified referees were instrumented with wireless surface electromyography (EMG). Following proper electrode preparation, electrodes were affixed to four muscles bilaterally: i) vastus lateralis (VL), ii) biceps femoris (BF), iii) tibialis anterior (TA), and iv) gastrocnemius (GC). EMG was measured continuously for the duration of each 15 minute period and sampled at 4000 Hz, low pass filtered (2nd order, dual pass Butterworth, 3 Hz cut-off) and normalized to maximal voluntary excitation (MVE) within each period. The amplitude probability distribution function (APDF) was generated for each muscle and used to determine the probability of time spent at a particular activation level. With data collapsed across periods, the largest activities occurred in the TA and GC for the right side and TA and VL for the left side. For the right side, peak activities were 47.4 ± 15.4%MVE, 38.3 ± 11.8%MVE, 37.5 ± 14.2%MVE and 35.1 ± 14.1%MVE for GC, TA, VL and BF, respectively. For the left side, peak muscle activities were 55.0 ± 5.0%MVE, 48.1 ± 12.0%MVE, 42.0 ± 15.4%MVE and 38.9 ± 13.5%MVE for VL, TA, GC and BF, respectively. These preliminary results suggest that hockey officials perform with a high level of muscle activity. It is clear that the demands of an official are different than that of a player and this information can be used to guide hockey-specific training programs.

The spinal portion of the silent period after transcranial magnetic stimulation

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When transcranial magnetic stimulation (TMS) is applied to the motor cortex during a voluntary contraction, the motor evoked potential is followed by a transient interruption of the electrical activity recorded at the muscle (EMG). Based on H-reflex data, spinal mechanisms are proposed to be responsible for the first 50-80ms of this silent period; however, a number of methodological issues can compromise the validity of H-reflex as a measure of motoneuron excitability. Hence, the purpose of this study was to use transmastoid stimulation, the most direct method to test motoneuron excitability in humans, to assess the duration of the spinal portion of the silent period. Seven subjects performed 32 brief (~3s) elbow flexor contractions at 25% of maximal torque during which transmastoid stimulation was delivered to evoke a biceps cervicomedullary motor evoked potential (CMEP) in isolation (unconditioned) and at different intervals (50-120ms in 10ms steps) after a TMS pulse (conditioned). The stimulus intensity for TMS and transmastoid stimulation were set to elicit a silent period of ~200ms and an unconditioned CMEP of 10-15% of the maximal compound muscle action potential, respectively. At each interval, the mean of the four conditioned CMEPs was expressed as a percentage of the mean of the four unconditioned CMEPs. At all intervals, the conditioned CMEP was less than 50% the size of the unconditioned CMEP (e.g., 17±17% at 50ms and 43±25% at 120ms; mean±SD). Contrary to published H-reflex data, the CMEP did not recover within 50-80ms after TMS. Instead, the CMEP remained depressed at even the longest interval tested in this experiment (120ms). These data suggest that the spinal portion of the TMS-evoked silent period is considerably longer than reported previously. (Supported by NSERC and CFI.)