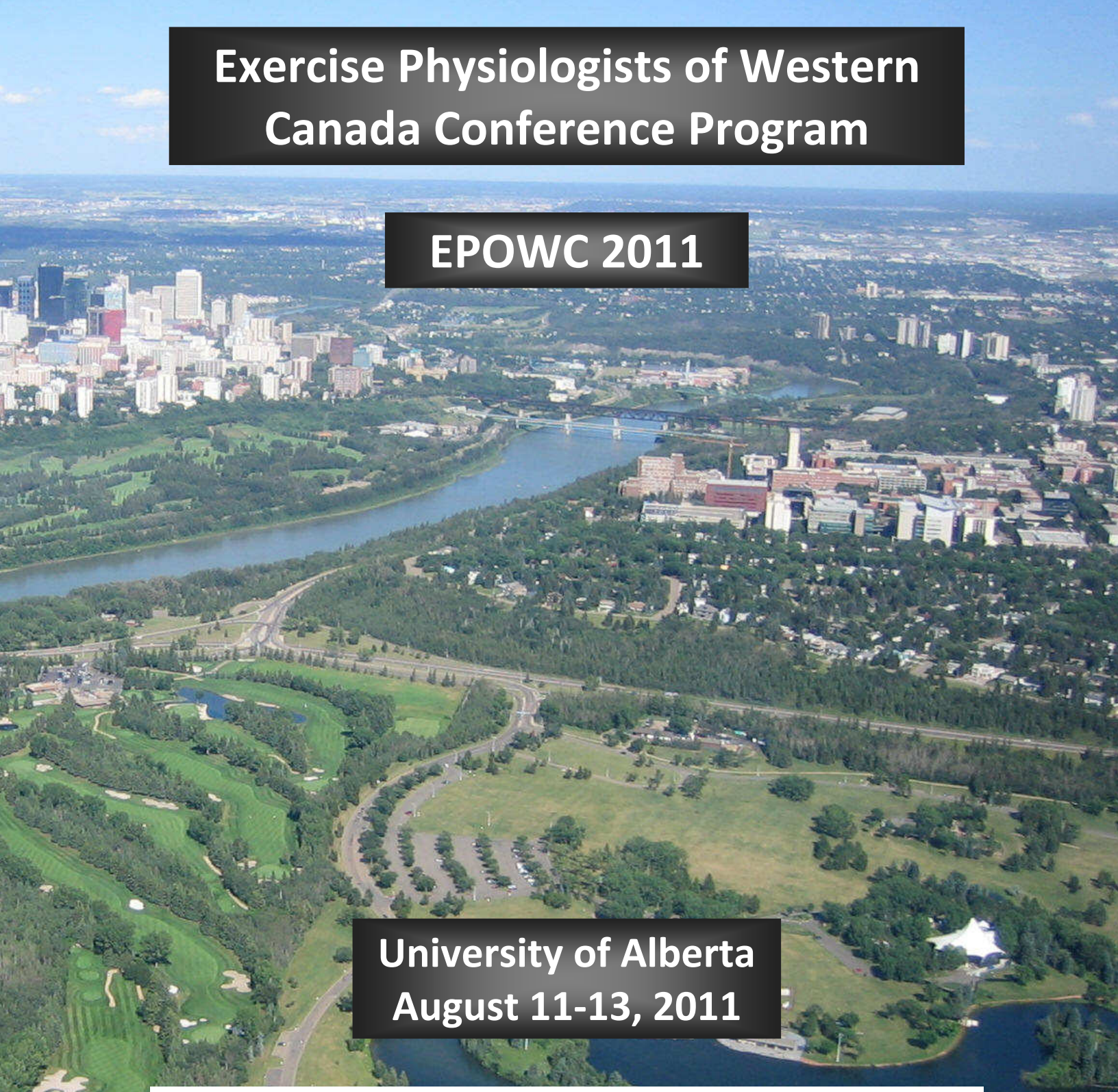
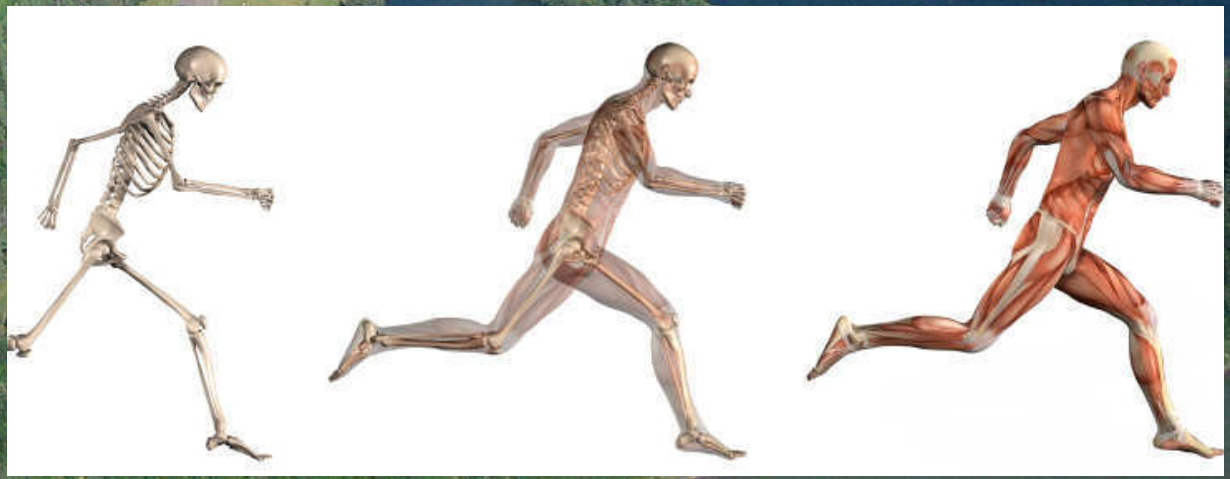
Exercise Physiologists of Western Canada Conference Program

EPOWC 2011



University of Alberta
August 11-13, 2011



Welcome

On behalf of the Faculty of Physical Education and Recreation at the University of Alberta, I would like to welcome you to the 5th annual Exercise Physiologists of Western Canada conference. This conference provides an opportunity for students to present their research and get feedback from their peers and mentors and in a relaxed and constructive manner. The conference also provides an opportunity for exercise physiologists from across western Canada to interact professionally and socially on an annual basis.

I hope you enjoy yourself in Edmonton!

David F. Collins

EPOWC 2011 Conference Chairperson

Conference Sponsors

We would like to thank our generous sponsors for making EPOWC 2011 possible:

Faculty of Kinesiology and Recreation Management, University of Manitoba
Faculty of Kinesiology and Health Studies, University of Regina
College of Kinesiology, University of Saskatchewan
Canadian Society of Exercise Physiologists
University of Alberta Bookstores
Faculty of Physical Education and Recreation, University of Alberta
University of Alberta Conference Fund
The Canadian Physiological Society

Conference Information

See the maps on the next page for locations of conference venues. All sessions will be held in Room E-120 in the east wing of the Van Vliet Centre. A hard copy of this program will be provided in the conference bag you will receive upon registration at the meeting.

Accommodations

Many of the registrants will be staying in Lister Centre, a 5 minute walk from the conference site.

Conference Registration (outside Room E-120)

Thursday, August 11, 2011, 2:00 to 3:00 PM

Meal Information

Meals will be provided in the lounge outside of E-120 (except dinner Friday, see below). Your conference fee includes breakfast on Friday and Saturday, lunch and dinner on Friday and numerous nutrition breaks. Please contact Dr. Collins (dave.collins@ualberta.ca) as soon as possible if you have particular dietary needs.

Parking

As a guest staying at a residence on campus, parking is included in your accommodation fee. If you are not staying in one of the U of A residences, parking is $14 per day.

- Jubilee parking garage
- Varsity parking lot
- Stadium parking garage
- Education parking garage

Award Categories

There will be cash awards for student presentations in the following categories:

Undergraduate student
Master's student
PhD student/post-doctoral fellow

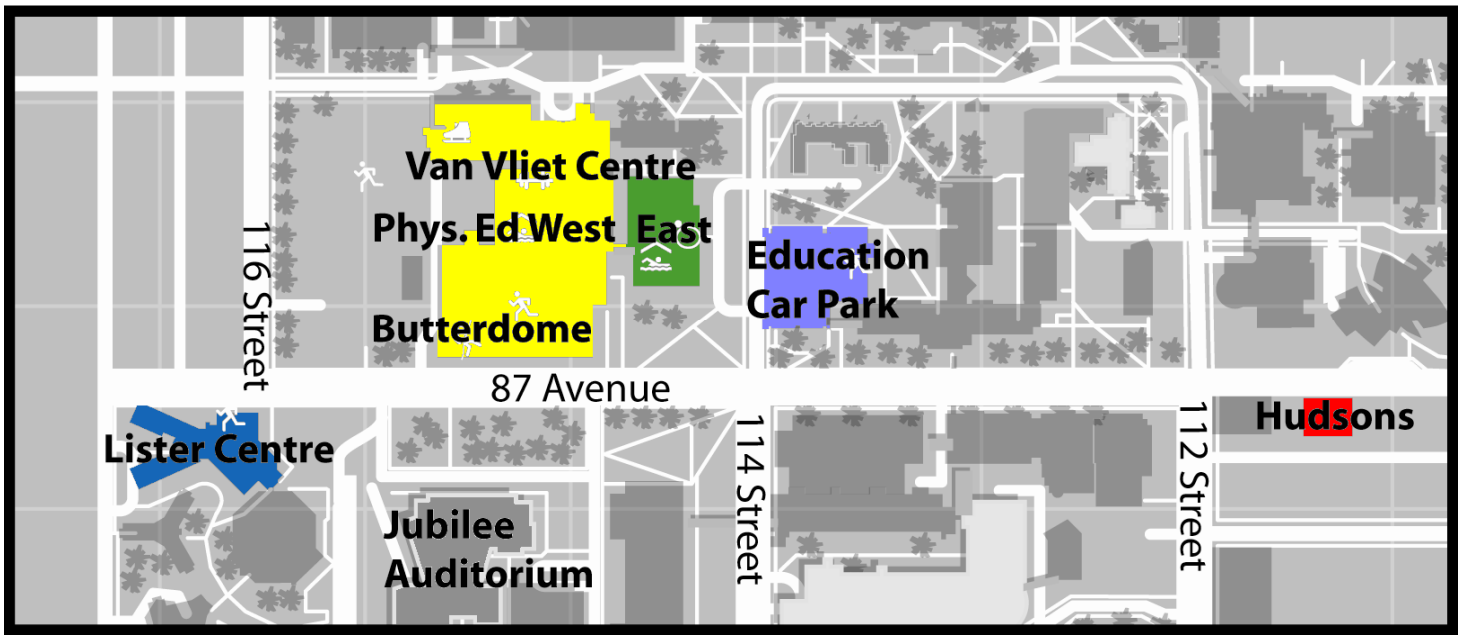
First place: $200; Second place: $100; Third place $50.

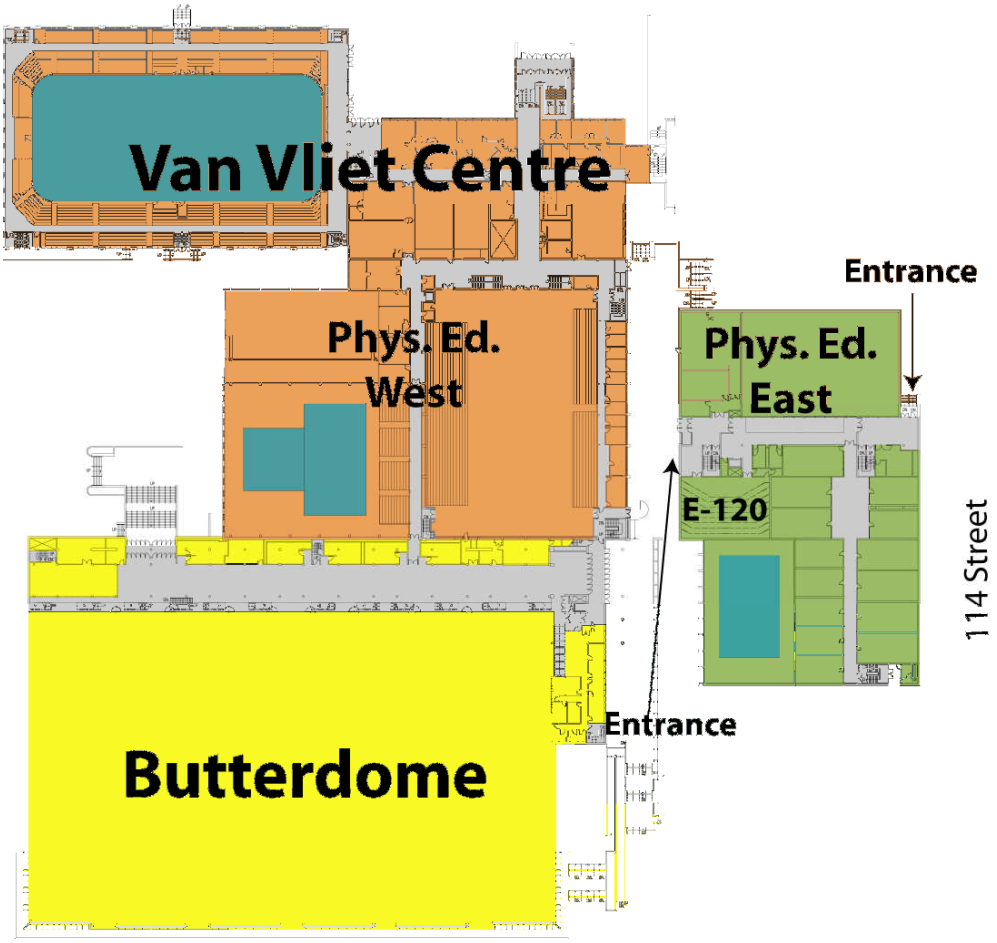
Social Events

Thursday- Your registration fee includes admission to "The Surprise" a play at the world famous Edmonton Fringe Festival Thursday night at 8 pm (see www.martindockery.com). We encourage you to grab a bite to eat before the show at one of the "Festival food" outlets or one of the many restaurants close to the Fringe site. A shuttle bus service will be provided. For those who prefer to walk, the Fringe Festival grounds are an ~30 min walk from the EPOWC 2011 meeting site.

Friday- We will be hosting a social get-together at Hudsons on Campus (www.hudsonstaphouse.com) starting at 6:30 pm. Hudsons is a short (5-10 min) walk from the meeting site (see map). Dinner and non-alcoholic beverages will be provided.

Conference Maps





Keynote Speakers

Thursday

Dr. Mark Haykowsky - University of Alberta

Dr Haykowsky is a Professor in the Faculty of Rehabilitation Medicine and adjunct Professor in Medicine (Cardiology) at the University of Alberta. Dr. Haykowsky's research program examines the biologic mechanisms for impaired cardiac function in healthy older individuals, heart failure patients, and breast cancer patients/survivors and the role of exercise training to improve cardiovascular and health outcomes. He is a member of the MANTICORE cardio-oncology research group and exercise physiology section leader for the Alberta Heart Diastolic Heart Failure team grant. Dr. Haykowsky has published his research findings in leading cardiology, internal medicine and oncology journals.

Friday

Dr. Phillip Gardiner - University of Manitoba

Dr. Phillip Gardiner is Director of the Health, Leisure & Human Performance Research Institute, and holds professorial positions in the Faculty of Kinesiology and Recreation Management (as Associate Dean, Research), and in the Department of Physiology, Faculty of Medicine, at the University of Manitoba. He currently holds a Tier I Canada Research Chair in Physical Activity and Health Studies. Dr. Gardiner is a member of the Spinal Cord Research Center, where he directs a research laboratory, and of the Neurodegenerative Disease Research Group. After receiving his PhD in exercise physiology at University of Alberta in 1976, and spending 2 years of post-doctoral studies in neuromuscular physiology at UCLA, he took a position as Professor of Kinesiology at University of Montreal, where he worked for 26 years before taking his current position at University of Manitoba in 2002. Dr. Gardiner has been Editor-in Chief of the *Canadian Journal of Applied Physiology* (1995-2000), and President (2000-2002) and Executive Director (2006-2008) of the Canadian Society for Exercise Physiology. He conducts research on the effects of physical activity on the nervous and neuromuscular systems, and has published over 100 articles and 3 books in this area. His research has been supported by grants from the Canadian Institutes for Health Research, Natural Sciences & Engineering Research Council Canada, the Canadian Space Agency, and the National Institutes of Health in the US. He has served as the University of Manitoba representative to the Canadian Institutes for Health Research, and has been a member and Chair of the MOV peer-review committee of CIHR. He is currently Chair of the Advisory Board for the Institute of Musculoskeletal Health and Arthritis, one of the 13 institutes of CIHR.

Saturday

Dr. Darren Candow - University of Regina

Dr. Darren Candow, PhD, CSEP-CEP, is an Associate Professor in the Faculty of Kinesiology & Health Studies and the Gerontology Graduate Coordinator, Centre on Aging and Health at the University of Regina. Dr. Candow supervises the Aging Muscle and Bone Health Laboratory, and serves on the editorial board for the *Journal of Aging and Physical Activity* and the *Journal of the International Society of Sports Nutrition*, and the board of directors for the Saskatchewan Kinesiology and Exercise Science Association.

Dr. Candow is an academic member of the American College of Sports Medicine, Canadian Society for Exercise Physiology, The National Strength and Conditioning Association, and the International Society for Aging and Physical Activity. Dr. Candow's research program involves the development of effective resistance training and nutritional intervention strategies for improving properties of aging muscle and bone health. Dr. Candow's research is funded by the Canada Foundation for Innovation (CFI), the Saskatchewan Health Research Foundation (SHRF), and the Nutricia Research Foundation.

CONFERENCE SCHEDULE

Day 1 - Thursday, August 11th, 2011

14:00-15:00 **Welcome reception/Registration**

15:00-15:15 **Opening remarks**
Dr. David Collins, Conference Chair

15:15-16:15 **Keynote speaker**
Dr. Mark Haykowsky, University of Alberta
Acute effects of high-intensity interval exercise on biventricular function: A view from the athletic to the failing heart.

16:15-16:30 **Nutrition break**

16:30-18:00 **Session 1 (p.12-14 for the abstracts)**

Cardiovascular: Clinical **Chair: Duncan Raymond**

16:30-16:45 *Impact of exercise on function and physical activity of elderly cardiac patients*
D. Buijs, M. Senaratne, & R. G. Haennel
Faculty of Rehabilitation Medicine and Covenant Health, Edmonton, AB.

16:45-17:00 *Impact of exercise on physical activity of elderly cardiopulmonary patients*
A. Ramadi, D. Buijs, M. Stickland, M. Senaratne, & R. G. Haennel
Faculty of Rehabilitation Medicine, University of Alberta, Edmonton, AB; Covenant Health, Edmonton, AB.

17:00-17:15 *Acute responses to high and low velocity resistance training in patients with chronic heart failure*
B. Pikaluk, P. Chilibeck, J. Akhtar, R. Stene, M. Yurach, J. Rooke, & S. Butcher
College of Kinesiology, University of Saskatchewan, Saskatoon, Saskatchewan

17:15-17:30 *The acute effects of high intensity interval exercise on pulmonary function and exhaled Nitric Oxide in adult asthmatics*
M. T. Yurach, S. Butcher, D. Cockcroft, & D. Marciniuk
College of Kinesiology; School of Physical Therapy; and College of Medicine, University of Saskatchewan

17:30-17:45 *Pre-surgery exercise therapy for patients waiting for CABG: A Pilot Project*
D. S. Kehler[1,2], E. Garcia[1,2], D. Kent[1,2], R. C. Arora[2,3], J. Sawatzky[3, ‡], & T. A. Duhamel[1,2, ‡]
Faculty of Kinesiology and Recreation Management, Institute of Cardiovascular Sciences, St. Boniface Hospital Research Centre, [3]Faculty of Medicine, University of Manitoba.
[‡]Co-principal investigators, Winnipeg, MB.

17:45-18:00 *Examining the effects of two cardiac rehab program delivery models: Preliminary data.*
E. Garcia[1,2], D. S. Kehler[1,2], D. Kent[1,2], N. Wangasekara[1,2], D. Luchik[3], D. Lamont[3], S. Boreskie[3], & T. A. Duhamel[1,2]
[1]Faculty of Kinesiology and Recreation Management, University of Manitoba, [2]Institute of Cardiovascular Sciences, St. Boniface Hospital Research, [3]Reh-Fit Centre, Winnipeg, MB.

18:30-22:30 **Social Event: Fringe Play "The Surprise",** 8 pm at the Academy at King Edward School, 8525 101 Street. Transportation to be announced.

Day 2 - Friday, August 12th, 2011

8:00-9:00 **Breakfast**

9:00-10:00 **Keynote speaker**
Dr. Phillip Gardiner, University of Manitoba
Adaptations in spinal neurons and circuits in response to altered activity levels

10:00-10:15 **Nutrition break**

10:15-12:00 **Session 2 (p.15-18 for the abstracts)**
Motor Control & Muscle **Chair: Austin Bergquist**

10:15-10:30 *Modulating motor output through serotonin receptor activation: Is there a difference between flexor and extensor output?*
J. W. Chopek, C. W. MacDonell, K. E. Power, K. Gardiner, & P. Gardiner
Spinal Cord Research Centre, Department of Physiology, Faculty of Medicine, University of Manitoba, Winnipeg, MB

10:30-10:45 *Chronic exercise alters motoneuron mRNA levels: potential mechanisms for enhanced excitability*
L. Woodrow, P. Sheppard, K. Gardiner, & P. Gardiner
Faculty of Kinesiology and Recreation Management, University of Manitoba, Winnipeg, MB; Spinal Cord Research Centre, Department of Physiology, University of Manitoba, Winnipeg, MB

10:45-11:00 *"Calibrating" Our Sense of Muscle Contraction Force*
A. Bui, & D. Collins
Human Neurophysiology Laboratory, Faculty of Physical Education and Recreation, Centre for Neuroscience, University of Alberta, Edmonton, AB

11:00-11:15 *Motor unit recruitment during electrical stimulation over the tibialis anterior muscle compared to the common peroneal nerve*
M. Hong, Y. Okuma, A.J. Bergquist, & D.F. Collins
Human Neurophysiology Laboratory, University of Alberta

11:15-11:30 *Spatial recruitment of motor units during electrical stimulation*
Y. Okuma[1,2], A.J. Bergquist[1,2], M. Hong[2], K. M. Chan[2,3], & D.F. Collins[1,2]
[1]Faculty of Physical Education and Recreation, [2]Centre for Neuroscience, [3]Division of Physical Medicine & Rehabilitation, University of Alberta, Edmonton, AB

11:30-11:45 *Sensory-conditioning of cortical circuits depends on the size of the sensory*
SM Roshko, CS Mang, AJ Bergquist, and DF Collins
Human Neurophysiology Laboratory, Faculty of Physical Education and Recreation, Centre for Neuroscience, University of Alberta, Edmonton, AB, Canada.

11:45-12:00 *AMPK regulates sarcoplasmic reticulum calcium pump activity in muscle*
M.P. Morissette, R.A. Epp, S.E. Susser, Y. Xu., & T.A. Duhamel
Faculty of Kinesiology and Recreation Management, University of Manitoba & Institute of Cardiovascular Sciences, St. Boniface General Hospital Research Centre, Winnipeg, MB, Canada.

12:00-13:30 **Lunch Break**

13:30-15:15 Session 3 **(p.18-21 for the abstracts)**
Cardiovascular Fitness & Cerebrovascular Chair: Erin Gillespie

13:30-13:45 *Aerobic fitness and neurovascular control*
D.A. Raymond, K.E. Jones, N.S. Chua, & D.S. DeLorey
Integrative Human Exercise Physiology Laboratory, Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB

13:45-14:00 *Functional sympatholysis is enhanced by short-term exercise training*
N.G. Jendzjowsky, & D.S. DeLorey
Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB

14:00-14:15 *The effects of fitness and age on cerebrovascular function*
S.M. Case[1,2], J.G. Harrison[1,2], B. Wilson[3], S. Parimi[3], R. Leigh[1,3], M.J. Poulin[1-5] , & M.H. Davenport[1,2]
[1]Department of Physiology & Pharmacology, [2]Hotchkiss Brain Institute, [3]Faculty of Medicine, [4]Libin Cardiovascular Institute of Alberta, and [5]Faculty of Kinesiology, University of Calgary, Calgary, AB

14:15-14:30 *Prefrontal oxyhemoglobin & aerobic capacity: A near infrared spectroscopy study*
H. Grant, M. Rehani, & Y. Bhambhani
Work Physiology Research Lab, Faculty of Rehabilitation Medicine, University of Alberta, Edmonton, AB

14:30-14:45 *Peripheral arterial pulse wave velocity predicts cerebral artery stiffness*
J.G. Harrison[1,2], B. Wilson[3], S. Parimi[3], R. Leigh[1,3], M.J. Poulin[1,5], & M.H. Davenport[1,2]
[1]Department of Physiology & Pharmacology, [2]Hotchkiss Brain Institute, [3]Faculty of Medicine, [4]Libin Cardiovascular Institute of Alberta, and [5]Faculty of Kinesiology, University of Calgary, Calgary, AB

14:45-15:00 *The effects of head-up and head-down tilt on cerebrovascular reactivity in the middle cerebral artery*
R.J. Skow, M.M. Tymko, & T.A. Day
Mount Royal University, Calgary, AB

15:00-15:15 *The effects of hyperoxic hypercapnia on cerebrovascular reactivity in the middle and posterior cerebral arteries in supine Position*
M.M. Tymko, R. J. Skow, & T.A. Day
Mount Royal University, Calgary, AB

15:15-15:30 **Nutrition break**

15:30-17:15 **Session 4**
Fitness (p.22-25 for the abstracts) **Chair: Scott Forbes**

15:30-15:45 *Calculation of spatio-temporal gait variables using physical activity monitors*
Q. Paterson[1], J. Lanovaz[2], & S. Webber[2]
[1]College of Kinesiology, [2]School of Physical Therapy, University of Saskatchewan, Saskatoon, SK

15:45-16:00 *Timing of whole-body vibration on muscle performance and muscle recovery*
A. Kosar, & D.G. Candow
Department of Kinesiology & Health Studies, University of Regina, Regina, SK

16:00-16:15 *Back fitness lowers muscle activation and fatigue during a dental procedure*
J.R. Krentz[1], M. J. Smith[1], J. Lalli[2], K. Currie[2], T. Bevans[2], J. L. Lanovaz[1], & P.D. Chilibeck[1]
Colleges of Kinesiology[1] and Dentistry[2], University of Saskatchewan, Saskatoon, SK

16:15-16:30 *The Metabolic Demands of a Vinyasa Power Yoga Practice*
J. Rooke, & P. Chilibeck
College of Kinesiology, University of Saskatchewan, Saskatoon, SK

16:30-16:45 *The effects of functional fatigue on dynamic balance in female athletes and non-athletes and compare between them*
F. Baghbaninaghadehi, A. Ramazani, & F. Hatami
Faculty of physical education and sport, Shahid Rajee Teacher Training University, Iran

16:45-17:00 *Physiological and psychological measures of fatigue in varsity swimmers*
W. Lampe, M. Dowling, N. Holt, & M.D. Kennedy
Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB

17:00-17:15 *Influence of swimming duration and intensity on airway hyper-responsiveness in varsity swimmers*
J.M.S. Gill, A.N.H. Hodges, B. Humby, & M.D. Kennedy
Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB

18:30 **Social Event:** Get-together at Hudson's on Campus.

Day 3 - Saturday, August 13th, 2011

8:00-9:00 **Breakfast**

9:00-10:00 **Keynote speaker**
Dr. Darren Candow, University of Regina
Designing the optimal nutritional cocktail for improving aging muscle and bone health

10:00-10:45 **Session 5 (p.25-26 for the abstracts)**
Supplementation **Chair: Yoshino Okuma**

10:00-10:15 *Effects of protein supplementation during resistance-training in young adults*
K. Weisgarber, E. Vogt, A. Kosar, & D.G. Candow
Department of Kinesiology & Health Studies, University of Regina, Regina, SK

10:15-10:30 *Effect of a lentil sports nutrition bar on endurance exercise performance*
J.T. Jochim, P.D. Chilibeck, J. Rooke, & G.A. Zello
College of Kinesiology, College of Pharmacy and Nutrition, University of Saskatchewan, Saskatoon, SK

10:30-10:45 *The effects of acute L-arginine supplementation combined with resistance exercise on growth hormone, growth hormone secretagogues, and insulin-growth factor-1 in strength trained males*
S.C. Forbes, & G.J. Bell
Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB.

10:45-11:00 **Nutrition break**

11:00-12:15 Session 6 (p.27-29 for the abstracts)
Physiology & Hypoxia Chair: Nicholas Jendzjowsky

11:00-11:15 *Resveratrol prevents the inhibition of SERCA2a in the diabetic heart*
S.E. Susser[1,2], R.A. Epp[1,2], M.P. Morissette[1,2], D.R.. Smith[3,4], P. Fernyhough[3,4], & T.A. Duhamel[1,2].
[1] Faculty of Kinesiology and Recreation Management, University of Manitoba, [2] Institute of CardiovascularSciences, St. Boniface General Hospital Research Centre, [3] Department of Pharmacology, Faculty of Medicine, University of Manitoba, [4]Division of Neurodegenerative Disorders, St. Boniface General Hospital Research Centre**,** Winnipeg, MB

11:15-11:30 *Interaction among hypoxia, anti-inflammatories and cerebrovascular function*
M. Pun[1], A. E. Beaudin[1], S. B. Ahmed[2,5], P. J. Hanly[2,4] & M. J. Poulin[1,3,4,5]
Departments of Physiology and Pharmacology[1], Medicine[2], and Clinical Neuroscience[3]s, Hotchkiss Brain Institute[4] and the Libin Cardiovascular Institute of Alberta[5], Faculty of Medicine, University of Calgary

11:30-11:45 *Cardiovascular responses to low oxygen during sleep*
C. D. Steinback[1], A. E. Beaudin[1], P. J. Hanly[2,4] , & M. J. Poulin[1,3,4,5,6]
Departments of Physiology and Pharmacology[1], Medicine[2], and Clinical Neurosciences[3], Hotchkiss Brain Institute[4] and the Libin Cardiovascular Institute of Alberta[5], Faculty of Medicine, University of Calgary

11:45-12:00 *Effect of intermittent hypoxia on renal blood flow in healthy humans*
A. A. Zalucky[1] , S. B. Ahmed[2,6], M. Pun[4], M. J. Poulin[3,4,5,6] & C. D. Steinback[4]
Departments of Biochemistry[1], Medicine[2], Clinical Neurosciences[3] and Physiology and Pharmacology[4], Hotchkiss BrainInstitute[5] and the Libin Cardiovascular Institute of Alberta[6], Faculty of Medicine, University of Calgary, AB

12:00-12:15 *Apnoea training, chemosensitivity, and erythropoietin*
E.J. Gillespie, C.A. Drever, K.M.T. Peressini, D.S. DeLorey, G.J. Bell, and A.N.H. Hodges
Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB

12:15-12:30 Break

12:30-12:45 *Closing remarks and awards: Dr. David Collins*

Abstract Index

Session 1 Cardiovascular: Clinical

Impact of exercise on function and physical activity of elderly cardiac patients

D Buijs, M Senaratne and R G. Haennel
Faculty of Rehabilitation Medicine and Covenant Health, Edmonton, Alberta, Canada.

Exercise Rehabilitation (ER) has been shown to improve exercise capacity, morbidity and mortality in elderly cardiac patients. However, little is known about the impact of ER on daily physical activity (PA). **PURPOSE**: To determine the impact of an ER on PA in elderly cardiac patients. **METHODS:** 19 patients (10 males: 9 females) age 75 $\pm$ 6 years with a diagnosis of myocardial infarction participated. Patients were tested prior to and after a 10 week (2 days/week) ER program. The ER program included 40 minutes of aerobic and resistance training supplemented by 1-2 days of home based exercise. Exercise capacity was assessed using the 6 minute walk test (6MWT).Physical function, the ability to perform activities of daily living, was assessed using the Continuous Scale – Physical Function Performance test battery (CS-PFP-10) which includes 10 everyday tasks that progress from easy (personal tasks) to moderate (household tasks) to difficult (mobility tasks). PA was assessed by measuring energy expenditure (EE) using the SenseWear™ Pro Armband (SWA). Patients were asked to wear the SWA for at least 11 hours/day for three consecutive days. **RESULTS:** Post ER 6MWT distance increased from 421 $\pm$ 88 m to 481 $\pm$ 77 m ($p<0.00$). Performance on the CS-PFP-10 improved from 52 $\pm$ 17 to 60 $\pm$ 13. However, no significant changes were observed in total daily EE. **CONCLUSION**: Findings indicate that ER improves aerobic capacity and the ability to perform activities of daily living but these improvements did not translate into increased daily PA as measured by EE.

Impact of exercise on physical activity of elderly cardiopulmonary patients

Ailar Ramadi, David Buijs, Michael Stickland, Mano Senaratne and Robert G. Haennel

Faculty of Rehabilitation Medicine, University of Alberta, Edmonton, AB; Covenant Health, Edmonton, Alberta, Canada.

Exercise Rehabilitation (ER) has been shown to improve health outcomes such as exercise capacity, morbidity and mortality in cardiopulmonary patients. PURPOSE: This study was undertaken to determine the impact of an ER on daily sedentary time or time spent in mild and moderate activity in elderly cardiopulmonary patients. METHODS: 30 patients (14 males: 16 females) age 73.2 + 8.3 years with a primary diagnosis of either cardiac (n=15) or chronic obstructive pulmonary disease (n=15) participated in this study. Patients were tested prior to and 4 weeks after an 8-10 week (2 days/week) ER program. Physical activity was assessed by measuring energy expenditure (EE) using the SenseWear™ Pro Armband (SWA). Patients were asked to wear the SWA for at least 15 hours/day for three consecutive days. Sedentary time was defined as the total time spent at an EE <1.5 METS while mild and moderate activity were defined as the time spent at 1.5-3.0 METS and >3 METS respectively. RESULTS: Following ER, no significant changes were observed in total daily EE. However, sedentary time decreased from 18.0 + 2.5 hrs/day to 16.4 + 3.4 hrs/day ($p<0.05$). There was a significant increase in the amount of time patients spent in mild activity (2.9 +1.4 hrs/day to 3.6 +1.7 hrs/day; $p<0.05$) however, the amount of time spent in moderate activity did not change.CONCLUSION: Findings indicate that 1 month after ER patients were indeed less sedentary. However, the ER program did not result in an increase in time spent in moderate physical activity levels which are typically associated with improved health outcomes.

ACUTE RESPONSES TO HIGH AND LOW VELOCITY RESISTANCE TRAINING IN PATIENTS WITH CHRONIC HEART FAILURE

Brendan Pikaluk, Dr. Philip Chilibeck, Dr. Jawed Akhtar, Rick Stene, Madison Yurach, Julianne Rooke, & Dr. Scotty Butcher.
University of Saskatchewan, Saskatoon, Saskatchewan

In chronic heart failure (CHF), resistance training results in reduced risk of mortality, decreased disease severity, and increased functional ability. Optimal training programs that produce physiological and functional benefits at minimal perceived exertion and cardiovascular stress have yet to be identified. In older populations, high velocity resistance training results in greater improvements in functional ability than low velocity resistance training. The use of high velocity resistance training in CHF patients has not been examined. **Purpose:** To compare the acute cardiovascular responses and perceived exertion of high and low velocity resistance exercises. **Methods:** 6 male CHF patients with systolic heart failure (CHF NYHA Class I-III) were recruited. In a cross-over design, they randomly performed two separate exercise sessions of 5 exercises; one with a low velocity of contraction (3 second concentric phase: 3 second eccentric phase) and one with a high velocity (1 second concentric phase: 3 second eccentric phase). During both sessions, heart rate, blood pressure, and a rating of perceived exertion (RPE) were obtained after the completion of each exercise. **Results:** The high velocity workout produced significantly lower systolic blood pressure, diastolic blood pressure and mean arterial pressure than the low velocity workout ($p<0.05$). The high velocity workout was not significantly different from the low velocity workout for rate pressure product, RPE, and heart rate. **Conclusion:** We conclude that the high velocity workout produces more favourable blood pressure responses to resistance training than the low velocity workout and may be used to enhance functional outcomes in cardiac rehabilitation programs.

The Acute Effects of High Intensity Interval Exercise on Pulmonary Function and Exhaled Nitric Oxide in Adult Asthmatics

Madison T. Yurach, Dr. Scotty Butcher, Dr. Don Cockcroft & Dr. Darcy Marciniuk.
College of Kinesiology; School of Physical Therapy; and College of Medicine, University of Saskatchewan

INTRODUCTION: Exercise induced bronchoconstriction (EIB) is common with longer duration constant workrate (CWR) exercise (greater than ~15 min) in patients with asthma and may be, in part, due to increased airway inflammation. High intensity interval exercise (HIIE) may reduce the risk of EIB development and decreasing inflammation; however, the acute effects of HIIE for adult asthmatics are unknown. **PURPOSE:** To compare the acute effects of HIIE with CWR on pulmonary function, lung mechanics, and airway inflammation (exhaled nitric oxide (eNO)) in asthmatics. **METHODS:** Fifteen asthmatics and fifteen non-asthmatic subjects will be recruited. Six days of testing will be conducted over three weeks. Day 1 will consist of eNO and a methacholine challenge test. Day 2 will include pulmonary function tests (PFTs) and a VO_2max test. During the third and fifth visits, one of two 20 minute exercise trials will be performed; CWR at 60% of VO_2max, or intervals of 140% of VO_2max for 30 seconds, followed by 90 seconds at 20%. During exercise, expired gases, lung volumes, work of breathing, and forced expiration will be measured. Before and following exercise, eNO and PFTs will be recorded. The fourth and sixth visits will be 24 hours after the exercise sessions and subjects will repeat eNO and PFTs. By studying the acute effects of HIIE and CWR exercise, more appropriately designed exercise programs will be available for adult asthmatics that would greatly benefit from improving their fitness levels.

Pre-surgery exercise therapy for patients waiting for CABG: A Pilot Project

D Scott Kehler[1,2], Eric Garcia[1,2], Dave Kent[1,2], Rakesh C Arora[2,3,‡], Jo-Ann Sawatzky [3,‡], and Todd A Duhamel[1,2,‡].
[1] Faculty of Kinesiology and Recreation Management, [2] Institute of Cardiovascular Sciences, St. Boniface Hospital Research Centre. [3] Faculty of Medicine, University of Manitoba. [‡] Co-principal investigators. Winnipeg, MB, Canada.

Wait times for elective cardiac surgery negatively impact the health status of patients with established cardiovascular disease. In fact, the literature indicates that patients who wait for cardiac surgery for more than one month are at an increased risk for mortality. Wait times for elective coronary artery bypass graft (CABG) surgery range between 10-16 weeks in Manitoba. Many patients become fearful of participating in physical activity while waiting for surgery and, thus, may experience further cardiovascular de-conditioning during this period. Notably, the literature indicates that patients with higher levels of physical fitness prior to cardiac surgery are less likely to experience adverse events after surgery. Therefore, we believe there is an opportunity to utilize exercise pre-habilitation therapy (Pre-hab) to enhance the cardiovascular health status for patients waiting for CABG surgery. With this objective in mind, 20 patients who are currently on the elective wait list for CABG surgery will be recruited and randomized to receive standard care or to participate in the Pre-hab intervention. The primary outcome will be a change in functional walking ability, as assessed using the 6-Minute Walk Test. Secondary outcomes include objectively measured physical activity and overall mood status. Data will be collected at baseline, 1 week before surgery (which in most cases will be 8-12 weeks after patients are recruited), and 3 months post-surgery. We hypothesize that functional walking ability will be enhanced above baseline levels amongst patients who complete the Pre-hab intervention, but will remain unchanged amongst patients who receive standard care.

Examining the effects of two cardiac rehab program delivery models: preliminary data.

Eric Garcia[1,2], D Scott Kehler[1,2], Dave Kent[1,2], Nilu Wangasekara[1,2], Dean Luchik[3], Darlene Lamont[3], Sue Boreskie[3] and Todd A Duhamel[1,2].
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Less than 40% of patients attend Cardiac Rehabilitation (CR) in Manitoba. A major issue limiting enrollment appears to be the 4-12 week wait period for entry into CR programming, which is directly influenced by patient readiness and program start dates. Therefore, we plan to determine if a “continuous entry” CR program, where patients can enter CR soon after referral, is more effective than the traditional CR program for modifying outcomes. A total of 64 patients enrolled in the traditional (TRAD) or the continuous entry (CONTIN) CR program will be recruited. The primary outcome will be a change in functional walking ability, as assessed using the 6-Minute Walk Test (6MWT). Secondary outcomes include gait speed. Data will be collected at baseline, 1, 4, 6 and 12 months after enrolling in CR. Twenty-eight participants have completed the 1 month assessment so far and will be described in this abstract. The length of time between patient referral and entry into the TRAD program was 60 ± 12 days, but only 32 ± 6 days for the CONTIN program. At baseline, patients in the TRAD program walked 512 ±16 meters during the 6MWT, as compared to 567 ± 26 meters for CONTIN. Both groups improved their walking distance by 9% after 1 month of CR, but the group differences were maintained. Similar group differences were also observed for gait walking speed, where CONTIN patients walked faster than TRAD at baseline and after 1-month of CR. Based on these results, we suggest that both CR program models improve functional walking ability. Furthermore, it is possible that the longer wait period prior to CR amongst the patients enrolled in the TRAD program negatively influenced their walking ability at baseline.

Session 2 Motor Control & Muscle

Modulating motor output through serotonin receptor activation: Is there a difference between flexor and extensor output?

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Serotonin (5-HT) is a well-known neuromodulator of motor output. In particular, 5-HT2R agonists increase the monosynaptic reflex (MSR) amplitude and enhance the excitability of motoneurons (Mns). Whether quipazine, a 5HT2R agonist has a differential modulating effect on flexor and extensor motor output, is unknown. Measurements were taken of both the tibial (extensor nerve) and the peroneal (flexor nerve) MSR, properties of identified extensor and flexor Mns, and extracellular field potentials of both the extensor and flexor Ia pathways. All experiments were performed *in vivo* in an adult decerebrate rat preparation. Measurements were taken pre- and post- injection of quipazine. The tibial and peroneal ENG showed a 3.76- and 5.97-fold increase in MSR amplitude, respectively, after quipazine administration, with the peroneal showing a significantly larger increase than the tibial. In separate experiments, extensor and flexor Mns were examined. Quipazine enhanced the overall excitability of the Mns with no differences between flexor and extensor Mns. Measurements of extracellular Ia field potentials of both the tibial and peroneal nerves suggest that the difference in excitability is partially presynaptic as evident by a larger increase in the peroneal field potential amplitude compared to that of the tibial following quipazine. These data confirm that the 5-HT2R enhances the excitability of motor output, and the difference in enhancement of excitability seen between extensor and flexor motor output is due at least in part to presynaptic modulation in addition to known modulation of motoneuron properties. This knowledge will provide the basis for further investigation in which we will investigate 5-HT modulation of motor output in models of inactivity and activity. Supported by Canadian Institutes of Health Research (J.C., P.G.), Canada Research Chairs program (P.G.), and Manitoba Health Research Council (C.M., J.C.)

Chronic exercise alters motoneuron mRNA levels: potential mechanisms for enhanced excitability

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Motoneurons express a variety of ion channels and neurotransmitter receptors, allowing fine-tuning of motoneuron excitability to ensure optimal motor output. Chronic physical activity is known to increase motoneuron excitability; however the changes in ion channel subunit and/or neurotransmitter receptor gene expression that may contribute to these changes are unknown. Therefore, the purpose of this study was to examine the effect of exercise on the mRNA levels of 24 genes related to motoneuron excitability in lumbar motoneurons. Eight female Sprague-Dawley rats were assigned to either a treadmill exercise or sedentary control group. The treadmill exercise protocol consisted of 1 training session daily for 16 weeks, peaking at approximately 27 m/min. with a 10° incline for 60 minutes during the final week of training. Animals were sacrificed immediately after the final training session. Lumbar spinal cords were fresh frozen, sectioned, slide-mounted, fixed and stained in preparation for laser capture microdissection (LCM). Individual motoneuron cross-sections were collected from the ventrolateral lumbar spinal cord with LCM. Total RNA was isolated from these samples, RNA integrity was measured and real-time reverse transcription polymerase chain reactions were performed to determine differences in mRNA levels between exercised and sedentary animals for each gene. Serotonin receptor subtype 5-HT_{1A} (↓ 82.07% ± 6.96%), GABA receptor subtype $GABA_A\alpha 2$ (↓ 24.58% ± 5.95%), and small conductance calcium-activated potassium channel subunit SK2 (↓ 26.26% ± 6.59%) mRNA levels were significantly lower ($p < 0.026$) in the lumbar motoneurons of treadmill-exercised animals compared to sedentary controls. These findings suggest that exercise training may enhance motoneuron excitability through decreased potassium and chloride conductances and may induce a shift in motoneuron phenotype from fast to slow. Supported by CIHR and NSERC.

"Calibrating" Our Sense of Muscle Contraction Force

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Signals about muscle contraction force may come from receptors in muscle, or from brain via signals associated with voluntary commands. Humans are poor at judging contraction force based on sensory feedback alone. When subjects reproduced, with voluntary "matching" contractions, forces produced during "target" contractions generated using electrical stimulation (when only sensory feedback could signal contraction force), matching contractions were twice as big as the targets. We propose that, the ability to accurately assess contraction force requires an ongoing "calibration" of sensory feedback, by comparing sensory feedback with voluntary commands. We hypothesised that relaxed subjects would overestimate electrically-evoked target contraction force but when subjects held a voluntary contraction they would match accurately. Ankle dorsiflexion torque was measured from 10 subjects. Electrically-evoked "target" contractions were followed by voluntary "matching" contractions. Subjects remained relaxed during the "target" contraction (uncalibrated condition; n=40) or maintained a contraction (calibrated condition; n=40). When relaxed, all 10 subjects overestimated target forces. On average, the matching contractions (23$\pm$13% MVC) were twice as large as the targets (11$\pm$3% MVC) ($p<0.001$). When subjects held a contraction (4$\pm$2% MVC), 3 matched accurately, 4 overestimated and 3 underestimated and there was no significant difference between the target (15$\pm$4%MVC) and matching (18$\pm$10%) forces ($p>0.05$). We suggest that the nervous system continuously compares sensory feedback with motor commands to "calibrate" the feedback signal. This may allow for accurate assessment of contraction force in the face of changes that occur in the force generating capacity of muscle over time.

Motor unit recruitment during electrical stimulation over the tibialis anterior muscle compared to the common peroneal nerve

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The tibialis anterior (TA) muscle is often affected by central nervous system trauma and is consequently targeted for neuromuscular electrical stimulation (NMES) therapy. During NMES, motor units (MUs) are recruited via central pathways (H-reflex and asynchronous activity) or peripheral pathways (M-wave). Central recruitment of MUs follows the physiological order, recruiting fatigue resistant MUs first, while peripheral recruitment is random in relation to MU type. Previous studies show that, for the triceps surae muscles, stimulation applied over the nerve trunk, compared to the muscle belly, recruits MUs with more central contribution. This suggests that nerve stimulation may recruit more fatigue-resistant MUs than muscle stimulation. We hypothesize that stimulation over the common peroneal (CP) nerve will generate torque with greater central contribution compared to stimulation over the TA muscle. Electrodes were placed over the TA muscle belly and CP nerve trunk and NMES was applied at low and high intensities. Electromyographic activity and torque were recorded from electrodes placed over the TA and a Biodex Dynamometer, respectively. H-reflexes and asynchronous activity were miniscule for both sites, thus there was little central contribution to the evoked contractions. Conversely, M-waves were significantly larger for stimulation over the muscle compared to over the nerve despite generating the same torque. Larger M-waves with the same torque suggests that stimulation over the muscle recruits MUs closer to the stimulation and recording sites, i.e. superficial, while stimulation over the nerve recruits MUs that are spatially dispersed. In a companion study, we used intramuscular recordings to test this idea.

Spatial recruitment of motor units during electrical stimulation

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Neuromuscular electrical stimulation (NMES) is commonly used to restore or retrain muscle function after trauma to the central nervous system. Since the spatial distribution of muscle fibre types may vary within a muscle, understanding how electrically recruited muscle fibres are spatially distributed may help to optimize the use of NMES. While some studies have shown that superficial muscle fibres closest to the stimulating electrodes are preferentially activated during stimulation over the muscle; others suggested more diffuse activation. **HYPOTHESIS:** Superficial muscle fibres are preferentially activated during stimulation over the muscle belly while superficial and deep muscle fibres are equally activated during stimulation over the nerve trunk. **METHODS:** In 9 healthy participants, intramuscular electrodes were inserted into superficial and deep portions of tibialis anterior (TA) under ultrasound guidance imaging. M-wave recruitment curves (RCs) were constructed for stimulation over the common peroneal (CP) nerve and TA muscle**. RESULTS:** M-wave RCs during stimulation over the CP nerve were similar at superficial and deep EMG recording sites. In contrast, with stimulation over the muscle belly, the M-wave RCs at the deep EMG site were shifted to the right relative to the RC for the superficial site suggesting that more current was required to activate deep muscle fibres. **CONCLUSIONS:** Stimulation over the nerve trunk activates muscle fibres diffusely; whereas superficial muscle fibres are preferentially activated during stimulation over the muscle belly. A better understanding of how electrically activated muscle fibres are spatially distributed in the muscle could help to optimize the clinical applications of NMES.

Sensory-conditioning of cortical circuits depends on the size of the sensory volley

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Sensory feedback contributes to the formation and control of movement. At the level of the brain, motor output can be attenuated or potentiated by sensory input in a time-dependent manner. When an electric stimulus is delivered to a peripheral nerve (conditioning stimulus) just before a magnetic stimulus is applied over the motor cortex (test stimulus), periods of sensory-induced inhibition and facilitation can be observed at different conditioning-test intervals. **PURPOSE:** To evaluate the effects of the size of the sensory volley on cortical motor output to the hand. **METHODS:** Eight conditioning-test intervals (18, 20, 22, 25, 28, 30, 32 and 35 ms) were tested using a paired-pulse paradigm whereby an electrical stimulus delivered to the ulnar nerve preceded a magnetic pulse applied over the hand area of the motor cortex. Conditioned motor evoked potentials were recorded from the first dorsal interosseous and abductor pollicis brevis muscles, and normalized to the unconditioned responses. Cortical output was evaluated at four conditioning intensities: perceptual threshold, motor threshold to evoke a muscular response ($MT_{M\text{-}wave}$), motor threshold to evoke a visible muscular twitch, and two times $MT_{M\text{-}wave}$. **RESULTS:** Data were collected from three healthy participants. Sensory-induced inhibition and facilitation were recorded at ~20 ms and ~30 ms, respectively. The inhibition tended to be stronger at higher conditioning intensities while the facilitation tended to be stronger at lower conditioning intensities. **IMPLICATIONS:** These findings suggest that sensory-induced inhibition and facilitation can be preferentially observed at different conditioning intensities. In future investigations, it may be appropriate to vary conditioning intensity according to the phenomenon being studied.

AMPK regulates sarcoplasmic reticulum calcium pump activity in muscle

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The 5'adenosine-mono-phosphate-activated protein kinase (AMPK) regulates energy metabolism. However, very little information exists regarding the potential role that AMPK may have for regulating intracellular calcium in cardiac and skeletal muscle. We hypothesize that AMPK regulates sarcoplasmic reticulum calcium-pump (SERCA)-dependent calcium transport mechanisms in muscle. Cultured C_2C_{12} and H_9C_2 myocytes were cultured and loaded with fura2-AM and treated for 10 minutes in the presence of the AMPK activator AICAR or the AMPK inhibitor Compound C. Intracellular calcium levels were then measured before and after the addition of Thapsigargin, which inhibits SERCA. Although AICAR did not alter basal intracellular calcium levels in C_2C_{12} cells, the observed Thapsigargin-induced intracellular calcium changes were larger when myocytes were pre-treated with 1 mM AICAR (196 ± 11 nM), as compared to control (157 ± 8 nM). An opposite effect was observed when myocytes were pre-treated with 1 mM Compound C (142 ± 10 nM). A similar effect of AICAR and Compound C was observed for H_9C_2 myocytes. In a different set of experiments, we measured SERCA activity in cardiac and quadriceps samples isolated from wild-type or muscle-specific AMPKalpha$_2$ kinase-dead (KD) transgenic mice. Notably, SERCA calcium-sensitivity was impaired in cardiac tissue samples isolated from KD mice (Ca_{50}, 227 ± 14 nM, n_H, 1.5 ± 0.1), as compared to WT (Ca_{50}, 174 ± 16 nM, n_H, 1.9 ± 0.1). Similar changes were observed for quadriceps samples. In conclusion, our data indicate that AMPK signaling acutely enhances SERCA calcium sensitivity in both cardiac and skeletal muscle.

Session 3 Cardiovascular Fitness & Cerebrovascular

Aerobic fitness and neurovascular control

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A cardio-protective adaptation associated with aerobic fitness may be an attenuated sympathetic nervous system (SNS) and cardiovascular response to physiological stress. **PURPOSE:** To determine if the cardiovascular and SNS responses to acute physiological stress are a function of maximal aerobic capacity (VO_{2max}). **METHODS:** Young males (mean ± SD; Age: 25 ± 3 yrs; Height: 175 ± 4 cm; Body Mass: 76 ± 13 kg; n=15) were studied. On separate days, subjects performed ramp cycling exercise (30W•min^{-1}) to determine VO_{2max}, and 3 min of isometric handgrip (IHG) exercise at 40% MVC. Mean arterial pressure (MAP) was measured on a beat-by-beat basis. Femoral artery blood flow was measured continuously via Doppler ultrasound and femoral vascular conductance (FVC; ml• min^{-1}•mmHg^{-1}) was calculated. Multiunit recordings of muscle sympathetic nerve activity (MSNA) were obtained from the left peroneal nerve at the fibular head using microneurography. The peak response of each variable was calculated as a percent change from the pre-IHG value. Relationships between VO_{2max} and the peak response to the IHG were established by Pearson-product correlation. A p-value of <0.05 was considered significant. **RESULTS:** Absolute and relative VO_{2peak} were 3.7 ± 0.5 L•min^{-1} (Range: 3.1 – 4.6 L•min^{-1}) and 50 ± 12 ml•kg^{-1}•min^{-1} (Range: 38 – 72 ml•kg^{-1}•min^{-1}), respectively. MAP and MSNA increased and FVC declined during IHG. However, the magnitude of change was similar in all subjects and not correlated (p>0.05) with absolute or relative VO_{2max}. **CONCLUSION:** These preliminary data suggest that the cardiovascular and SNS responses to IHG stimulation are not a function of VO_{2max}. Supported by NSERC, Canada.

Functional sympatholysis is enhanced by short-term exercise training

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This study tested the hypothesis that exercise training (ET) enhances the inhibition of sympathetic vasoconstriction during muscle contraction (i.e. sympatholysis). Sprague-Dawley rats were randomly assigned to sedentary (S; n=10), mild- (M; n=10, 20m/min 5% grade) or heavy-intensity ET groups (H; n=12, 40m/min 5% grade). Rats trained 5d/week for 4 weeks with total work matched between groups. Rats were anesthetised and instrumented with an indwelling brachial artery catheter, femoral artery flow probe and stimulating electrodes on the lumbar sympathetic chain. Triceps surae muscles were stimulated to contract rhythmically at 30% and 60% of maximal contractile force (MCF). Percent changes of femoral vascular conductance (Δ%FVC) in response to lumbar sympathetic chain stimulation at 2 and 5Hz were determined at rest and during muscle contraction. In resting skeletal muscle, ET resulted in a training-intensity dependent increase ($p<0.05$) in the vascular response to sympathetic stimulation (**2Hz**; S: -24±7, M: -32±5, H: -45±5; **5Hz**; S: -38±9, M:-49±6, H:-61±7; Δ%FVC). At 30% MCF, the magnitude of sympatholysis (difference between Δ%FVC at rest and contraction) was greater ($p<0.05$) in H compared to M and S (**2Hz**; S: 8±5, M: 13±7, H: 18±7; **5Hz**; S: 6±7, M: 13±9, H: 16±7). At 60% MCF, sympatholysis increased ($p<0.05$) in a training-intensity dependent manner (**2Hz**: S: 17±4; M: 25±4; H: 37±5; **5Hz**: S: 23±7; M: 32±6; H: 38±7). Short-term ET increased sympathetic vascular responsiveness at rest and enhanced sympatholysis. Heavy-intensity ET rodents demonstrated augmented sympatholysis, suggesting that a dose-response relationship may exist between ET-intensity and functional sympatholysis. NSERC, Canada.

The effects of fitness and age on cerebrovascular function

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Aging is associated with a decline in many processes including vascular and cognitive function, which may be mitigated by physical fitness. However, the underlying mechanisms are not well understood. In a cross-sectional study of 29 healthy, sedentary men and post-menopausal women (16 males, 66±6yrs, mean±SD), we examined the effect of aging and maximal aerobic capacity ($VO_{2\ max}$) on cerebrovascular conductance (CVC). $VO_{2\ max}$ (percent of predicted for age and gender) was determined using a ramped treadmill exercise protocol. Cardiovascular and respiratory variables were monitored continuously (Parvo Medics, USA) to ensure achievement of maximal exertion. At least 24 hours following the exercise test, an index of cerebral blood flow (CBF, transcranial Doppler ultrasound) was measured from the right middle cerebral artery. Baseline measures were recorded following 30 minutes quiet rest. Resting CVC, a measure of CBF, was calculated by dividing CBF by mean arterial pressure (MAP, photoplethysmography). As expected, advancing age was negatively correlated with $VO_{2\ max}$ ($r=-0.524$, $p=0.003$). However, $VO_{2\ max}$ was negatively correlated with heart rate ($r=-0.466$, $p=0.014$) and positively correlated with resting CBF ($r=0.392$, $p=0.039$) and CVC ($r=0.371$, $p=0.048$) across both men and women. These data suggest that increased fitness is associated with an increased resting perfusion of the brain. The implications for cerebrovascular health and cognitive function require further investigation.

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Prefrontal Oxyhemoglobin & Aerobic Capacity: a Near Infrared Spectroscopy Study

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Physical exercise is thought to improve brain function by increasing cerebral blood flow through the accompanying increase in neuronal activity and metabolism. The ability to perform exercise, i.e. aerobic capacity, may influence such changes in blood flow. During exercise, cerebral oxygenation (a proxy for cerebral blood flow) peaks before the lactic acid threshold (<55% of predicted $V0_{2max}$). Nevertheless, the correlation between cerebral oxygenation during exercise and aerobic capacity is poorly understood. This study investigated cerebral oxygenation changes, using oxyhemoglobin concentration, associated with aerobic capacity during submaximal testing. **Purpose:** To evaluate the correlation between left prefrontal oxyhemoglobin concentration and predicted $V0_{2max}$ during submaximal cycling. We hypothesized that [0_2Hb] levels rise with aerobic capacity in healthy adult men.**Methods**: Five healthy males, age 25 to 58 yrs, with activity levels ranging from "sedentary" to "athletic" performed an Astrand & Rhyming submaximal test while NIRS recorded changes in [0_2Hb] levels by probes attached to the left forehead. **Results:** Using the Astrand & Rhyming protocol we calculated predicted $VO_{2max,}$ and determined delta [0_2Hb] at steady state heart rate. We found a Pearson correlation (r=0.69) and Coefficient of Determination (R^2=0.46) between $V0_{2max}$ and delta [0_2Hb].**Implications:** These results indicate that with a small sample size NIRS identified changes in [0_2Hb] response in males of varying levels of fitness, and establish that a positive correlation exists between [0_2Hb] levels and aerobic capacity in this population. These findings on cerebral oxygenation are consistent with the increase in middle cerebral artery velocity during exercise as determined by Transcranial Doppler Ultrasound and may help explain a persistent finding of lower risk of cardiovascular disease in the aerobically trained.

Peripheral arterial pulse wave velocity predicts cerebral artery stiffness

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Increased arterial stiffness has been found to be an independent predictor of cardiovascular disease, stroke and cognitive function in older adults. This study examined the relationship between cerebral and peripheral pulse-wave velocity (PWV) in a cohort of healthy, sedentary men and post-menopausal women (28 subjects (15 male, 65±6yrs, mean±SD)). Continuous arterial blood pressure waveforms in the finger (photoplethysmography (Finometer)), blood velocity waveforms in the brain (Transcranial Doppler Ultrasound (SciMed PC Dop 842)) and heart rate (HR; 3-lead ECG) were collected at baseline (end-tidal P_{CO_2} = +1 Torr above resting values; end-tidal P_{O_2} = 88 Torr) and during acute euoxic hypercapnia (HC; end-tidal P_{CO_2} = +8 Torr above resting values; end-tidal P_{O_2} = 88 Torr). The ECG r-wave and diastolic foot of finger and brain waveforms were used to calculate heart-cerebral PWV (PWV_b), and heart-finger PWV (PWV_f). Vessel-by-time interactions were tested using a two way repeated measures ANOVA. Acute HC increased mean arterial pressure (MAP: 89±12mmHg to 98±15 mmHg, P<0.05) but not HR (62±7 bpm to 63±8 bpm, P=0.25). Therefore, PWV was normalized to MAP (normalized PWV = 100*(PWV/MAP)). Normalized PWV_f was correlated with age (R^2 = 0.249, P < 0.01) and decreased with HC (+1: 6.5±0.9, +8: 6.1±0.8 m/s, P=0.001). Normalized PWV_f and normalized PWV_b were strongly correlated at baseline (R^2 =0.669, P<0.001) and during HC (R^2 = 0.576, P<0.001). All values were not different between men and women. These data suggest that PWV_f may serve as a proxy for arterial stiffness of cerebral blood vessels.

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The Effects of Head-Up and Head-Down Tilt on Cerebrovascular Reactivity in the Middle Cerebral Artery

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Cerebral autoregulation is a protective feature of the cerebrovasculature that maintains constant cerebral perfusion in the face of static and dynamic fluctuations in mean arterial pressure (MAP). However, gravity-dependent shifts in blood volume distribution during head-up and head-down tilt (HUT, HDT) have profound effects on cardiac filling, cardiac output and mean arterial pressure. Further, cerebral blood flow is highly sensitive to the vasodilatory influence of increases in arterial CO_2 ($PaCO_2$). We hypothesized that HUT and HDT would alter cerebral blood flow velocity (CBFV) and cerebrovascular reactivity to increases in inspired CO_2 in the middle cerebral artery (MCA). We tested the influence of tilt on CBFV using transcranial Doppler (TCD) ultrasound in various positions on a tilt table. Using supine as a reference position, subjects were then randomly placed in each of 4 positions: 90° HDT, 45° HDT, 45° HUT and 90° HUT. Following a 5-min baseline in each position breathing room air, subjects underwent a rebreathing protocol using a 5L rebreathing bag initially containing 93% O_2 and 7% CO_2. The rebreathing protocol consisted of 1-min voluntary hyperventilation, rebreathing from the bag until they reached ~55 mmHg end-tidal CO_2 ($P_{ET}CO_2$) and a 2-min recovery period. We plotted MCA CBFV (cm/s) against $P_{ET}CO_2$ (mmHg) and calculated cerebrovascular reactivity slopes using linear regression. Preliminary data reveals that there are no differences in baseline MCA CBFV or cerebrovascular reactivity in all 5 positions, suggesting that cerebral autoregulation is well maintained in the face of orthostatic stress and increases in $PaCO_2$.

The Effects of Hyperoxic Hypercapnia on Cerebrovascular Reactivity in the Middle and Posterior Cerebral Arteries in Supine Position

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Transcranial Doppler (TCD) ultrasound is a non-invasive technique used to assess cerebral blood flow velocity (CBFV). The middle cerebral artery (MCA) branches off the internal carotid artery and is easily insonated through the temporal window as it courses laterally from the circle of Willis. Given its ease of insonation, the MCA is the most commonly measured vessel as a marker of global CBFV, including studies which investigate the control of breathing. However, the central respiratory chemoreceptors are located within the brainstem, which is perfused by the basilar artery. We hypothesized that there may be differences in cerebral vascular reactivity to increases in arterial CO_2 between the MCA and posterior vessels of the vertebrobasilar circuit. Using the posterior cerebral artery (PCA) as a surrogate of basilar flow, we simultaneously tested the cerebrovascular reactivity of both MCA and PCA using TCD in supine position. Following a ten-minute baseline breathing room air, subjects underwent a rebreathing protocol using a 5L rebreathing bag initially containing 93% O_2 and 7% CO_2. The rebreathing protocol consisted of 1-min voluntary hyperventilation, rebreathing from the bag until they reached ~55 mmHg end-tidal CO_2 ($P_{ET}CO_2$) and a 2-min recovery period. We plotted MCA and PCA CBFV (cm/s) against $P_{ET}CO_2$ (mmHg) and calculated cerebrovascular reactivity slopes using linear regression. Preliminary data reveals that the sensitivity of PCA cerebrovascular reactivity is reduced compared to the MCA, suggesting that the MCA may not be an appropriate index of brainstem blood flow in studies investigating the control of breathing.
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Session 4 Fitness

Calculation of Spatio-Temporal Gait Variables Using Physical Activity Monitors

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Accelerometers have been used to provide objective estimates of physical activity levels for decades. Due to limitations of size, memory and battery life, outputs from commercial accelerometer-based physical activity monitors have typically been reduced to activity "counts" reported with temporal resolutions on the order of minutes. However, the newest generation of activity monitors now have the capability of recording and retaining raw three dimensional accelerations with temporal resolutions on the order of milliseconds. This enriched data set offers the opportunity to extract additional biomechanical variables beyond typical activity measures.The purpose of this study was to assess the feasibility of using commercial physical activity monitors to calculate spatio-temporal gait variables. Accelerometer-based activity monitors were attached over the right and left anterior-superior iliac spines of university-aged subjects as they walked along a six metre pathway. Three-dimensional accelerations were recorded by each monitor at a rate of 100 Hz. Algorithms were developed to extract gait variables such as stride length and cadence. The results were evaluated against concurrently collected gold standard values obtained with a high speed motion capture system and force platform.Preliminary results are promising, showing consistent identification of spatio-temporal parameters. This study demonstrates the feasibility of using the newest generation of physical activity monitors to estimate many gait variables typically assessed in a laboratory setting. Study supported by CIHR's Undergraduate: Mobility, Musculoskeletal Health and Arthritis Program.

Timing of Whole-Body Vibration on Muscle Performance and Muscle Recovery

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Delayed-onset of muscle soreness (DOMS), which occurs after heavy resistance-exercise, may inhibit muscle performance if adequate muscle recovery is not achieved. Performing whole-body vibration (WBV) prior to and following resistance-exercise has been shown decrease DOMS which may lead to an increase in body composition, strength and endurance over time. However, the effects of WBV immediately before vs. immediately after resistance-exercise are unknown. Purpose: To investigate the effects of WBV prior to vs. following resistance-exercise on body composition, strength, endurance, and muscle soreness. Methods: Young exercising adults (N=40, 18-25 yrs) will be randomly assigned to one of two groups: WBV-Before (5 minutes of WBV before eccentric resistance-exercise and 5 minutes of stationary cycling after resistance-exercise) or WBV-After (5 minutes of stationary cycling before resistance-exercise and 5 minutes of WBV following resistance-exercise). Whole-body vibration exercises will consist of squat, pushup, bent over row, Romanian deadlift, and plank for 60s. Cycling exercise will be performed at 70-80% heart rate reserve. Machine-based resistance-exercises will be performed 3 days per week, on non-consecutive days, for 9 weeks. Exercises to be performed include leg press, chest press, leg extension, leg curl, biceps curl, and triceps extension. Subjects will perform 3 sets of 6 eccentric repetitions at 80-100% 1-RM per limb with 1 minute rest between sets. Subjects will train unilaterally, where one limb will be exercised at a time and the opposite limb will assist the exercising limb back to the starting position. The primary dependent variables to be assessed prior to and following the study will include body composition (muscle, bone, fat; dual energy x-ray absorptiometry), muscle thickness of the elbow and knee flexors and extensors (ultrasound), strength (1-repetition maximum leg press and chest press), and muscle endurance (total number of reps performed over 3 sets at 70% baseline 1-RM for leg press and chest press). Daily muscle soreness (questionnaire) will be assessed prior to each training session.

Back fitness lowers muscle activation and fatigue during a dental procedure

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Our purpose was to examine the effects of different degrees of back fitness on muscle activation and fatigue during a standard dental procedure. 26 dental students completed the Canadian Society for Exercise Physiology's Composite Back Fitness assessment, which is comprised of: Healthy Physical Activity Questionnaire, waist circumference, sit-and-reach (i.e. hamstrings flexibility), partial curl ups and lower back muscular endurance (i.e. the Biering-Sorenson test). Participants were classified into low or high back fitness groups and completed a standard dental procedure (preparation of a 1-6 dentoform tooth) while muscle activation of the erector spinae was measured via electromyography (EMG). Activation was assessed by determining the mean absolute value normalized for maximal isometric contraction from the EMG, while fatigue was assessed by the decrease in median frequency. Participants with low back fitness had higher EMG activity (mean absolute value) and greater reduction in median frequency during the dental procedure than those with high back fitness ($p< 0.05$). For males, there was a correlation ($R = 0.55$; $p< 0.05$) between back extension muscular endurance and change in median frequency. For females, waist girth correlated with mean absolute value ($R=0.81$; $p<0.009$) and, unexpectedly, a negative correlation was found between sit and reach scores and change in median frequency ($R= -0.67$; $p<0.05$). Greater composite back fitness in dental students is associated with decreased levels of muscular strain and less fatigue during a dental procedure. Overall, these findings suggest that increased back fitness may be important in the prevention of occupational related pain and injury in dentists.

The Metabolic Demands of a Vinyasa Power Yoga Practice

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Yoga is gaining popularity in western cultures but despite this raise there remains minimal scientific research on the subject. Vinyasa yoga, also known as power flow yoga, is among one of the growing types of yoga. Vinyasa yoga is characterized by moving with the breath and connecting the postures by a series of dynamic movement in between traditional yoga poses. **Purpose:** 1) To determine the intensity and metabolic costs of a typical vinyasa yoga routine by measuring gas exchange, heart rate, and perceived rating of exertion. 2) To compare differences in the metabolic demand between a beginner yoga practitioner and an advanced yoga practitioner while completing a vinyasa yoga routine. **Method:** Beginners (*n*=13) and advanced (*n*=13) yoga practitioners of both sexes will be recruited. Participants will complete a VO_2 max test on a treadmill to determine what relative workload they are working at while they complete a yoga session. After adequate rest, the participant will compete a 90-minute vinyasa yoga session but with no measures taken as a familiarization to the protocol. After 4 – 7 days the participant will return to do the same vinyasa yoga practice but with all the measurements being taken. To allow the participants to move freely, they will be wearing a portable oxygen exchange system that measures gas exchange. **Implications:** It is hoped that with the results collected we can better understand the metabolic demands of this type of yoga and the differences that a beginner practitioner would experience versus an advanced practitioner.

The effects of functional fatigue on dynamic balance in female athletes and non-athletes and compare between them

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Balance is one of the important factors to determine athletes' proficiency and be recognized as an important factor in sport injury prevention. However, the controversial results of fatigue effect on balance have been reported by some researchers in athletes and by some others in non athletes with different procedures to fatigue subjects. The effect of functional fatigue on balance and its comparable effect on athlete and non athlete have not well studied. **PURPOSE**: Compare the athletes and non-athletes dynamic balance to respond the functional fatigue. **METHODS:** Subjects completed the pre-SEBT (star excursion balance test) in eight directions. Each direction was performed with three times. They then performed a functional fatigue protocol that lasted 20 minutes. Meanwhile their rating of perceived exertion (RPE) were measured before, during and after of the protocol. The post -SEBT test was given after the fatiguing protocol had been completed. **RESULTS:** The findings demonstrated that the effect of functional fatigue was not significant on dynamic balance in athlete group but it was significant in non-athletic group ($P<0.01$). The athlete and non athlete groups had significantly difference in dynamic balance performance of medial, posteriormedial and posterior directions ($p<0.05$). **IMPLICATIONS:** It can conclude that exercise can decrease the effect of fatigue on balance disturbance. Clinician can improve non athletes' dynamic balance by improving medial, posteriormedial and posterior directions balance in non athletes female and should consider the effect of fatigue on balance distribution. The results also could help to prevent the injuries related to the balance.

Physiological and Psychological Measures of Fatigue in Varsity Swimmers.

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Fatigue measures sensitive to training volume change are crucial in preventing chronic fatigue and overtraining syndrome. PURPOSE: Determine physiological and psychological markers of fatigue sensitive to changes in training volume during a varsity swim season. We hypothesized that measures of fatigue would improve with reduced training volume. METHODS: Weekly evaluation (10 female, 19 male varsity swimmers) included an orthostatic tolerance test (OTT; 5 min lying, 3 min standing to measure heart rate response (HR)), self-reported form, feeling, energy level (EL), and 3 night sleep average. Training volume was determined for 3 intensive (Build 1,2,3) and 2 reduced (Taper 1,2) training periods. OTT measures were: SUPINE (4-5 min lying heart rate (HR)), HR15 (HR at 15 sec after standing), HRPEAK (peak HR during first 30 seconds of standing), STAND (HR from 6:30 – 7 min), DP (HRPEAK – STAND) and DP15 (HR15 – STAND). RESULTS: There was a main effect ($p < 0.05$) for all measures of OTT except DP. Highest training volume (Build 2 and 3) corresponded with lowest STAND, PEAK, and DP15. SUPINE was lowest during Build 2. Form, feeling, EL, and sleep were greatest during taper phases ($p < 0.05$). Post hoc analysis revealed positive correlations between EL and both form and feeling. IMPLICATIONS: Findings suggest that measures are useful markers of fatigue in swimmers and thus modification of training volume is reasonable. However coaches and sport scientists may want to focus on physiological changes during periods of high volume and psychological measures during taper phases to modify training volume.

Influence of Swimming Duration and Intensity on Airway Hyper-responsiveness in Varsity Swimmers.

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Airway hyper-responsiveness (AHR) in swimmers appears prevalent due to prolonged exposure to the pool environment. Bronchial provocation tests are used to determine AHR (decrease in FEV_1 from baseline of ≥ 10%) and include an 8min field swim test. A race involves high ventilation rates which may trigger bronchoconstriction, however the influence of race pace on AHR has not been evaluated. PURPOSE: To determine the prevalence and magnitude of AHR after a race compared to 8min field swim field test and a typical swim practice. We hypothesized in order of greatest prevalence and magnitude of AHR post race, field test, and then workout. METHODS: Eight female and 17 male swimmers completed three conditions (race, 8min field test, workout) where FVC, FEV_1 and FEF_{25-75} were measured pre-post (expressed as % change, measures taken 6min post). RESULTS: A significant increase in FEV_1 and FEF_{25-75} both post race (FEV_1 = 3.6%, FEF_{25-75} = 15.4%) and field test (FEV_1 = 4.2%, FEF_{25-75} = 10.8%). However, there was a mean decrease in FVC post race (-1.2%; prevalence = 19 swimmers showing FVC decrease). Only one swimmer had a fall in FEV_1≥10 % for any condition (post 1500m race). Overall, race distance did not influence magnitude of FEV_1 change (3.9% sprint, 1.5% middle, 3.6% long distance race). IMPLICATIONS: A race may be a better method to identify AHR in swimmers however the race distance might need to be of a sufficient duration to induce AHR. The decreased FVC post race in contrast to increased FEV_1 and FEF_{25-75} requires further investigation.

Session 5 Supplementation

Effects of protein supplementation during resistance-training in young adults

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Although the signaling pathways for stimulating muscle protein synthesis are increased after resistance-training (RT), this response is delayed in the post-absorptive period. Emerging evidence suggests that protein supplementation immediately before and after RT is important for creating an anabolic environment for muscle growth. However, the effects of protein supplementation during RT are unknown. Purpose: To investigate the effects of protein supplementation during RT on body composition, muscle strength, endurance, and kidney function. Methods: Using a double-blind, repeated measures design, healthy adults (N=30, 18-30 yrs) will be randomly assigned to one of two groups: Protein (N=15; 0.3g/kg body mass of protein during RT) or Placebo (N=15; 0.3g/kg body mass of maltodextrin and sucrose during RT). Supplements will be mixed with water and 1/27th of the solution will be consumed following each set: 3 sets of 10, 8 and 6 reps to muscle fatigue, 9 exercises, 4x/week, 8 weeks). The primary dependent variables to be assessed prior to and following the study will include: body composition (muscle, fat; dual energy x-ray absorptiometry), muscle thickness of the elbow and knee flexor and extensors (ultrasound), strength (1-repetition maximum leg press and chest press), muscle endurance (total number of reps performed over 3 sets at 70% baseline 1-RM for leg press and chest press), and kidney function (urinary microalbumin).

Effect of a lentil sports nutrition bar on endurance exercise performance

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Carbohydrates are the rate limiting energy source during endurance exercise. The glycemic index (GI) measures how quickly and how much a food raises blood glucose levels. Foods with a low GI (e.g. lentils) will release glucose slower and at a more sustained rate. Low GI foods should theoretically offer a longer lasting energy source during exercise. Consuming a high GI meal causes a quick spike in blood glucose and insulin which may increase carbohydrate oxidation and impair fat oxidation, leading to an early depletion of muscle glycogen. **PURPOSE:** The purpose of this study is to compare pre-exercise feeding with: 1) a lentil-based sport nutrition bar (Genki bar); 2) a commercially-available sport nutrition bar (Harvest PowerBar); and 3) diet jelly (placebo) on metabolism and performance during endurance cycling. **METHODS:** Using a randomized, counterbalanced, cross-over design, endurance athletes will consume 1.5 g/kg available carbohydrate from a lentil bar, or a PowerBar, or consume placebo one hour before endurance cycling that involves 75 minutes at 50% VO_2 max, followed by a 7 km time trial. Each feeding condition will be separated by one week. Dependent variables include blood glucose, lactate, fat oxidation, carbohydrate oxidation, and 7 km time trial performance. **RESULTS:** At the time of the abstract writing we have just started data collection. Results from some of the participants will be presented. **IMPLICATIONS:** A low GI lentil-based sport nutrition bar may provide metabolic and performance benefits to endurance cyclists. Supported by the Saskatchewan Pulse Growers and Agriculture Agri-Food Canada.

The effects of acute L-arginine supplementation combined with resistance exercise on growth hormone, growth hormone secretagogues, and insulin-growth factor-1 in strength trained males.

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Acute resistance exercise and L-arginine have both been shown to stimulate growth hormone. **PURPOSE:** This study investigated the combined effects of resistance exercise and L-arginine supplementation on growth hormone, growth hormone secretagogues [growth hormone releasing hormone (GHRH) and growth hormone inhibiting hormone (GHIH)], and insulin-growth factor-1 (IGF-1) in strength trained males. **METHODS:** Fourteen strength trained males (age: 25±4 yrs; weight: 81.4±9.0 kg; height: 179.4±6.9 cm; body fat: 11.5±3.8 %: experience: 6.3±3.4 yrs; relative 1 repetition maximum (RM) bench press to body mass ratio: 1.3±0.2) participated in a crossover study in which they were randomized to supplement with L-arginine (0.075 $g \cdot kg^{-1}$ body mass) or a placebo, separated by 7 days. Subjects reported to the laboratory at 08:00 in a fasted state, consumed the supplement 60 min prior to performing a resistance training session (3 sets of 8 exercises, 10 repetitions at ~75% 1RM). Blood samples were collected at rest, before exercise, and 0, 15, 30, and 60 min after exercise. **RESULTS:** Integrated growth hormone area under the curve was significantly attenuated in the L-arginine condition (L-arginine = 288.4±368.7 vs. placebo = 487.9±482.0 $min \cdot ng \cdot ml^{-1}$, $p<0.05$). There was no significant differences between conditions for GHRH, GHIH, or IGF-1. **IMPLICATIONS:** Acute L-arginine supplementation when combined with a resistance training session in strength trained athletes seems to blunt the growth hormone response, however L-arginine had no effect on GHRH, GHIH, or IGF-1.

Session 6 Physiology & Hypoxia

Resveratrol prevents the inhibition of SERCA2a in the diabetic heart.

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Abnormal calcium transport and the down-regulation of sarcoplasmic reticulum calcium ATPase (SERCA2a) protein expression in the heart are known to contribute to diabetic cardiomyopathy. Resveratrol (RES) has previously been shown to improve cardiovascular function in diabetic rats. However, when we started this experiment, it was not yet known if resveratrol would regulate SERCA protein expression and function. We hypothesized that resveratrol supplementation would normalize SERCA protein expression and function in the type 1 diabetic heart. Twenty-four Sprague Dawley rats were split into one of three groups. The first group were age matched control animals. The second group were injected with streptozotocin (STZ) and were, therefore, type 1 diabetic. The third group of rats were also injected with STZ, maintained for 9 weeks and then received resveratrol (5 mg/kg body wt) by gavage daily for the final 9 weeks of the study (STZ+RES). Tissue was collected after the completion of the 18 week study. Left ventricle samples were collected and prepared for Western blotting, qPCR and biochemical analyses. As expected, SERCA2a protein content was reduced by 44% by diabetes, as compared to control. Diabetes also enhanced the ratio of phospholamban monomers by 5-fold, which is expected to inhibit SERCA2a calcium-sensitivity. Biochemical analysis supported this outcome, as SERCA2a Ca^{2+}-sensitivity was inhibited by diabetes, where Ca_{50} was 243 ± 27 nM for STZ-induced diabetic, as compared to 382 ± 56 nM for control. Resveratrol-treatment normalized the phospholamban monomers ratio as well as SERCA2a calcium-sensitivity. In conclusion, resveratrol prevents the inhibition of SERCA2a protein expression and function in the diabetic heart.

INTERACTION AMONG HYPOXIA, ANTI-INFLAMMATORIES AND CEREBROVASCULAR FUNCTION

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Both high-altitudes sojourners and sleep apnea patients commonly experience periodic breathing and intermittent hypoxia (IH) during sleep. Chronic IH is associated with hypertension and decreased vascular reactivity, mediated in part by a decrease in prostaglandin production. Commonly used anti-inflammatory drugs, such as cyclooxygenase (COX) inhibitors block prostaglandin production and may further increase blood pressure (BP) and CV risk. As COX-inhibitors are commonly used by trekkers and patients for other ailments, we plan to investigate the interaction between IH and anti-inflammatory use on cardiovascular function.

On three occasions, healthy volunteers will take Indomethacin (non-selective COX inhibitor), Celecoxib (selective COX-2 inhibitor), or placebo for four days in a double-blind, randomized, placebo-controlled crossover fashion. On experimental days participants will undergo acute tests in the morning and afternoon, consisting of six cycles of isocapnic IH ($P_{ET}CO_2$ =+1 above resting, $P_{ET}O_2$ = cycling between 88 and 45 Torr every 90s), 5-min of isocapnic hyperoxia ($P_{ET}O_2$=300 Torr) and 5-min of hyperoxic-hypercapnia ($P_{ET}CO_2$ =+9 Torr) to assess BP and CBF reactivity. Acute tests will be separated by 6-hrs of isocapnic IH. BP (finger photoplethysmography) and CBF (transcranial Doppler ultrasound) will be measured continuously and vasoactive prostaglandins will be measured in urine samples. We hypothesize that BP will increase and CBF reactivity will decrease following IH exposure to a greater degree with COX inhibitors compared to placebo with the greatest changes observed post-celecoxib ingestion. The study will improve our understanding of the role of prostaglandins in this relationship and the potential long term CV consequences of these medications. **Acknowledgment** The study is supported from Natural Sciences and Engineering Research Council (NSERC) of Canada by its NSERC Discovery Grant.

Cardiovascular responses to low oxygen during sleep

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Chronic exposure to low oxygen (hypoxia) can produce beneficial (e.g. altitude training regimes in athletes) or deleterious (e.g. sleep apnea syndrome) cardiovascular adaptations. Both of these scenarios are typified by hypoxia exposure during sleep, which is associated with a normal depression in cardiovascular function, the major difference being the nature of the hypoxic exposure - continuous (CH) versus intermittent (IH) respectively. As such, the interaction between sleep state and the type of hypoxic exposure may be an important factor defining the resulting cardiovascular adaptation. We propose to examine the influence of CH and IH on cardiovascular function during and following sleep in healthy individuals. We hypothesize that sleep will result in a normally decreased cardiovascular reactivity that will remain depressed following IH, but not CH. Hypoxia will be administered using a dynamic gas delivery system. CH will be titrated to achieve 80% blood oxygen saturation whereas IH will be administered in a cyclical pattern to achieve oscillations between 100% and 80% saturation. Non-invasive blood pressure (BP; photoplethysmography), heart rate (HR; ECG), cerebral blood flow (CBF; transcranial Doppler ultrasound), and sleep architecture (polysomnography) will be recorded throughout sleep. Cardiovascular reactivity will be assessed prior to and following sleep as the change in HR, BP and CBF for a given change in oxygen saturation during brief periods of hypoxia and hypercapnia. It is expected that these data will help us understand the processes leading to varying cardiovascular adaptations in response to different hypoxic exposures.

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Effect of Intermittent Hypoxia on Renal Blood Flow in Healthy Humans

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High altitude trekking is associated with decreased arterial blood oxygen saturation which may be worsened by periodic breathing and intermittent hypoxia (IH) during sleep. IH is also observed in sleep apnea patients. The prevalence of sleep apnea amongst patients with kidney disease suggests that IH may play a role in renal dysfunction, a potential concern for high altitude travellers and dwellers. Therefore, we sought to determine changes in renal vascular function following a 6 hour exposure to IH in healthy volunteers using ultrasonography. We measured renal blood flow (RBF) and conductance (RVC) as well as heart rate, systemic blood pressure (BP), cardiac output (CO) and systemic conductance (SVC) before and after IH exposure. Following IH, systolic BP increased (114 ±6 to 118 ± 8mmHg, P=0.028) while diastolic (P=0.288) and mean BP (P=0.784) remained unchanged. There was no change in systemic measures of CO (4.66 ± 0.96 to 4.42±0.88L/min, P=0.167) or SVC (58±10 to 55±8ml/min/mmHg, P=0.176). Conversely, vasodilation of the renal artery was measured in all participants (4.1±0.2 to 4.4±0.2mm, P=0.001) following IH exposure, resulting in an increase in RBF (0.20 ±0.04 to 0.24 ±0.03 L/min, P=0.006) and RVC (2.4±0.5 to 3±0.4ml/min/mmHg, P=0.008). However, estimated glomerular filtration rate calculated as a marker of renal function, showed no change (P=0.813). Exposure to IH therefore increased renal blood flow without any modification to the systemic vasculature, implying an intrinsic mechanism specific to the kidney. This may provide insight to the regulation of kidney function in both high altitude travellers and sleep apnea patients.

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Apnoea training, chemosensitivity, and erythropoietin

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Intermittent hypoxia typically increases ventilatory chemosensitivity, erythropoietin concentration ([EPO]), haemoglobin (Hb), and haematocrit (Hct). A single bout of 15 maximal duration voluntary apnoeas has also been shown to increase [EPO]. It is unknown if repeated sessions of such apnoeas produce further haematological adaptations associated with improved oxygen carrying capacity and alter ventilatory chemosensitivity. We hypothesized that seven days of maximal duration voluntary apnoea training would increase isocapnic ventilatory response (HVR), [EPO], Hb, Hct, and VO_2max. Twelve males underwent seven consecutive days of 15 maximal duration apnoeas per day (mean daily training time = 74.2 ± 9.6 min; mean SaO_2 nadir = 79.9 ± 4.8%). HVR and VO_2max were assessed pre- and post-training. Venous blood was sampled pre and 3 hours post-training on days one, three, and seven, and on day eight. [EPO] was measured from all samples. Hct and Hb were measured from the pre-training samples on days one and three, and on day eight. No significant ($P<0.05$) differences were found in HVR (0.59 ± 0.24 vs. 0.54 ± 0.27 $L.min^{-1}.\%^{-1}$) or VO_2max (48.4 ± 7.8 vs. 48.5 ± 6.8 $ml.kg^{-1}.min^{-1}$). [EPO], Hct, and Hb were unchanged across all time points (EPO: 7.2 ± 2.1 vs. 8.9 ± 3.1 IU/L for day one pre and day seven post; Hct: 45.0 ± 2.3 vs. 45.7 ± 3.4%, Hb: 14.9 ± 2.5 vs. 14.2 ± 3.4 $g.100ml^{-1}$ for first and last measures respectively). These findings indicate that voluntary apnoea training does not alter chemosensitivity or oxygen carrying capacity of the blood.

Notes

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