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High-intensity exercise: an efficient approach to improve several health and performance indicators

Submission date	Recruitment status	[_] Prospectively registered
07/04/2020	No longer recruiting	[_] Protocol
Registration date	**Overall study status**	[_] Statistical analysis plan
01/05/2020	Completed	[X] Results
Last Edited	**Condition category**	[_] Individual participant data
14/06/2023	Other	

Plain English summary of protocol

Background and study aims
Today, physical activity levels remain low, with a lack of time often cited as the key barrier to participation. As such, interest has grown in time-efficient exercise strategies, which reduce the exercise duration required to provide health benefits. Recently, our laboratory demonstrated that very brief high-intensity exercise in the form of sprinting, which typically comprised 6 to 10 s sprints, is very brief, motivating and tolerable for subjects and seem able to improve many health and performance parameters. This intervention has been tested in adolescents and now we are interested to evaluate its effects in sedentary adults and older individuals of both genders.

Who can participate?
Sedentary adults and older individuals

What does the study involve?
Body mass, height, waist and hip circumferences, body mass index and body fat percentage are measured. On day 1, after a 12-hour overnight fast participants undergo breathing tests and blood tests at rest and during and at the end of exercise. On day 2, following 10 minutes of warm-up, the participants undergo an exercise bike test. They are then instructed to complete a total of 18 cycling training sessions (three sessions per week for 6 weeks) after which the tests are repeated.

What are the possible benefits and risks of participating?
Participants will benefit from being informed about their health and fitness level and could also take advantage of intervention to enhance many of their fitness and health parameters. There are no direct risks to participants taking part in this study.

Where is the study run from?
University of Moncton (Canada)

When is the study starting and how long is it expected to run for?
January 2014 to June 2017

Who is funding the study?
University of Moncton (Canada)

Who is the main contact?
1. Prof. Georges Jabbour
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Contact information

Type(s)
Scientific

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Study information

Scientific Title
Effect of supra-maximal exercise training (SET) on performance and health parameters in adults and older individuals of both genders

Acronym
SET

Study objectives
Because of its form, high exercise stimulus and time-efficient, it is thought that SET will confer several health and performance benefits among individuals with or at high risk of metabolic and cardiovascular diseases.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 27/06/2015, by the Human Research Ethics Committee (UHRC) of the University of Moncton (Comite Ethique de la Recherche avec les Etres Humains, /FESR/Université de Moncton, 18, Avenue Antonine-Maillet, Moncton (NB), E1A3E9, Canada; +1 (0)5068584310; fesr@umoncton.ca), ref: 1415-071

Primary study design
Interventional

Study design
Single-center non-randomised study

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Sedentary individuals

Interventions
The study was carried out in compliance with the principles laid down in the Helsinki Declaration. One hundred one individuals (women and men; students and employers) were recruited from the Moncton campus of the Université de Moncton. The study was approved by the University's Human Research Ethics Committee (UHRC), and the participants were asked to sign a full consent form prior to beginning the study. The participants had to be sedentary (participating in <1 hour/week of structured exercise, as assessed by the International Physical Activity Questionnaire) with no history of cardiovascular or chronic health problems, drug consumption, or smoking before the beginning of the study. To reduce and control the potential effect of ovarian hormones on substrate metabolism in women, the researchers controlled for the phase within the menstrual cycle (follicular phase) and the oral contraceptives.

Before entering the protocol, each of the participants was familiarized with all testing equipment and procedures. Additionally, each participant was asked to determine the height of the seat at which they are able to pedal comfortably. The protocol then began with two sessions of preliminary testing after an overnight fast to determine certain key variables.

Anthropometric measurements
Body mass was measured to the nearest 0.1 kg using an electronic scale with the subject in light clothing and without shoes (Kern, MFB 150K100). Height was determined to the nearest 0.5 cm with a measuring tape affixed to the wall. Waist and hip circumferences were measured to the nearest 0.1 cm. Body mass index (BMI) was calculated as the ratio of mass (kg) to height2 (m2). Body fat percentage was estimated using electrical bioimpedance (Vacumed, Bodystat1500).

Physiology testing
On day one (D1), subjects arrived at the laboratory after a 12-hour overnight fast. They lay in a supine position for 10 minutes before continuous measurement of pulmonary gas exchange using a breath-by-breath automated metabolic system (CPX, Medical Graphics, St. Paul, Minnesota). This test was used to determine several main outcomes (VO2max, VO2 submaximal, SBP, DBP, lipid oxydation, mechanical efficiency, energy expenditure, heart rate variability).

At day 1, venous blood samples from an antecubital vein were drawn at rest and during and at the end of graded maximal exercise. At extraction, the blood was collected in a vacutainer tube

containing Ethylene Diamine Tetra Acetic Acid (EDTA). Plasma from the venous blood samples was separated by centrifugation at 3000 g for 20 min (4o C) (ORTO ALRESA mod. Digicen.R, Spain). Aliquots were immediately frozen and stored at -80oC for use in subsequent chemical and hormonal analyses.

On day 2, following 10 min of warm-up, the subjects performed a force-velocity test on a cycle ergometer using a technique adapted from the study performed by Vandewalle et al. [1988]. This test consisted of a succession of supramaximal bouts of approximately six seconds, with exercise loads increasing by 1 kg after each bout until the subject was unable to perform the test. A period of passive recovery (5 minutes) was allowed between successive bouts. The peak velocity for each bout was recorded, and the power output was calculated by multiplying the load and speed. The optimal load corresponded to the load at which maximal power (POmax) was achieved. This load was then used for the training protocol that followed. The force-velocity test was also performed every 2 weeks to adjust the individual power level of SET.

Training sessions
Once the participants completed preliminary testing, they were instructed to complete a total of 18 training sessions (three sessions per week for six weeks). Each of the prescribed sessions began with a 5-minute warm-up of continuous cycling at moderate intensity followed by 6 repetitions of SET intervals with 2 minutes of passive recovery between each repetition. Each SET repetition lasted six seconds, and the participants were asked to pedal at maximal velocity against the resistance determined during D2. The total duration of each session was approximately 15 minutes.

Intervention Type
Behavioural

Primary outcome(s)
Measured at baseline and at post-intervention:
1. Waist conference (WC) and hip circumference (HC) measured twice to the nearest 0.5 cm with a flexible tape. Waist to hip ratio (WHR) was calculated using the following formula: WHR = WC (cm)/HC (cm)
2. Maximal and submaximal oxygen consumption evaluated through maximal and submaximal test on an upright cycle ergometer (Monark Ergomedic 839E electronic test cycle, Sweden) with continuous measurement of pulmonary gas exchange using a breath-by-breath automated metabolic system (Ergocard MEDI-SOFT, Sorinnes, Belgium)
3. Plasma epinephrine and norepinephrine concentrations measured using high-performance liquid chromatography (HPLC; Chromsystems; Thermo Finnigan, France) following the method of Koubi et al.
4. The frequency-domain analyses evaluated in both groups at rest, at VT1, and at baseline, and repeated post-intervention. Fast Fourier transformation and Hanning windows (512) with 50% overlap obtained the power spectral density.
5. The energy consumption, (E) in watts, calculated as follows: (E = (4.94 RER + 16.04) × VO2net /60
6. For women: menopausal status calculated on the basis of Stages of Reproductive Aging Workshop (STRAW)

Key secondary outcome(s)
Measured at baseline and at post-intervention:
1. Heart rate values continuously measured using an electrocardiogram machine (CASE 16 exercise testing system, Marquette, Wisconsin, USA)

2. Maximal power output determined by the Force-Velocity test on a cycle ergometer using a technique adapted from the study of Vandewalle et al
3. Plasma glucose concentrations determined using commercially available kits (all ABX Pentra, Montpellier, France)
4. Plasma insulin concentrations measured in the centralized laboratory by a radioimmunoassay procedure (Phaadebas Insulin Kit; Pharmacia Diagnostics AB, Piscataway, NJ). The insulin resistance was estimated by the homoeostasis model assessment (HOMA-IR) index as [fasting insulin (µU/ml) × fasting glucose (mmol/l]/22.5
5. Lipid oxidation (%LO) contributing to energy calculated using the method of McGilvery and Goldstein (1983) as follows: %LO = [(1 – RER)/0.29] × 100
6. Net mechanical efficiency (MEnet, %) calculated using the formula developed by Lafortuna et al. (2006) as the ratio of work performed (W) to the rate of energy consumed (E, W) above resting level, that was in turn computed as follows: E = (4.94 RER + 16.04) × VO2net / 60

Completion date
21/06/2017

Eligibility

Key inclusion criteria
1. Sedentary and healthy
2. Adults and senior

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Mixed

Sex
All

Total final enrolment
37

Key exclusion criteria
No history of cardiovascular or chronic health problems, drug consumption, or smoking before the beginning of the study

Date of first enrolment
01/02/2013

Date of final enrolment
01/12/2016

Locations

Countries of recruitment
Canada

Study participating centre
Université de Moncton
School of Kinesiology and Leisure
Faculty of Health Sciences and Community Services
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Sponsor information

Organisation
Université de Moncton

ROR
https://ror.org/029tnqt29

Funder(s)

Funder type
University/education

Funder Name
Université de Moncton

Alternative Name(s)
University of Moncton, U de M

Funding Body Type
Private sector organisation

Funding Body Subtype
Universities (academic only)

Location
Canada

Results and Publications

Individual participant data (IPD) sharing plan

The datasets generated during and/or analysed during the current study are/will be available upon request from Prof. Georges Jabbour (gjabbour@qu.edu.qa).

IPD sharing plan summary

Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		30/03/2021	14/06/2023	Yes	No