INFORMATION and CONSENT to PARTICIPATE in RESEARCH

Prolonged Exercise and Cardiovascular Function Study

Investigators

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Introduction

You are being asked to participate in a research study conducted in the Department of Human Health and Nutritional Sciences at the University of Guelph.

Following prolonged endurance exercise, there is temporary decrease in cardiac function, termed exercise-induced cardiac fatigue. It is also demonstrated that following some forms of prolonged exercise (including trail running), there is a period in which stiffening of the arteries occurs, and there is a change in the way they respond to an induced stress. While there is no indication to date that cardiac fatigue or these arterial dysfunctions having lasting detrimental effects, further research is warranted to better understand the causes and effects of exercise-induced cardiovascular impairments. This will also help us to understand what, if anything, an athlete could do to offset any potential changes.

Individual fitness appears to delay the onset of cardiac fatigue, however the individual exercise intensity required to bring-about cardiovascular fatigue is relatively unexplored. Further, there is likely a time-course of impairment, such that arterial dysfunction may occur prior to cardiac dysfunction. Lastly, individual inflammatory responses may lead to the occurrence of cardiovascular impairment. Therefore, the purpose of this research is to explore the

relationships of fitness, exercise intensity, and inflammation in the occurrence of exercise induced cardiovascular impairment.

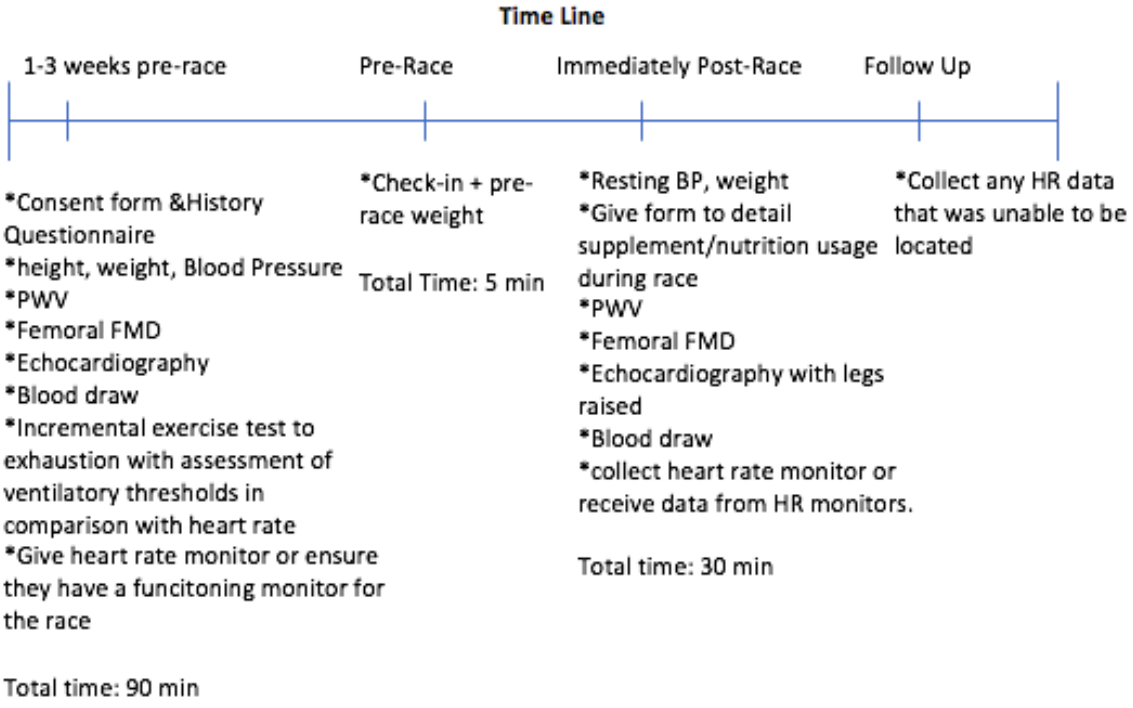
This study will only involve two testing sessions. The first will take place at the University of Guelph's Human Performance and Health Research lab, 1-3 weeks prior to the race, to assess baseline cardiovascular function and to determine your aerobic fitness and thresholds with a maximal oxygen consumption test (VO_2max). On race morning you will check in with us and do a weigh in. The second testing session will take place directly at the finish of your race, where you will go through the cardiovascular testing one more time to assess any cardiovascular impairments. You will receive your individual fitness results, and be asked to wear a heart rate monitor throughout the race to track exercise intensity.

This research is funded by an NSERC Discovery Grant through Dr. Jamie Burr.

Inclusion Criteria

- Between the ages of 18-60 and participating in the 25km, 50km, 50 mile, or 100mile Sulphur Springs Trail Race, 2018
- Healthy, with no known diseases or active use of medications known to influence cardiovascular function
- No history of smoking
- Desire to know personal fitness levels and cardiovascular testing results

Procedure



First visit (approximately 90 minutes): This visit will take place at the Human Performance and Health Research Lab at the University of Guelph. Prior to beginning the study you will be asked to thoroughly read and sign this consent form in person. You will also be asked to fill out a general health and training history questionnaire. **If you have a heart rate monitor you would like to use in the race, please bring it to this testing session**. We will lend you a heart rate monitor for the testing and for the race if you do not have your own. **Please arrive at the lab having not had caffeine or big meals for 3 hours prior, as well as no alcohol or drugs (including aspirin) for 24 hours prior.**

Order of Tests:

- **Health and Training History Questionnaire**
- **Height/Weight/Resting Blood Pressure**
- **Pulse Wave Velocity**
- **Femoral Flow Mediated Dilation**
- **Echocardiography (ultrasound of heart)**
- **Blood draw**
- **VO_2 peak test on the Treadmill**

Resting Blood Pressure:
Using an automated blood pressure cuff while seated.

Pulse Wave Velocity:
Pulse wave velocity assesses arterial stiffness, and requires you to wear shorts, and either a sports bra (for females), or loose shirt/no shirt for males. You will be lying down, and have a 3 electrode ECG on the torso. A tonometer (pen-like structure) will be placed against two sites to get a reading. The sites are at your neck (carotid pulse), and inner thigh (femoral pulse).

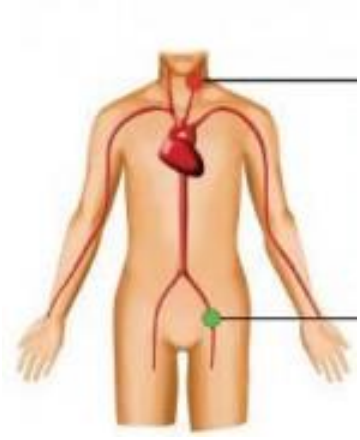


Figure 1. Sites for Pulse Wave Velocity

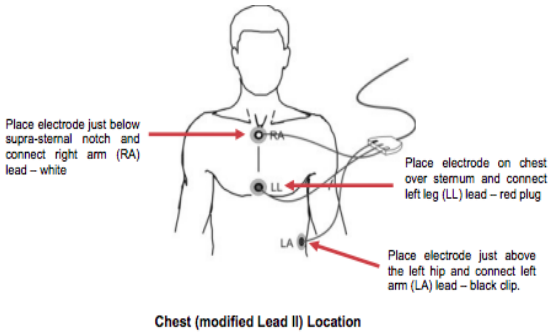


Figure 2. Sites for ECG electrode placement

Femoral Flow-Mediated Dilation

FMD assesses arterial function, by determining how much an artery dilates after a period of occlusion. You will be required to wear shorts for this procedure as well. The femoral artery will be imaged using an ultrasound machine. During the image, you will feel nothing, with the exception of a gel placed on your skin and light pressure from the imaging probe. Next, a blood pressure cuff will be inflated on the distal thigh to ~250mmHg. During this measure you will feel pressure and some possible discomfort as the blood flow is stopped, but it should not be painful. The cuff will stay inflated for 5 minutes, after which the cuff will be deflated, and the assessment of blood flow and dilation of the artery will be measured.

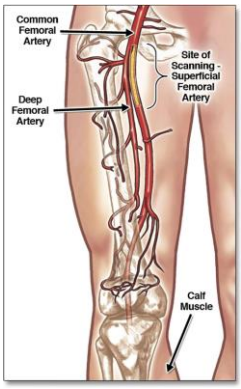


Figure 3. Site of superficial femoral artery scanning

Echocardiography:

Following FMD, we will will assess heart function using the same ultrasound machine. We will obtain images of the heart while you lie on your side. Once resting data has been assessed, you will perform a maximal handgrip exercise in the same position, before performing a 2-minute sustained static handgrip at 30% of max, in which cardiac images will be obtained to assess cardiac function under increased load. For this procedure, you will have to be completely undressed from the waist up, however blankets or towels will cover your torso, and the ultrasound will be used under these towels.

Blood Draw:

A trained phlebotomist will take a small venous blood sample from the antecubital area to assess for inflammatory markers, and muscle damage.

Fitness Testing (VO_2max test):

You will be asked to warm up on the treadmill for 3-5 minutes. **You will be wearing your heart rate monitor that you will use in the race during this test**. A face mask will be fitted to your face to measure your oxygen consumption throughout the test. The test will take approximately 10-14 minutes, and will consist of a stepwise increase in speed and then incline on the treadmill every 2 minutes. The test is concluded when your oxygen consumption plateaus despite increases in intensity or you have reached volitional exhaustion (i.e. you feel you cannot continue).

Figure 4. Image of the mask that will be worn during the VO_2max test

Second visit (approximately 30 minutes): This visit will take place at the race, in a tent at the start/finish line of the race.

PRE RACE: Please come **check-in** at the tent, which will be stationed at the start/finish line, on race morning. You will do a **pre-race weigh-in** so that we can monitor your water loss following the race. You are encouraged to leave your extra dry clothing, nutrition, etc. in this tent with us, and can use the tent as a pre-race area to relax.

POST RACE
Following the race, we will bring you directly to the tent, where we will be set up as a recovery area. We will have screens and/or sheets hung up to ensure privacy during changing and testing. You will quickly remove any excess clothing, perform a secondary weight, and then you can change into dry clothing and have post-race nutrition and hydration. We will then have you lie down (we will provide blankets and other recovery items) and we will perform the same cardiovascular measures as performed during baseline testing. The post-race testing should take under 30 minutes, and will be treated as your recovery area.

Order of tests:

- **Weight/Resting Blood Pressure**
- **Pulse Wave Velocity**
- **Femoral Flow Mediated Dilation**
- **Echocardiography (ultrasound of heart)**
- **Blood draw**
- **Questions about in-race nutrition, hydration, and supplement intake (e.g. Caffeine/salt tabs)**

<u>Potential Benefits</u>

You will receive exercise test data to understand your fitness, your maximal heart rate, and your heart rate thresholds. You may use this information for your own training. You will also learn about your own cardiovascular response to prolonged exercise.

This research will help coaches and scientists understand the causes of exercise-induced cardiovascular impairments, and the role of intensity vs duration, inflammation and arterial dysfunction in the occurrence of cardiac fatigue. While we will not be able to determine whether this cardiovascular fatigue has long-term consequences from this study, we may be able to better delay the occurrence of cardiac fatigue with a greater understanding of its etiology.

Data

You may also request to receive a form of aggregate results of the study. Every effort will be made to ensure confidentiality of personal information that is obtained in connection with this study. Confidentiality will be secured by the use of participant ID Codes on all correspondence. Data will be kept on a password-protected computer and all written material secured in a locked cabinet on site.

Coded data will be retained for 5 years for possible use for future analysis for the lab group in the case the project may be expanded upon. All data will be stored electronically in databases with access only granted to investigators involved in the use of the data (see investigators above). All personal identifiers will be destroyed following the participants study completion. Jamie Burr, PhD, Assistant Professor will be in charge of data stewardship.

Potential Risks and Discomforts

Venipuncture/blood draws can be painful and frightening for some individuals. Mild bruising surrounding the needle injection site and temporary bleeding is common and will be minimized by application of pressure at the wound site following needle removal. As the skin will be broken, there is the possibility of infection, however the risk is minor as all surfaces will be cleaned and sterilized. Vasovagal reactions, including faintness, light-headedness, sweating, lowered blood pressure, or nausea may be experienced during or after a blood test, especially in individuals who have a fear of needles or injections. Other more serious and extremely rare complications include a hematoma (excessive bleeding underneath the skin, leading to swelling) and temporary nerve damage as nerve endings may be brushed during venipuncture. These symptoms are rare and recovery is usually spontaneous and rapid within 24 hours.

Pulse Wave Velocity is a non-invasive method of assessing arterial stiffness, and will not be painful or risky in any way. However, some participants may feel some discomfort, as the femoral site is where the thigh creases at the pelvis.

Flow Mediated Dilation (FMD) is a non-invasive assessment of vascular function, however does involve occlusion (blockage and alteration) of normal blood flow as a result of leg cuff inflation

to pressures of approximately 250mmHg (full occlusion, variable based on participant). The inflations are at levels commonly above pressures used in a doctor's office to measure blood pressure, however, they remain far below those used during certain medical processes. There is a slight risk of soft tissue trauma (i.e. pinching or bruising of the skin) during inflation, however, this risk is minor and a specifically designed woven sleeve will be placed between the skin and cuff to minimize the risk further. There is also the very low theoretical possibility that a blood clot could form in the lower leg during blood flow restriction, which could come loose and travel to other parts of the body causing embolism, however this type of adverse event has never been reported to occur. The restriction induced by FMD inflation causes a lack of blood supply to the leg muscles, therefore inducing a lack of oxygen supply or ischemia. Commonly associated with ischemia is numbness, tingling, and at times burning sensations throughout the leg. This discomfort will last for approximately 5 minutes of total cuff inflation, which is required to produce adequate hyperemia (increases in blood flow through the vasculature after cuff deflation) to collect data.

Echocardiography is non-invasive and safe for all populations. However, you will have to be uncovered from the waist up, with the ultrasound device touching bare skin, and this may cause some psychological discomfort, especially for female participants. However, towels or blankets will be provided to cover you at all times, and the testing will take place in an area where only the main researchers are present. Subjects will be allowed to undress and cover up completely in private prior to the ultrasound testing. Female athletes will only be tested by female sonographers, and this should minimize the psychological discomfort.

The handgrip exercise for 2 minutes of sustained 30% effort is difficult and should cause an increase in blood pressure. This may cause discomfort and fatigue.

The VO_2 peak exercise test may cause discomfort as a result of fatigue. This may also result in normal leg muscle soreness and/or soreness in the legs for one or two days after. These tests can also be associated with shortness of breath or breathing difficulty and light-headedness due to the requirement to breathe through the mask during the VO_2 assessment.

Participation and Withdrawal

You may choose whether to be involved with this study or not. If you volunteer, you may **withdraw at any time without consequence.** You may exercise the option of removing your data from the study up until the completion of data collection. At this point in time the master list will be destroyed, and we will be unable to separate your data from that of the other participants. The researchers wish to be inclusive in their recruitment process. This project requires:

- Coming to Guelph for the initial testing session
- The use of needles and blood flow occlusion
- Removal of articles of clothing
- Testing being performed by both male and female testers, although you may request same-gender investigators if desired.

If for any reason you may feel uncomfortable taking part, please contact the researcher to discuss these requirements and possible modifications to the procedure to address your concerns. The data found during this study is only experimental, and does not constitute a diagnosis. Should any incidental findings occur, we will communicate these to you, and will recommend you to inquire with a physician.

Compensation for Participation

Parking at U of G will be covered using a pre-paid parking pass.

Rights of Research Participants

This project has been reviewed by the University of Guelph Research Ethics Board for compliance with federal guidelines for research involving human participants. If you have any questions regarding your rights and welfare as a research participant in this study (REB # 18-01-020), please contact: Director, Research Ethics; University of Guelph: reb@uoguelph.ca: 519-824-4120 ext. 56606. You do not waive any legal rights by agreeing to take part in this study.

SIGNATURE of RESEARCH PARTICIPANT

I have read the information provided for the study "Prolonged Exercise and Cardiovascular Health" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____ Name of Participant (please print)

_____ _____

Signature of Participant Date

SIGNATURE OF WITNESS

_____

Name of Witness (please print)

_____ _____

Signature of Witness Date