ISRCTN59736069 https://doi.org/10.1186/ISRCTN59736069

Low-intensity interval exercise with blood flow restriction increased plasma cardiac troponin

Submission date
14/01/2024

Recruitment status
No longer recruiting

Registration date
24/01/2024

Overall study status
Completed

Last Edited
11/06/2025

Condition category
Other

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[X] Results
[ ] Individual participant data

Plain English summary of protocol
Background and study aims
Blood flow restriction (BFR) training can induce endurance adaptations with low-intensity training, but its cardiac risks remain unclear compared to those without BFR. Consequently, the influence of low-intensity interval exercise with and without BFR and high-intensity interval training (HIIT) on cardiac troponin will be determined in this study.

Who can participate?
Physically active healthy male volunteers aged between 18 and 26 years old

What does the study involve?
The participants will complete three exercise tests in random order, including 40% VO2max low-intensity cycling without BFR (group L), 40% VO2max low-intensity cycling with BFR set at 60% limb occlusion pressure (LOP) (group B), and 80% VO2max high-intensity cycling without BFR (group H). Participant muscle oxygen, blood flow, oxygen uptake (VO2), heart rate (HR), perceived exertion (RPE) rating, and pain levels were determined before and after exercise, after cuff inflation, and pre-and post-each exercise. Moreover, before each protocol, immediately after the exercises, and 3 and 4 hours after each exercise, elbow vein blood samples were collected to evaluate serum lactate (LA) and high-sensitivity cardiac troponin T (cTnT).

What are the possible benefits and risks of participating?
The benefits of participating include obtaining a fitness exercise prescription, while the risk is that muscle soreness may occur after high-intensity exercise.

Where is the study run from?
Ocean University of China (China)

When is the study starting and how long is it expected to run for?
January 2021 to March 2022

Who is funding the study?
The Natural Science Foundation of Shandong Province (No.ZR2022MC205) (China)

Who is the main contact?
Yu Wenbing (haiyangyuwenbing@163.com) and Li Shiming (Shiming Li@ouc.edu.cn).

Contact information

Type(s)
Public, Scientific

Contact name
Prof Wenbing Yu

Contact details
238 Songling Road, Laoshan District
Qingdao City, Shandong Province
China
266101
+8615731114483
haiyangyuwenbing@163.com

Type(s)
Principal investigator

Contact name
Prof Shiming Li

Contact details
238 Songling Road, Laoshan District
Qingdao City, Shandong Province
China
266101
+8616651738983
Shiming.li@ouc.edu.cn

Additional identifiers

Clinical Trials Information System (CTIS)
Nil known

ClinicalTrials.gov (NCT)
Nil known

Protocol serial number
Nil known

Study information

Scientific Title
The effect of low-intensity interval exercise with blood flow restriction on plasma cardiac troponin: a cross-design trial

Study objectives
Low-intensity interval exercise combined with blood flow restriction causes high-sensitivity cardiac troponin T (cTnT) elevations compared to those without blood flow restriction. The increase is similar to high-intensity interval exercise (HIIE) protocols.

Ethics approval required
Ethics approval required

Ethics approval(s)
approved 08/11/2021, Ocean University of China (238 Songling Road, Laoshan District, Qingdao City, Shandong Province, 266101, China; None provided; 21211913076@ouc.edu.cn), ref: OUC-HM-2021016

Study design
Cross-design trial

Primary study design
Observational

Study type(s)
Diagnostic, Safety

Health condition(s) or problem(s) studied
Healthy volunteers

Interventions
This study is a cross-sectional study, with participants being healthy adults and college students from the school basketball team in three intervention groups involving three types of exercise:
1. 40% VO2max low-intensity cycling without blood flow restriction (Group L)
2. 40% VO2max low-intensity cycling with blood flow restriction set at 60% limb occlusion pressure (LOP) (Group B)
3. 80% VO2max high-intensity cycling without blood flow restriction (Group H)

The crossover experiment in the present study will require the participants to visit the laboratory four times at a minimum of 48-hour intervals. The individuals will be asked to not perform vigorous physical activity 24 hours before each meeting. A hot, neutral environment and approximately similar times will be maintained throughout data collection.

The participants familiarise themselves with the assessment protocols during initial laboratory visits. The individuals also will complete a graded physical activity protocol to determine their VO2max. During the subsequent visits, the participants will complete three physical activity protocols in random order. The exercise plans utilised in the current study will be chosen to represent current aerobic exercise guidelines that incorporated or did not incorporate BFR. Participant muscle oxygen, blood flow, oxygen uptake (VO2), HR, perceived exertion (RPE) rating, and pain levels will be determined before and after exercise, after cuff inflation, and pre- and post-each exercise. Moreover, before each protocol, immediately after the exercises, and 3 and 4 hours after each exercise, elbow vein blood samples will be collected to evaluate lactate (LA) and high-sensitivity cardiac troponin T (cTnT).

Exercise protocol
Before the intermittent cycling protocol, the participants will be asked to rest on the cycle

ergometer for 5 min to obtain their baseline (Pre) responses. Subsequently, the cuffs will be inflated to 60% LOP (only group B) during a 1-minute rest. The exercise protocols of groups L and H included a 1 min rest. The individuals will be required to complete 18 sets of 2-minute cycling intervals with a 1-minute rest between sets. The intermittent cycling procedure in the present study will be based on the hypothesis that work-rest
Interval with inflated pressure cuffs is advantageous over continuous cycling when considering the incorporation of BFR. For the cycling conditions that included BFR, the blood flow in each leg will be restricted with a 7 cm wide nylon inflatable cuff (The Occlusion Cuff, Belfast, Britain). The cuff will be positioned around the thigh at the most proximal location. The pressure in the cuff will be sustained throughout the workout before being deflated immediately upon completion of the last cycling set.

Intervention Type
Behavioural

Primary outcome(s)
High-sensitivity cardiac troponin T in plasma is measured using electrochemiluminescence technology-based high-sensitivity immunoassay at baseline, 0, 3 and 4 hours

Key secondary outcome(s))
Oxygen uptake measured using a gas metabolism analyzer over the exercise test

Completion date
01/03/2022

Eligibility

Key inclusion criteria
1. Male
2. No diseases that are not suitable for high-intensity exercise
3. Individuals reporting performing moderate to high-intensity aerobic exercises for a minimum of 150min/week per the American College of Sports Medicine (ACSM) guidelines.

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 years

Upper age limit
26 years

Sex
Male

Total final enrolment
12

Key exclusion criteria
Having cardiovascular and skeletal muscle diseases

Date of first enrolment
01/01/2022

Date of final enrolment
15/02/2022

Locations

Countries of recruitment
China

Study participating centre
Ocean University of China
238 Songling Road, Laoshan District
Qingdao City, Shandong Province
China
266101

Sponsor information

Organisation
Ocean University of China

ROR
https://ror.org/04rdtx186

Funder(s)

Funder type
Government

Funder Name
Natural Science Foundation of Shandong Province

Alternative Name(s)

Shandong Provincial Natural Science Foundation, Shandong Natural Science Foundation, Natural Science Foundation of Shandong, Shandong Province Natural Science Foundation,

Funding Body Type
Government organisation

Funding Body Subtype
Local government

Location
China

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated and analysed during the current study will be published as a supplement to the results publication.

IPD sharing plan summary
Published as a supplement to the results publication

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		18/09/2024	11/06/2025	Yes	No
Participant information sheet	Participant information sheet	11/11/2025	11/11/2025	No	Yes