

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

Submission date 14/01/2024	Recruitment status No longer recruiting	☐ Prospectively registered ☐ Protocol
Registration date 24/01/2024	Overall study status Completed	☐ Statistical analysis plan ☒ Results
Last Edited 11/06/2025	Condition category Other	☐ 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).

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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 (HIIIE) 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

Primary study design

Observational

Study design

Cross-design trial

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

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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