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Investigating how sprint cycling with restricted blood flow influences blood lactate, mental performance, and exercise perception

Submission date
06/10/2025

Recruitment status
No longer recruiting

Registration date
07/10/2025

Overall study status
Completed

Last Edited
25/11/2025

Condition category
Mental and Behavioural Disorders

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

Plain English summary of protocol

Background and study aims
Exercise is pivotal in slowing down age-related cognitive decline. Recently, there is growing interest in sprint interval exercise (SIE) due to its time efficiency in exercise training. SIE studies on healthy young adults have attributed improvements in cognitive function to neurovascular changes induced by exercising at supramaximal intensity or 'all out' exercise bouts. A novel approach which may accentuate these benefits is the addition of blood flow restriction to active muscles during SIE (BFR-SIE). BFR restricts the blood flow in exercising muscles, increases metabolic stress and stimulates the release of neuroprotective molecules, which may help to improve cognition. However, there is a lack of research on the effect of BFR-SIE on cognitive function as most studies have focused on BFR with resistance exercises or lower intensity aerobic exercises. Therefore, the main objective of the study is to investigate the acute effects of BFR-SIE on cognitive function in healthy young adults. The secondary objective is to identify the differences in physiological and perceptual responses between BFR-SIE and SIE alone.

Who can participate?
Healthy young adults who are aged between 18 to 35 years and are recreationally active (two or more times of physical activity per week) with no prior experience of BFR-related training

What does the study involve?
The research will be conducted as a randomised controlled trial with a crossover design. Each participant is first randomly allocated to either the Intervention (sprint interval exercise with blood flow restriction) or Control trial (sprint interval exercise alone). Following which there will be a rest period of at least 7 days before you swap over to the other trial. For this study, you need to complete both trials.

What are the possible benefits and risks of participating?
You might possibly experience short term gains in cognition. You may also consider adopting the tailored sprint interval training as an exercise modality for better health and fitness.
There is a risk of blood clot formation in the circulation during complete occlusion of blood vessels. Thrombosis, or blocked arteries/veins due to blood clots can lead to reduced tissue

perfusion which can cause pain and swelling. If the blood clot is dislodged, this can cause stroke or heart attack. However, the incidence of thrombosis in BFR training is very low (0.06%) and it is considered safe to practice for healthy people.
The risk will be mitigated in this study by close monitoring of the lower limb blood flow to prevent complete blood flow occlusion during exercise and ensuring that the occlusion pressure is correctly applied.
There could be muscle strain or injury if one adopts an improper posture on the bike while performing the exercise. To reduce this risk, researchers will educate you on proper seated cycling posture and safe and correct techniques on mounting and dismounting the bike, as well as pedaling. Bike seat and handlebars will be adjusted to an appropriate height and angle for each individual. The exercise will be done under supervision with assistance on standby.
There may be risks of over-exertion and fatigue due to the high intensity exercise. To reduce these risks, warm-up will be done before performing the exercises and adequate rest will be provided after the exercise.
For safety reasons, you will be asked to report any post-trial adverse effects experienced such as prolonged numbness or bruising. The study will be terminated if deemed necessary. At any point in the study, you can also choose to leave the study without any obligation.
In the event of any unexpected serious adverse event (such as injury/cardiovascular incident) during the trials, you will be sent to the nearest hospital (National University Hospital) accompanied by the researchers.
As this study will be conducted during the COVID-19 pandemic, there is a risk of disease transmission as participants will be situated in the same compound. Measures to minimise risk of disease transmission will be enforced according to the national and institutional guidelines. All individuals will also be required to wear a mask when not exercising.

Where is the study run from?
Singapore Institute of Technology (Singapore)

When is the study starting and how long is it expected to run for?
August 2022 to April 2023

Who is funding the study?
Singapore Institute of Technology (Singapore)

Who is the main contact?
Dr Tan Xiang Ren, XiangRen.Tan@singaporetech.edu.sg

Contact information

Type(s)
Public, Scientific, Principal investigator

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Additional identifiers

Clinical Trials Information System (CTIS)
Nil known

ClinicalTrials.gov (NCT)
Nil known

Protocol serial number
10.17605/OSF.IO/YZXQJ

Study information

Scientific Title
Effect of sprint interval cycling with blood flow restriction on capillary blood lactate, cognitive function and perceptual response: a randomized controlled trial

Acronym
BFRT

Study objectives
The study aimed to investigate the effect of a single bout of blood flow restriction sprint interval exercise (BFR-SIE) on:
1. Cognition
2. Capillary blood lactate levels
3. Perceptual strain of healthy young adults as compared to SIE alone

We hypothesised that BFR-SIE promotes greater blood lactate production which enhances brain metabolism and function, leading to improved cognitive performance post-exercise.

Ethics approval required
Ethics approval required

Ethics approval(s)
approved 05/08/2022, Singapore Institute of Technology Institutional Review Board (SIT-IRB) (1 Punggol Coast Road, Singapore, 828608, Singapore; +65 (0)6592 1189; IRB@SingaporeTech.edu.sg), ref: 2022118

Study design
Single-centre randomized controlled trial with a crossover design and without blinding

Primary study design
Interventional

Study type(s)

Prevention, Other

Health condition(s) or problem(s) studied
Cognitive decline

Interventions
The study was conducted as a randomized controlled trial with a crossover design. Due to the physical nature of the intervention involving physical compression of the muscles during blood flow restriction (BFR), there was no blinding involved. After screening, all eligible participants attended three separate sessions including a familiarization session and two exercise sessions at the Singapore Institute of Technology campus. Participants were randomly assigned by the study team to two study trials (Trial A or B) using an online random generator tool (https://www.randomlists.com/team-generator), with participants starting with either the sprint cycling with BFR, or without BFR. Participants completed sprint interval cycling involving six sets of 10 s all-out sprints with 1-min rest intervals, performed with BFR applied at 50% occlusion pressure on both thighs, and without BFR. After the completion of the first exercise session, participants returned for the second exercise session after a washout period of at least 7 days. Participants were advised not to engage in any form of strenuous physical activity between experimental sessions to avoid any confounding effect.

Intervention Type
Other

Primary outcome(s)
Working memory, selective attention, and executive function were assessed using cognitive assessments (namely Stroop test and Digit Span) performed at baseline before exercise and after exercise

Key secondary outcome(s))
1. Blood lactate measured via a finger prick test using a handheld lactate analyzer at baseline before exercise and after exercise
2. Rating of perceived exertion self-reported using Borg scale at baseline before exercise, after each sprint interval, and after exercise
3. Cycling power output measured via the Monark Bike software during the whole duration of the exercise
4. Respiratory variables including VO2, VCO2 and respiratory exchange ratio measured with a metabolic cart (Quark COSMED) during the whole duration of the exercise

Completion date
30/04/2023

Eligibility

Key inclusion criteria
1. Healthy young adults aged 18 to 35 years
2. Recreationally active (at least two times of physical activity per week)
3. No prior experience of training in BFR-related exercises

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
Yes

Age group
Adult

Lower age limit
18 years

Upper age limit
35 years

Sex
All

Total final enrolment
19

Key exclusion criteria
1. Any cardiovascular or clotting disorders*
2. Any conditions contraindicated to cycling
3. Taking of any medications that influence heart rate and blood pressure such as beta-blockers, diuretics or ACE inhibitors
4. Deep vein thrombosis
5. Peripheral vascular disease
6. Nerve entrapments in hip region

*Examples: Coronary artery disease, arrythmias (abnormal heart rhythm), peripheral vascular disease, congenital heart disease, haemophilia, Von Willebrand disease.

Date of first enrolment
19/10/2022

Date of final enrolment
09/01/2023

Locations

Countries of recruitment
Singapore

Study participating centre
Singapore Institute of Technology
10 Dover Drive, SIT@Dover Campus
Singapore
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S138683

Sponsor information

Organisation
Singapore Institute of Technology

ROR
https://ror.org/01v2c2791

Funder(s)

Funder type
Government

Funder Name
Singapore Institute of Technology

Alternative Name(s)
Singaporetech, , Institut Teknologi Singapura, , SIT,

Funding Body Type
Government organisation

Funding Body Subtype
Universities (academic only)

Location
Singapore

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study will be available upon request from Dr Tan Xiang Ren (tan.xiangren@gmail.com).

IPD sharing plan summary
Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		24/11/2025	25/11/2025	Yes	No