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The role of exercise training frequency in long-term blood pressure control

Submission date
12/06/2025

Recruitment status
No longer recruiting

Registration date
16/06/2025

Overall study status
Completed

Last Edited
18/06/2025

Condition category
Circulatory System

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

Plain English summary of protocol

Background and study aims
High blood pressure is a major risk factor for heart disease. Recent research suggests that performing isometric wall squat exercise training can significantly reduce blood pressure. This study aimed to find out how the frequency of wall squat training affects blood pressure and cardiovascular health, and whether stopping the exercise leads to a reversal of benefits.

Who could take part?
Adults aged 18–65 years with normal to slightly raised blood pressure (systolic 120–139 mmHg) who were not taking blood pressure medication and had no known cardiovascular, metabolic, or musculoskeletal conditions.

What did the study involve?
Participants were randomly allocated to one of five groups. All groups completed wall squat training three times per week for the first 4 weeks. In the second 4-week phase, training frequency varied: participants either continued training at three, two or one time per week, stopped training entirely, or were in a control group with no training throughout. Blood pressure and other cardiovascular measurements were taken at baseline, mid-point (week 4), and after 8 weeks.

What were the possible benefits and risks of taking part?
Participants may have experienced improvements in blood pressure. The exercise is low-risk but may have caused some temporary muscle discomfort. All procedures were designed to be safe and accessible to people with no prior exercise experience.

Where was the study run from?
The study was conducted at Canterbury Christ Church University (CCCU), within the School of Psychology and Life Sciences.

When did the study take place and how long did it run for?
September 2019 to March 2025

Who funded the study?
The study was funded internally by Canterbury Christ Church University as part of a postgraduate research degree

Who was the main contact?
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Contact information

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Principal investigator

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Additional identifiers

Protocol serial number
19/SAS/12C

Study information

Scientific Title
Understanding dose-response in isometric exercise training: the role of training frequency in long-term blood pressure control

Study objectives
Increasing the frequency of isometric exercise training will result in greater improvements in blood pressure, vascular resistance, and autonomic function in normotensive to pre-hypertensive adults, compared to lower-frequency training or no training.

Ethics approval required
Ethics approval required

Ethics approval(s)
approved 19/12/2019, Canterbury Christ Church University ethics board (School of Psychology and Life Sciences, Canterbury Christ Church University, Kent,, Canterbury, CT1 1QU, United Kingdom; +44 (0)1227767700; red.resgov@canterbury.ac.uk), ref: 19/SAS/12C

Study design
Single-centre interventional randomized controlled trial

Primary study design
Interventional

Study type(s)
Efficacy

Health condition(s) or problem(s) studied
Prevention of hypertension in normotensive to pre-hypertensive adults through isometric exercise training

Interventions
All participants are randomly assigned using stratified random allocation to one of five groups. During the first 4 weeks, all intervention groups complete isometric wall squat training three

times per week, consisting of four 2-minute bouts at 95% peak heart rate, with 2 minutes rest between bouts. In the final 4 weeks, training frequency is modified: participants either continue training at 3x/week, reduce to 2x/week, reduce to 1x/week, stop training entirely, or remain in the control group with no training throughout.

Training is supervised or remotely monitored to ensure adherence. Assessments are conducted at baseline, mid-point (week 4), and end-point (week 8), measuring resting blood pressure, cardiac output, total peripheral resistance, heart rate variability, and baroreflex sensitivity.

Intervention Type
Other

Primary outcome(s)
Resting systolic blood pressure (SBP) is measured using the Task Force® Monitor during a 5-minute seated continuous recording at baseline, week 4, and week 8

Key secondary outcome(s))
1. Mean arterial pressure (MAP) is calculated from continuous blood pressure data recorded by the Task Force® Monitor during a 5-minute seated period at baseline, week 4, and week 8
2. Diastolic blood pressure (DBP) is measured using the Task Force® Monitor during the same 5-minute seated recording at baseline, week 4, and week 8
3. Total peripheral resistance (TPR) is derived from concurrent blood pressure and cardiac output signals via the Task Force® Monitor during a 5-minute seated measurement at baseline, week 4, and week 8
4. Cardiac output (Q) and stroke volume (SV) are recorded via impedance cardiography using the Task Force® Monitor during a 5-minute seated recording at baseline, week 4, and week 8
5. Heart rate variability (HRV) metrics (LF, HF, LFnu, HFnu, LF/HF ratio) are calculated from ECG data obtained via the Task Force® Monitor during the 5-minute seated period at baseline, week 4, and week 8
6. Baroreflex sensitivity (BRS) is assessed using sequence and spectral methods applied to the 5-minute continuous Task Force® Monitor data at baseline, week 4, and week 8

Completion date
01/03/2025

Eligibility

Key inclusion criteria
1. Male and female participants with normal to high-normal sBP (range 120-140 mmHg)
2. University staff and students from Canterbury Christ Church University and their associates via social media and word of mouth
3. Total weekly physical activity level below the 150 minutes of moderate physical activity per week, or specifically ≤600 MET-minutes, calculated as the sum of all light-intensity activities (light walking = 3.3 METs, light cycling = 3.0 METs, household work = 2.5 METs). Total MET-minutes were computed as MET × duration (min). To exclude structured exercise, any reported bout ≥4 METs lasting ≥ 10 minutes (e.g. jogging and weight training) led to exclusion.
4. Free from any injuries or illnesses
5. Not taking any medication (or had previously taken any anti-hypertensive medication)
6. Non-smokers

7. Consumed less than 14 units of alcohol per week
8. Screening was conducted using a standard Physical Activity Readiness Questionnaire
9. Provided written informed consent

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 years

Upper age limit
65 years

Sex
All

Total final enrolment
100

Key exclusion criteria
1. Free from any injuries or illnesses
2. Not taking any medication (or had previously taken any anti-hypertensive medication)
3. Non-smokers
4. Consumed less than 14 units of alcohol per week

Date of first enrolment
21/01/2020

Date of final enrolment
16/08/2024

Locations

Countries of recruitment
United Kingdom

England

Study participating centre
Canterbury Christ Church University
St. Georges Place

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Sponsor information

Organisation
Canterbury Christ Church University

ROR
https://ror.org/0489ggv38

Funder(s)

Funder type
University/education

Funder Name
Canterbury Christ Church University

Alternative Name(s)

Funding Body Type
Private sector organisation

Funding Body Subtype
Universities (academic only)

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study will be stored in a publicly available repository.
The dataset is stored in the UK Data Service ReShare repository.
The dataset includes fully anonymised individual-level data on blood pressure, heart rate variability, cardiac output, and vascular resistance across three timepoints (baseline, week 4, week 8), as well as group allocation and basic demographics (age, sex).
Data will be made available indefinitely through the UK Data Service under standard academic licensing terms.

Access will be open to registered users for non-commercial research and teaching purposes, subject to acceptance of a user agreement.
No personally identifiable data are included. Anonymisation involved the removal of names, dates, and indirect identifiers, and aggregation of sensitive subgroups where needed. Informed consent for data sharing was obtained from participants via approved ethics documentation, and the study was reviewed and approved by Canterbury Christ Church University's ethics committee.

IPD sharing plan summary

Stored in publicly available repository

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Basic results		18/06/2025	18/06/2025	No	No
Participant information sheet			13/06/2025	No	Yes