ISRCTN95727228 https://doi.org/10.1186/ISRCTN95727228

High versus low load training in females

Submission date 17/04/2025	**Recruitment status** No longer recruiting	[X] Prospectively registered [_] Protocol
Registration date 01/05/2025	**Overall study status** Completed	[_] Statistical analysis plan [_] Results
Last Edited 23/04/2025	**Condition category** Other	[_] Individual participant data [_] Record updated in last year

Plain English summary of protocol

Background and study aims
Performing resistance exercise increases muscle mass and muscle mass is a strong predictor of illness and death in North America's aging population. Recent research has found that both relatively heavy loads and relatively light loads are equally effective at producing muscular adaptations. Additionally, extrinsic factors such as protein provision/diet may influence adaptations. However, the source of protein intake and its interaction with different training loads have yet to be extensively investigated in women. Research to date emphasises that protein types – casein, whey, egg, soy and even other forms of protein from plant sources – are likely no different in their ability to promote training-induced hypertrophy (muscle growth) and strength gains. However, very little of this work is carried out in younger women. Thus, the main aim of this study is to assess the interaction between training load (high vs low) and protein source (casein vs whey) on body composition, muscle hypertrophy and strength gains in women.

Who can participate?
Healthy female volunteers aged 18-35 years

What does the study involve?
The participants will be randomly allocated to either a relatively heavy-lifting group (about 80% one-rep max [1RM], able to perform 8-12 repetitions) or a relatively light-lifting group (about 30-50% 1RM, able to perform 15-25 repetitions). They will perform 10 weeks of resistance exercise training and be given 40 g of whey or casein protein following each training session. The researchers will take various measurements on muscle size, body composition and muscle strength pre- and post-training intervention.

What are the possible benefits and risks of participating?
There are no proposed benefits to participants. However, the findings of this study may contribute to the development of nutritional guidelines that maximise muscle health.
As with any research, there are risks associated with participating, such as during blood sampling or muscle biopsies (samples). The research team has done everything possible to mitigate these risks and will gladly provide further information if requested.

Where is the study run from?
McMaster University in Hamilton, Ontario (Canada)

When is the study expected to run for?
January 2025 to August 2026

Who is funding the study?
Natural Sciences and Engineering Research Council of Canada (NSERC) (Canada)

Who is the main contact?
Dr Stuart Phillips, phillis@mcmaster.ca

Contact information

Type(s)
Scientific, Principal investigator

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Additional identifiers

Protocol serial number
HiREB #18158

Study information

Scientific Title
The effect of high load versus low load resistance training and protein type on muscle mass and strength in females

Acronym
HER-TRAIN

Study objectives
The working hypothesis is that higher and lower load resistance exercise training (RET) will induce equivalent muscle hypertrophy, measured as muscle mass (D3-creatine), lean mass (dual-energy x-ray absorptiometry [DXA]), and strength (i.e., no effect of load); and protein supplementation will be equally effective regardless of source in promoting strength and hypertrophy.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 07/04/2025, Hamilton Integrated Research Ethics Board (237 Barton Street East, Hamilton, L8L 2X2, Canada; +1 (0)905 521 2100, Ext 42013; eREBhelpdesk@hhsca.ca), ref: 18158

Primary study design
Interventional

Study design
Randomized controlled trial

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Resistance exercise and protein feeding

Interventions
This is a 2 x 2 nested factorial RCT where participants will be randomized to a training intervention (higher or lower load) and then randomized within each arm to receive either whey or casein protein.

Participants will be randomized to either a relatively heavy-lifting group (HL: ~80% 1RM, able to perform 8-12 repetitions/set) or a relatively light-lifting group (LL: ~30-50% 1RM, able to perform 15-25 repetitions/set). They will perform 10 weeks of resistance exercise training (training twice weekly) and be given 40 g of whey or casein protein (also by random assignment) following each training session. The researchers will take various measurements of muscle size, body composition and muscle strength pre- and post-training intervention.

Intervention Type
Other

Primary outcome(s)
Skeletal muscle mass assessed by D3-Cr-measured muscle mass at baseline and 10 weeks

Key secondary outcome(s)
Lean body mass:
1. Dual-energy x-ray absorptiometry (DXA)-measured lean body mass at baseline and 10 weeks.

Muscle strength:
2. One repetition-maximum on a leg press machine and biceps curl measured at baseline, 5 and 10 weeks
3. Unilateral isometric maximum voluntary contraction of knee extension/elbow flexion measured at baseline and 10 weeks

Completion date
31/08/2026

Eligibility

Key inclusion criteria
1. Between the ages of 18-35 years (inclusive)
2. Able to maintain a habitual diet and perform RET three times per week throughout the trial
3. Able to begin exercise (assessed by Get Active Questionnaire [GAQ])
4. Understand the study procedures and sign this form providing informed consent to participate in the study

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 Years

Upper age limit
35 Years

Sex
Female

Key exclusion criteria
1. Use of tobacco- or cannabis-related products (smoking or vaping)
2. A history of neuromuscular problems or muscle and/or bone-wasting diseases
3. Any acute or chronic illness; cardiac, pulmonary, liver, or kidney abnormalities; insulin- or non-

insulin-dependent diabetes or other metabolic disorders (all ascertained through medical questionnaires)
4. Use of medications known to affect protein metabolism (i.e. corticosteroids, non-steroidal anti-inflammatory drugs (prescription use or daily use of over-the-counter medication), or prescription strength acne medications)
5. Have any electronic medical or metal implants
6. Currently pregnant or planning to get pregnant
7. Dairy allergy

Date of first enrolment
05/05/2025

Date of final enrolment
31/05/2026

Locations

Countries of recruitment
Canada

Study participating centre
McMaster University
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Sponsor information

Organisation
McMaster University

ROR
https://ror.org/02fa3aq29

Funder(s)

Funder type
Government

Funder Name
Natural Sciences and Engineering Research Council of Canada

Alternative Name(s)
The Natural Sciences and Engineering Research Council of Canada, nserc_crsng, Conseil de Recherches en Sciences Naturelles et en Génie du Canada, NSERC, CRSNG

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
Canada

Results and Publications

Individual participant data (IPD) sharing plan
The data-sharing plans for the current study are that all data will be made publicly available upon reasonable request from the PI, Dr Stuart Phillips (phillis@mcmaster.ca).

IPD sharing plan summary
Available on request