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Does plyometric training improve explosive muscle performance in experienced boulder climbers?

Submission date
22/06/2026

Recruitment status
No longer recruiting

Registration date
09/07/2026

Overall study status
Completed

Last Edited
05/10/2026

Condition category
Other

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

Plain English summary of protocol

Background and study aims
Boulder climbing requires the ability to produce force rapidly in pulling movements. This study investigated whether a 10-week plyometric training programme of exercises involving explosive jumps and reactive pulls, could improve this capacity in experienced male boulder climbers.

Who can participate?
Male boulder climbers aged 20–40 years with a minimum bouldering performance level of V5 (self-reported current maximum redpoint grade).

What does the study involve?
Participants were randomly assigned to either a training group or a control group. The training group performed two plyometric sessions per week for 10 weeks, while the control group continued their usual climbing training. Muscle function was assessed before and after the intervention using tests of pulling strength, explosive push-up power, finger flexor strength, and jump performance.

What are the possible benefits and risks of participating?
Possible benefits: participants may experience improvements in explosive muscle performance, pulling strength, push-up power, and jump ability as a result of the plyometric training program.

Possible risks: as with any exercise program involving high-intensity explosive movements, there was a small risk of musculoskeletal injury, particularly to the upper limbs, fingers, and lower limbs. Participants were screened for pre-existing injuries before inclusion, and all sessions were supervised by a qualified coach to minimize this risk.

Where is the study run from?
Viña del Mar University, Chile.

When is the study starting and how long is it expected to run for?
August 2025 to October 2025.

Who is funding the study?
Viña del Mar University, Chile.

Who is the main contact?
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Contact information

Type(s)
Principal investigator, Public, Scientific

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Additional identifiers

Study information

Scientific Title
The effects of a 10-week plyometric training programme on selected neuromuscular outcomes in trained-to-highly-trained male boulder climbers: a preliminary exploratory trial

Study objectives
To determine the effect of a 10-week plyometric training programme on selected neuromuscular outcomes, including isometric pull-up rate of force development, upper-body explosive power, and finger flexor strength , in trained-to-highly-trained male boulder climbers.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 08/07/2025, Scientific Ethics Committee, Viña del Mar University (Comité Ético Científico, Universidad Viña del Mar; CEC-UVM) (Avenida Agua Santa 7055, Sector Rodelillo, Viña del Mar, 2560000, Chile; +56 9 8292 6125; consultascec@uvm.cl), ref: 32-25

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Blinded (masking used)

Control
Active

Assignment
Single

Purpose
Treatment

Study type(s)

Health condition(s) or problem(s) studied
Neuromuscular performance in sport. This study examined the effects of plyometric training on explosive force production and rate of force development in trained boulder climbers. No clinical condition or disease was studied; participants were healthy, trained athletes.

Interventions
Participants were randomly assigned to groups using a computer-generated random number sequence produced in Microsoft Excel prior to the baseline assessment. The sequence was generated by a researcher not involved in the intervention delivery or outcome assessment.

The intervention group performed two plyometric training sessions per week for 10 weeks (45–60 minutes per session), including plyometric push-ups, reactive pull-ups, campus board exercises, and lower-body plyometric jumps, supervised by a qualified strength and conditioning coach. Session volume was progressed across four phases: adaptation (weeks 1–4), bouldering-specific plyometrics (weeks 5–6 and 8–10), and a deload week (week 7). The control group maintained their habitual climbing training (minimum three sessions per week) without additional plyometric stimuli.

Intervention Type
Behavioural

Primary outcome(s)
1. Isometric pull-up rate of force development (RFD) measured using a load cell (Tindeq Progressor®); RFD calculated from force-time curve at 0–200ms and 20–80% of maximal force intervals, at pre-intervention (August 2025) and post-intervention (October 2025)

Key secondary outcome(s)
1. Upper-body explosive power, finger flexor strength and RFD, lower-body explosive power, and pull-up performance measured using plyometric push-up power (W) and Power Slap distance (cm) assessed using Chronojump® and campus board; maximum isometric finger flexor strength (kg) and RFD at 0–200ms and 20–80% Fmax on 20mm hold using Tindeq Progressor®; countermovement jump height (cm) and power (W) using Chronojump®; maximum pull-up repetitions to failure at pre-intervention (August 2025) and post-intervention (October 2025)

2. Pull-up repetition performance measured using the maximum pull-up repetitions to failure; prone grip, dead-hang start, chin above bar criterion, no kipping at pre-intervention (August 2025) and post-intervention (October 2025)

Completion date
25/10/2025

Eligibility

Key inclusion criteria
1. Male boulder climbers aged 20–40 years
2. Minimum bouldering performance level of V5 (self-reported current maximum redpoint grade)
3. At least two years of continuous sport climbing experience
4. Training frequency of three or more sessions per week over the previous six months
5. Absence of active musculoskeletal injuries at the time of initial assessment

Healthy volunteers allowed
Yes

Age group
Adult

Lower age limit
20 Years

Upper age limit
40 Years

Sex
Male

Total final enrolment
18

Key exclusion criteria
1. Active musculoskeletal injury at the time of initial assessment
2. Medical conditions contraindicating reactive or ballistic training
3. Injury sustained during the intervention period preventing continuation of the protocol
4. Session adherence rate below 80% of scheduled sessions

Date of first enrolment
02/08/2025

Date of final enrolment
09/08/2025

Locations

Countries of recruitment
Chile

Sponsor information

Organisation
Viña del Mar University

ROR
https://ror.org/00txsqk22

Funder(s)

Funder type

Funder Name
Universidad Viña del Mar

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		23/07/2026	05/10/2026	Yes	No
Dataset			05/10/2026	No	No