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Can blood flow restriction induce cross-education of muscle strength and volume? Based on systematic review and meta-analysis

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ADMINISTRATIVE INFORMATION

Support - Non.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 08 April 2024 and was last updated on 08 April 2024.

INTRODUCTION

Review question / Objective This research systematically assesses the effects of low-load blood flow restriction on the cross-education of muscle strength and volume, providing evidence-based guidance for clinicians and rehabilitation therapists.

Condition being studied Muscle weakness is the most common clinical musculoskeletal (MSK) disease worldwide. Muscle atrophy's degenerative effects are clear in acute and chronic MSK injuries, typically requiring muscle immobilization and prolonged rehabilitation for fractures and ligament injuries. Diminished strength is the main contributor to osteoarthritis (OA). OA, a leading MSK disorder, markedly affects patient function and life quality, affecting approximately 250 million adults globally. Essential to clinical MSK recovery,

strength training requires healthcare providers to apply emerging research practically. Significantly, enhanced quadriceps strength is associated with less symptomatic knee osteoarthritis, reduced joint space narrowing, and improvements in pain relief and physical function. Proponents recommend high-load resistance training to mitigate age-related declines in muscle strength and volume, highlighting the vital importance of post-immobilization strength training in restoring atrophied muscle strength.

METHODS

Participant or population Participants are adults aged 18 or older.

Intervention Interventions consist of synchronous training for a minimum of 4 weeks.

Comparator Comparisons include at least one unilateral training group or a non-intervention control.

Study designs to be included In adherence to the PICOS framework for systematic reviews, this study's inclusion criteria are: ① participants are adults aged 18 or older; ② interventions consist of synchronous training for a minimum of 4 weeks; ③ comparisons include at least one unilateral training group or a non-intervention control; ④ outcomes report on at least one measure of maximal force, voluntary contraction, isometric strength, torque, or muscle cross-sectional area pre- and post-intervention; ⑤ the research design is experimental.

Eligibility criteria Exclusion criteria are: ① absence of a strength training group; ② outcome measures excluding muscle-related indicators; ③ animal studies; ④ unpublished works; ⑤ duplicate publications; ⑥ concurrent interventions like diet control or cognitive training during the study period.

Information sources Retrieve literature published as of March 1, 2024 through databases such as PubMed, Web of Science, and Embase.

Main outcome(s) Outcomes report on at least one measure of maximal force, voluntary contraction, isometric strength, torque, or muscle cross-sectional area pre- and post-intervention.

Quality assessment / Risk of bias analysis The bias risk assessment included in the literature was evaluated using Cochrane Collaboration's RCT bias evaluation tool¹⁶: 1) The generation of random sequences; 2) Allocation hidden; 3) Blind method between implementers and participants; 4) Blind method for outcome evaluation; 5) The completeness of the result data; 6) Selective reporting; 7) Other sources of bias. The risk of bias will be evaluated independently by two researchers. If there is any disagreement, it will be resolved through negotiation or discussion with a third researcher before making a decision.

Strategy of data synthesis Statistical analysis was conducted on the included data using RevMan 5.4 software. The outcome measures included in this article are all continuous variables, and the strength data are tested in different units. Therefore, the standard mean difference (SMD) is chosen as the effect measure, while the muscle volume test unit is the same. Therefore, the mean

difference (MD) is chosen, and both use a 95% confidence interval (CI) as the effect scale for muscle related indicators. Evaluate the quality of the included literature using RevMan 5.4 software. I² is used as a statistical measure to evaluate the consistency between studies. I² values of 25%, 50%, and 75% respectively represent no significant heterogeneity, moderate heterogeneity, and significant heterogeneity in the merged results¹⁵. The statistical significance level is $P < 0.05$.

Subgroup analysis Non.

Sensitivity analysis Non.

Country(ies) involved China.

Keywords Blood flow restriction; Cross-education; Clinical rehabilitation; Muscle strength; Muscle volume.

Contributions of each author

Author 1 - Jiong Luo.

Author 2 - Liang Sun.

Author 3 - Hengxu Liu.

Author 4 - Yi Yang.