INPLASY PROTOCOL

To cite: Li et al. Effect of Low-intensity resistance training with blood flow restriction on anti-fall intervention in middle-aged and older adults: A meta-analysis. Inplasy protocol 2022110150. doi: 10.37766/inplasy2022.11.0150

Received: 29 November 2022

Published: 29 November 2022

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Support: **None.**

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

Conflicts of interest:
None declared.

Effect of Low-intensity resistance training with blood flow restriction on anti-fall intervention in middle-aged and older adults: A meta-analysis

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Review question / Objective: **To systematically evaluate the intervention effect of Low-intensity resistance training with blood flow restriction on anti-fall in middle-aged and older adults.**
Condition being studied: **Falls are an important cause of disability and death in middle-aged and older adults, with approximately 28%-35% of those aged 65 years and older fall each year, and the incidence of falls increases with age. The decline in muscle strength and muscle mass in middle-aged and older adults is a core factor triggering falls, and human muscle mass declines at a rate of 3% to 8% every 10 years after age 30, and muscle strength declines by 12% to 14% every 10 years in middle-aged and older adults over age 50.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 29 November 2022 and was last updated on 29 November 2022 (registration number INPLASY2022110150).

INTRODUCTION

Review question / Objective: **To systematically evaluate the intervention effect of Low-intensity resistance training with blood flow restriction on anti-fall in middle-aged and older adults.**

Rationale: **The World Health Organization reported that the number and proportion of people aged 60 years and older in the population is increasing dramatically and is expected to increase to 1.4 billion by 2030 and to 2.1 billion by 2050, accounting for 22% of the world's total population. Falls are an important cause of disability and death in middle-aged and older adults, with approximately 28%-35% of those aged 65 years and older fall each year, and the incidence of falls increases with age. The decline in muscle strength and muscle mass in middle-aged and older adults is a**

core factor triggering falls, and human muscle mass declines at a rate of 3% to 8% every 10 years after age 30, and muscle strength declines by 12% to 14% every 10 years in middle-aged and older adults over age 50. Changes in muscle strength of the lower extremities affect physical activities such as walking, sitting, standing, and climbing ladders, resulting in decreased muscle function of the lower extremities, balance and gait disorders, and consequently, falls. Therefore, it is important to improve lower extremity muscle strength, lower extremity muscle quality, and lower extremity muscle function to maintain and improve balance and walking ability in middle-aged and older adults to reduce the risk of falls.

Blood flow restriction training (BFRT), also known as KAATSU training or vascular occlusion training, is a training method in which external pressure is applied to the upper and proximal extremities during exercise using a special compression device to occlude venous blood flow while partially blocking arterial blood flow to improve the training effect. Low-intensity resistance training with blood flow restriction (LIRT + BFR) has the characteristics of low intensity, high efficiency, and high safety, and can achieve similar effects to high-intensity resistance training (HIRT) by using lower intensity. Numerous studies have demonstrated that LIRT + BFR can effectively increase muscle strength and mass, improve the secretion of growth hormone, activate the mechanism of muscle growth, and induce type II fast fibers to participate in muscle work thus maintaining muscle strength, while the increase in muscle mass and strength can further improve muscle function.

A review of previous studies found that LIRT + BFR induced increases in muscle strength and muscle mass at least similar to conventional HIRT, but the effects on lower extremity muscle function, balance, and walking need to be further explored. Therefore, this paper proposes to ask the following research question: Can LIRT + BFR effectively increase lower limb muscle strength and lower limb muscle mass in middle-aged and older adults? Can LIRT + BFR effectively improve lower limb muscle function, balance, and walking ability in middle-aged and older adults? To more objectively evaluate the anti-fall effect of LIRT + BFR, this study conducted a Meta-analysis of 14 RCTs at home and abroad, and selected anti-fall indexes such as lower limb muscle strength, lower limb muscle mass, lower limb muscle function, and balance and walking as outcome indexes, and conducted subgroup analysis on an exercise cycle, exercise frequency, exercise intensity, vascular flow resistance pressure, and different intervention programs, to provide a basis for the development of LIRT + BFR programs for middle-aged and older adults.

Condition being studied: Falls are an important cause of disability and death in middle-aged and older adults, with approximately 28%-35% of those aged 65 years and older fall each year, and the incidence of falls increases with age. The decline in muscle strength and muscle mass in middle-aged and older adults is a core factor triggering falls, and human muscle mass declines at a rate of 3% to 8% every 10 years after age 30, and muscle strength declines by 12% to 14% every 10 years in middle-aged and older adults over age 50.

METHODS

Participant or population: Middle-aged and older adults aged ≥50 years, regardless of gender, race, or country; no psychiatric abnormalities or severe perceptual disturbances, no musculoskeletal disorders or surgical history, and no major organic diseases.

Intervention: Subjects in the experimental group underwent LIRT + BFR (<50% 1RM).

Comparator: subjects in the control group underwent daily exercise or LIRT (<50% 1RM), HIRT (≥70% 1RM) or other exercises.

Study designs to be included: Randomized controlled trials.

Eligibility criteria: Exclusion criteria:(1) Non-RCTs; (2) non-Chinese and English literature; (3) duplicate published literature; (4) animal experiments; (5) incomplete experimental data that could not be calculated; (6) full text of the literature was not available; (7) the experimental group was a combined intervention study, such as blood flow restriction with a combined intervention of low-intensity resistance training with aerobic exercise and nutritional intake.

Information sources: Nine databases were searched by two researchers, PubMed, The Cochrane Library, Web of Science, Embase, EBSCO host, CNKI, VIP database, Wan fang database, and China Biomedical Literature Database, and supplemented by the literature retrospective method, and the search periods were all from the establishment to July 25, 2022, to collect RTCs of LIRT + BFR interventions on lower limb muscle strength, quality, function, and balance, walking and other anti-fall indicators in middle-aged and older adults. Searches were conducted using a combination of subject terms and free terms, and English search terms were included: Blood Flow Restriction Therapy、BFR Therapy、KAATSU、vascular occlusion training、ischemic training、accidental falls、Falls、Slip and Fall、muscle strength、strength、muscle mass、Physical Functional Performance、muscular function、Postural Balance、balance、Walking、middle-aged and older adults、older adults、old people、Randomized Controlled Trial.

Main outcome(s): The main outcome indicators were lower limb muscle strength and lower limb muscle mass. For lower extremity muscle strength, 1 or 10 repetitions of maximum strength (1RM/10RM), maximum voluntary contraction (MVC), and isokinetic moment were selected; for lower extremity muscle mass, muscle cross-sectional area (CSA) was selected.

Additional outcome(s): Secondary outcome indicators were lower extremity muscle function, balance, and walking ability. For lower extremity muscle function, SPPB (Simple Physical Performance Scale) and 30 s chair stand were selected; for balance, balance extension test and single-leg stand test (eyes open and closed) were selected; for walking ability, timed up and go (TUG) and walking time was selected.

Quality assessment / Risk of bias analysis: The methodological quality of the included literature was evaluated. In this paper, the risk of bias in the included literature was evaluated in seven aspects according to the risk bias assessment tool recommended in Cochrane Handbook 5.1.0. These included random sequence generation, allocation concealment, blinding of subjects and investigators, blinding of outcome assessors, incomplete outcome data, selective reporting, and other biases, with "low risk of bias," "uncertainty of bias," and "high risk of bias" for each indicator. "high risk of bias" was used to determine each indicator.

Strategy of data synthesis: The software RevMan 5.4 was used for statistical analysis. P-values and I^2 were used to test for heterogeneity, and if there was statistical heterogeneity ($I^2 \geq 50\%$, $P < 0.10$) among the findings, a random-effects model was selected, and vice versa, a fixed-effects model was used. The weighted mean difference (MD) and its 95% confidence interval (CI) were used for measures with the same measurement instrument, otherwise, the standardized mean difference (SMD) and its 95% CI were used. A meta-analysis of all outcome indicators in the included literature was performed by applying RevMan 5.4, and the Begg test in Stata 15.1 was applied to test for publication bias for outcome indicators for more than 10 studies.

Subgroup analysis: Low-intensity resistance training with blood flow restriction has a positive effect on lower extremity muscle strength, lower extremity muscle mass, and walking ability in middle-aged and older adults, which may be

influenced by different exercise cycles, exercise frequency, exercise intensity, and vascular flow blocking pressure. Since there are few included studies on lower extremity muscle mass and walking ability, and the characteristics of the moderating variables are similar among studies, no subgroups were set up, so this paper conducted subgroup analysis on exercise cycles, exercise frequency, exercise intensity, and vascular flow blocking pressure for lower extremity muscle strength.

Sensitivity analysis: In this study, publication bias test was performed for lower limb muscle strength, and other outcome indicators were included in fewer studies, less than 10, with insufficient test efficacy to perform publication bias test. Observation of the funnel plot (Figure 8) reveals that the graph is basically symmetrical and the result of Begg's test shows that Z= 0.58, P>|z|= 0.559, P>0.05 suggesting no publication bias in the study.

Country(ies) involved: China.

Keywords: blood flow restriction training; middle-aged and older adults; falls; muscle strength; muscle mass; muscle function; balance; walking;Meta-analysis.

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