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Effects of Different Resistance Training Modalities on Athletes' Strength Performance: A Network Meta-Analysis of Randomized Controlled Trials

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 11 July 2026 and was last updated on 11 July 2026.

INTRODUCTION

Review question / Objective This review aims to compare the effects of different resistance training modalities on strength performance in athletes. The review will focus on variable resistance training, constant resistance training, blood flow restriction training, and plyometric resistance training. A network meta-analysis will be used to compare the relative effects of these training modalities. The review will also rank the training modalities according to their effects on strength performance.

Rationale Strength is an important physical quality for athletes. Coaches use different resistance training methods to improve strength. Constant resistance training is widely used in strength training programs. Variable resistance training changes external resistance across the range of motion. Blood flow restriction training uses external pressure during exercise and is often performed with low or moderate training loads. Plyometric resistance training uses rapid stretch-shortening cycle actions and aims to improve force production during explosive movements.Previous studies have examined these training methods separately. Some studies have also compared two training methods directly. However, direct comparisons between all four training modalities are limited. Traditional pairwise meta-analysis cannot fully compare several training modalities within one analytical framework. A network meta-analysis can combine direct and indirect evidence when the required assumptions are met. Therefore, this review will compare and rank the effects of four resistance training modalities on athletes' strength performance.

Condition being studied This review will study strength performance in athletes who receive resistance training. Strength performance refers to the ability of the neuromuscular system to produce force during a physical task. The review will focus on strength outcomes measured by validated strength tests. These outcomes may include one-repetition maximum, maximal voluntary contraction, isometric strength, isokinetic strength,

and other direct measures of muscular strength reported in the included studies.

METHODS

Search strategy The review will search several electronic databases. These databases include PubMed, Web of Science, Cochrane Library, Embase, EBSCO, and Scopus. The review will also search Google Scholar. The review will check the reference lists of relevant studies. The main search terms will include combinations of the following words:("blood flow restriction" OR "variable resistance training" OR "chain training" OR "resistance training" OR "strength training" OR "plyometric" OR "stretch-shortening cycle")AND(power OR strength)AND(athlete* OR "professional athlete*" OR player*)AND("randomized controlled trial" OR "randomized trial").The search strategy will be adapted according to the search requirements of each database.

Participant or population This review will include athletes who participate in organized and regular sport training. Participants may compete in team sports or individual sports. Participants may be male or female. Youth and adult athletes will be included if the original study clearly identifies the participants as athletes or competitive sport participants.

Intervention The interventions of interest will include four resistance training modalities:1.Variable resistance training. This modality uses resistance that changes across the range of motion. The training may use elastic bands, chains, or other methods that systematically change external resistance.2.Constant resistance training. This modality uses a relatively constant external load during the exercise. The training may include traditional free-weight or machine-based resistance exercises.3.Blood flow restriction training. This modality uses an external cuff or pressure device to partially restrict arterial inflow and restrict venous outflow during resistance exercise.4.Plyometric resistance training. This modality uses rapid stretch-shortening cycle exercises. The training may include jumps, hops, bounds, or other explosive plyometric exercises.The intervention must be delivered as a structured training program.

Comparator The comparator may be another eligible resistance training modality, usual sport training, or a control condition without additional resistance training.For the network meta-analysis, eligible interventions will be grouped into variable resistance training, constant resistance training, blood flow restriction training, plyometric resistance training, and control when appropriate.

Study designs to be included This review will include randomized controlled trials. Cluster randomized controlled trials will also be considered if appropriate data are available.Non-randomized studies, observational studies, case reports, cross-sectional studies, reviews, study protocols, and conference abstracts without sufficient outcome data will be excluded.

Eligibility criteria Studies will be included if they meet the following criteria: participants are athletes; the study uses a randomized controlled design; the intervention includes at least one eligible resistance training modality; the study includes an eligible comparator; and the study reports at least one direct measure of strength performance.Studies will be excluded if the participants are not athletes, the intervention cannot be classified into the predefined training modalities, or the study does not report strength outcomes. Studies that only report jumping, sprinting, agility, or endurance outcomes without a direct strength measure will also be excluded.

Information sources Information sources will include PubMed, Web of Science, Cochrane Library, Embase, EBSCO, Scopus, and Google Scholar. The reference lists of relevant studies will also be checked. Full-text articles will be reviewed when available.

Main outcome(s) The main outcome will be strength performance. Eligible outcomes may include one-repetition maximum strength, maximal voluntary contraction, isometric peak force or torque, isokinetic peak torque, and other direct measures of maximal muscular strength.When several strength outcomes are reported within the same outcome domain, the review will use a predefined outcome selection rule to reduce selective outcome inclusion.

Additional outcome(s) When data are available, the review may describe changes in muscle power and strength-related performance as secondary outcomes. These outcomes will be analyzed separately from the primary strength outcome.

Data management Two reviewers will independently screen titles and abstracts. The same reviewers will independently assess the full texts of potentially eligible studies. Two reviewers will also extract data independently.The extracted

information will include study characteristics, participant characteristics, sport type, sample size, training modality, training duration, weekly training frequency, training load, training volume, and strength outcomes.Disagreements will be resolved through discussion. A third reviewer will be consulted if agreement cannot be reached.

Quality assessment / Risk of bias analysis The risk of bias of the included randomized controlled trials will be assessed using the Cochrane Risk of Bias 2 tool. Two reviewers will conduct the assessment independently.The assessment will consider bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result.Each domain and the overall risk of bias will be judged according to the RoB 2 guidance. Disagreements will be resolved through discussion or consultation with a third reviewer.

Strategy of data synthesis A random-effects model will be used because differences in athlete characteristics, sport types, and training programs are expected across studies.The network structure will be presented using a network plot. Direct and indirect evidence will be combined in the network meta-analysis. The consistency between direct and indirect evidence will be assessed when the available network allows this analysis.The relative effects of the training modalities will be estimated. Treatment ranking probabilities or an appropriate ranking measure will also be reported. Rankings will be interpreted together with effect estimates, uncertainty, and the structure of the evidence network.

Subgroup analysis If sufficient data are available, subgroup analyses will be conducted according to sex, age group, sport type, training status, training duration, and training frequency.Training-specific subgroup analyses may also be conducted when sufficient studies are available. These analyses may consider resistance training load, blood flow restriction pressure prescription, and the type of variable resistance.

Sensitivity analysis None.

Language restriction English language studies will be included.

Country(ies) involved China.

Other relevant information None.

Keywords Resistance training; variable resistance training; constant resistance training; blood flow restriction training; plyometric training; strength performance; athletes; network meta-analysis.

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