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Meta-analysis of the effects of resistance training on body composition and physical function in college students

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ADMINISTRATIVE INFORMATION

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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 15 April 2025 and was last updated on 15 April 2025.

INTRODUCTION

Review question / Objective To explore the effects of resistance training and its dosage on body composition and physical function of college students.

Condition being studied Body composition and functional indicators are important dimensions for assessing physical health. Body composition reflects the proportion and quality of fat, muscle, bone, and water in the human body, while physical function represents the ability of various physiological systems to work synergistically to sustain vital activities. Long-term systematic resistance training can effectively improve body composition by promoting muscle protein synthesis, regulating the secretion of hormones such as testosterone and growth hormone, thereby increasing muscle and bone mass while reducing fat accumulation. Additionally, it enhances physical function by improving respiratory and myocardial contractility, reducing insulin resistance, accelerating glucose uptake, and boosting the efficiency of oxygen transport and metabolic systems.

However, current research on the effects of resistance training on body composition and physical function has largely overlooked the college student population, and there remains controversy regarding the optimal dose of resistance training.

METHODS

Participant or population College students.

Intervention Resistance training as an intervention.

Comparator No intervention.

Study designs to be included Randomized controlled trial.

Eligibility criteria
Inclusion criteria:

(P) College/university students;
(I) Resistance training as the intervention method;
(C) Studies reporting baseline (pre-intervention) data;
(O) Outcomes including at least one body composition indicator (BMI, body fat percentage, or fat-free mass) and/or at least one physical function indicator (blood pressure [systolic, diastolic, or arterial occlusion pressure], VO2max [relative or absolute], or basal metabolic rate);
(S) Experimental studies (e.g., randomized controlled trials or controlled trials).

Information sources The literature search was conducted across multiple databases including PubMed, Web of Science, SPORTDiscus, and China National Knowledge Infrastructure (CNKI), with the search deadline set at October 1, 2024.

Main outcome(s) The meta-analysis demonstrated that resistance training significantly improved body composition (BMI and BF%) and physical function (BP and VO2max) in college students. Subgroup analyses revealed three key findings: (1) While training modality showed no differential effects on body composition, free weights were more effective than machines for enhancing physical function; (2) Moderate-intensity training (30%-70% 1RM) produced superior outcomes for both body composition and physical function compared to other intensities; (3) A frequency of 3 sessions/week was optimal, outperforming twice-weekly training. Most importantly, the combined analysis identified machine-based, moderate-intensity resistance training at 3 sessions/week as the most effective protocol for overall health improvements in this population. These findings provide evidence-based recommendations for designing college exercise programs.

Quality assessment / Risk of bias analysis The risk of bias in included studies was assessed using the Cochrane Risk of Bias Tool (RoB 2). Publication bias was examined through Egger's linear regression test.

Strategy of data synthesis The meta-analysis employed a random-effects model to account for significant heterogeneity across studies in participant characteristics, intervention protocols, and outcome measurement methods. Heterogeneity was quantitatively assessed using Cochran's Q test ($p<0.05$ threshold) and the I^2 statistic, interpreted as follows: 0-40% (low), 30-60% (moderate), 50-90% (substantial), and 75-100% (considerable). Effect sizes for continuous outcomes were calculated as standardized mean differences (SMDs) with 95% confidence intervals, with clinical significance interpreted using Cohen's criteria: <0.2 (trivial), 0.2-0.49 (small), 0.5-0.79 (medium), and ≥0.8 (large) (Cohen, 2013). To ensure robust analyses, subgroup comparisons required a minimum of 3 studies per group. All statistical tests used a significance threshold of $p\leq0.05$. This analytical approach optimizes the generalizability of findings while accounting for methodological variability across studies.

Subgroup analysis Subgroup analyses were conducted with resistance training modalities, intensity levels, frequency protocols, and combined intervention regimens as categorical variables.

Sensitivity analysis A sensitivity analysis was performed on the outcome measures of the included studies using Stata software version 16.0.

Country(ies) involved China.

Keywords Resistance training, muscle mass, cardiovascular health, college students.

Contributions of each author

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