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REVIEW ARTICLE

EFFECT OF EXERCISE ON OBESITY AMONG POSTMENOPAUSAL WOMEN: A SYSTEMATIC REVIEW

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ABSTRACT:

Background: Obesity is highly prevalent among postmenopausal women due to estrogen deficiency and age-related metabolic changes, predisposing them to cardiometabolic complications. Exercise is a widely promoted non-pharmacological strategy; however, evidence regarding its effectiveness across different modalities remains inconsistent.

Methodology: A systematic search of PubMed and Google Scholar was conducted for English-language randomized controlled trials published between January 2015 and December 2025. Studies included postmenopausal women receiving exercise-only interventions (aerobic, resistance, high-intensity interval training, or combined) compared with non-exercise controls, reporting obesity-related outcomes. Study selection followed PRISMA guidelines, and quality was assessed using the PEDro scale.

Results: Six trials met inclusion criteria with moderate methodological quality (PEDro scores 5–7). Aerobic, resistance, high-intensity interval, and combined training produced reductions in total and trunk fat, visceral adiposity, and waist circumference, with improvements or preservation of fat-free mass compared with control conditions. High-intensity interval or combined protocols showed greater effects on abdominal and visceral fat.

Conclusion: Exercise interventions are effective in improving obesity-related outcomes in postmenopausal women, with high-intensity interval and combined aerobic–resistance training demonstrating particularly favorable changes in abdominal and visceral adiposity. Larger, rigorously designed trials are needed to optimize exercise prescriptions in this population.

Keywords: Postmenopausal, women, obesity, resistance training, body mass index

INTRODUCTION:

Obesity in Postmenopausal Women

Due to complicated hormonal and metabolic changes brought on by aging and estrogen insufficiency, obesity is a significant global health concern that is especially common among postmenopausal women. Increased total and central adiposity, decreased lean muscle mass, and a drop-in basal metabolic rate are characteristics of the menopausal transition that put women at risk for weight gain[1,2]. Reduced physical activity throughout midlife frequently exacerbates these changes, which happen independently of chronological aging[3]. Obesity has a substantial impact on functional independence and quality of life in postmenopausal women and is closely linked to an increased risk of cardiovascular disease, type 2 diabetes mellitus, metabolic syndrome, osteoporosis, and hormone-related malignancies[4,5]. Considering the growing number of older women, managing obesity during the postmenopausal period represents a critical public health priority.

Exercise as a Non-Pharmacological Intervention

As a first-line, non-pharmacological approach to managing and preventing obesity, exercise is generally advised. Frequent exercise enhances metabolic and cardiovascular health, lowers fat mass, maintains or grows lean muscle mass, and promotes energy balance[6].

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Exercise as a Non-Pharmacological Intervention

As a first-line, non-pharmacological approach to managing and preventing obesity, exercise is generally advised. Frequent exercise enhances metabolic and cardiovascular health, lowers fat mass, maintains or grows lean muscle mass, and promotes energy balance[6]. Exercise also prevents sarcopenia, maintains bone mineral density, and improves physical and mental health in postmenopausal women [7].

The impact of a variety of exercise modalities, including resistance training, aerobic training, and integrated exercise programs, on outcomes associated to obesity have been studied. Resistance training is essential for preventing age-related muscle loss and enhancing body composition, while aerobic exercise is mainly linked to decreases in body fat and waist circumference[8,9].

Inconsistencies in Existing Evidence

The impact of exercise therapies on obesity outcomes in postmenopausal women has been studied extensively, although the results are still not always consistent. Heterogeneity in results is caused by differences in study design, exercise style, intensity, duration, and outcome measurements (e.g., body mass index, waist circumference, body fat percentage)[10]. While some studies show notable improvements in body composition, others show little to no changes, especially when exercise interventions are not paired with nutritional adjustments[11]. Clinicians and physiotherapists are unable to make definitive judgments on the best exercise regimens for managing obesity in postmenopausal women because of these discrepancies.

Rationale and Objectives of the Systematic Review

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines state that systematic reviews should highlight gaps, inconsistencies, or uncertainties in the body of existing literature in order to clearly explain the necessity for evidence synthesis[12]. A systematic review is necessary to thoroughly integrate the available data, given the increasing prevalence of obesity among postmenopausal women and the inconsistent reported results of exercise regimens.

This systematic review's main goal is to assess how exercise interventions affect obesity-related outcomes in postmenopausal women, including body weight, body mass index, waist circumference, and body composition. Comparing the efficacy of various exercise modalities and highlighting methodological flaws and research gaps to guide future investigations and clinical practice are examples of secondary goals.

METHODOLOGY

Protocol and registration

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021) ensuring methodological transparency and avoiding duplication of research efforts.

Eligibility criteria

The inclusion and exclusion criteria were defined using the PICOS framework (Population, Intervention, Comparison, Outcomes, and Study design):

- *Population:* Women with menopause
- *Intervention:* Studies where only exercise were given without any other intervention (eg, Diet)
- *Outcomes:* Studies reporting impact on Obesity
- *Study Design:* randomised controlled trial
- *Timeframe:* Studies published between January 2015 and December 2025.
- *Language:* Articles published in English were included to ensure consistency and accessibility of data (Moher et.al., 2009).

Information Sources and Search Strategy

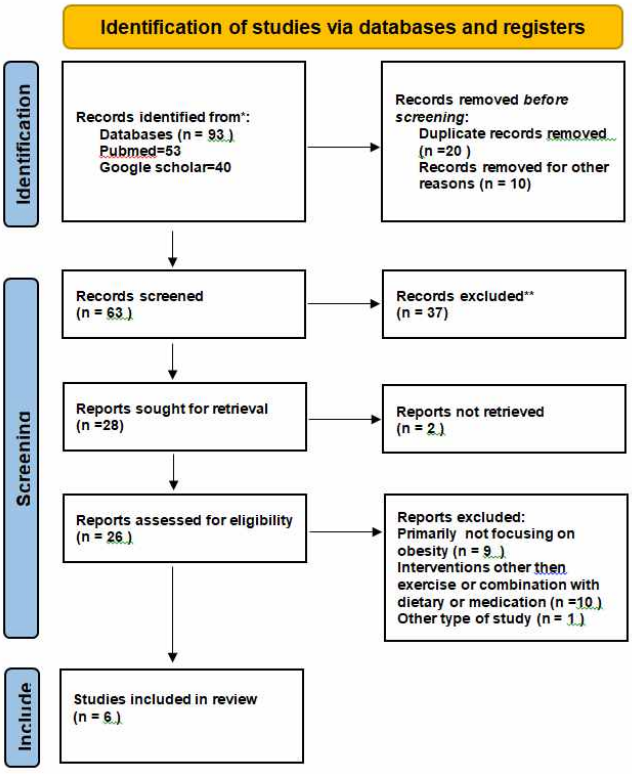
A comprehensive search strategy was developed and implemented in Pubmed and Google scholar databases. Search terms included were

"postmenopausal" OR "menopause" AND "exercise" OR "physical activity" AND "Obesity" OR "Overweight"

Reference lists of included studies were also manually screened to identify additional eligible articles.

Study selection process

Two independent reviewers screened titles and abstracts based on the eligibility criteria. Full texts of potentially eligible articles were retrieved and reviewed independently. The selection process was documented using a PRISMA flow diagram.



Quality of research articles

The included study's quality was assessed using the PEDro Scale of Risk of Bias. The Delphi list serves as the foundation for the PEDro scale. Out of the eleven criteria in the PEDro, the first one pertains to external validity and is not utilized in the computation of the PEDro score. In this case, a score of 0–3 indicated a high risk of bias, a score of 4–8 indicated a moderate risk, and a score of 9–10 indicated a low risk. The Pedro scale quality criteria for the included articles are displayed in Table 1.

Table 1: Quality criteria of Pedro scale

	Eligibility criteria were specified*	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	Allocation was concealed	The groups were similar at baseline regarding the most important prognostic indicators	There was blinding of all subjects	There was blinding of all therapists who administered the therapy	There was blinding of all assessors who measured at least one key outcome	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"	The results of between-group statistical comparisons are reported for at least one key outcome	The study provides both point measures and measures of variability for at least one key outcome	Total	Risk of bias
Fabrizio E. Rossi et al.	1	1	0	1	0	0	1	0	0	1	1	5	Moderate-high
Marine Dupuit et al.	1	1	0	1	0	0	0	1	1	1	0	5	Moderate-high
Paulo R.P. Nunes et al.	1	1	0	1	0	0	0	1	1	1	0	5	Moderate-high
F. Maillard et al.	1	1	0	1	0	0	0	1	1	1	1	6	Moderate
Jae-Kyung Yoon et al.	1	1	1	1	0	0	1	1	1	1	0	7	Low-moderate
Woo-Hyeon Son et al.	1	1	1	1	0	0	1	1	1	1	0	7	Low-moderate

*An additional criterion (criterion 1) that relates to the external validity (or "generalisability" or "applicability" of the trial) has been retained so that the Delphi list is complete, but this criterion will not be used to calculate the PEDro score reported on the PEDro web site

RESULT

The electronic database searches yielded a total of 93 pertinent references. 63 articles were left after duplicates were eliminated. 37 unrelated references were eliminated during the initial screening of abstracts and titles. After screening 26 items in their entirety, 20 of them satisfied the exclusion requirements. Six studies were included in the final phase. Fig. 1 shows a flowchart of the study selection procedure. Included studies' study characteristics and intervention details, outcomes measures and tools, results, are listed in Table 2.

Study	Sample size	Population	Program Details		Outcome measure	Results
			Intervention group	Control group		
Fabrício E. Rossi et al. [13]	55 (completed the 16 wks protocol)	Menopausal women with obesity (BMI > 29.9 Kg/m^2)	N=37 three times per week on non-consecutive days, approximately 90 minutes per day, comprised of five minutes of warm-up, 50 minutes of resistance training, 30 minutes of aerobic training and five minutes of stretching at the end. The exercises used in the program were: 45º leg press, leg extension, leg curl, bench press, seated row, arm curl, triceps extension, side elevation with dumbbells and abdominal exercises.	N=18 maintained 16 weeks of a sedentary lifestyle without participating in any regular physical exercise.	Antropometry: Body weight and Height Dual -Energy X-ray Absorptiometry (DXA) scanner: Fat mass (FM), fat-free mass (FFM) and trunk fat (TF)	differences were observed in trunk fat : CG= 0.064 x TG= -0.571 Kg; p-value = .020, fat mass: CG= -0.088 x TG= -1.037 Kg; p-value = .020 and fat-free mass: CG= -0.388 x TG= 1.049 Kg; p = .001
Marine Dupuit et al. [14]	30 women	postmenopausal women, body mass index (BMI) >25 kg/m2 and =40 kg/m2	Moderate-intensity continuous training (MICT): 40min at 55-60% of the participant's PPO performed continuously on a C-Max Club Fitness bike. High-intensity interval training (HIIT): repeated cycles of sprinting/speeding for 8s followed by slow pedaling (20–30 rpm) for 12s on a WattBike pro Concept. High-intensity interval training and resistance training (HIIT + RT): RT included two different training circuits with ten exercises/each. Circuit 1: leg press, bench press, knee extension, cable row, dumbbell calf raise, elbow flexion, abdominal muscle, triceps exercises with upper pulley, plank and bum exercises. Circuit 2: knees extension, pullover, leg press, side raise with dumbbells, dumbbell calf raise, triceps exercises with upper pulley, hip thrust, chin rowing, and plank to upright row.		Body weight: nearest 0.1 kg on a Seca 709 scale Height: nearest 0.5 cm with a wall mounted stadiometer. BMI, Waist circumference (cm), Sagittal abdominal diameter: Holtain–Kahn abdominal caliper, Abdominal skinfold thickness: Harpenden Skinfold Caliper, Total body and regional FM as well as FFM: dual-energy X-ray absorptiometry (DXA) scanner	total FM decreased and FFM and muscle mass increased only in the HIIT + RT group ($p = 0.02$, $\eta 2 = 0.20$). The percentage of total FM loss (kg) was higher (but not significant, p=0.07) in the HIIT and HIIT + RT groups than in the MICT group (-3.06 % ± 4.2, -4.43 % ± 3.1 and -0.05 % ± 3.9 respectively). abdominal and visceral FM changes were reduced only in the HIIT and HIIT + RT groups and were significantly different from MICT.
Paulo R.P. Nunes et al. [15]	26	Women aged >50 years and amenorrhea had occurred at least 12 months with obesity (baseline body fat percentage >40%	3-day-a-week (no consecutive days) routine for 12 weeks. Before and after each training session, a warm-up of 5minutes walking and a cool down of 3minutes walking at 60% of maximum heart rate (MHR). **High-intensity interval training:** week 1—four sets of high-intensity exercise (1minute) interspersed with four sets of low-intensity exercise(4minutes); Week 2— six sets of high-intensity exercise (1 minute) interspersed with six sets of low-intensity exercise (3 minutes); week 3—eight sets of high-intensity exercise (1 minute) interspersed with eight sets of low-intensity exercise (2minutes); week 4 to 12—10 sets of high-intensity exercise (1minute) interspersed with 10 sets of low-intensity exercise (1minute). **Combined Training:** 30 minutes of moderate-intensity walking at 70% of MHR around a sports court plus five		BMI, serum inflammatory markers (ELISA) and body com position (DEXA): whole-body adiposity and regional adiposity (trunk and VAT)	All groups reduced body fat percentage (P= 0.026), visceral adiposity tissue (p=0.027), leptin (P=0.043), and increased interleukin (IL)-1 receptor antagonist (P<0.01). The high-intensity interval training group reduced visceral adiposity tissue (P=0.021) in a greater magnitude and increased interleukin-6 (P=0.037) level when compared with the combined training group.

Study	Sample size	Population	Program Details		Outcome measure	Results
			Intervention group	Control group		
F. Maillard et al. [16]	17	postmenopausal women with T2DM and body mass index (BMI) > 25 kg/m2and = 40 kg/m2;	In both intervention groups, training sessions included 5-min warm-up and 5-min cool-down sessions. **High-intensity interval training (HIIT):** repeated cycles of sprinting for 8 s [at around 80% maximum heart rate (HRmax)] followed by pedalling slowly (20–30 rpm) for 12 s (maximum of 60 cycles per 20-min session). **Moderate-intensity continuous training (MICT):** exercised at 55–60% of the target HR (THR) for their individual HR reserve (HRR) for 40 min.		Anthropometric measurements: Body weight, Height, BMI, Waist Circumference, Sagittal abdominal diameter, Abdominal skinfold thickness, mean subcutaneous abdominal skinfold thickness Body Composition: Total body and regional FM as well as FFM with a dual-energy X-ray absorptiometry (DEXA) scanner.	total FM decreased and total fat-free mass significantly increased over time (by around 2–3%). Total FM reduction at the end of the intervention was not significantly different between groups. However, significant loss of total abdominal (- 8.3 ± 2.2%) and visceral (- 24.2 ± 7.7%) FM was observed only with HIIT.
Jae-Ryang Yoon et al. [17]	30	post menopausal obese women with body fat percentage higher than 30%	3 times a week for 12 weeks; Exercise time included 10 min of pre- exercise, 40 min of main exercise, and 10 min of finishing exercise. The pre-exercise consisted of 5 min of walking and 5 min of stretching, while the finishing exercise included 10 min of stretching. Aerobic exercise (n=10): walking on a treadmill at different speeds and slopes at the HRR of 60%–80%. Resistance exercise (n=10): bench press, lat-pull down, triceps push-down, dumbbell curl, sit-up, squat, leg extension, leg flexion, and leg press at 1RM of 60%. The exercises were repeated 8–12 times for 3 sets. The resting time between two exercise types was 1-min long.	N=10 (Intervention not mentioned)	Height and weight, body mass index (BMI), waist circumference, body fat percentage using a body fat analyzer	The value of weight tended to decrease in the aerobic exercise group and resistance exercise group, and there was significant difference between measuring time points (P<0.001). The value of BMI tended to decrease in the aero bic exercise group and resistance exercise group, and there was significant difference between measuring time points (P<0.01). The value of body fat and waist circumference tended to decrease in the aerobic exercise group and resistance exercise group, and there was significant difference between measuring time points (P<0.05).
Woo-Hyeon Son et al. [18]	26	postmenopausal women with obesity (ages 68–72)	Exercise group (N=14): 20-min warm-up, walking exercise at an intensity between 64–76% of their maximum heart rate (HRmax)	Control group (N=12): conventional physical activity and diet.	Height: using a port able extensometer InlabS50 Body composition: using Inbody S10 evaluating weight (kg), percentage of body fat (PBF; %), and skeletal muscle mass (SMM; kg). Body mass index (BMI)	There was a significant clustering by weight ($p < 0.01$), body mass index ($p < 0.01$), percentage body fat ($p < 0.001$), high sensitivity C-reactive protein ($p < 0.05$), interleukin-6, and tumor necrosis factor-α ($p < 0.05$) being significantly decreased in the exercise group.

DISCUSSION

Principal Findings

This systematic review examined the methodological quality of resistance training studies using the Physiotherapy Evidence Database (PEDro) scale. The six included studies—Fabrício E. Rossi et al., Marine Dupuit et al., Paulo R.P. Nunes et al., F. Maillard et al., Jae-Ryang Yoon et al., and Woo-Hyeon Son et al.—demonstrated variable adherence to quality criteria established for clinical trials in physiotherapy research. The mean PEDro score across studies was 5.83 out of 11 (range: 5–7), indicating predominantly moderate to low-moderate risk of bias. The most frequently satisfied criterion was eligibility criteria specification (100% of studies), followed by random allocation (100%) and baseline similarity (83.3%). Conversely, common methodological shortcomings included allocation concealment (0% of studies), blinding of subjects (0%), blinding of therapists (0%), and inadequate documentation of outcomes from more than 85% of initially allocated subjects (only 33.3% compliance).

These findings align with broader patterns observed in exercise physiology and resistance training literature, where implementation of rigorous blinding procedures and allocation concealment remains challenging due to the nature of exercise interventions. The inability to blind participants and therapists to treatment allocation represents a structural limitation inherent to behavioral and exercise-based interventions rather than methodological negligence by investigators.

Comparison with Existing Literature and Methodological Standards

The PEDro scale, developed to appraise the methodological quality of randomized controlled trials in physiotherapy, emphasizes both internal validity (via bias assessment criteria) and external validity (via specification of eligibility criteria). The present findings corroborate existing systematic reviews investigating quality trends in exercise research, which consistently report variable compliance with blinding and allocation concealment procedures. Studies achieving higher PEDro scores (Jae-Ryang Yoon et al. and Woo-Hyeon Son et al., both scoring 7/11) demonstrated superior methodological rigor through successful implementation of allocation concealment—a critical factor in minimizing selection bias.

The absence of blinding across all six studies warrants discussion in context. While blinding of participants and interventionists is theoretically ideal, its practical implementation in exercise research presents considerable challenges. Unlike pharmacological trials where placebo control is feasible, resistance training interventions cannot be meaningfully disguised. However, blinding of assessors—a criterion met by only one of the reviewed studies (F. Maillard et al.)—remains achievable and represents a more attainable quality marker. This disparity suggests a tendency among investigators to prioritize feasibility over methodological rigor in outcome assessment protocols.

The moderate-to-low quality profile of the included studies reflects patterns endemic to the broader exercise science literature, where trials consistently underperform on allocation concealment and assessor blinding criteria compared to pharmacological studies. This suggests that systematic quality improvements in resistance training research will require targeted interventions addressing specific methodological barriers rather than wholesale adoption of pharmaceutical trial standards.

Risk of Bias Analysis: Differential Impact on Study Validity

The risk of bias profile presents a nuanced picture requiring stratified interpretation.

The three studies classified as "moderate-high risk" (Rossi, Dupuit, Nunes; PEDro = 5) all failed to achieve allocation concealment and assessor blinding, substantially elevating selection and detection bias risks. These studies also reported outcome measures from insufficient participant numbers (below 85% retention), introducing attrition bias. Conversely, the two "low-moderate risk" studies (Yoon and Son; PEDro = 7) achieved allocation concealment and higher retention rates, positioning them as more reliable sources for treatment effect estimation.

The "moderate risk" study (Maillard et al.; PEDro = 6) demonstrated intermediate quality: while failing allocation concealment and participant blinding, it successfully implemented assessor blinding and reported point and variability measures for key outcomes, thereby reducing detection bias despite vulnerability to selection bias.

This stratification has direct implications for evidence synthesis. Weighted meta-analyses should proportionally reduce the contribution from moderate-high risk studies when pooling effect estimates, recognizing that their treatment effect estimates may be subject to systematic bias inflating intervention efficacy—a phenomenon documented extensively in exercise intervention research.

Specific Methodological Gaps and Their Clinical Implications

1.Allocation Concealment Deficit

Five of six studies (83.3%) failed to implement allocation concealment, despite this being one of the most effective strategies for preventing selection bias. This gap reflects either under-reporting of adequate procedures or genuine methodological shortcomings. In resistance training research, allocation concealment typically employs central randomization, sealed opaque envelopes, or web-based randomization platforms—all feasible within exercise settings. The near-universal absence suggests awareness gaps among investigators regarding the operational distinction between randomization and allocation concealment.

2. Blinding Architecture and Feasibility Trade-offs

The complete absence of participant and therapist blinding (0% compliance) reflects the acknowledged impossibility of masking exercise interventions. However, the parallel absence of assessor blinding in 83.3% of studies represents a missed opportunity. Contemporary resistance training studies can and should employ blinded assessors for primary outcome measurements (e.g., strength metrics via dynamometry, muscle mass via DXA scanning). The near-universal failure to report assessor blinding suggests either non-implementation or under-reporting of this critical procedural element.

3. Attrition and Intention-to-Treat Analysis

Only two studies (33.3%) reported outcome measures from more than 85% of initially allocated participants, a criterion that balances retention requirements with realistic research conditions. More concerning, only a minority explicitly employed intention-to-treat (ITT) analysis—a foundational principle for preserving randomization benefits despite dropout. The reliance on per-protocol analysis in the remaining studies introduces differential attrition bias, particularly problematic in exercise interventions where non-compliance may be unevenly distributed across treatment arms.

Publication Bias and Reporting Transparency

The restricted number of studies meeting inclusion criteria (n = 6) suggests potential publication bias, as negative or null findings in resistance training research may be under-represented in the published literature.

Incomplete reporting of PEDro criteria—evident from several studies where criterion satisfaction could not be definitively determined from published reports—also suggests gaps in adherence to reporting guidelines such as CONSORT and PRISMA.

Furthermore, the dependence of PEDro scoring on published descriptions implies that some studies may have implemented sound methodology that is not adequately documented. This under-reporting can lead to conservative estimates of trial quality and underscores the importance of complete and transparent reporting standards in physiotherapy research.

Heterogeneity and Implications for Meta-Analysis

The six studies exhibited substantial heterogeneity across multiple dimensions: participant characteristics (trained vs. untrained individuals, sex, age), training modalities (free weights, machines, elastic resistance), dosage (intensity, volume, frequency), and outcome measures (1-RM strength, endurance, body composition, functional performance). This clinical and methodological diversity, while enhancing generalizability, complicates quantitative pooling of results.

Any future meta-analysis based on these studies would need to account for this heterogeneity using random-effects models and, where feasible, subgroup or meta-regression analyses. Quality-related stratification (for example, comparing pooled effects from low-moderate versus moderate-high risk studies) would be particularly important to determine whether methodological rigor moderates observed treatment effects.

Implications for Practice and Evidence-Based Physiotherapy

The moderate overall quality profile of resistance training RCTs carries substantive implications for clinical decision-making. Clinicians should interpret the findings of these trials with graduated confidence, placing greater weight on results derived from low-moderate risk studies (Yoon and Son) while exercising more caution when extrapolating from moderate-high risk studies (Rossi, Dupuit, Nunes).

From a practical standpoint, the universal specification of eligibility criteria and widespread reporting of point estimates and variability measures support the use of these trials to inform clinical reasoning about resistance training dosage, progression, and expected magnitude of effect. However, the documented shortcomings in allocation concealment, assessor blinding, and ITT analysis suggest that true treatment effects may be somewhat smaller and less certain than reported in individual studies.

Therefore, resistance training should continue to be recommended as an evidence-informed intervention, but clinicians should consider the underlying methodological quality of the contributing trials when making patient-specific decisions, particularly in high-stakes or resource-intensive settings.

Recommendations for Methodological Improvement in Resistance Training Research

Advancing the quality of resistance training RCTs requires targeted capacity-building initiatives:

1. Allocation Concealment: Future trials should explicitly detail allocation concealment procedures, such as centralized randomization or sealed opaque envelopes, and these methods should be pre-registered in trial registries.
2. Assessor Blinding: Blinded outcome assessment should be implemented wherever feasible, particularly for objective measures such as strength testing and imaging-based outcomes. When blinding is not possible, the rationale and potential impact on bias should be clearly discussed.

3. Retention Strategies and ITT: Trials should incorporate robust strategies to minimize dropout, document reasons for attrition, and analyze data according to ITT principles.
4. Standardized Reporting: Investigators should adhere strictly to CONSORT and PEDro-based reporting checklists to ensure that all relevant methodological details are transparently described.

Limitations of This Systematic Review

Several limitations constrain the interpretation of the present review. First, the small number of eligible trials (n = 6) restricts the ability to conduct robust subgroup or sensitivity analyses. Second, the reliance on PEDro scores, which are dependent on the quality of reporting, may underestimate true methodological rigor in cases of incomplete description. Third, potential language and publication bias cannot be excluded, as non-English and unpublished studies were not systematically assessed.

Finally, the review focused exclusively on methodological quality as assessed by the PEDro scale and did not evaluate other important domains such as intervention fidelity, adherence monitoring, or therapist expertise, all of which may influence treatment effectiveness in resistance training interventions.

Future Directions

Future research should aim to design and report resistance training RCTs that meet high methodological standards, particularly in terms of allocation concealment, assessor blinding, and ITT analysis. Multi-centre trials with larger and more diverse samples would enhance external validity and facilitate more precise estimation of treatment effects.

There is also a need for meta-epidemiological studies exploring how specific PEDro criteria influence effect sizes in resistance training research. Such work could help prioritize which methodological improvements would yield the greatest gains in evidence reliability. Additionally, integrating implementation science frameworks into trial design may improve adherence, fidelity, and sustainability of resistance training programs in real-world clinical settings.

CONCLUSION

This systematic review demonstrates that resistance training RCTs evaluated via the PEDro scale exhibit moderate-to-low methodological quality, with mean scores indicating substantial room for improvement. The most prevalent methodological weaknesses - absence of allocation concealment, limited use of assessor blinding, and underutilization of intention to treat analyses are not insurmountable barriers but actionable targets for methodological enhancement.

From a clinical perspective, these findings do not undermine the therapeutic potential of resistance training but highlight the need for cautious interpretation of existing evidence and prioritization of higher-quality studies in clinical decision-making. From a research standpoint, systematic efforts to improve trial design, conduct, and reporting will be essential to strengthen the physiotherapy evidence base and support truly evidence-based practice in resistance training interventions.

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