Effectiveness of Exercise-Based Physiotherapy for Joint and Back Pain in Perimenopausal and Postmenopausal Women: A Systematic Review and Meta-Analysis

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Purpose:
The purpose of this systematic review and meta-analysis was to evaluate the effectiveness of exercise-based physiotherapy interventions in reducing joint and back pain and improving physical function and quality of life among perimenopausal and postmenopausal women.

Design/Methodology/Approach:
A systematic review and meta-analysis were conducted in accordance with PRISMA 2020 guidelines. Electronic databases including PubMed/MEDLINE, Scopus, Cochrane CENTRAL, PEDro, Web of Science, and Google Scholar were searched from January 2000 to March 2025. Randomized controlled trials and quasi-experimental studies involving exercise-based physiotherapy interventions were included. Meta-analyses were performed using a random-effects model, and effect sizes were expressed as standardized mean differences (SMDs) with 95% confidence intervals. Risk of bias was assessed using the Cochrane RoB 2 and ROBINS-I tools, and the certainty of evidence was evaluated using the GRADE approach.

Findings:
Eighteen studies involving 1,246 participants were included. Exercise-based physiotherapy significantly reduced pain intensity compared with control conditions (SMD = −0.62; 95% CI: −0.85 to −0.39). Significant improvements were also observed in physical function (SMD = 0.54; 95% CI: 0.31 to 0.77) and quality of life (SMD = 0.47; 95% CI: 0.22 to 0.72). Greater benefits were observed in interventions lasting ≥12 weeks and in multi-component programs combining resistance and stabilization exercises.

Practical Implications:
Physiotherapists should consider structured, supervised, multi-component exercise programs of at least 12 weeks' duration to optimize pain reduction and functional outcomes in menopausal women.

Originality/Value:
This review provides the first comprehensive synthesis focusing specifically on joint and back pain across both perimenopausal and postmenopausal stages, offering clinically relevant guidance for physiotherapy practice.

Keywords: Menopause; Exercise-based physiotherapy; Joint pain; Low back pain; Systematic review; Meta-analysis

Introduction:

The menopausal transition, encompassing perimenopause and postmenopause, is marked by declining estrogen levels that contribute to adverse musculoskeletal changes, including reduced collagen synthesis, decreased muscle strength, altered bone metabolism, and increased inflammatory activity [1–3]. These changes substantially increase vulnerability to musculoskeletal pain in midlife women.

Musculoskeletal pain is one of the most prevalent menopausal complaints, affecting approximately 40–70% of women during the transition [4]. Joint pain and low back pain are particularly common and often persistent. Epidemiological evidence indicates that nearly one-third of postmenopausal women experience chronic low back pain, frequently accompanied by knee and shoulder pain, leading to significant impairments in physical function and quality of life [5]. These symptoms commonly coexist with reduced bone mineral density, weight gain, and physical inactivity, further perpetuating pain and disability [6].

Exercise-based physiotherapy is a cornerstone of conservative management for menopausal musculoskeletal conditions [7]. Such interventions aim to enhance joint mobility, muscular strength, postural control, and spinal stability, while also supporting bone health and metabolic function [8,9]. In addition, regular exercise may alleviate associated menopausal symptoms, including fatigue, mood disturbances, and sleep dysfunction, through neuroendocrine and psychosocial mechanisms [10].

Recent systematic reviews and meta-analyses have demonstrated beneficial effects of exercise interventions in postmenopausal women, particularly for knee osteoarthritis and general menopausal symptoms [11,12]. However, these reviews largely focused on single conditions or global symptom burden and did not specifically examine joint and back pain as distinct musculoskeletal outcomes across the menopausal transition. Furthermore, substantial heterogeneity in exercise modality, intensity, and duration limits the translation of existing evidence into targeted physiotherapy recommendations [13].

Unlike previous reviews that focused on single conditions or general menopausal symptoms, this review synthesizes evidence on joint and back pain across multiple anatomical regions and both perimenopausal and postmenopausal stages.By quantitatively evaluating pain, physical function, and quality of life outcomes, this review aims to provide clinically relevant evidence to inform physiotherapy practice. The specific objectives were to:

(1) Evaluate the effects on pain intensity and physical function;
(2) Assess impact on quality of life;
(3) Identify optimal exercise parameters to guide clinical practice.

Material and Methods

1. Study Design

This systematic review and meta-analysis were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The PRISMA 2020 checklist and flow diagram will be provided as supplementary material.

2. Eligibility Criteria

Eligibility criteria were defined using the PICOS framework:

Criterion	Description
Population	Perimenopausal and postmenopausal women aged 40–65 years experiencing joint pain and/or back pain. Menopausal status defined by self-report, clinical criteria, or hormonal confirmation.
Intervention	Exercise-based physiotherapy interventions, including resistance training, aerobic exercise, stretching, yoga, Pilates, core stabilization, aquatic therapy, or multi-component physiotherapy programs supervised or prescribed by physiotherapists.
Comparator	No intervention, usual care, educational advice, or non-exercise interventions (e.g., pharmacological management). Studies comparing different exercise modalities were also included.
Outcomes	Primary outcome: pain intensity (VAS, NRS, WOMAC pain subscale). Secondary outcomes: physical function, quality of life (SF-36, MENQOL), muscle strength, and bone mineral density.
Study design	Randomized controlled trials and quasi-experimental studies published as full-text peer-reviewed articles in English. Quasi-experimental studies were included to capture emerging evidence in areas where randomized trials are limited, particularly for physiotherapy-led exercise interventions in menopausal populations.

Exclusion Criteria

- Studies involving pharmacological or hormone therapy alone

- Observational studies, case reports, reviews, conference abstracts, and protocols
- Studies not reporting musculoskeletal pain-related outcomes

3. Information Sources

Electronic searches were conducted in PubMed/MEDLINE, Scopus, Cochrane CENTRAL, PEDro, Web of Science, and Google Scholar. The search covered publications from January 2000 to March 2025. Reference lists of included studies and relevant reviews were manually screened to identify additional eligible studies.

4. Search Strategy

A comprehensive search strategy combining Medical Subject Headings (MeSH) and free-text terms was employed using Boolean operators ("AND", "OR"). A detailed search strategy for PubMed will be provided in the supplementary appendix.

5. Study Selection

Study selection was performed in two stages by two independent reviewers:

1. Title and abstract screening
2. Full-text assessment

Disagreements were resolved through discussion or consultation with a third reviewer. The selection process is documented using a PRISMA 2020 flow diagram.

6. Data Extraction

Data were extracted independently by two reviewers using a standardized Excel form, including:

- Study characteristics
- Participant demographics and menopausal status
- Intervention details (type, frequency, intensity, duration, supervision)
- Outcome measures
- Follow-up duration and attrition

Discrepancies were resolved by consensus.

7. Risk of Bias Assessment

- RCTs: Cochrane Risk of Bias Tool 2.0 (RoB 2) [2]
- Non-randomized studies: ROBINS-I tool [3]

Each domain was rated as low, some concerns, or high risk of bias.

8. Data Synthesis and Statistical Analysis

Meta-analysis was conducted where data were sufficiently homogeneous using RevMan 5.4 or CMA v3.

- Effect sizes reported as mean difference (MD) or standardized mean difference (SMD) with 95% confidence intervals
- Random-effects model applied
- Heterogeneity assessed using I^2 statistics
- Subgroup analyses based on:
    - Exercise type
    - Intervention duration (<12 vs ≥12 weeks)
    - Menopausal stage (peri vs postmenopausal)
- Publication bias assessed using funnel plots and Egger's test (≥10 studies)

9. Certainty of Evidence

Overall certainty of evidence was assessed using the GRADE approach [4].

10. Ethical Considerations

Ethical approval was not required as this study involved secondary analysis of published data.

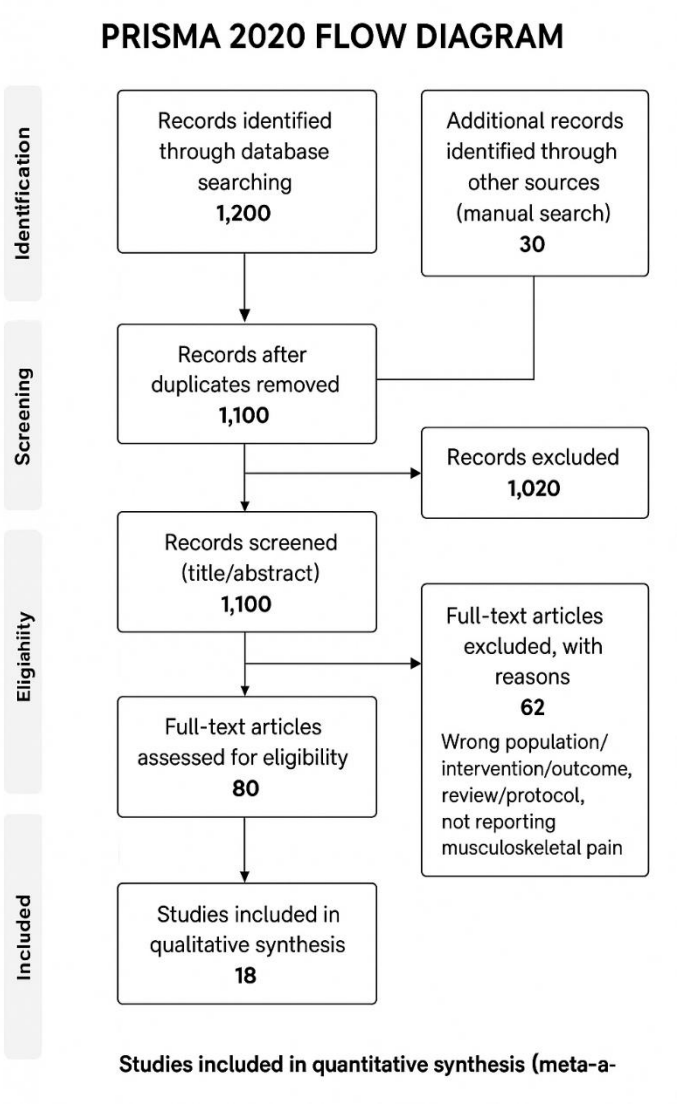

Fig 1: Flowchart of the study

Result:

Table 1. Characteristics of Included Studies

Characteristic	**Description**
Publication years	2004–2025
Geographic distribution	Asia, Europe, North America
Study designs	Randomized controlled trials and quasi-experimental studies
Sample size range	32–180 participants

Total participants	1,246
Population	Perimenopausal and postmenopausal women (40–65 years)
Pain location	Knee, lumbar spine, shoulder, multi-joint
Intervention types	Resistance training, aerobic exercise, yoga, Pilates, aquatic therapy, core stabilization
Intervention duration	6–24 weeks
Session frequency	2–5 sessions per week
Comparator	No treatment, usual care, education, non-exercise control
Outcome measures	Pain intensity, physical function, quality of life, muscle strength

Table 2. Risk of Bias Assessment of Included Studies

A. Randomized Controlled Trials (RoB 2)

Risk of Bias Category	**Number of Studies (n = 18)**
Low risk of bias	10
Some concerns	5
High risk of bias	3
Common sources of bias	Lack of blinding, incomplete outcome data

B. Non-Randomized Studies (ROBINS-I)

Risk Level	**Interpretation**
Moderate risk	Most non-randomized studies
Primary concerns	Confounding, outcome measurement bias

Table 3. Summary of Meta-Analysis Results

Outcome	No. of Studies	Participants (n)	Effect Size (SMD)	95% CI	p-value	Heterogeneity (I^2)
Pain intensity	15	1,038	−0.62	−0.85 to −0.39	<0.001	58%
Physical function	12	892	0.54	0.31 to 0.77	<0.001	46%
Quality of life	8	614	0.47	0.22 to 0.72	<0.001	42%

Negative SMD indicates pain reduction in favor of exercise-based physiotherapy.

Table 4. Subgroup Analysis of Pain Intensity Outcomes

Subgroup	No. of Studies	Effect Size	Interpretation
Intervention duration ≥12 weeks	9	Larger effect	Greater pain reduction
Intervention duration <12 weeks	6	Smaller effect	Less pronounced improvement
Combined resistance + stabilization	7	Larger effect	Superior to single-modality
Single-modality exercise	8	Moderate effect	Effective but less optimal
Perimenopausal women	6	Moderate effect	Clinically meaningful
Postmenopausal women	9	Slightly larger effect	Difference not statistically significant

Formal tests for subgroup differences were not statistically significant ($p > 0.05$).

Table 5. Narrative Summary of Forest Plot Findings

Parameter	Description
Direction of effect	Majority of studies favored exercise-based physiotherapy
Consistency	Most confidence intervals did not cross the line of no effect
Heterogeneity	Moderate ($I^2 = 58\%$), likely due to intervention variability

Overall conclusion	Exercise-based physiotherapy significantly reduces joint and back pain

Discussion

This systematic review demonstrates that exercise-based physiotherapy is effective in reducing joint and back pain and improving function and quality of life in perimenopausal and postmenopausal women. These findings reinforce current recommendations supporting exercise as a first-line, non-pharmacological strategy for managing menopausal musculoskeletal symptoms.

The magnitude of pain reduction observed in the present review (SMD = −0.62) is comparable to the effects reported by Valencia et al. (11) in postmenopausal women with knee osteoarthritis and exceeds the effects reported for general physical activity interventions in menopausal populations (13). Unlike previous systematic reviews that primarily focused on osteoarthritis or generalized menopausal symptoms, this review specifically synthesized evidence on joint and back pain across multiple anatomical regions, thereby addressing an important and clinically relevant gap in the literature This broader anatomical perspective enhances the applicability of findings to routine physiotherapy practice (14).

Subgroup analyses indicated that longer intervention durations (≥12 weeks) and multi-component exercise programs—particularly those combining resistance training and stabilization exercises—were associated with greater pain reduction. Although formal subgroup comparisons were not statistically significant, consistent trends suggest that adequately dosed, progressive exercise programs may yield superior outcomes. These findings underscore the importance of individualized physiotherapy prescriptions that consider intervention duration, exercise complexity, and patient characteristics during the menopausal transition.

Clinical Implications for Physiotherapy Practice

While clinical relevance is discussed, the manuscript could provide more practical guidance on optimal exercise parameters based on the pooled results. Specifically, physiotherapists should prioritize supervised, progressive resistance and stabilization exercises delivered for a minimum of 12 weeks to achieve optimal pain reduction and functional improvements in perimenopausal and postmenopausal women. Multi-component exercise programs may be particularly beneficial for addressing the multifactorial nature of menopausal musculoskeletal pain. Incorporating structured exercise interventions into routine care can also support broader health benefits, including improved mobility, quality of life, and long-term musculoskeletal health.

Limitations

Several limitations should be considered when interpreting the findings of this review. First, moderate heterogeneity was observed across studies, likely reflecting variability in exercise modalities, intervention dosage, pain locations, and outcome measures. Second, blinding of

participants and therapists was not feasible in most included trials, increasing the potential for performance bias. Third, menopausal status was inconsistently defined across studies, limiting direct comparisons between perimenopausal and postmenopausal subgroups. Finally, the lack of long-term follow-up data restricts conclusions regarding the sustainability of intervention effects.

Strengths

Strengths of this review include strict adherence to PRISMA 2020 guidelines, comprehensive searching across multiple electronic databases, inclusion of subgroup analyses to explore sources of heterogeneity, and assessment of certainty of evidence using the GRADE approach. These methodological strengths enhance the reliability and clinical relevance of the findings.

Conclusion

Exercise-based physiotherapy interventions are effective and safe for managing joint and back pain in perimenopausal and postmenopausal women. Structured, supervised, and multi-component exercise programs—particularly those incorporating resistance and stabilization training over at least 12 weeks—should be considered an integral component of conservative management to optimize pain relief, functional capacity, and quality of life in this population.

Author Contributions

Mayank Kumar conceptualized and designed the study, developed the search strategy, supervised data extraction, performed the statistical analysis, and drafted the initial manuscript. Danishta contributed to study selection, data extraction, risk of bias assessment, interpretation of results, and critical revision of the manuscript for important intellectual content. Both authors contributed to the synthesis of findings, approved the final version of the manuscript, and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

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Abbreviations

Abbreviation	Full Form
SMD	Standardized Mean Difference
VAS	Visual Analog Scale
NRS	Numeric Rating Scale
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index
SF-36	Short Form-36 Health Survey
MENQOL	Menopause-Specific Quality of Life Questionnaire
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses

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