



Review article

Physical exercise and mind–body exercise in the menopausal transition: A systematic review and meta-analysis of effects on quality of life, symptoms, and psychological health

Africa Ruiz-Cerezo ^{*} , Nuria Mendoza Laiz, Carmen Romero Ferreiro

Faculty of Health Sciences, Universidad Francisco de Vitoria, Pozuelo de Alarcón, 28223 Madrid, Spain



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ABSTRACT

Objectives: The climacteric period is associated with endocrine changes and multisystem symptoms that may adversely affect health-related quality of life and psychological well-being. This systematic review and meta-analysis aimed to evaluate the effects of conventional and mind–body exercise interventions on menopausal symptomatology, health-related quality of life, anxiety, and depression in women during the climacteric period.

Methods: A systematic search and meta-analysis of randomized controlled trials were conducted according to the PRISMA 2020 statement and prospectively registered in PROSPERO (CRD420251148069). PubMed (MEDLINE), Scopus, and Web of Science were searched from January 2020 to September 2025. Risk of bias was assessed using the Cochrane RoB tool, certainty of evidence using the GRADE approach, and random-effects meta-analyses, prespecified subgroup analyses, and leave-one-out sensitivity analyses were performed.

Results: Twelve randomized controlled trials including 1,050 participants were included in the systematic review. Exercise was associated with significant improvements in menopausal symptomatology (Hedges' $g = -2.10$; 95% CI $[-4.14, -0.06]$), health-related quality of life (Hedges' $g = 1.41$; 95% CI $[0.46, 2.36]$), anxiety (MD = -1.20 ; 95% CI $[-1.52, -0.88]$), and depressive symptoms (MD = -1.17 ; 95% CI $[-1.40, -0.94]$) compared with control conditions. Exploratory subgroup analyses suggested that the effects of exercise may differ according to exercise modality. Sensitivity analyses supported the robustness of the pooled estimates.

Conclusions: The available evidence suggests that physical exercise represents an effective non-pharmacological strategy for improving menopausal symptomatology, health-related quality of life, anxiety, and depressive symptoms in women during the climacteric period. These findings support its incorporation into routine clinical care and highlight the importance of individualised exercise prescription.

Introduction

The menopausal transition, commonly referred to as the climacteric period, encompasses perimenopause, menopause, and postmenopause and is characterised by progressive endocrine changes and multisystem physiological adaptations [1]. Menopause is clinically defined as the permanent cessation of menstruation after 12 consecutive months of amenorrhoea in the absence of pathological causes [2]. The timing and clinical expression of this transition vary considerably among women [3].

The climacteric period is commonly associated with vasomotor symptoms, sleep disturbances, urogenital complaints, musculoskeletal pain, fatigue, weight gain, sarcopenia, anxiety, and depressive

symptoms, which may substantially impair health-related quality of life, daily functioning, and social participation [1,3–5]. It is also associated with increased long-term risks, including osteoporosis, adverse cardiometabolic profiles, cardiovascular disease, chronic pain, and psychological distress [6,7].

Hormone therapy remains an effective treatment for menopausal symptoms; however, its use may be limited by contraindications, safety concerns, or individual preferences [8,9]. Consequently, non-pharmacological interventions have gained increasing attention, with structured exercise representing a safe, accessible, and cost-effective strategy that provides cardiovascular, musculoskeletal, metabolic, and psychological benefits [10–12].

Both conventional exercise (e.g., aerobic, resistance,

^{*} Corresponding author.

E-mail addresses: africa.ruiz@ufv.es (A. Ruiz-Cerezo), nuria.mendoza@ufv.es (N. Mendoza Laiz), mc.romero@ufv.es (C. Romero Ferreiro).

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multicomponent training) and mind–body modalities have been proposed to improve menopausal health. While conventional exercise primarily targets physical function and cardiometabolic health, mind–body exercise may additionally enhance psychological well-being through integrated movement, breathing, and attentional regulation [13,14]. However, the available evidence remains heterogeneous because of differences in exercise modality, intervention characteristics, outcome measures, and methodological quality, limiting conclusions regarding the most effective exercise approaches during the climacteric period [12,15].

Therefore, this systematic review and meta-analysis aimed to synthesise evidence from randomized controlled trials evaluating the effects of conventional and mind–body exercise on menopausal symptomatology, health-related quality of life, anxiety, and depressive symptoms in women during the climacteric period.

Methods

Protocol registration

This systematic review and meta-analysis was conducted in accordance with PRISMA 2020 to synthesize evidence on conventional and mind–body exercise interventions in women undergoing the climacteric period [16]. Eligibility criteria and search procedures were defined a priori using the PICO framework [17]. The completed PRISMA 2020 checklist, including the corresponding page numbers for each item, is provided as [Supplementary Material](#) (Appendix I).

Search strategy and eligibility criteria

A systematic search of articles was conducted in PubMed (MEDLINE), Scopus, and Web of Science to identify studies relevant to the present review. The electronic search covered the period from January 2020 to September 2025, both inclusive. The last search of all databases was performed on 11 September 2025. The search strategy combined controlled vocabulary (e.g., MeSH terms) and free-text keywords related to the population (menopause, perimenopause, postmenopause, climacteric), interventions (structured conventional or mind–body exercise), and outcomes (menopausal symptoms, quality of life, anxiety, depression, and stress). The complete search strategies for each database are provided in Appendix II.

The inclusion criteria were: (i) Clinical Trials, Controlled Clinical Trials, or Randomized Controlled Trials; (ii) participants consisting of women in the climacteric period, including perimenopause, menopause, or postmenopause; (iii) interventions consisting of structured exercise programmes, such as aerobic exercise, resistance or strength training, functional or circuit training, walking, running, swimming, or dance-based exercise, as well as mind–body or conscious exercise modalities including yoga, tai chi/tai ji, qigong/qi gong, Pilates, Feldenkrais method, Alexander technique or mindfulness-based movement; (iv) comparison with no intervention, usual or routine care, monitoring or clinical follow-up, or minimal educational interventions without a structured exercise component; and (v) reporting at least one relevant outcome related to menopausal symptomatology, health-related quality of life, or psychological outcomes.

Studies including populations other than women in the climacteric period, studies in which sex-specific data could not be extracted, populations primarily defined by specific clinical conditions, multimodal interventions in which the independent effects of exercise could not be isolated, and non-eligible study designs (qualitative, observational, and narrative reviews) were excluded.

All retrieved records were imported into a reference manager, duplicates were removed, and two reviewers independently screened titles, abstracts, and full texts. Disagreements were resolved through discussion or consultation with a third reviewer. Screening was performed using Zotero and Rayyan, and reasons for full-text exclusion were

recorded ([Fig. 1](#)).

Evaluation of studies

Primary outcomes included menopausal symptomatology, health-related quality of life, and psychological outcomes, specifically anxiety and depression, assessed using validated instruments at the time point closest to post-intervention, with follow-up data extracted when available. Methodological quality was independently assessed by two reviewers using the Cochrane Risk of Bias tool (RoB), which evaluates bias related to randomization, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results [18]. Disagreements were resolved through discussion or consultation with a third reviewer.

The certainty of the evidence for each outcome was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, considering risk of bias, inconsistency, indirectness, imprecision, and publication bias. Certainty was classified as high, moderate, low, or very low, and the findings were summarized in a Summary of Findings table ([Supplementary Table S2](#)).

Data extraction

Sample sizes (intervention and control) as well as means and standard deviations (SDs) before and after the intervention, were collected. For studies included in the quantitative synthesis, post-intervention means and standard deviations, or change scores when required, were extracted for each intervention and control group. The outcome data used in the meta-analysis are provided in [Supplementary Table S1](#). Extracted variables included study design and setting, country or region, sample size, menopausal stage, eligibility criteria, intervention characteristics described according to the FITT principle (frequency, intensity, time, and type), comparator details, duration of the intervention, supervision modality, outcome domains and measurement instruments, assessment time points, main results, adherence indicators, adverse events, withdrawals and reasons for attrition, as well as sources of funding and conflicts of interest. Disagreements were resolved by discussion or consultation with a third reviewer. When necessary, corresponding authors were contacted for clarification.

Statistical analysis

The primary outcome was menopausal symptoms, assessed using validated scales such as the Menopause Rating Scale (MRS). When available, results were extracted as mean values and standard deviations. Changes in menopausal symptoms were calculated as the difference between post-intervention and baseline scores when not directly reported in the original studies. If the standard deviation of the change was not provided, it was estimated using established statistical methods described in previous research [19,20]. The outcomes evaluated in the meta-analysis were menopausal symptomatology, health-related quality of life, anxiety, and depressive symptoms, assessed using validated instruments. To ensure a consistent interpretation of the results, the direction of all outcome scales was harmonized so that effect estimates pointed in the same direction across studies. When necessary, the sign of the mean values or change scores was reversed so that negative effects consistently represented reductions in menopausal or psychological symptoms, whereas positive effects represented improvements in health-related quality of life.

The statistical heterogeneity assumption was assessed using Cochran's Q test based on χ^2 (considered significant at p-value < 0.05) and quantified with the I² statistic (with values < 25%, 25% to 75%, and > 75% interpreted as representing low, moderate, and high levels of heterogeneity, respectively [21]). A random-effects model was used for all meta-analyses owing to the expected clinical and methodological heterogeneity among studies, including differences in exercise modality,

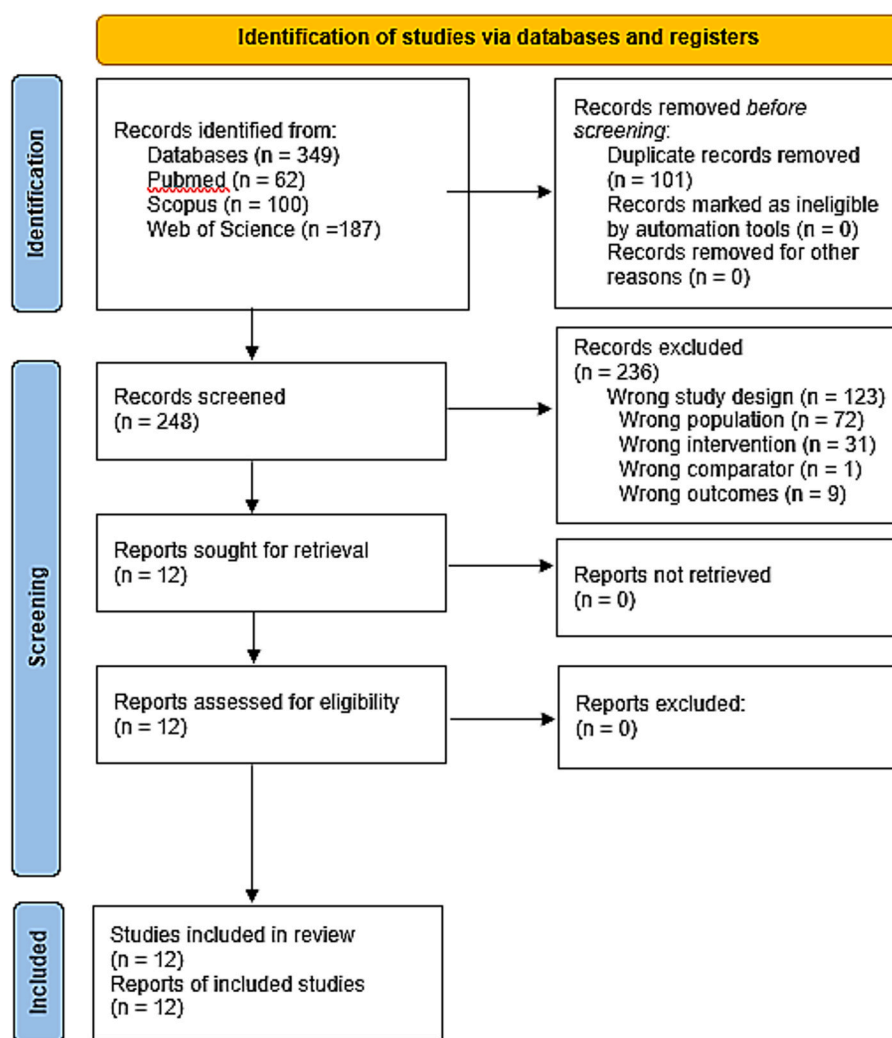


Fig. 1. Flowchart of the search strategy according to PRISMA.

intervention duration, supervision, outcome measures, and participant characteristics.

The standardized mean difference (SMD; Hedges' *g*) with 95% confidence intervals (CIs) was used when studies assessed the same outcome using different instruments, as occurred for menopausal symptomatology and health-related quality of life. The mean difference (MD) with 95% CIs was retained for anxiety and depressive symptoms because all studies included in the respective quantitative syntheses used the same measurement instrument and subscale: the Hospital Anxiety and Depression Scale-Anxiety subscale (HADS-A) for anxiety and the Hospital Anxiety and Depression Scale-Depression subscale (HADS-D) for depressive symptoms. Therefore, these pooled estimates remained interpretable in the original units of the corresponding HADS subscale. The DASS-21 outcomes reported by Susanti et al. were retained in the qualitative synthesis but excluded from the quantitative syntheses of anxiety and depression because they were not directly comparable with the HADS subscales used by the remaining studies.

For studies with multiple intervention arms sharing a single control group, the sample size of the control group was divided equally among the corresponding comparisons while preserving the original means and standard deviations, in accordance with Cochrane recommendations, to avoid double-counting participants.

Exploratory subgroup analyses were conducted according to exercise modality (conventional exercise versus mind-body exercise) when both intervention categories were represented by a sufficient number of

studies. Accordingly, subgroup analyses were performed for menopausal symptoms and health-related quality of life, whereas they were not undertaken for anxiety or depression because only one study evaluating a mind-body intervention was available for each outcome. Given the small number of studies within each subgroup, these analyses were considered exploratory and were interpreted cautiously.

Sensitivity analyses using a leave-one-out approach were performed for all outcomes by sequentially excluding one study or comparison at a time to assess the robustness of the pooled estimates and identify potentially influential studies. The results of the meta-analyses were displayed in forest plots.

Publication bias was not formally assessed, as fewer than ten studies were available for each outcome, making funnel-plot interpretation and statistical tests such as Egger's regression unreliable according to current methodological recommendations.

Statistical analyses were performed using IBM SPSS Statistics 29 and results were considered statistically significant when $p < 0.05$.

Results

Review and selection of studies

A total of 349 records were identified across PubMed (MEDLINE), Scopus, and Web of Science. After removal of 101 duplicates, 248 records were screened. Twelve studies met the eligibility criteria and were

included in the qualitative synthesis, of which ten contributed data to at least one meta-analysis according to outcome availability.

Characteristics of included studies

The 12 included randomized controlled trials enrolled a total of 1,050 women at baseline. Of these, 719 participants were included in the quantitative synthesis. Participants included women across perimenopausal, menopausal, and postmenopausal stages. We included only one intervention and one control group taken from each randomized controlled trial (RCT) except for the studies by Ben Waer et al. [22] and Fausto et al. [23] which assigned participants to two intervention groups and one control group.

The interventions analysed comprised a heterogeneous range of exercise-based approaches, including conventional exercise modalities (such as aerobic training, resistance training, concurrent and multi-component programmes, functional training, and dance-based exercise including Zumba) as well as mind-body exercise interventions (including yoga, Pilates, and Qigong). Of the 12 included studies, 7 (58.3%) evaluated conventional exercise interventions, 4 (33.3%) investigated mind-body exercise interventions, and 1 study (8.3%) incorporated a combination of both approaches. Interventions lasted 8–20 weeks, with sessions of 50–75 min, 2–3 times per week, under supervised, partially supervised or home-based conditions.

The main characteristics of the studies included are summarised in Table 1.

All included studies were retained in the qualitative synthesis. However, the intervention arms and outcome measures corresponding to the prespecified quantitative comparisons were included in the meta-analyses. Consequently, some outcome measures, such as the Depression Anxiety Stress Scale-21 (DASS-21), and non-selected intervention arms from multi-arm trials, such as the task-specific functional training arm of Aragão-Santos et al. [24], were retained only for the qualitative synthesis. Likewise, Marín-Jiménez et al. [25] and Berin et al. [26] were included in the qualitative synthesis but were not entered into the quantitative synthesis because health-related quality of life outcomes were reported as domain-specific scores rather than as a single overall score, precluding the calculation of comparable pooled effect estimates.

Quality assessment

Overall, most studies presented an unclear risk of bias across domains. Notably, high risk of bias was identified in only one study and limited to a single domain (Figs. 2A and 2B). Random sequence generation was generally better reported, whereas allocation concealment and blinding were frequently unclear.

All included studies were randomized controlled trials and reported losses to follow-up. Dropout rates ranged from 0% to 26.7%, with several studies reporting attrition below 20%, although higher losses were observed in some groups, particularly in control conditions. Adherence was clearly defined only in some supervised interventions, where it was generally high. Several studies, particularly mind-body or partially unsupervised interventions, did not quantify adherence, introducing uncertainty regarding the actual intervention dose received.

According to the GRADE approach, the certainty of evidence ranged from low to moderate across the primary outcomes. Low-certainty evidence was identified for menopausal symptoms, health-related quality of life, and anxiety, whereas moderate-certainty evidence was identified for depression. Detailed certainty ratings and the rationale for downgrading are presented in the Summary of Findings table (Supplementary Table S2).

Meta-analysis of menopausal symptoms outcomes

The meta-analysis demonstrated that exercise interventions were associated with a very large reduction in menopausal symptomatology

compared with control conditions (Hedges' $g = -2.10$; 95% CI $[-4.14, -0.06]$; $p = 0.04$) (Fig. 3). These findings indicate that exercise interventions may substantially reduce menopausal symptom burden during the climacteric period. Considerable between-study heterogeneity was observed ($I^2 = 99\%$), consistent with the clinical diversity of the included interventions and outcome measures. Exploratory subgroup analyses suggested that mind-body exercise was associated with larger improvements in menopausal symptoms than conventional exercise. Leave-one-out sensitivity analyses showed that the overall direction of the effect remained unchanged following sequential exclusion of individual comparisons, supporting the robustness of the pooled estimate despite the observed heterogeneity.

Meta-analysis of health-related quality of life outcomes

The meta-analysis showed that exercise interventions were associated with a large improvement in health-related quality of life compared with control conditions (Hedges' $g = 1.41$; 95% CI $[0.46, 2.36]$; $p = 0.004$) (Fig. 4). These findings suggest that exercise interventions may meaningfully improve health-related quality of life in women during the climacteric period. Statistical heterogeneity was substantial ($I^2 = 84\%$), reflecting differences in intervention characteristics and quality-of-life instruments across studies. Exploratory subgroup analyses suggested that conventional exercise was associated with larger improvements in health-related quality of life than mind-body exercise. Leave-one-out sensitivity analyses demonstrated that the pooled estimate remained stable after sequential exclusion of individual comparisons.

Meta-analysis of anxiety outcomes

The meta-analysis demonstrated that exercise interventions were associated with significantly lower anxiety scores than control conditions (MD = -1.20 ; 95% CI $[-1.52, -0.88]$; $p < 0.001$), indicating a beneficial effect of exercise on anxiety symptoms (Fig. 5). These findings support the beneficial effects of exercise on anxiety symptoms during the climacteric period. No statistical heterogeneity was observed across studies ($I^2 = 0\%$); nevertheless, a random-effects model was retained according to the prespecified analysis strategy because clinical heterogeneity between studies was expected. Subgroup analyses were not performed because only one study evaluated a mind-body intervention. Leave-one-out sensitivity analyses confirmed the robustness of the pooled estimate.

Meta-analysis of depression

The meta-analysis demonstrated that exercise interventions were associated with significantly lower depressive symptom scores than control conditions (MD = -1.17 ; 95% CI $[-1.40, -0.94]$; $p < 0.001$), indicating a beneficial effect of exercise on depressive symptoms (Fig. 6). These findings support the beneficial effects of exercise on depressive symptoms during the climacteric period. No statistical heterogeneity was observed across studies ($I^2 = 0\%$); nevertheless, a random-effects model was retained according to the prespecified analysis strategy because clinical heterogeneity between studies was expected. Subgroup analyses were not performed because only one study evaluated a mind-body intervention. Leave-one-out sensitivity analyses showed that the pooled estimate remained statistically significant and largely unchanged after sequential exclusion of individual comparisons, supporting the robustness of the findings.

Discussion

The present systematic review and meta-analysis aimed to evaluate the effects of structured physical exercise and mind-body exercise on menopausal symptoms, health-related quality of life, and psychological outcomes in women undergoing the climacteric period.

Table 1
Characteristics of the studies included.

Study	Population	Age (years)*	n (IG/CG)	Exercise intervention (type; frequency; duration)	Control	Outcomes	Outcome measure (score range; direction)	Contributed to quantitative synthesis
Ben Waer et al. 2024 [22]	Postmenopausal women	IG1: 57.1 (1.4) IG2: 57.4 (0.6) CG: 58.06 (0.94)	16/ 16/ 16**	IG1: supervised Pilates; 3 sessions/week; 50 min/session; 12 weeks IG2: supervised Zumba; 3 sessions/week; 50 min/session; 12 weeks	Usual activities	SF-36	SF-36 (0–100; higher = better)	Yes***
Fausto et al. 2025 [23]	Early postmenopausal women	53.19 (3.39)	22/ 22/ 20**	IG1: supervised jazz dance; 2 sessions/week, 60 min/session; 16 weeks IG2: supervised concurrent training; 3 sessions/week; 60 min/session; 16 weeks	Usual activities (monthly telephone contact)	HADS	HADS-A (0–21; higher = worse); HADS-D (0–21; higher = worse)	Yes***
Aragão-Santos et al. 2020 [24]	Postmenopausal women	IG1: 65.2 (4.3) IG2: 66 (5.2) CG: 66.1 (4.1)	13 /15/ 11**	IG1: supervised element-based functional training (EBFT); 3 sessions/week; 50 min/session; 14 weeks IG2: supervised task-specific functional training (TSBFT); 3 sessions/week; 50 min/session; 14 weeks	Usual activities	WHOQOL-Bref	WHOQOL-BREF (0–130; higher = better)	Yes
Marín-Jiménez et al. 2023 [25]	Women during the menopausal transition	IG: 52.4 (4.4) CG: 52.1 (4.1)	58/ 53	Concurrent training (aerobic + resistance, balance and coordination); 3 sessions/week; 60 min/session; 16 weeks	Counselling and lifestyle advice	EQ-5DEQ-VAS SF-36	EQ-5D (index, approximately 0–1; higher = better); EQ-VAS (0–100; higher = better); SF-36 (0–100; higher = better)	No
Berin et al. 2022 [26]	Postmenopausal women	IG: 55.2 (5.5) CG: 55.4 (5.0)	28/ 29	Resistance training; 3 sessions/week; 15 weeks	No intervention	WHQSF-36	WHQ domains (0–1; higher = worse); SF-36 (0–100; higher = better)	No
Scarpel et al. 2025 [27]	Menopausal women	53.21 (3.65)	22/ 20	Concurrent training (aerobic + resistance); 3 sessions/week; 16 weeks	Usual activities	MRS HADS-D	MRS (0–44; higher = worse); HADS-D (0–21; higher = worse)	Yes
Carcelén-Fraile et al. 2022 [28]	Postmenopausal women	IG: 69.70 (6.15) CG: 69.75 (6.76)	57/ 60	Qigong (BaDuanJin); 2 sessions/week; 60 min/session; 12 weeks	Usual activities	HADS	HADS-A (0–21; higher = worse); HADS-D (0–21; higher = worse)	Yes
Susanti et al. 2022 [29]	Premenopausal, perimenopausal and postmenopausal women	IG: 52.39 (4.23) CG: 52.57 (3.90)	95/ 92	Yoga; 3 sessions/week; 75 min/session; 20 weeks	Usual care (no structured exercise)	MRS DASS-21	MRS (0–44; higher = worse); DASS-21 (0–42; higher = worse)	Yes
Abiç y Yilmaz Vefikuluçay 2024 [30]	Menopausal women	IG: 54.6 (3.6) CG: 54.9 (4.0)	31/ 31	Yoga; 2 sessions/week; 60 min/session; 10 weeks	No intervention	MRS	MRS (0–44; higher = worse)	Yes
Baena-García et al. 2022 [31]	Perimenopausal women	IG: 52.3 (4.4) CG: 51.9 (4.1)	56 / 51	Supervised multicomponent exercise; 3 sessions/week; 60 min/session; 16 weeks	Counselling and lifestyle advice	Cervantes Menopause and Health Subscale	Cervantes Menopause and Health Subscale (0–15; higher = worse)	Yes
Yiğit Kocamer y Merve 2025 [32]	Postmenopausal women	45–65 years	15/ 15	Supervised Pilates; 2 sessions/week; 60 min/session; 8 weeks	Menopause education sessions (no structured exercise)	MRS MENQOL	MRS (0–44; higher = worse); MENQOL (0–174; higher = worse)	Yes
Lahiani et al. 2024 [33]	Postmenopausal women	IG: 56.2 (3.8) CG: 55.9 (4.2)	19/ 19	Supervised Zumba; 3 sessions/week; 50 min/session; 12 weeks	Usual activities	SF-36	SF-36 (0–100; higher = better)	Yes

*Age reported as mean (standard deviation), group-specific mean (standard deviation), or age range according to the original studies.

**Multi-arm studies reported as IG1, IG2, and CG.

*** For the multi-arm trials by Ben Waer et al. [22] and Fausto et al. [23], the shared control group was equally divided across comparisons in accordance with the Cochrane Handbook for Systematic Reviews of Interventions to avoid double-counting participants.

Abbreviations: CG, control group; DASS-21, Depression Anxiety Stress Scale-21; EBFT, element-based functional training; EQ-5D, EuroQol 5-Dimension questionnaire;

EQ-VAS, EuroQol Visual Analogue Scale; HADS, Hospital Anxiety and Depression Scale; HADS-A, Hospital Anxiety and Depression Scale-Anxiety subscale; HADS-D, Hospital Anxiety and Depression Scale-Depression subscale; IG, intervention group; IG1, first intervention group; IG2, second intervention group; MENQOL, Menopause-Specific Quality of Life Questionnaire; MRS, Menopause Rating Scale; NR, not reported; SF-36, 36-Item Short Form Health Survey; TSBFT, task-specific functional training; WHQ, Women's Health Questionnaire; WHOQOL-BREF, World Health Organization Quality of Life-BREF.

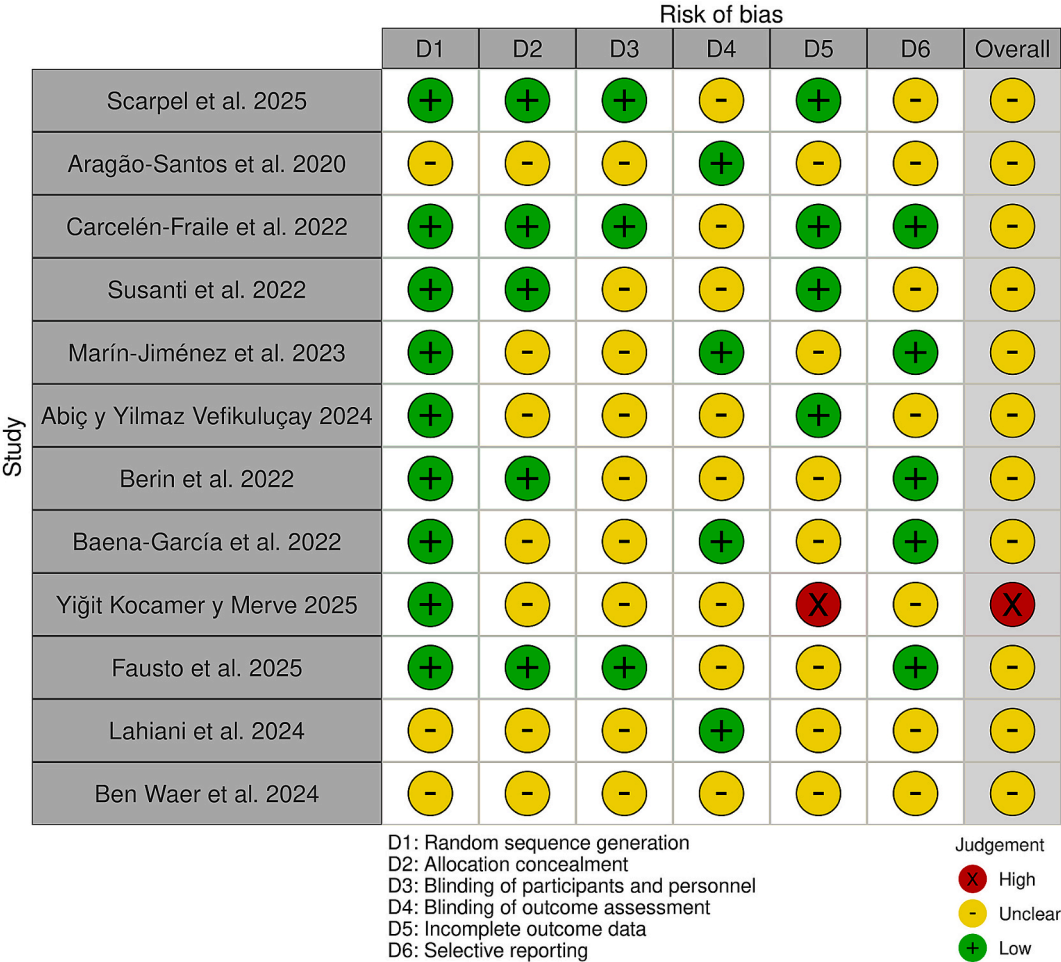


Fig. 2A. Traffic light plot of risk of bias assessment using the Cochrane RoB tool.

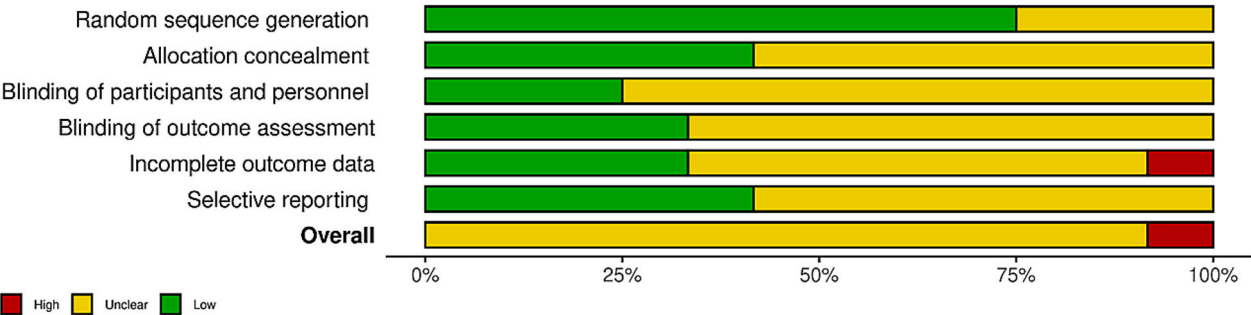


Fig. 2B. Summary plot of risk of bias assessment using the Cochrane RoB tool.

Overall, exercise-based interventions were associated with significant improvements in menopausal symptomatology, health-related quality of life, anxiety, and depressive symptoms compared with control conditions. Although the magnitude of these effects varied across outcomes, the present findings support the role of exercise as a beneficial non-pharmacological intervention for women during the climacteric period, in agreement with previous systematic reviews and meta-

analyses [12,13,34]. Exploratory subgroup analyses suggested that the effects of exercise may differ according to exercise modality. Conventional exercise appeared to be associated with greater improvements in health-related quality of life, whereas mind-body exercise appeared to be associated with greater improvements in menopausal symptomatology. However, these observations should be interpreted with caution, as they were

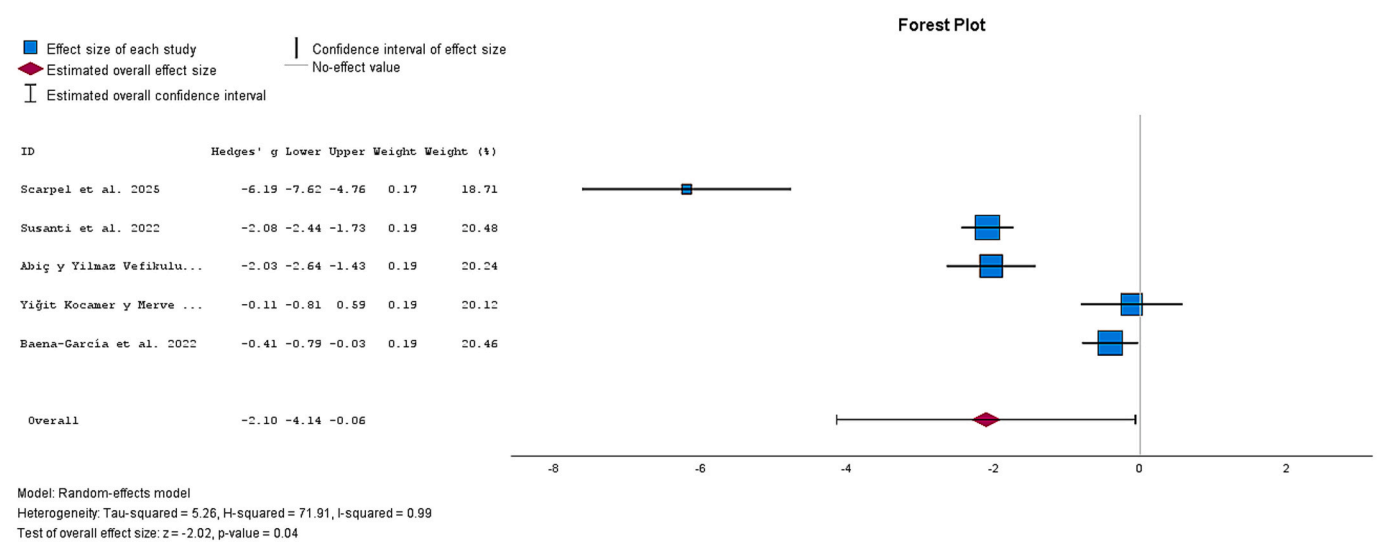


Fig. 3. Meta-analysis of changes in menopausal symptoms between post- and pre-intervention in exercise versus control groups.

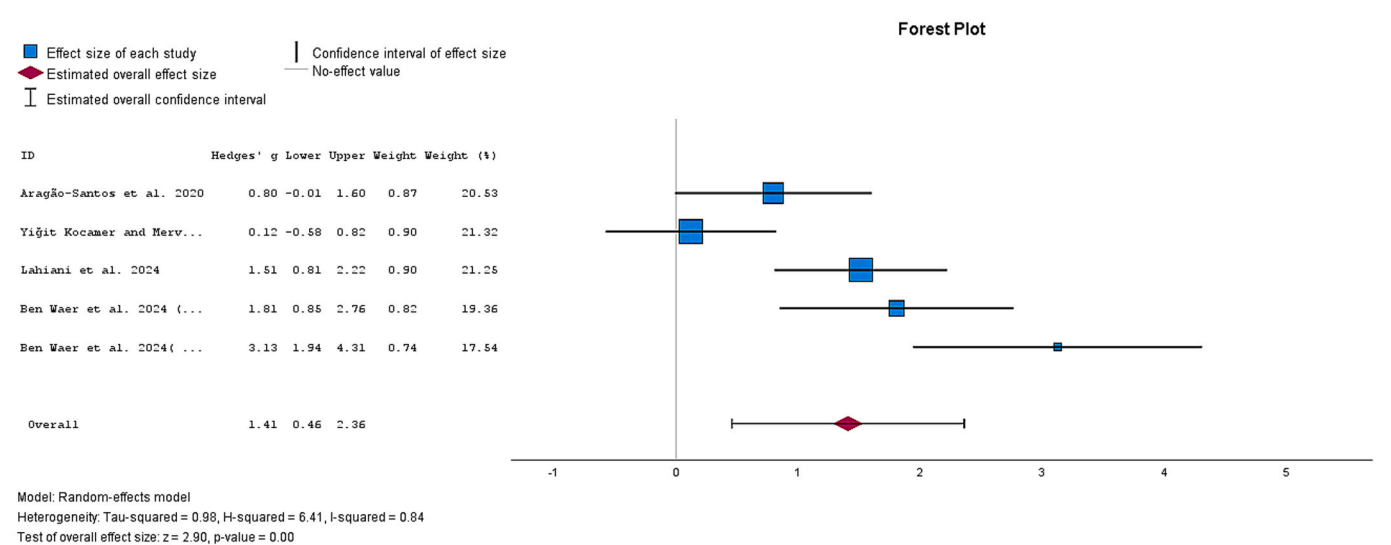


Fig. 4. Meta-analysis of changes in health-related quality of life between post- and pre-intervention in exercise versus control groups.

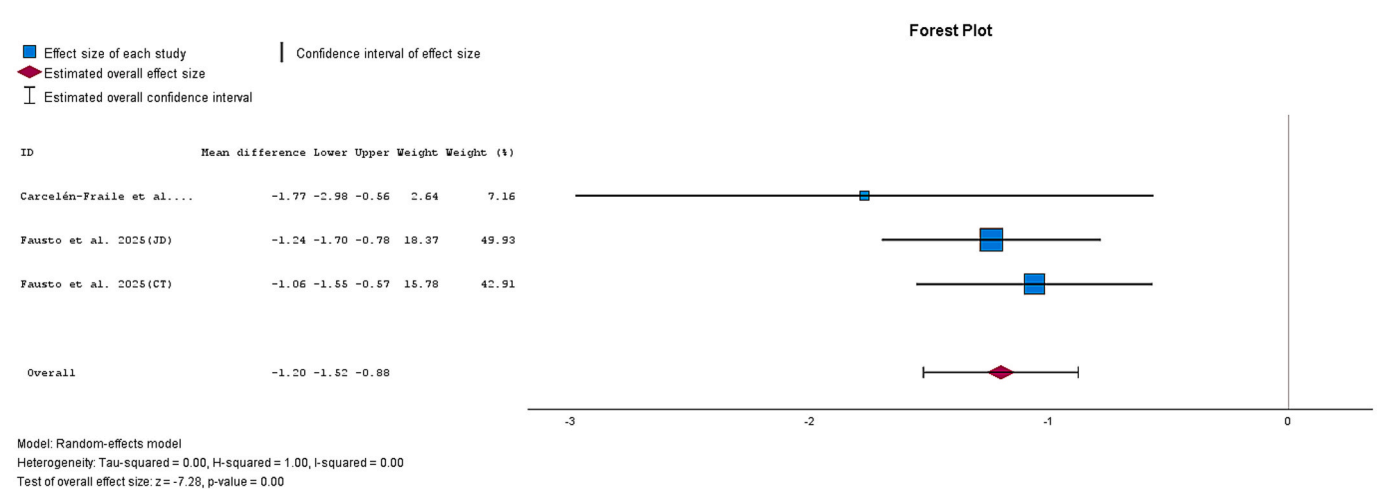


Fig. 5. Meta-analysis of changes in anxiety between post- and pre-intervention in exercise versus control groups.

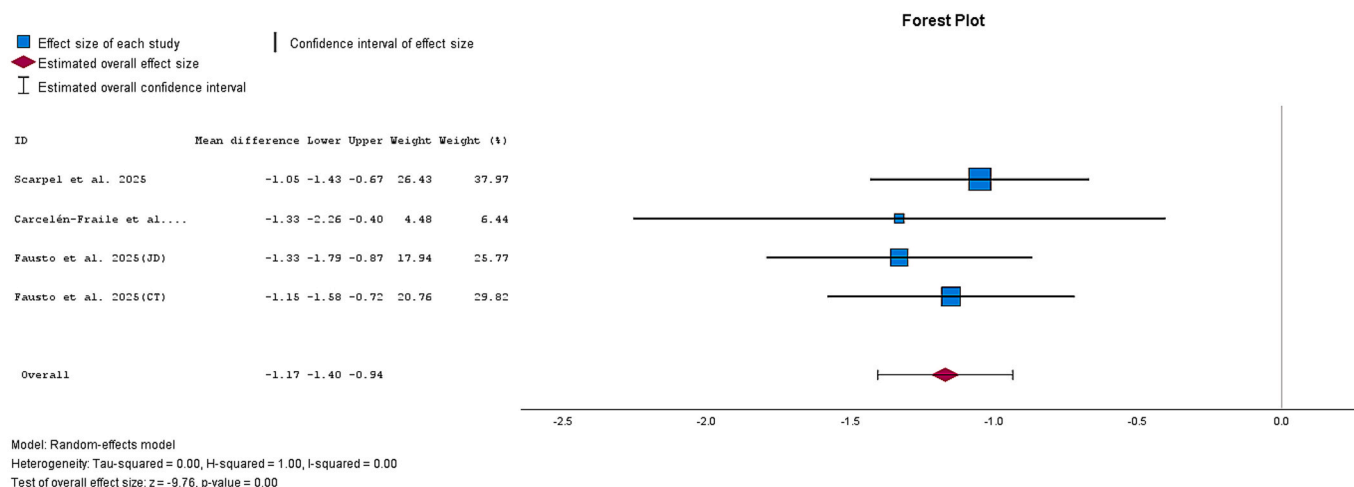


Fig. 6. Meta-analysis of changes in depression between post- and pre-intervention in exercise versus control groups.

based on a limited number of studies. Subgroup analyses were not feasible for anxiety and depression because only one study evaluating a mind–body intervention was available for each outcome. Nevertheless, these findings are consistent with previous evidence suggesting that different exercise modalities may preferentially influence specific menopausal outcomes [14,15,35].

Importantly, the pattern of effects observed across outcomes suggests that exercise may influence different dimensions of the menopausal experience through partially distinct mechanisms. Although significant improvements were observed across all analysed outcomes, greater between-study heterogeneity was identified for menopausal symptomatology and health-related quality of life than for anxiety and depression. This variability probably reflects differences in exercise modality, intervention characteristics, participant profiles, and outcome measures across studies, limiting direct comparability. Similar heterogeneity has been reported in previous systematic reviews, highlighting the complexity of evaluating exercise interventions during the climacteric period [12,36].

The differential response observed across outcomes may be explained by distinct, although interconnected, physiological and behavioural mechanisms. Exercise may improve psychological outcomes through behavioural activation, enhanced self-efficacy, improved sleep quality, and neurobiological adaptations, including modulation of serotonergic pathways, increased brain-derived neurotrophic factor (BDNF) expression, and reduced systemic inflammation, all of which contribute to better mood regulation and emotional well-being [37–39]. In contrast, menopausal symptoms, particularly vasomotor symptoms, are primarily associated with oestrogen withdrawal, hypothalamic thermoregulatory dysfunction, and autonomic nervous system alterations [36,40]. Consequently, the response to exercise is likely to depend on exercise modality, intervention dose, baseline symptom severity, and individual physiological variability, which may partly explain the greater heterogeneity observed for these outcomes [34,35,41].

The observed differences between exercise modalities are likely to reflect the specific physiological and functional adaptations promoted by each intervention. Conventional exercise programmes, including aerobic, resistance, and multicomponent training, may exert greater effects on physical function and health-related quality of life by improving cardiovascular fitness, muscle strength, functional capacity, and fatigue, while also promoting favourable metabolic and anti-inflammatory adaptations, all of which contribute to better daily functioning and perceived health status [13,42,43]. Accordingly, several of the included studies reported clinically meaningful improvements in functional performance and quality of life following aerobic, resistance, concurrent, and dance-based exercise programmes [22,24,26,33].

In contrast, mind–body exercises may confer additional benefits in psychological domains, particularly in relation to emotional well-being, stress regulation, and sleep quality [14,37]. These effects may be attributed to the integrative nature of such approaches, which combine physical movement with breathing regulation and attentional focus [44]. Physiologically, these components may enhance autonomic regulation, reduce sympathetic arousal and lower perceived stress, contributing to mood and emotional regulation [45,46]. In this context, the emphasis on attentional control and body awareness may also facilitate improved perception and regulation of symptoms, which may contribute to the observed effects on subjective outcomes such as quality of life and psychological well-being [47].

Overall, these findings suggest that the clinical benefits of exercise during the climacteric period depend not only on participation but also on individualised exercise prescription, as treatment response may vary considerably between women [48]. Although no single exercise modality appears universally superior, personalised and multimodal exercise programmes may maximize benefits by addressing both the physical and psychological dimensions of menopause [49]. These findings support tailoring exercise prescription according to individual clinical characteristics and exercise dose to optimise outcomes [12,49].

Despite the overall favourable effects observed, several limitations should be considered when interpreting these findings. Considerable clinical and statistical heterogeneity was observed across studies because of differences in intervention characteristics, participant profiles, and outcome measures, limiting the direct comparability of individual studies. In addition, the relatively small number of studies contributing to each meta-analysis reduced the precision of the pooled estimates and limited the possibility of performing more comprehensive subgroup analyses. Further variability may have arisen from differences in participants' menopausal stage, which was not consistently defined or reported across studies, and the eligibility criteria applied in the included trials may limit the generalisability of these findings to the wider population of women during the climacteric. Furthermore, adherence to the interventions and the degree of supervision were not consistently reported, although both factors may substantially influence the effectiveness of exercise programmes [23,27]. Finally, the pre-defined search period and the selection of electronic databases may have resulted in the omission of potentially relevant studies. Nevertheless, the use of random-effects models, exploratory subgroup analyses, leave-one-out sensitivity analyses, and GRADE assessment provides a more comprehensive evaluation of the available evidence and increases confidence in the overall interpretation of the findings.

Building on these considerations, the findings of this review have important implications for clinical practice, health policy, and future

research. From a clinical perspective, exercise should be recognised as a central non-pharmacological strategy during the menopausal transition [35,36]. Both conventional and mind-body modalities may be incorporated into routine care; however, their prescription should be individualised according to symptom profile, functional capacity, exercise dose, and broader biopsychosocial factors, including personal preferences, motivation, and perceived barriers [12,48]. Such a patient-centred approach may enhance adherence and optimise long-term effectiveness.

At the health policy level, integrating structured exercise programmes into primary care and community-based settings may represent a cost-effective strategy to improve women's health during the climacteric period [12,50,51]. Future research should determine the optimal exercise modality and dose for different menopausal profiles through larger, high-quality randomised trials [34,48,49]. Overall, these findings provide further evidence supporting the integration of structured exercise into the comprehensive management of women during the climacteric period.

Conclusions

This systematic review and meta-analysis indicates that exercise-based interventions improve menopausal symptomatology, health-related quality of life, anxiety, and depressive symptoms in women during the climacteric period. Different exercise modalities may preferentially benefit specific outcomes, highlighting the importance of individualising exercise prescription according to symptom profile and clinical characteristics.

These findings support the incorporation of structured exercise programmes as part of a multidisciplinary strategy to improve physical and psychological health during the climacteric period. Further high-quality randomized controlled trials using standardised exercise protocols, validated outcome measures, and longer follow-up periods are warranted to strengthen the evidence base and establish the optimal exercise prescription.

CRedit authorship contribution statement

África Ruiz-Cerezo: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nuria Mendoza Laiz:** Writing – review & editing, Validation, Supervision, Methodology. **Carmen Romero Ferreira:** Writing – review & editing, Validation, Supervision, Software, Methodology, Formal analysis.

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Registration

This systematic review and meta-analysis was prospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD420251148069.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used ChatGPT (OpenAI) to assist with language editing, text refinement, and manuscript organization. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejogrb.2026.115338>.

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