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eISSN 2450-3118 · Open Access · Peer-reviewed

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KLEIBER, Maja, KLINCIEWICZ, Jan, KLINCIEWICZ, Julia, NIEDZIELA, Natalia, DENISEWICZ, Natalia, FORNALSKI, Emil, WOŹNICKA, Antonina, TRZECIAK, Zuzanna, FILIPPOTO, Oliwia, NOWAK, Filip, KOPEĆ, Stanisław and KUJAWIŃSKA, Matylda. The role of physical activity in managing menopausal symptoms: a narrative review. *Quality in Sport*. 2026;70:74707. <https://doi.org/10.12775/QS.2026.70.74707>

ARTICLE TIMELINE

Received: 28.07.2026. Accepted: 17.08.2026. Published: 23.08.2026.

The journal has been awarded 20 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32553). Unique Journal Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences). Punkty Ministerialne z 2019 – aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). © The Authors 2026.

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The role of physical activity in managing menopausal symptoms: a narrative review

Maja Kleiber¹, ORCID: <https://orcid.org/0009-0008-8385-4795>

E-

mail: maja.kleiber@gmail.com

¹Poznan University of Medical Sciences, Poznan, Poland

Jan Klincewicz¹, ORCID: <https://orcid.org/0009-0006-1235-2814>

E-mail: jan.klincewicz15@gmail.com

¹Poznan

University of Medical Sciences, Poznan, Poland

Julia Klincewicz¹, ORCID: <https://orcid.org/0009-0002-2135-0117>

E-

mail: julia.klincewicz00@gmail.com

¹Poznan

University of Medical Sciences, Poznan, Poland

Natalia Niedziela², ORCID: <https://orcid.org/0009-0005-1814-2693>

E-

mail: n.niedziela@gmail.com

²University

Clinical Hospital in Poznan, Poznan, Poland

Natalia Denisewicz¹, ORCID: <https://orcid.org/0000-0002-3245-570X>

E-

mail: denisewiczn@gmail.com

¹Poznan

University of Medical Sciences, Poznan, Poland

Emil Fornalski¹, ORCID: <https://orcid.org/0009-0008-4241-809X> E-mail: emilf162@gmail.com

¹Poznan University of Medical Sciences, Poznan, Poland

Antonina Woźnicka², ORCID: <https://orcid.org/0009-0001-3602-4819> E-mail: t.woznicka@gmail.com ²University

Clinical Hospital in Poznan, Poznan, Poland

Zuzanna Trzeciak², ORCID: <https://orcid.org/0009-0005-4341-5710> E-mail: z.trzeciak00@gmail.com ²University

Clinical Hospital in Poznan, Poznan, Poland

Oliwia Filippoto³, ORCID: <https://orcid.org/0009-0005-2412-837X> E-mail: oliwiafilippoto@gmail.com ³Provincial

Hospital in Poznan, Poznan, Poland

Filip Nowak², ORCID: <https://orcid.org/0009-0001-7872-7635> E-mail: nowakfilip123@gmail.com ²University

Clinical Hospital in Poznan, Poznan, Poland

Stanisław Kopec², ORCID: <https://orcid.org/0009-0008-3495-0676> E-mail: s.kopec@macron.pl ²University

Clinical Hospital in Poznan, Poznan, Poland

Matylda Kujawińska⁴, ORCID: <https://orcid.org/0009-0000-9293-3737> E-mail: metix1574@gmail.com

⁴Medical University of Silesia, Katowice, Poland

Corresponding Author: Maja Kleiber, E-mail: maja.kleiber@gmail.com

Abstract

Background: Menopause is accompanied by a decline in ovarian estrogen production that gives rise to vasomotor, psychological, musculoskeletal, metabolic and cardiovascular disturbances that materially reduce women's quality of life. Growing recognition of the need for holistic and accessible wellness solutions has increased interest in non-pharmacological strategies, among which physical activity occupies a central place.

Aim: This narrative review synthesizes current evidence on the effects and mechanisms of action of physical activity in the management of menopausal symptoms.

Material and methods: A narrative review of the literature was performed, drawing on 66 peer-reviewed articles retrieved from PubMed, Google Scholar and related databases, comprising systematic reviews, meta-analyses, randomized controlled trials, cohort studies and clinical guidelines published mainly between 2022 and 2026.

Results: The evidence indicates that regular physical activity, particularly combined aerobic and resistance exercise, reduces the frequency and severity of vasomotor symptoms, enhances mood and reduces anxiety and depressive symptoms, improves subjective sleep quality, preserves bone mineral density and muscle mass, and optimizes cardiometabolic and vascular health during the menopausal transition and beyond.

Conclusions: Physical activity should be considered a first-line, evidence-based component of menopause management, complementary to or, in selected patients, as an alternative to hormone therapy. Individualized, sustainable exercise interventions combining aerobic, resistance and mind-body modalities are recommended for clinicians, physiotherapists and exercise professionals working with midlife women.

Keywords: menopause; physical activity; exercise; vasomotor symptoms; musculoskeletal health; quality of life.

1. INTRODUCTION

Menopause is a universal, biologically determined transition marked by the cessation of ovarian follicular activity and a consequent decline in circulating estrogen and progesterone [1]. This hormonal shift is not an isolated reproductive event; it reshapes neuroendocrine, metabolic, musculoskeletal and cardiovascular physiology across the remaining decades of a woman's life [2]. Vasomotor symptoms such as hot flashes and night sweats, sleep disturbance, mood instability, weight redistribution, loss of bone and muscle mass, and increased cardiovascular risk are among the most frequently reported consequences of this transition, and together they can substantially diminish quality of life [2,3].

The prevalence of bothersome symptoms and their impact on daily functioning, work productivity and interpersonal relationships have been documented across diverse populations and remains a major driver of clinical consultation during midlife [4,5]. For decades, menopausal hormone therapy (MHT) has represented the most effective pharmacological treatment for vasomotor symptoms and has additional benefits for bone health [6]. However, current guidance from major professional bodies, including the European Society of Endocrinology and the International Menopause Society, explicitly recognizes lifestyle interventions, and physical activity in particular, as a foundational element of menopause care that should be offered regardless of whether hormone therapy is also prescribed [5,7].

Physical activity is uniquely positioned among non-pharmacological approaches because it addresses several menopausal domains simultaneously: it modulates thermoregulatory and autonomic function relevant to vasomotor symptoms, exerts antidepressant and anxiolytic effects, supports sleep architecture, preserves musculoskeletal integrity, and improves cardiometabolic risk profiles [3,8]. For women who cannot or choose not to use hormone therapy, including those with primary ovarian insufficiency or contraindications to estrogen, exercise represents a viable adjunct or alternative for symptom control [9,10]. A recent bibliometric analysis confirms that research output on exercise and menopause has grown rapidly over the past decade, reflecting the increasing recognition of physical activity as a critical non-pharmacological intervention in this field [3], and recent commentary has emphasized the need to rebuild patient and clinician trust in menopause management by positioning physical activity as a genuinely critical, not merely adjunctive, modality [11]. Broader socio-cultural perspectives further stress that culturally sensitive, women-centered approaches to exercise promotion are needed for menopause care to be equitable and effective across diverse populations [12].

The purpose of this narrative review is to synthesize and critically discuss the current literature on the effects and mechanisms of physical activity in managing menopausal symptoms, spanning vasomotor, psychological, sleep-related, musculoskeletal, metabolic and cardiovascular domains, and to translate this evidence into practical recommendations regarding the type and dose of exercise for clinicians, physiotherapists and exercise professionals working with women during and after the menopausal transition.

2. MATERIALS AND RESEARCH METHODS

This paper was prepared as a narrative review, in keeping with the aim of providing a broad, clinically oriented synthesis of a rapidly expanding evidence base. A structured literature search was conducted using the PubMed/MEDLINE and Google Scholar databases, supplemented by

hand-searching of reference lists of retrieved articles. Search terms combined "menopause" or "menopausal transition" or "postmenopausal" with "physical activity", "exercise", "aerobic training", "resistance training", "vasomotor symptoms", "hot flashes", "sleep", "depression", "anxiety", "bone mineral density", "sarcopenia", "cardiometabolic" and "cardiovascular". The search prioritized publications from 2022 to 2026, although foundational and highly cited earlier studies were also incorporated where relevant.

Eligible sources included systematic reviews and meta-analyses, randomized controlled trials, prospective cohort and cross-sectional studies, scoping reviews, clinical practice guidelines and position statements, and narrative reviews addressing the relationship between physical activity and menopausal health outcomes. Non-English-language articles without an English abstract and studies unrelated to the menopausal population were excluded. In total, 66 publications meeting these criteria were retained and analyzed thematically to construct the results section.

3. RESULTS

3.1. Impact on Vasomotor Symptoms

Vasomotor symptoms, comprising hot flashes and night sweats, affect a majority of women during the menopausal transition and are among the most frequently cited reasons for seeking treatment. A systematic review and meta-analysis of randomized controlled trials found that structured exercise programs produced modest but consistent reductions in the frequency and severity of vasomotor symptoms compared with usual care or no intervention, with effects most apparent when modalities combined aerobic exercise with behavioral components [13]. However, the relationship between physical activity and hot flashes is not uniformly linear: some experimental and ambulatory-monitoring studies suggest that acute bouts of vigorous exercise can transiently trigger a hot flash by raising core body temperature, even while regular physical activity over time is associated with a reduced overall symptom burden, indicating that exercise may act simultaneously as both a short-term trigger and a long-term treatment [14]. Objective monitoring of hot flashes in relation to habitual activity and sedentary behavior has similarly shown complex, individualized associations, underscoring that the timing, intensity and modality of exercise likely matter as much as its overall volume [15,16].

Cross-sectional and interventional data converge on the conclusion that women who maintain higher sustained levels of physical training report fewer and less severe menopausal symptoms overall, including vasomotor complaints [17]. Even activity accumulated during working hours appears relevant: greater workplace movement and reduced prolonged sitting time have been associated with a more favorable menopausal symptom profile in employed women [18]. Qualitative and mixed-methods research exploring women's own experiences of being active

during the menopausal transition reveals that many women use exercise deliberately to manage hot flashes and associated distress, although barriers such as fear of triggering a flush, fatigue and lack of tailored guidance are common [19,20]. Understanding women's training preferences, including preferred modality, intensity and social context, is therefore an important prerequisite for designing acceptable and sustainable vasomotor-symptom-targeted interventions [21].

3.2. Psychological Well-being and Mood Regulation

The menopausal transition is associated with an increased risk of low mood, anxiety and depressive symptoms, driven by the interplay of hormonal fluctuation, sleep disruption and psychosocial stressors. An umbrella review synthesizing multiple systematic reviews concluded that physical exercise produces a consistent, moderate beneficial effect on the mental health of menopausal women, with the strongest evidence supporting aerobic and mixed-modality programs [22]. This is corroborated by a systematic review and meta-analysis specifically examining leisure-time activity, which found a dose-dependent inverse association between movement levels and depressive symptoms in menopausal women [23], and by a comprehensive network meta-analysis comparing different exercise modalities for depressive symptoms, which suggested that mind-body training such as yoga and tai chi, alongside aerobic ones, ranked among the most effective practices [24].

A further comprehensive systematic review and meta-analysis of randomized controlled trials confirmed that physical activity significantly reduces both depressive and anxiety symptoms across the menopausal transition and post-menopause, with effects sustained over treatment periods of eight weeks or longer [25]. Complementary meta-analytic evidence indicates that combined exercise interventions reduce depression scores and overall menopausal symptom severity concurrently, suggesting a bidirectional relationship between mood and somatic symptom burden [26]. Observational data reinforce these interventional findings: postmenopausal women reporting high regular activity levels have a substantially reduced likelihood of clinically significant depressive symptoms [27], and the psychological benefit appears to be moderated by perceived social support, such that socially embedded training participation confers the greatest mental health advantage [28].

Beyond mood disorders, physical exercise has been proposed as a strategy for healthy cognitive aging during menopause, with regular aerobic and resistance regimens linked to a reduced risk of cognitive decline and dementia, potentially through neurotrophic and vascular mechanisms [29]. Structured sports-therapy interventions combining physical training with psychoeducational components have likewise demonstrated improvements not only in

menopausal symptom scores but also in psychological status and body image among perimenopausal women [30], while sustained activity participation has been associated with improved self-efficacy and life satisfaction in women transitioning through menopause [31].

3.3. Sleep Quality and Fatigue

Sleep disturbance, ranging from difficulty initiating sleep to frequent nocturnal awakenings associated with night sweats, is a near-universal complaint during the menopausal transition and contributes substantially to daytime fatigue and reduced quality of life. A systematic review focused specifically on exercise interventions for sleep in menopausal women found that structured regimens, particularly those combining aerobic and resistance components performed in the morning or early afternoon, produced clinically meaningful improvements in subjective sleep quality and reductions in sleep latency [32]. A broader systematic review examining the relationship between movement, sleep and psychological well-being similarly concluded that regular physical exertion improves both objective and subjective sleep parameters while simultaneously reducing anxiety, supporting an integrated view of sleep and mood as jointly modifiable through exercise [33].

3.4. Musculoskeletal and Metabolic Benefits

Estrogen withdrawal accelerates bone remodeling and lean mass loss, placing postmenopausal women at heightened risk of osteoporosis and sarcopenia. Sarcopenia during and after menopause reflects the combined effects of hormonal decline, reduced body movement and age-related anabolic resistance, and has been recognized as a distinct clinical entity warranting proactive screening and intervention [34,35]. Cross-sectional evidence links reduced habitual physical activity and impaired physical performance to a higher risk of sarcopenia and poorer quality of life among postmenopausal women, reinforcing the rationale for resistance-based protocols in this population [36].

Longitudinal cohort data from large studies such as the Study of Women's Health Across the Nation demonstrate that greater leisure-time physical engagement during the menopausal transition and beyond is associated with better preservation of bone mineral density over time [37]. Structured exercise programs specifically designed for osteopenic and osteoporotic menopausal women have shown feasibility, although dropout remains a challenge that must be addressed through intervention design and behavioral support [38]; ongoing pilot trials such as the Strength Training for Osteoporosis Prevention during Early Menopause (STOP-EM) protocol aim to clarify optimal resistance-training regimens for bone protection in this population [39]. Notably, even recreational, sport-based activity can confer skeletal benefits: a nine-year follow-up of recreational football in women demonstrated sustained preservation of

bone health across the menopausal transition [40], and structured resistance training interventions have shown that increases in activity levels attained during a trial can be sustained for at least two years afterward, suggesting durable behavior change is achievable [41]. A systematic review and meta-analysis comparing exercise types further indicates that combined aerobic and resistance regimens produce superior gains in cardiorespiratory fitness and muscular strength compared with either modality alone in postmenopausal women [42], and a dedicated systematic review of strength-training interventions confirmed meaningful reductions in overall menopausal symptom severity alongside improvements in muscular function [43].

Metabolically, menopause is associated with a shift toward central adiposity, altered adipocyte function, and dyslipidemia, changes that are at least partly attenuated by regular training [44]. Cross-sectional characterization of body composition and exertional metabolism in menopausal women reveals that fat mass and its distribution, rather than menopausal status per se, are key determinants of exercise-related metabolic outcomes [45], while a four-year longitudinal follow-up demonstrated that sustained physical activity is associated with more favorable trajectories of metabolic health across the menopausal transition [46]. The interrelationship between body composition, physical activity and symptom burden is bidirectional and complex, as body composition itself appears to influence how participation relates to menopausal symptoms [47], and weight and body-shape changes at menopause have distinct hormonal and behavioral causes and consequences that a purely pharmacological approach cannot fully address [48]. Dietary patterns and lifestyle factors also interact; adherence to a high plant-based diet combined with greater physical exertion has been associated with a more favorable metabolic and symptomatic profile during the menopausal transition [49], and regular exercise has been proposed as a preventive strategy against non-alcoholic fatty liver disease, a condition whose prevalence rises sharply after menopause [50]. Importantly, cardiorespiratory fitness and body composition appear to jointly mediate the association between physical engagement and menopausal symptom severity, suggesting that improving fitness, not simply increasing activity counts, may be the more proximal therapeutic target [51].

3.5. Cardiovascular Health

Cardiovascular risk rises sharply after menopause, and physical activity is one of the most robust modifiable protective factors in this period. Systematic reviews and meta-analyses of randomized controlled trials confirm that structured exercise improves cardiorespiratory fitness and multiple markers of cardiovascular disease risk in menopausal and postmenopausal women [52,53], with aerobic modalities specifically shown to improve cardiometabolic parameters

including blood pressure, lipid profile and glycemic control in postmenopausal women [54]. A nine-year randomized controlled trial follow-up demonstrated that long-term continuous training counteracts the adverse cardiometabolic trajectory typically observed across the menopausal transition in women with hypertension [55], and a broader lifespan review emphasizes that the cumulative cardiovascular protection afforded by sustained physical exertion across menopause represents a critical, underutilized opportunity for prevention [56,57]. Mechanistically, regular exertion appears to preserve vascular endothelial function and arterial compliance that would otherwise decline with estrogen loss, supporting a direct therapeutic role for exercise in reducing vascular disease risk during menopause [58,59]. Randomized trial evidence from multicomponent engagement initiatives, such as the FLAMENCO project, further demonstrates that structured 16-week interventions improve a broad range of menopause-related symptoms in middle-aged women, spanning both somatic and psychological domains [60], while detraining studies show that many of these gains diminish once high-intensity exertion is discontinued, underscoring the need for continuity of engagement [61]. A focused review of the physiological changes accompanying exercise during menopause provides a mechanistic framework linking these clinical benefits to underlying neuroendocrine and metabolic adaptations [62].

3.6. Recommended Types and Dose of Exercise

Across the reviewed literature, no single intervention modality emerges as uniformly superior; rather, the evidence supports a combined, individualized approach. Aerobic exercise (e.g. brisk walking, cycling, swimming) is most consistently linked to improvements in cardiorespiratory fitness, cardiometabolic risk markers and mood, typically at moderate intensity for 150 minutes or more per week. Resistance or strength training, performed at least twice weekly, is most strongly associated with preservation of bone mineral density, muscle mass and physical function, and appears particularly important for preventing sarcopenia and osteoporosis [35,42,43]. Mind-body practices, including yoga and tai chi, contribute meaningfully to psychological well-being and sleep quality and may be especially valuable for women who find higher-intensity training aversive or who wish to specifically target anxiety and sleep disturbance [24,33]. Weight-bearing recreational sports, such as football, offer an enjoyable and sustainable route to skeletal loading with additional social and cardiovascular benefits [40]. Broader lifestyle-medicine frameworks emphasize that physical activity should not be prescribed in isolation but integrated with nutrition, sleep hygiene, stress management and, where appropriate, hormone therapy, as part of a holistic approach to menopausal health [63,64]. A scoping review examining the combined effects of menopause hormone therapy and

exercise on bone density and mental well-being suggests that the two interventions may act synergistically, supporting combined rather than either/or approaches in clinical practice [65]. Clinical commentary from sports medicine specialists likewise stresses that structured training prescriptions, tailored to the individual woman's baseline fitness, symptom profile and preferences, should form part of routine menopause consultations rather than being offered only as a generic lifestyle suggestion [66].

4. DISCUSSION

The body of evidence reviewed here converges on a consistent conclusion: physical activity exerts measurable, clinically relevant benefits across nearly every major domain affected by the menopausal transition, from vasomotor symptoms and mood to sleep, musculoskeletal integrity and cardiovascular risk. These effects are plausible on mechanistic grounds, reflecting exercise-induced improvements in thermoregulatory control, neurotransmitter and neurotrophic signaling, sleep architecture, bone and muscle anabolism, and vascular and metabolic function [58,62]. The consistency of findings across systematic reviews, meta-analyses and large cohort studies, spanning multiple countries and study designs, strengthens confidence that these associations are not artefacts of a single research tradition or population.

Nevertheless, important inconsistencies and limitations temper an overly optimistic interpretation. First, the relationship between exercise and vasomotor symptoms is not straightforward: acute bouts of vigorous training sessions can transiently provoke hot flashes even as habitual activity reduces overall symptom burden over time, a paradox that likely explains why some individual trials report null or even adverse short-term effects on hot flash frequency despite favorable long-term associations [13,14]. Second, effect sizes across psychological outcomes vary considerably depending on exertion modality, intensity, supervision and adherence, and network meta-analyses attempting to rank interventions are constrained by heterogeneous outcome measures and relatively small trial sample sizes [24,25]. Third, much of the musculoskeletal and cardiometabolic evidence derives from observational or short-duration interventional studies, and long-term randomized trials with hard clinical endpoints, such as fracture or cardiovascular event rates, remain comparatively scarce, with the nine-year follow-up studies from football-based and hypertension cohorts representing notable exceptions [40,55].

A further limitation concerns adherence and dropout: multiple studies documented in this review, including trials targeting osteopenic women and detraining trials following high-intensity programs, show that benefits are contingent on sustained participation, and that dropout rates in structured exercise regimens can be substantial [38,61]. This underscores those

findings related to women's own preferences and lived experience of exercising during menopause, which suggest that acceptability, enjoyment and social context are as important to treatment success as physiological efficacy [19,21]. Clinicians should therefore resist a one-size-fits-all exercise prescription in favor of individualized planning informed by patient preference, baseline symptom profile and comorbidities.

Limitations of this review itself must also be acknowledged. As a narrative rather than systematic review, the selection and synthesis of literature, while structured, cannot fully exclude selection bias, and no formal quality appraisal or meta-analytic pooling of effect sizes was performed. The evidence base is also skewed toward observational and small-to-moderate-sized randomized studies, with relatively few large, multi-year randomized controlled trials with hard clinical endpoints. Finally, most of the reviewed reports were conducted in high-income countries, and the generalizability of findings to more diverse socio-cultural and economic contexts, an issue explicitly raised in recent commentary on the cultural dimensions of menopause care, deserves further investigation [12].

5. CONCLUSIONS

Physical activity constitutes a safe, accessible and multi-dimensionally effective strategy for managing menopausal symptoms, with evidence supporting benefits for vasomotor symptoms, mood and anxiety, sleep quality, musculoskeletal health and cardiometabolic and vascular risk. The strongest and most consistent evidence favors combined aerobic and resistance training protocols, complemented where appropriate by mind-body practices such as yoga, delivered at a dose of at least 150 minutes of moderate-intensity aerobic activity and two resistance-training sessions per week, individualized to the woman's symptom profile, fitness level and preferences.

For clinical practice, these findings support three practical recommendations. First, physicians, gynecologists and general practitioners should routinely discuss and prescribe physical activity as a first-line, evidence-based component of menopause management, whether alongside or, where hormone therapy is contraindicated or declined, as an alternative to it [7,9]. Second, physiotherapists and exercise professionals should design programs that explicitly combine aerobic, resistance and mind-body elements, with particular attention to bone- and muscle-loading exercises for women at risk of osteoporosis and sarcopenia, and to strategies that promote long-term adherence rather than short-term compliance alone. Third, given the documented gap between women's needs and current primary care provision, health systems should invest in structured referral pathways and patient education to ensure that evidence-based exercise guidance reaches menopausal women in routine practice, not only in research

settings [4,5]. Future research should prioritize long-duration randomized controlled trials with hard clinical endpoints, greater representation of diverse populations, and pragmatic implementation studies examining how best to support sustained exercise engagement across the menopausal transition and beyond.

Disclosure

Author's contribution

Conceptualization, Maja Kleiber; methodology, Maja Kleiber, Jan Klincewicz, Julia Klincewicz; formal analysis, Natalia Denisewicz, Natalia Niedziela, Julia Klincewicz; investigation, Maja Kleiber, Emil Fornalski, Natalia Niedziela, Oliwia Filippoto, Antonina Woźnicka, Zuzanna Trzeciak, Stanisław Kopeć; resources, Maja Kleiber, Jan Klincewicz, Julia Klincewicz ; data curation, Matylda Kujawińska, Emil Fornalski, Natalia Denisewicz; writing - rough preparation, Maja Kleiber, Jan Klincewicz; writing - review and editing, Maja Kleiber, Natalia Niedziela, Antonina Woźnicka, Emil Fornalski, Filip Nowak, Jan Klincewicz, Julia Klincewicz, Natalia Denisewicz, Oliwia Filippoto, Zuzanna Trzeciak, Matylda Kujawińska, Stanisław Kopeć; visualization, Julia Klincewicz; supervision, Maja Kleiber; project administration, Maja Kleiber. All authors have read and agreed with the published version of the manuscript.

Funding statement: No funding was received for conducting this study.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: Not applicable.

Conflict of Interest Statement: The authors declare no conflict of interest.

Declaration of generative AI and AI-assisted technologies in the writing process: In preparing this work, the authors used Google Gemini for the purpose of language editing, text clarity improvement, and formatting the manuscript to meet journal requirements. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

REFERENCES

[1]Gatenby C, Simpson P. Menopause: Physiology, definitions, and symptoms. Menopause - Diagn Ther Strateg 2024;38:101855. <https://doi.org/10.1016/j.beem.2023.101855>.

- [2]Davis SR, Pinkerton J, Santoro N, Simoncini T. Menopause—Biology, consequences, supportive care, and therapeutic options. *Cell* 2023;186:4038–58. <https://doi.org/10.1016/j.cell.2023.08.016>.
- [3]Yang Z, Zhang P, Yu W. A decade of research on exercise and menopause: a comprehensive bibliometric analysis and emerging hotspots (2016–2025). *Sport Sci Health* 2026;22:232. <https://doi.org/10.1007/s11332-026-01817-3>.
- [4]Fatima U, Rasheed R. The unmet needs of menopausal women in primary care. *Br J Gen Pract* 2024;74:bjgp24X737949. <https://doi.org/10.3399/bjgp24X737949>.
- [5]Panay N, Fenton A, Hamoda H, Hillard T, Islam R, Pedder H, et al. International Menopause Society (IMS) recommendations and key messages on women’s midlife health and menopause. *Climacteric* 2025;28:634–56. <https://doi.org/10.1080/13697137.2025.2585487>.
- [6]Santoro NF, Wolfman W, Lobo RA, Hodis HN, Maki PM, Manson JE, et al. The 2022 hormone therapy position statement of The North American Menopause Society. *Menopause* 2022;29:767–94. <https://doi.org/10.1097/GME.0000000000002028>.
- [7]Lumsden MA, Dekkers OM, Faubion SS, Lindén Hirschberg A, Jayasena CN, Lambrinoudaki I, et al. European Society of Endocrinology clinical practice guideline for evaluation and management of menopause and the perimenopause. *Eur J Endocrinol* 2025;193:G49–81. <https://doi.org/10.1093/ejendo/lvaf206>.
- [8]Hulsteen RM; M Kara L; Allerton, Timothy D; Lovre, Dragana. Detrimental Changes in Health during Menopause: The Role of Physical Activity. *Int J Sports Med* 2023;44:389–96. <https://doi.org/10.1055/a-2003-9406>.
- [9]Ayala F, Blümel JE, Vallejo MS, Chedraui P, Gutiérrez-Crespo H, López M, et al. Physical activity as an alternative or adjunct to menopausal hormone therapy for symptom management in women with primary ovarian insufficiency. *Maturitas* 2026;206:108855. <https://doi.org/10.1016/j.maturitas.2026.108855>.
- [10] Grossman JA. Estrogen therapy and physical activity. *Menopause* 2023;30:883–4. <https://doi.org/10.1097/GME.0000000000002242>.
- [11] Tulloh L. Restoring trust in menopause management: menopause hormone therapy is not a panacea, and physical activity remains a critical intervention. *Br J Sports Med* 2025;59:828. <https://doi.org/10.1136/bjsports-2025-110217>.
- [12] Delanerolle G, Pathiraja V, Elneil S, Kurmi O, Talaulikar V, Briggs P, et al. Breaking the silence and building strength; rethinking menopause care through exercise and cultural insight. *Front Glob Womens Health* 2026;Volume 7-2026. <https://doi.org/10.3389/fgwh.2026.1683735>.
- [13] Liu T, Chen S, Mielke GI, McCarthy AL, Bailey TG. Effects of exercise on vasomotor symptoms in menopausal women: a systematic review and meta-analysis. *Climacteric* 2022;25:552–61. <https://doi.org/10.1080/13697137.2022.2097865>.

- [14] Evard R, Sievert LL, Rickson JJ, Witkowski S, White Q. Physical activity and exercise for hot flashes: trigger or treatment? *Menopause* 2022;30:218–24. <https://doi.org/10.1097/GME.0000000000002107>.
- [15] Shreyer S, Witkowski S, Sievert LL, White Q, Brown DE. The influence of habitual physical activity and sedentary behavior on objective and subjective hot flashes at midlife. *Menopause* 2024;31:381–9. <https://doi.org/10.1097/GME.0000000000002341>.
- [16] Colfer K, Bajpai S, Naghavi N, Busa M, Shreyer S, Paluch AE. Physical Activity Variations Around Menopausal Hot Flashes: 1197. *Med Sci Sports Exerc* 2022;54:295–295. <https://doi.org/10.1249/01.mss.0000878708.34427.b9>.
- [17] Dąbrowska-Galas M, Dąbrowska J, Ptaszkowski K, Plinta R. High Physical Activity Level May Reduce Menopausal Symptoms. *Medicina (Mex)* 2019;55:466. <https://doi.org/10.3390/medicina55080466>.
- [18] Campbell AK, Carter SE, Beaumont AJ. Workplace physical activity, sitting time, and menopause symptoms. *Menopause* 2025;32:306–14. <https://doi.org/10.1097/GME.0000000000002497>.
- [19] Sivaramakrishnan D, Mutrie N, Fitzsimons C, Reid J, Niven AG, Strain T. Moving through menopause: a mixed methods study of UK women’s experiences of being physically active during the menopause life stage. *Menopause* 2025;33:167–79. <https://doi.org/10.1097/GME.0000000000002641>.
- [20] Wasley D, Gailey S. Menopause and the role of physical activity – The views and knowledge of women aged 40–65. *Post Reprod Health* 2024;30:77–84. <https://doi.org/10.1177/20533691241235273>.
- [21] Kaluta L, Billington EO, McDonough MH, Burt LA, Gabel L. Exercise preferences and perceptions of women during the menopausal transition. *Appl Physiol Nutr Metab* 2025;50:1–11. <https://doi.org/10.1139/apnm-2025-0232>.
- [22] Silveira J, Dominski FH, Leitão AE, Martins JBB, Fausto DY, Guimarães ACA. An umbrella systematic review of the effect of physical exercise on mental health of women in menopause. *Menopause* 2022;30:225–34. <https://doi.org/10.1097/GME.0000000000002105>.
- [23] Liu R, Tang X. Effect of leisure-time physical activity on depression and depressive symptoms in menopausal women: a systematic review and meta-analysis of randomized controlled trials. *Front Psychiatry* 2025;Volume 15-2024. <https://doi.org/10.3389/fpsy.2024.1480623>.
- [24] Wang H, Li S, Zhang X, Zhu Y, Huang Q, Guo K-L, et al. Effects of different physical activity interventions on depressive symptoms in menopausal women: a systematic review and network meta-analysis. *BMC Public Health* 2025;25:3088. <https://doi.org/10.1186/s12889-025-24398-1>.
- [25] Yue H, Yang Y, Xie F, Cui J, Li Y, Si M, et al. Effects of physical activity on depressive and anxiety symptoms of women in the menopausal transition and menopause: a

comprehensive systematic review and meta-analysis of randomized controlled trials. *Int J Behav Nutr Phys Act* 2025;22:13. <https://doi.org/10.1186/s12966-025-01712-z>.

[26] Park S-H, Han KS, Jang YJ. Effects of Physical Activity on Reducing Depression and Menopausal Symptoms: A Meta-Analysis. *J Korean Acad Psychiatr Ment Health Nurs* 2023;32:325–39. <https://doi.org/10.12934/jkpmhn.2023.32.3.325>.

[27] Tong C, Meng Y, Li T, Luo Y. High levels of physical activity are associated with a reduced likelihood of depressive symptoms in postmenopausal women. *Women Health* 2023;63:308–18. <https://doi.org/10.1080/03630242.2023.2188100>.

[28] Denche-Zamorano Á, García-Paniagua R, Pastor-Cisneros R, Pereira-Payo D, Pérez Gómez J. Influence of physical activity level and perceived social support on mental health and psychological distress in women with menopause problems. *Psychol Health Med* 2024;29:1493–511. <https://doi.org/10.1080/13548506.2024.2347522>.

[29] Guerrero-González C, Cueto-Ureña C, Cantón-Habas V, Ramírez-Expósito MJ, Martínez-Martos JM. Healthy Aging in Menopause: Prevention of Cognitive Decline, Depression and Dementia through Physical Exercise. *Physiologia* 2024;4:115–38. <https://doi.org/10.3390/physiologia4010007>.

[30] Hwang HC, Kim DS, Kim SM, Kim NY, Ko Y, Han DH. Effects of sports therapy on improvement of menopausal symptoms, psychological status, and body morphology in perimenopausal women. *Menopause* 2024;31:326–35. <https://doi.org/10.1097/GME.0000000000002329>.

[31] Kulak A, Toros T, Ogras EB, Etiler IE, Bagci E, Gokyurek B, et al. The Impact of Sustainable Exercise on Self-Efficacy and Life Satisfaction in Women before and after Menopause. *Behav Sci* 2023;13:759. <https://doi.org/10.3390/bs13090759>.

[32] Qian J, Sun S, Wang M, Sun Y, Sun X, Jevitt C, et al. The effect of exercise intervention on improving sleep in menopausal women: a systematic review and meta-analysis. *Front Med* 2023;Volume 10-2023. <https://doi.org/10.3389/fmed.2023.1092294>.

[33] Bansal K, Choudhary A. Menopause and movement: exercise for better sleep and psychological well-being—a systematic review. *Menopause* 2025;32:1063–71. <https://doi.org/10.1097/GME.0000000000002610>.

[34] Liu JH. Sarcopenia and menopause. *Menopause* 2022;30:119–20. <https://doi.org/10.1097/GME.0000000000002140>.

[35] Buckinx F, Aubertin-Leheudre M. Sarcopenia in Menopausal Women: Current Perspectives. *Int J Womens Health* 2022;14:805–19. <https://doi.org/10.2147/IJWH.S340537>.

[36] Panhale V, Mayuri K, Anulucia A, Sakina K. Risk of sarcopenia with physical activity and performance, menopausal symptoms, and QOL in postmenopause. *Bull Fac Phys Ther* 2025;30:47. <https://doi.org/10.1186/s43161-025-00306-x>.

[37] Greendale GA, Jackson NJ, Shieh A, Cauley JA, Karvonen-Gutierrez C, Ylitalo KR, et al. Leisure time physical activity and bone mineral density preservation during the menopause

transition and postmenopause: a longitudinal cohort analysis from the Study of Women's Health Across the Nation (SWAN). *Lancet Reg Health – Am* 2023;21. <https://doi.org/10.1016/j.lana.2023.100481>.

[38] Grazioli E, Cerulli C, Tranchita E, Moretti E, Mauri C, Broccatelli M, et al. Dropout and compliance to physical exercise in menopausal osteopenic women: the European “happy bones” project. *Front Sports Act Living* 2023;Volume 5-2023. <https://doi.org/10.3389/fspor.2023.1221409>.

[39] Alexander CJ, Kaluta L, Whitman PW, Billington EO, Burt LA, Gabel L. Strength training for osteoporosis prevention during early menopause (STOP-EM): a pilot study protocol for a single centre randomised waitlisted control trial in Canada. *BMJ Open* 2025;15:e093711. <https://doi.org/10.1136/bmjopen-2024-093711>.

[40] Mohr M, Skoradal M-B, Sjúrdarson T, Jørgensen NR, Mortensen J, Krstrup P. Recreational football training preserves bone health in women over 9 years during the menopause transition. *Biol Sport* 2026;43:281–90. <https://doi.org/10.5114/biol sport.2026.154145>.

[41] Henriksson M, Nilsson S, Berin E, Hammar M, Spetz Holm A-C, Lindblom H. Increased and sustained physical activity in postmenopausal women: 2-year follow-up of a resistance training intervention. *Maturitas* 2025;202:108696. <https://doi.org/10.1016/j.maturitas.2025.108696>.

[42] Khalafi M, Sakhaei MH, Habibi Maleki A, Rosenkranz SK, Pourvaghar MJ, Fang Y, et al. Influence of exercise type and duration on cardiorespiratory fitness and muscular strength in post-menopausal women: a systematic review and meta-analysis. *Front Cardiovasc Med* 2023;Volume 10-2023. <https://doi.org/10.3389/fcvm.2023.1190187>.

[43] Capel-Alcaraz AM, García-López H, Castro-Sánchez AM, Fernández-Sánchez M, Lara-Palomo IC. The Efficacy of Strength Exercises for Reducing the Symptoms of Menopause: A Systematic Review. *J Clin Med* 2023;12:548. <https://doi.org/10.3390/jcm12020548>.

[44] Marsh ML, Oliveira MN, Vieira-Potter VJ. Adipocyte Metabolism and Health after the Menopause: The Role of Exercise. *Nutrients* 2023;15:444. <https://doi.org/10.3390/nu15020444>.

[45] Gould LM, Gordon AN, Cabre HE, Hoyle AT, Ryan ED, Hackney AC, et al. Metabolic effects of menopause: a cross-sectional characterization of body composition and exercise metabolism. *Menopause* 2022;29:377–89. <https://doi.org/10.1097/GME.0000000000001932>.

[46] Hyvärinen M, Juppi H-K, Taskinen S, Karppinen JE, Karvinen S, Tammelin TH, et al. Metabolic health, menopause, and physical activity—a 4-year follow-up study. *Int J Obes* 2022;46:544–54. <https://doi.org/10.1038/s41366-021-01022-x>.

[47] Moore SR, Smith-Ryan AE, Cabre HE. Body composition, physical activity, and menopause symptoms: how do they relate? *Menopause* 2024;31:336–41. <https://doi.org/10.1097/GME.0000000000002334>.

- [48] Fenton A, Smart C, Goldschmidt L, Price V, Scott J. Fat mass, weight and body shape changes at menopause – causes and consequences: a narrative review. *Climacteric* 2023;26:381–7. <https://doi.org/10.1080/13697137.2023.2178892>.
- [49] Lombardo M, Rizzo G, Feraco A, Perrone MA, Bellia C, Lauro D, et al. High plant-based diet and physical activity in women during menopausal transition. *Nutr Food Sci* 2021;52:547–60. <https://doi.org/10.1108/NFS-06-2021-0195>.
- [50] Molina-Molina E, Furtado GE, Eustaquio, Jones JG, Portincasa P, Vieira-Pedrosa A, Teixeira AM, et al. The advantages of physical exercise as a preventive strategy against NAFLD in postmenopausal women. *Eur J Clin Invest* 2022;52:e13731. <https://doi.org/10.1111/eci.13731>.
- [51] Karavirta L, Sipilä S, Laakkonen EK, Aukee P, Tammelin TH, Karppinen JE, et al. The role of cardiorespiratory fitness and body composition in the association between physical activity and menopausal symptoms. *Menopause* 2024;31:828–36. <https://doi.org/10.1097/GME.0000000000002397>.
- [52] Woodward A, Mason-Jones AJ, Faires M, Jones V, Beaumont A. Effect of Physical Activity on Cardiorespiratory Fitness and Markers of Cardiovascular Disease Risk During Menopause: A Systematic Review and Meta-Analysis of Randomised-Controlled Trials. *J Sci Sport Exerc* 2026;8:9–31. <https://doi.org/10.1007/s42978-025-00343-x>.
- [53] Maldonado-Martin S, Ruiz-Rios M. Physical activity on cardiorespiratory fitness and cardiovascular risk in premenopausal and postmenopausal women: a systematic review of randomized controlled trials. *Menopause* 2022;29:1222–9. <https://doi.org/10.1097/GME.0000000000002037>.
- [54] Huynh E, Wiley E, Noguchi KS, Fang H, Beauchamp MK, MacDonald MJ, et al. The effects of aerobic exercise on cardiometabolic health in postmenopausal females: A systematic review and meta-analysis of randomized controlled trials. *Womens Health* 2024;20:17455057241290889. <https://doi.org/10.1177/17455057241290889>.
- [55] Mohr M, Sjúrdarson T, Skoradal M-B, Nordsborg NB, Krstrup P. Long-term continuous exercise training counteracts the negative impact of the menopause transition on cardiometabolic health in hypertensive women - a 9-year RCT follow-up. *Prog Cardiovasc Dis* 2024;85:54–62. <https://doi.org/10.1016/j.pcad.2023.12.001>.
- [56] Bucciarelli V, Mattioli AV, Sciomer S, Moscucci F, Renda G, Gallina S. The Impact of Physical Activity and Inactivity on Cardiovascular Risk across Women's Lifespan: An Updated Review. *J Clin Med* 2023;12:4347. <https://doi.org/10.3390/jcm12134347>.
- [57] Miller KB, Moir ME, Fico BG. Vascular health and exercise in females throughout the lifespan: Exploring puberty, pregnancy and menopause. *Exp Physiol* 2026;111:2840–59. <https://doi.org/10.1113/EP092170>.
- [58] Shing CLH, Bond B, Moreau KL, Coombes JS, Taylor JL. The therapeutic role of exercise training during menopause for reducing vascular disease. *Exp Physiol* 2026;111:2813–27. <https://doi.org/10.1113/EP092191>.

- [59] Tamariz-Ellemann A, Wickham KA, Nørregaard LB, Gliemann L, Hellsten Y. The time is now: regular exercise maintains vascular health in ageing women. *J Physiol* 2023;601:2085–98. <https://doi.org/10.1113/JP282896>.
- [60] Aparicio VA, Aranda P, Marín-Jiménez N, Flor-Aleman M, Baena-García L. A 16-week multicomponent exercise training program improves menopause-related symptoms in middle-aged women. The FLAMENCO project randomized control trial. *Menopause* 2022;29:537–44. <https://doi.org/10.1097/GME.0000000000001947>.
- [61] Jungmann S, Hettchen M, Kohl M, Kemmler W. Impact of 3 months of detraining after high intensity exercise on menopause-related symptoms in early postmenopausal women – results of the randomized controlled actlife project. *Front Sports Act Living* 2023;Volume 4-2022. <https://doi.org/10.3389/fspor.2022.1039754>.
- [62] Ribeiro IC, de Lucena EGP, Oliveira AS, Fernandes PT. Physical exercise in menopause: a review of physiological changes. *Comp Exerc Physiol* 2022;18:275–80. <https://doi.org/10.3920/CEP220009>.
- [63] Molinari M, King KM, Gonzalez GB. Integrative Lifestyle Considerations for Women in the Menopause Transition. *ACSMS Health Fit J* 2024;28:74–9. <https://doi.org/10.1249/FIT.0000000000000976>.
- [64] Anekwe CV, Cano A, Mulligan J, Ang SB, Johnson CN, Panay N, et al. The role of lifestyle medicine in menopausal health: a review of non-pharmacologic interventions. *Climacteric* 2025;28:478–96. <https://doi.org/10.1080/13697137.2025.2548806>.
- [65] Platt O, Bateman J, Bakour S. Impact of menopause hormone therapy, exercise, and their combination on bone mineral density and mental wellbeing in menopausal women: a scoping review. *Front Reprod Health* 2025;Volume 7-2025. <https://doi.org/10.3389/frph.2025.1542746>.
- [66] Maître C. Sport and menopause. *Rev Prat* 2024;74:627–31.