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Comparison of different exercise modalities in women with polyendocrine metabolic ovarian syndrome: a narrative review

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Abstract

Background. Polyendocrine metabolic ovarian syndrome (PMOS), formerly known as polycystic ovary syndrome (PCOS), is a complex endocrine and metabolic disorder associated with insulin resistance, chronic low-grade inflammation, reproductive dysfunction, and reduced quality of life. Although physical activity is a cornerstone of PMOS management, the relative effectiveness of different exercise modalities remains unclear.

Aim. To compare the effects of aerobic exercise, resistance training, and high-intensity interval training (HIIT) on metabolic, reproductive, inflammatory, and psychological outcomes in women with PMOS.

Material and methods. A narrative literature review was conducted using PubMed and Google Scholar. Original studies, randomized controlled trials, observational studies, reviews, and clinical guidelines evaluating exercise interventions in women with PMOS/PCOS were included. Due to heterogeneity in study designs and outcomes, findings were synthesized qualitatively.

Results. Aerobic exercise, resistance training, and HIIT all demonstrated beneficial effects in women with PMOS. Aerobic exercise improved body composition, insulin sensitivity, cardiovascular fitness, and psychological well-being. Resistance training was particularly effective in increasing lean body mass and improving metabolic health, whereas HIIT provided a time-efficient strategy with favorable effects on insulin sensitivity and cardiorespiratory fitness. Combined exercise interventions appeared to offer the broadest benefits by targeting multiple pathophysiological mechanisms.

Conclusions. Exercise is a key component of PMOS management. Although no single modality appears universally superior, resistance training and HIIT may provide additional metabolic benefits beyond aerobic exercise. Exercise programs should be individualized according to patient characteristics and treatment goals. Further high-quality randomized controlled trials are needed to establish evidence-based recommendations for optimal exercise strategies in women with PMOS.

Keywords: polyendocrine metabolic ovarian syndrome; polycystic ovary syndrome; exercise; aerobic exercise; resistance training; high-intensity interval training; physical activity.

1. Introduction

Polyendocrine metabolic ovarian syndrome (PMOS), previously known as polycystic ovary syndrome (PCOS), is one of the most common endocrine disorders affecting women of reproductive age, with an estimated prevalence of 8–13% worldwide depending on the diagnostic criteria applied (Teede et al., 2018). The condition was recently renamed from PCOS to PMOS following an international consensus to better reflect its complex endocrine and metabolic nature and to reduce misconceptions associated with the previous terminology, which inaccurately emphasized the presence of ovarian cysts (Teede et al., 2026). PMOS is characterized by a heterogeneous clinical presentation that may include hyperandrogenism, ovulatory dysfunction, polycystic ovarian morphology, insulin resistance, obesity, and an increased risk of metabolic complications such as type 2 diabetes and cardiovascular disease (Teede et al., 2023). Beyond its reproductive manifestations, PMOS has substantial implications for psychological well-being and quality of life, being associated with higher rates of anxiety, depression, body image disturbances, and reduced health-related quality of life (Cooney et al., 2017). Given the central role of metabolic dysfunction in PMOS pathophysiology, lifestyle interventions, particularly physical activity and structured exercise programs, have become fundamental components of contemporary management strategies aimed at improving both metabolic and reproductive outcomes (Moran et al., 2009).

Despite significant advances in understanding the pathophysiology of PMOS, there is currently no definitive treatment that addresses all aspects of this complex disorder. Existing management strategies primarily focus on alleviating individual reproductive, metabolic, and psychological manifestations through lifestyle modification and pharmacological interventions tailored to the patient's predominant symptoms (Teede et al., 2023). Increasing evidence suggests that PMOS is associated with a state of chronic low-grade inflammation, characterized by elevated circulating concentrations of pro-inflammatory markers, including C-reactive protein, tumor necrosis factor-α, and interleukin-6, which may contribute to the development of insulin resistance, hyperandrogenism, and increased cardiometabolic risk (Escobar-Morreale et al., 2011). Regular physical activity has been recognized as an effective non-pharmacological strategy capable of modulating systemic inflammation through multiple

mechanisms, including reductions in adipose tissue mass and the promotion of anti-inflammatory cytokine responses (Gleeson et al., 2011) . Although aerobic exercise has traditionally been recommended as a cornerstone of lifestyle management in PMOS, emerging evidence and contemporary exercise trends increasingly emphasize the potential benefits of resistance training for improving metabolic health and body composition. However, it remains unclear whether one exercise modality is superior to others in women with PMOS. Therefore, this review aims to critically evaluate and compare the current evidence regarding the effects of aerobic exercise, resistance training, and high-intensity interval training on metabolic, reproductive, inflammatory, and psychological outcomes in women with PMOS, with the objective of identifying the most effective exercise strategies for clinical practice.

2. Research Materials and Methods

This study was designed as a narrative review aimed at summarizing and comparing the current evidence regarding the effects of various exercise modalities in women with polyendocrine metabolic ovarian syndrome (PMOS), formerly known as polycystic ovary syndrome (PCOS). A literature search was conducted using PubMed and Google Scholar to identify relevant articles published in English. The search strategy incorporated combinations of keywords and Medical Subject Headings (MeSH) related to the topic, including: "polyendocrine metabolic ovarian syndrome", "polycystic ovary syndrome", "PMOS", "PCOS", "exercise", "physical activity", "aerobic exercise", "resistance training", "strength training", "high-intensity interval training", and "HIIT". To maximize the completeness of the review, the reference lists of selected articles and review papers were also screened for additional eligible studies.

The review included original research articles, randomized controlled trials, observational studies, systematic reviews, narrative reviews, and evidence-based clinical guidelines examining the role of exercise interventions in women diagnosed with PMOS/PCOS. Studies investigating aerobic exercise, resistance training, HIIT, or combined exercise programs and their effects on metabolic, reproductive, inflammatory, or psychological outcomes were considered relevant. Studies conducted exclusively in animal

models, articles unrelated to exercise interventions, and publications focusing on other endocrine disorders were excluded from the review.

Preference was given to studies published within the last 15 years to ensure that the review reflected contemporary evidence and recent developments in the field. Nevertheless, earlier landmark publications were also considered when they provided important insights into the pathophysiology of PMOS or established the basis for current exercise recommendations. Owing to the diversity of study methodologies, intervention protocols, participant characteristics, and reported outcomes, a quantitative synthesis was not performed. Instead, the available evidence was analyzed and synthesized narratively. The results were categorized according to exercise modality and their reported effects on key clinical outcomes relevant to PMOS management.

Ethical approval was not required because this study was based exclusively on the analysis and interpretation of previously published scientific literature and did not involve human participants or the collection of original data.

3.1 Pathophysiology of PMOS

Polyendocrine metabolic ovarian syndrome (PMOS) is a complex and multifactorial disorder characterized by the interplay between genetic predisposition, environmental influences, endocrine dysfunction, and metabolic disturbances. Although the exact etiology of PMOS remains incompletely understood, insulin resistance and compensatory hyperinsulinemia are considered central components of its pathophysiology, affecting approximately 50–70% of affected women, regardless of body mass index (Teede et al., 2023). Hyperinsulinemia contributes to increased ovarian androgen production and reduced hepatic synthesis of sex hormone-binding globulin (SHBG), leading to hyperandrogenism, which is responsible for many of the characteristic clinical manifestations of PMOS, including menstrual irregularities, anovulation, hirsutism, and acne (Escobar-Morreale, 2018).

In addition to endocrine abnormalities, PMOS is frequently associated with obesity, particularly central adiposity, which further exacerbates insulin resistance and metabolic dysfunction. Increasing evidence indicates that PMOS is accompanied by a state of chronic low-grade inflammation, characterized by elevated concentrations of inflammatory mediators

such as C-reactive protein, tumor necrosis factor-α, and interleukin-6 (Escobar-Morreale et al., 2011). This pro-inflammatory environment has been implicated in the development of insulin resistance, endothelial dysfunction, and an increased risk of cardiovascular disease and type 2 diabetes mellitus among women with PMOS (Repaci et al., 2011).

Given the multifaceted nature of PMOS pathophysiology, interventions targeting metabolic dysfunction and systemic inflammation are of particular clinical importance. Regular physical activity has been proposed as an effective non-pharmacological approach capable of improving insulin sensitivity, reducing adiposity, modulating inflammatory responses, and enhancing overall metabolic health. Consequently, different exercise modalities have gained increasing attention as potential therapeutic strategies in the comprehensive management of PMOS.

3.2 Aerobic exercise

Aerobic exercise, commonly referred to as cardio training, consists of continuous, rhythmic activities that engage large muscle groups and rely primarily on oxidative metabolism for energy production. Common forms of aerobic exercise include walking, running, cycling, swimming, rowing, and aerobic dance. Aerobic training is typically characterized by prolonged duration and moderate intensity, although higher-intensity protocols may also be employed depending on individual fitness levels and training goals (Caspersen et al., 1985).

Aerobic exercise has been widely investigated as a non-pharmacological intervention for women with PMOS. Current evidence suggests that regular aerobic training contributes to reductions in body weight, body mass index, waist circumference, and visceral adiposity, all of which are frequently elevated in women with PMOS (Harrison et al., 2011). Moreover, aerobic exercise has been associated with improvements in insulin sensitivity and glucose metabolism, potentially reducing the risk of type 2 diabetes and cardiovascular complications (Benham et al., 2018). Several studies have also reported beneficial effects on reproductive function, including improved menstrual regularity and ovulatory frequency, as well as positive effects on psychological well-being and health-related quality of life (Lim et al.,

2019). Consequently, aerobic exercise remains one of the cornerstone lifestyle interventions recommended in the management of PMOS.

3.3 Resistance exercise

Resistance exercise, also known as strength or resistance training, involves repeated muscle contractions performed against an external load with the objective of improving muscular strength, endurance, power, and overall neuromuscular function. External resistance may be provided through free weights, resistance machines, elastic bands, body weight, or other training devices (Garber et al., 2011). Resistance training programs are commonly characterized by variables such as exercise selection, training intensity, number of sets and repetitions, rest intervals, and frequency of training sessions ("American College of Sports Medicine Position Stand. Progression Models in Resistance Training for Healthy Adults," 2009). In addition to promoting muscular adaptations, resistance exercise contributes to the development and maintenance of skeletal muscle mass and functional capacity across different age groups (Fragala et al., 2019).

Emerging evidence indicates that resistance training may be particularly beneficial for women with PMOS due to its favorable effects on metabolic health. By increasing skeletal muscle mass, resistance exercise enhances glucose uptake and insulin sensitivity, thereby addressing one of the central pathophysiological features of PMOS (Almenning et al., 2015). Studies have demonstrated improvements in body composition, including reductions in fat mass and increases in lean body mass, even in the absence of substantial weight loss (Thomson et al., 2008). Furthermore, resistance training has been associated with reductions in androgen excess and improvements in quality of life among women with PMOS (Kogure et al., 2016). Owing to these potential advantages, resistance exercise has gained increasing attention as a key component of exercise prescriptions for women with PMOS.

3.4 High-intensity interval training (HIIT)

High-intensity interval training (HIIT) is an exercise modality characterized by repeated bouts of vigorous or near-maximal intensity exercise interspersed with periods of active recovery or rest. HIIT protocols vary considerably in terms of exercise intensity, work-to-rest ratio, duration of intervals, and total session length, allowing for substantial flexibility in program design (Weston et al., 2014) . Typical HIIT activities include running, cycling, rowing, and circuit-based exercises performed at intensities often exceeding 80–90% of maximal heart rate or peak oxygen uptake (Gibala et al., 2012) . Compared with traditional continuous aerobic exercise, HIIT is generally more time-efficient, requiring shorter training sessions while maintaining a high exercise stimulus (Milanović et al., 2015) . Due to its adaptability and growing popularity, HIIT has emerged as an increasingly investigated exercise strategy in both healthy individuals and various clinical populations (Batacan et al., 2017).

Recent studies suggest that HIIT may offer substantial benefits for women with PMOS, particularly in improving cardiometabolic outcomes. HIIT has been associated with significant improvements in insulin sensitivity, cardiorespiratory fitness, and body composition, despite requiring a lower overall time commitment compared with conventional aerobic exercise (Almenning et al. 2015). Additionally, preliminary evidence indicates that HIIT may contribute to reductions in inflammatory markers and improvements in endothelial function, both of which are often impaired in PMOS (Patten et al., 2020) . However, the number of studies evaluating HIIT specifically in women with PMOS remains limited, and considerable heterogeneity exists among intervention protocols. Therefore, further well-designed randomized controlled trials are required to establish the long-term efficacy and safety of HIIT in this population.

3.5. Comparison of Exercise Modalities in PMOS

Although aerobic exercise, resistance training, and HIIT have all demonstrated beneficial effects in women with PMOS, the available evidence comparing these modalities directly remains limited. A systematic review by Benham et al. concluded that exercise interventions, regardless of type, were associated with improvements in insulin sensitivity, cardiorespiratory fitness, and body composition; however, the heterogeneity of exercise protocols precluded the identification of a clearly superior modality (Benham et al., 2018) .

Similarly, Patten et al. reported that both aerobic exercise and HIIT significantly improved metabolic parameters, although HIIT interventions tended to produce greater improvements in cardiorespiratory fitness while requiring a lower overall time commitment (Patten et al., 2020).

Direct comparisons between resistance training and HIIT were evaluated by Almenning et al. (2015) in a randomized pilot study involving women with PCOS. Both exercise modalities improved insulin sensitivity and body composition; however, HIIT resulted in greater improvements in maximal oxygen uptake, whereas resistance training was associated with more favorable changes in lean body mass. Furthermore, resistance exercise may provide additional benefits through increased skeletal muscle mass, which plays a critical role in glucose disposal and insulin-mediated glucose uptake (Almenning et al., 2015).

Despite the growing popularity of resistance training and HIIT, aerobic exercise remains the most extensively studied modality in PMOS and continues to be recommended as a cornerstone of lifestyle management in international guidelines (Teede et al., 2023) . Nevertheless, recent evidence suggests that combining aerobic and resistance exercise may offer the broadest range of benefits by simultaneously targeting cardiovascular fitness, body composition, insulin resistance, and psychological well-being (Patten et al., 2020).

Taken together, current evidence indicates that no single exercise modality appears universally superior for all women with PMOS. Instead, exercise prescriptions should be individualized according to patient preferences, metabolic characteristics, clinical goals, and exercise adherence. Future large-scale randomized controlled trials directly comparing different exercise interventions are warranted to establish evidence-based recommendations regarding the optimal type, intensity, and duration of exercise in women with PMOS.

A summary of the characteristics and principal findings of studies evaluating aerobic exercise, resistance training, and HIIT in women with PMOS is presented in Table 1.

Table 1. Summary of evidence regarding the effects of different exercise modalities in women with PMOS.

Study	Exercise intervention	Study type	Main findings
Almenning et al., 2015	HIIT vs resistance training	10 weeks	Both interventions improved metabolic parameters. HIIT was associated with

			greater improvements in cardiorespiratory fitness, whereas resistance training resulted in more favorable changes in lean body mass.
Thomson et al., 2008	Resistance training combined with dietary intervention	20 weeks	Participants demonstrated improvements in body composition and insulin sensitivity, with increases in lean body mass despite limited changes in overall body weight.
Harrison et al., 2011	Systematic review of aerobic exercise interventions	8 studies	Aerobic exercise was consistently associated with beneficial effects on body weight, body composition, and cardiometabolic outcomes.
Benham et al., 2018	Systematic review and meta-analysis of exercise interventions	16 studies	Exercise interventions were associated with improvements in insulin sensitivity, cardiorespiratory fitness, and anthropometric measures; however, insufficient evidence was available to identify a superior exercise modality.
Patten et al., 2020	Systematic review of exercise interventions	24 studies	Aerobic exercise, resistance training, and HIIT all demonstrated positive effects on metabolic health. Combined exercise approaches appeared to provide the broadest range of clinical benefits.
Lim et al., 2019	Cochrane systematic review	15 studies	Lifestyle interventions incorporating exercise contributed to improvements in reproductive outcomes, metabolic health, and quality of life in women with PMOS.

4. Discussion

The present review aimed to compare the effects of aerobic exercise, resistance training, and high-intensity interval training on metabolic, reproductive, inflammatory, and psychological outcomes in women with PMOS. The available evidence suggests that all exercise modalities provide clinically meaningful benefits; however, no single form of exercise appears to be universally superior across all outcomes. Instead, each exercise modality seems to exert distinct physiological effects that may be advantageous depending on the individual clinical profile and therapeutic goals of women with PMOS.

Aerobic exercise remains the most extensively investigated intervention in PMOS and has consistently demonstrated beneficial effects on body weight, visceral adiposity, insulin sensitivity, and cardiovascular fitness. Since obesity and insulin resistance are highly prevalent among women with PMOS and contribute to hyperandrogenism and ovulatory dysfunction, the improvements associated with aerobic exercise may have important implications for both metabolic and reproductive health. Furthermore, regular aerobic activity has been associated with improvements in quality of life and psychological well-being, which is particularly relevant given the increased prevalence of anxiety and depressive symptoms observed in this population.

Although aerobic exercise has traditionally been emphasized in clinical guidelines, increasing evidence supports the role of resistance training as an effective therapeutic strategy for women with PMOS. Resistance exercise enhances skeletal muscle mass, thereby improving glucose uptake and insulin sensitivity through increased peripheral glucose utilization. Unlike aerobic exercise, resistance training may induce favorable changes in body composition even in the absence of substantial weight loss, highlighting that improvements in metabolic health are not solely dependent on reductions in body weight. Moreover, emerging evidence suggests that resistance training may positively influence androgen levels and overall quality of life. These findings align with current trends in exercise medicine, which increasingly recognize skeletal muscle as an important endocrine organ involved in metabolic regulation.

HIIT has recently gained considerable attention due to its time-efficient nature and its ability to elicit substantial physiological adaptations. The available literature indicates that HIIT may provide improvements in insulin sensitivity, cardiorespiratory fitness, and body

composition comparable to or exceeding those achieved through traditional moderate-intensity aerobic exercise. This may be particularly important given that lack of time is frequently reported as a barrier to regular physical activity among women of reproductive age. Nevertheless, despite encouraging preliminary findings, the number of studies specifically evaluating HIIT in women with PMOS remains relatively limited. In addition, substantial variability exists regarding exercise intensity, interval duration, and overall training volume, making direct comparisons across studies difficult.

One of the most important findings of this review is that combined exercise programs integrating aerobic and resistance training may provide the broadest range of clinical benefits. Aerobic exercise primarily improves cardiovascular fitness and facilitates reductions in adiposity, whereas resistance training contributes to the preservation and development of lean body mass and improvements in insulin sensitivity. Therefore, combining these exercise modalities may simultaneously target multiple pathophysiological mechanisms involved in PMOS, including insulin resistance, chronic low-grade inflammation, and adverse body composition.

Despite the promising findings presented in this review, several limitations within the existing literature should be acknowledged. First, many available studies included relatively small sample sizes, limiting statistical power and generalizability. Second, considerable heterogeneity exists with respect to intervention duration, exercise intensity, frequency of training sessions, and outcome measures. Third, some studies combined exercise interventions with dietary modifications, making it difficult to determine the independent effects of physical activity. Finally, the recent transition from PCOS to PMOS terminology highlights the evolving understanding of this condition and underscores the need for future studies utilizing standardized diagnostic criteria and outcome measures.

Taken together, the current evidence supports exercise as a cornerstone of PMOS management. However, rather than identifying a single optimal exercise modality, the findings suggest that exercise prescriptions should be individualized according to patient preferences, baseline fitness levels, metabolic characteristics, and treatment objectives. Future large-scale randomized controlled trials directly comparing aerobic exercise, resistance training, HIIT, and combined interventions are warranted to establish evidence-based recommendations regarding the most effective exercise strategies for women with PMOS.

5. Conclusion

Exercise interventions represent a fundamental component of comprehensive PMOS management due to their beneficial effects on metabolic, reproductive, inflammatory, and psychological outcomes. Current evidence suggests that aerobic exercise, resistance training, and HIIT are all effective strategies; however, no single exercise modality appears to be universally superior for all women with PMOS. Resistance training and HIIT may offer additional advantages in improving insulin sensitivity, body composition, and metabolic health, whereas aerobic exercise remains the most extensively studied and widely recommended intervention. Therefore, exercise prescriptions should be individualized according to patient preferences, clinical characteristics, and therapeutic objectives to maximize adherence and long-term effectiveness. Further high-quality randomized controlled trials directly comparing different exercise modalities are required to establish evidence-based recommendations for optimal exercise programming in women with PMOS.

Disclosure

Supplementary Materials

No supplementary materials are associated with this article.

Author Contributions

Conceptualization: Bogumiła Szarek;
Methodology: Bogumiła Szarek, Rafał Szarek;
Literature search and data collection: Bogumiła Szarek, Rafał Szarek;
Data analysis and interpretation: Bogumiła Szarek, Rafał Szarek;
Writing – original draft preparation: Bogumiła Szarek;
Writing – review and editing: Bogumiła Szarek, Rafał Szarek;
Supervision: Rafał Szarek;
Project administration: Bogumiła Szarek;

All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

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Data Availability Statement

The authors confirm that the data supporting the findings of this study are available within the articles cited in the reference list.

Conflicts of Interest

The authors declare no conflict of interest.

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