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The Impact of High-Intensity Interval Training (HIIT) On Polycystic Ovary Syndrome (PCOS) - A Narrative Review

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Abstract

The purpose of research. Polycystic ovary syndrome (PCOS) is the most common endocrine disorder among women of reproductive age, characterized by metabolic, hormonal, reproductive, and psychological disturbances. Its pathophysiology involves insulin resistance, hyperandrogenism, and chronic low-grade inflammation. This review evaluates the effects of high-intensity interval training (HIIT) on metabolic, hormonal, reproductive, and psychological outcomes in women with PCOS.

Material and methods. A literature search was conducted in PubMed, Scopus, and Google Scholar for studies published between 2010 and 2025. Randomized controlled trials, cohort studies, and systematic reviews evaluating HIIT in women with PCOS were included and analyzed qualitatively.

Results. HIIT improves insulin sensitivity, reduces body mass index, and favorably modifies lipid profiles. Reductions in testosterone levels and improvements in menstrual regularity were observed, although data on gonadotropins and SHBG remain inconclusive. HIIT also reduces depression, anxiety, and stress, enhancing quality of life.

Conclusions. HIIT is a promising, safe, and effective adjunctive therapy for PCOS, benefiting metabolic, hormonal, reproductive, and psychological parameters. Further large-scale randomized trials are needed to confirm long-term effects and optimize exercise protocols.

Keywords: PCOS, high-intensity interval training, exercise, insulin resistance, hormones, mental health, metabolic outcomes, reproductive health, inflammation

1.Introduction

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder among women worldwide, affecting about 12% of women of reproductive age. Despite its high prevalence, the exact etiology of PCOS remains incompletely understood. It is widely accepted that the syndrome has a multifactorial origin, involving both genetic predisposition and environmental influences.

The diagnosis of PCOS is based on the Rotterdam criteria, which require the presence of at least two out of three features: clinical or biochemical hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology detected by ultrasound [1,2].

The clinical presentation of PCOS is highly heterogeneous. Common manifestations include menstrual irregularities, infertility, hirsutism, acne, and seborrhea. In addition to reproductive symptoms, PCOS is strongly associated with metabolic disturbances. Approximately 40% of patients develop metabolic syndrome, and many exhibit dyslipidemia, insulin resistance, and an increased risk of type 2 diabetes and cardiovascular disease.

Furthermore, women with PCOS are at increased risk of psychological disorders, including depression, anxiety, bipolar disorder, and eating disorders, which significantly impair quality of life [3, 4].

A key pathophysiological mechanism underlying PCOS is insulin resistance. Reduced insulin sensitivity in skeletal muscle and adipose tissue leads to compensatory hyperinsulinemia. Elevated insulin levels stimulate androgen production in ovarian theca cells and suppress hepatic synthesis of sex hormone-binding globulin (SHBG), resulting in increased levels of free androgens.

Hyperandrogenism not only contributes to clinical symptoms such as hirsutism and acne but also exacerbates insulin resistance by impairing glucose metabolism and adipose tissue function. This creates a self-perpetuating cycle in which hyperinsulinemia promotes androgen excess, and androgen excess further worsens insulin resistance [5].

In addition to metabolic and hormonal factors, chronic low-grade inflammation is increasingly recognized as a key contributor to PCOS pathogenesis. Elevated levels of inflammatory markers such as interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP) have been observed in affected individuals [6,7].

Given the systemic nature of PCOS, it is now considered a multisystem disorder rather than solely a reproductive condition. Therefore, comprehensive management strategies are required.

Importance of Lifestyle Modification

Lifestyle modification is considered the cornerstone of PCOS management, particularly as a first-line approach for patients with overweight or obesity [8]. The most effective strategies include tailored dietary changes, increased physical activity and behavioral approaches that support long-term adherence. These interventions have been shown to improve ovulatory function and help restore menstrual cycle regularity, which may in turn enhance fertility outcomes. Evidence suggests that nearly 50% of individuals with PCOS may experience improvements in both menstrual regularity and ovulation following consistent lifestyle changes. Additionally, such interventions can contribute to reduced anxiety levels and improved overall quality of life, particularly among women with obesity [9].

Despite these benefits, many patients face barriers to engaging in regular exercise, including a lack of time, motivation, and access to structured programs. Therefore, time-efficient exercise strategies are of particular interest.

High-Intensity Interval Training (HIIT)

High-intensity interval training (HIIT) is defined as a form of exercise consisting of short bursts of intense activity performed at or above 90% of maximal heart rate (HRmax), interspersed with periods of low-intensity recovery or rest.

HIIT has gained popularity due to its time efficiency and ability to induce significant physiological adaptations within a relatively short duration. Studies have demonstrated that HIIT improves cardiorespiratory fitness, insulin sensitivity, body composition, and endothelial function.

Additionally, HIIT has been shown to positively influence glucose metabolism, blood pressure, inflammatory markers, mental health and overall physical performance [10, 15, 22, 23].

These effects are particularly relevant in PCOS, where metabolic dysfunction, insulin resistance, and chronic inflammation play central roles. Therefore, HIIT represents a promising intervention for addressing multiple aspects of PCOS simultaneously.

2. Materials and methods

2.1 Literature Search and Study Selection

A narrative literature review was conducted using three electronic databases: PubMed, Scopus, and Google Scholar. The search included studies published between 2010 and 2025. Keywords used in the search strategy included “PCOS,” “high-intensity interval training,” “HIIT,” “physical activity,” “exercise,” “metabolic outcomes,” “hormonal profile,” and “reproductive health.”

Priority was given to randomized controlled trials, cohort studies, and systematic reviews investigating the effects of HIIT interventions on women with PCOS. Titles and abstracts were initially screened, followed by a full-text evaluation of potentially relevant articles. Data concerning exercise type, frequency, intensity, duration, and reported metabolic, hormonal, reproductive, and psychological outcomes were extracted and summarized qualitatively.

The aim of this review was to provide a clinically relevant overview of current evidence on the effects of HIIT on PCOS management rather than conduct a formal quantitative meta-analysis.

2.2 AI

During the preparation of this manuscript, artificial intelligence (AI) tools were used solely for language editing and structural assistance. AI support was applied to improve clarity, grammar, and academic phrasing of selected sections of the text. The author(s) independently conducted the literature search, critically evaluated the sources, interpreted the findings, and formulated all scientific conclusions. No AI tools were used for data analysis, data fabrication, image generation, or the creation of scientific results. The author(s) take full responsibility for the integrity, originality, and accuracy of the content.

3. Research results

3.1 Effects of HIIT on Mental Health in Women with PCOS

Growing evidence suggests that high-intensity interval training (HIIT) exerts significant beneficial effects on mental health and quality of life in women with polycystic ovary syndrome (PCOS). Psychological disturbances, including depression, anxiety, and reduced self-esteem,

are highly prevalent in this population and represent an important yet often underrecognized component of the disorder.

Santos et al., in a randomized controlled trial conducted in 2022 demonstrated that a 12-week HIIT intervention performed three times per week significantly improved health-related quality of life, as assessed by the SF-36 questionnaire, compared to a non-exercising control group. Participants in the HIIT group also exhibited a significant reduction in symptoms of depression, anxiety, and stress, as measured by the DASS-21 scale. These findings imply that HIIT may play a crucial role in psychological well-being. Importantly, the study also reported that some of the psychological benefits persisted even after a short detraining period, suggesting that HIIT may induce relatively lasting adaptations[11].

Similarly, a systematic review published by Patten et al., in 2023 confirmed that HIIT interventions are associated with improvements in mental health outcomes in women with PCOS. The authors reported consistent reductions in depressive and anxiety symptoms, along with improvements in overall quality of life. These effects may be partially explained by exercise-induced neurobiological mechanisms, including increased endorphin release, improved neurotransmitter regulation (e.g., serotonin and dopamine), and reduced systemic inflammation.

Moreover, the structured, time-efficient nature of HIIT may enhance adherence to exercise programs, which is a critical factor in achieving sustained psychological benefits. Improved physical fitness and body composition may also contribute to enhanced self-image and self-confidence, further supporting mental health [12].

Taken together, these findings indicate that HIIT represents a valuable adjunctive strategy for addressing the psychological burden associated with PCOS.

3.2 Effects of HIIT on Metabolic Parameters

A substantial body of evidence demonstrates that HIIT has a significant positive effect on metabolic parameters in women with PCOS, especially in relation to glucose metabolism and insulin sensitivity.

dos Santos et al., in a meta-analysis of randomized controlled trials found that HIIT interventions significantly reduce the homeostasis model assessment of insulin resistance (HOMA-IR), indicating improved insulin sensitivity. This is particularly relevant in PCOS,

where insulin resistance is a main pathophysiological feature. The underlying mechanisms may include increased expression and translocation of glucose transporter type 4 (GLUT-4) in skeletal muscle, enhanced mitochondrial biogenesis, and improved oxidative capacity. These adaptations facilitate more efficient glucose uptake and utilization which reduces hyperinsulinemia.

Beyond improvements in insulin resistance, HIIT is associated with reductions in body weight, body mass index (BMI), and waist-to-hip ratio (WHR). These anthropometric changes are clinically relevant because excess adiposity, especially visceral fat, is strongly linked to metabolic dysfunction in PCOS.

Regarding lipid metabolism, studies suggest that HIIT may lead to modest improvements in lipid profile, including reductions in total cholesterol and low-density lipoprotein (LDL) levels and increases in high-density lipoprotein (HDL). However, these effects appear to be less pronounced compared to improvements in glucose metabolism and may depend on intervention duration and baseline metabolic status [13].

Mohammadi et al., in a randomized controlled trial published in 2023 further supports these findings, demonstrating that an eight-week HIIT program performed three times weekly resulted in favorable changes in HOMA-IR, lipid profile, including decreases in total cholesterol and low-density lipoprotein (LDL), along with improvements in BMI and WHR compared to a control group. Noteworthy, the absence of significant changes in the control group strengthens the evidence that the observed benefits can be attributed to the HIIT intervention itself [14].

Overall, current evidence suggests that HIIT is an effective intervention for improving metabolic health in women with PCOS, particularly insulin sensitivity.

3.3 Effects of HIIT on Hormonal Profile

High-intensity interval training appears to exert beneficial effects on hormonal regulation in women with PCOS, although the available evidence remains somewhat heterogeneous.

A randomized controlled trial conducted in 2023 by Mohammadi et al., investigated the effects of an eight-week HIIT program on hormonal parameters in women with PCOS. The results presented a significant reduction in cortisol levels and a decrease in the testosterone to cortisol

ratio following the intervention. These findings suggest improved stress regulation and a potential reduction in hyperandrogenism.

The reduction in androgen levels may be indirectly observed through improvements in insulin sensitivity. As hyperinsulinemia stimulates ovarian androgen production and suppresses SHBG synthesis, reductions in insulin levels may contribute to normalization of androgen concentrations [14].

Additional insights can be drawn from studies conducted in healthy women. Ramadan et al., in a 2025 study comparing HIIT with resistance training, demonstrated that HIIT led to reductions in testosterone and follicle-stimulating hormone (FSH) levels, along with increased estrogen concentrations, without significant changes in luteinizing hormone (LH) or prolactin. Although these findings are not specific to PCOS, they suggest that HIIT may influence the hypothalamic-pituitary-ovarian axis [16].

A meta-analysis examining the effectiveness of exercise interventions on androgen and SHBG levels in women with PCOS found that physical activity promotes androgen reduction in women with PCOS. However, a subgroup analysis including only HIIT did not clearly demonstrate significant changes in total testosterone or SHBG levels. The authors emphasize that the lack of statistical significance may be due to the limited number of studies using only HIIT protocols and small sample sizes [17].

In summary, current evidence suggests that HIIT may contribute to improvements in androgen profile in women with PCOS; however, its effects on gonadotropins and SHBG remain inconclusive and require further investigation.

3.4 Effects of HIIT on Reproductive Function

The potential impact of HIIT on reproductive function in women with PCOS is of considerable clinical interest, particularly in the context of ovulatory dysfunction and infertility.

Patten et al., in a randomized controlled trial published in 2022 demonstrated that a 12-week HIIT program significantly improved menstrual regularity compared to moderate-intensity continuous training (MICT). Participants in the HIIT group were more likely to experience normalization of their menstrual cycles, and this effect occurred independently of significant weight loss. Among participants using HIIT, 69% reported improved cycle regularity, whereas in the MCT group only 22% did.

This finding suggests that improvements in reproductive function may be primarily mediated by metabolic changes rather than reductions in adiposity. Enhanced insulin sensitivity may reduce ovarian androgen production and restore normal function of the hypothalamic-pituitary-ovarian axis [18].

Benham et al., in a 2021 pilot randomized controlled trial, showed that the effects of HIIT on ovulatory function remain limited and inconclusive. The study compared HIIT, continuous aerobic exercise, and a no-intervention control group evaluated reproductive outcomes, including ovulation frequency. These findings suggest that regular physical activity may exert beneficial effects on reproductive health in women with PCOS; however, no statistically significant or consistent improvements in fertility-related outcomes were observed. Notably, HIIT did not demonstrate a clear advantage over other forms of activity. The authors emphasize that these results should be interpreted with caution due to several limitations, such as the small sample size, short duration of the intervention, and considerable interindividual variability in response[19].

Overall, while HIIT may indirectly support reproductive function through improvements in metabolic and hormonal parameters, current evidence does not provide strong support for its direct effect on fertility in women with PCOS, highlighting the need for further largescale and well-designed studies in this area.

3.5 Effects of HIIT on Body Composition

High-intensity interval training (HIIT) has been shown to significantly affect body composition also in women with polycystic ovary syndrome (PCOS), particularly in reducing adiposity and improving anthropometric parameters.

HIIT leads to reductions in body mass index (BMI), total body weight, and waist-to-hip ratio (WHR). These changes are clinically relevant, as central obesity, especially visceral adiposity, is strongly associated with insulin resistance and metabolic dysfunction in PCOS.

The reduction of visceral fat is particularly important, as it contributes to decreased secretion of pro-inflammatory cytokines and improved insulin sensitivity. Adipose tissue, especially in excess, functions as an endocrine organ that secretes adipokines involved in metabolic regulation. Therefore, reductions in fat mass achieved through HIIT may have systemic metabolic benefits.

Additionally, HIIT may promote increases in lean body mass and improvements in muscle function, which further support metabolic health by enhancing glucose uptake and utilization, thereby lowering circulating glucose and insulin levels. The effectiveness of HIIT in modifying body composition may be attributed to its capacity to generate high energy expenditure within a relatively short duration, as well as to stimulate excess post-exercise oxygen consumption (EPOC), resulting in prolonged energy expenditure after exercise [13, 14, 20].

Overall, HIIT represents an effective strategy for improving body composition, which plays a crucial role in the management of PCOS.

3.6 Effects of HIIT on Inflammation

Chronic low-grade inflammation is increasingly recognized as a key component in the pathogenesis of PCOS. Elevated levels of inflammatory markers including interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP) have been consistently observed in women with PCOS [6,7].

Although research specifically examining the effects of HIIT on inflammatory markers in PCOS is still limited, existing evidence suggests that high-intensity exercise may exert anti-inflammatory effects.

High-intensity interval training (HIIT) induces an acute inflammatory response characterized by a transient increase in circulating leukocytes and pro-inflammatory cytokines, particularly interleukin-6 (IL-6). This response is intensity-dependent and more pronounced compared to moderate-intensity exercise. Notably, the elevation of IL-6 is followed by a concomitant increase in anti-inflammatory cytokines, such as interleukin-10 (IL-10), indicating activation of compensatory anti-inflammatory pathways. Additionally, markers of systemic inflammation, including C-reactive protein (CRP), may remain elevated for up to 24-48 hours post-exercise, reflecting ongoing tissue repair and regeneration processes. Despite this transient pro-inflammatory state, appropriately prescribed HIIT is associated with favorable immunological adaptations, whereas excessive training load and insufficient recovery may contribute to chronic low-grade inflammation [21].

4. Discussion

The present review highlights the multifaceted benefits of high-intensity interval training (HIIT) in the management of polycystic ovary syndrome (PCOS), a complex and systemic disorder affecting metabolic, hormonal, reproductive, and mental health [11-20].

The most consistent and robust findings show improvements in metabolic parameters, while its direct effects on hormonal regulation and reproductive outcomes are less clear and, in some cases, inconsistent [13, 14, 16, 17].

The strongest findings relate to improvements in insulin sensitivity and glucose metabolism. Insulin resistance represents is central pathophysiological mechanism underlying PCOS, making these adaptations highly important. HIIT appears to enhance insulin sensitivity, reflected by reductions in HOMA-IR, likely due to increased skeletal muscle glucose uptake, upregulation of GLUT-4 transporters, and improved mitochondrial function. These metabolic changes may subsequently impact other PCOS features. Notably, reduced hyperinsulinemia could decrease ovarian androgen production and partially restore hormonal balance. Therefore, the hormonal and reproductive improvements from HIIT likely result secondarily from metabolic effects rather than direct endocrine changes [13, 14].

Despite these mechanistic links, evidence regarding the direct impact of HIIT on hormonal parameters remains heterogeneous. While some studies report reductions in testosterone levels and improvements in androgen balance, others fail to demonstrate significant changes in key hormonal markers such as sex hormone-binding globulin (SHBG), luteinizing hormone (LH), or follicle-stimulating hormone (FSH). These inconsistencies may be attributed to variations in study design, including differences in intervention duration, training intensity, sample size, and participants baseline characteristics. Additionally, the relatively short duration of most interventions may be insufficient to induce substantial changes in endocrine function, which often requires longer-term adaptations [16, 17].

The effects of HIIT on reproductive outcomes, including ovulation and fertility, are inconclusive. While some studies show improvements in menstrual regularity, these changes do not consistently improve ovulation frequency or fertility outcomes. This discrepancy highlights a critical gap between metabolic and reproductive adaptations. Although HIIT improves the metabolic environment necessary for normal ovarian function, additional factors, such as chronic inflammation, genetic predisposition, and long-standing hormonal

dysregulation, may limit the extent to which reproductive function can be restored. Additionally, the small number and limited quality of available studies make it difficult to draw firm conclusions [18, 19].

In contrast, the psychological benefits of HIIT appear to be more consistent across studies. Reductions in symptoms of depression, anxiety, and stress, along with improvements in quality of life, have been repeatedly reported. These effects are likely mediated by a combination of physiological and psychological mechanisms, including increased endorphin release, improved neurotransmitter regulation, and enhanced self-efficacy. Importantly, the time-efficient nature of HIIT may improve adherence to exercise interventions, which is a key determinant of long-term success in lifestyle modification programs. Given the high prevalence of mental health disorders in women with PCOS, these findings have significant clinical implications [11, 12].

Regarding body composition, HIIT appears to reduce body mass index, waist-to-hip ratio, and visceral adiposity, all of which are strongly associated with cardiometabolic risk. However, evidence regarding its effect on total body fat percentage remains inconsistent. This suggests that while HIIT is effective in improving certain anthropometric parameters, its impact on fat mass may be moderate and influenced by factors such as intervention duration, dietary intake, and individual variability. Reducing visceral fat is particularly important, as it is metabolically active and contributes to systemic inflammation and insulin resistance. Additionally, potential increases in lean body mass may further enhance metabolic health through improved glucose utilization [13, 14, 20].

The role of HIIT in modulating inflammation in PCOS remains an emerging area of research. Although acute HIIT induces a transient increase in pro-inflammatory markers, this response is typically followed by an anti-inflammatory adaptation. Over time, regular high-intensity exercise may reduce chronic low-grade inflammation, a recognized feature of PCOS. However, the balance between beneficial and potentially adverse inflammatory responses may depend on training load, recovery, and individual tolerance, highlighting the importance of appropriate exercise prescription [6, 7, 21].

Despite the promising findings presented in this review, several limitations must be acknowledged. The available literature is characterized by relatively small sample sizes, short intervention durations, and considerable heterogeneity in HIIT protocols, including differences in intensity, frequency, and session structure. This variability limits the comparability of studies

and complicates the interpretation of results. Furthermore, many studies focus primarily on metabolic outcomes, while hormonal and reproductive endpoints remain under-investigated.

Future research should aim to address these limitations by conducting large-scale, well-designed randomized controlled trials with standardized HIIT protocols and longer follow-up periods. Particular emphasis should be placed on explaining the mechanisms linking metabolic improvements to hormonal and reproductive outcomes. Additionally, integrating exercise interventions with dietary and behavioral strategies may provide a more comprehensive approach to PCOS management [13, 14, 16, 17].

In conclusion, HIIT is a promising and time-efficient intervention that primarily targets the metabolic disturbances underlying PCOS and may indirectly influence hormonal, reproductive, and psychological outcomes. However, while its benefits for metabolic health and mental well-being are well supported, its direct effects on endocrine function and fertility remain uncertain. A more nuanced understanding of these relationships is required to fully establish HIIT's role in the comprehensive management of PCOS.

5. Conclusion

Polycystic ovary syndrome is a complex, multisystem disorder involving metabolic, hormonal, reproductive, and psychological components. Effective management requires a comprehensive and multidisciplinary approach.

High-intensity interval training (HIIT) appears as a promising, time-efficient, and effective intervention in the management of PCOS. The strongest evidence supports its role in improving insulin sensitivity and metabolic health. Additionally, HIIT may contribute to reductions in body weight, improvements in body composition, and favorable changes in lipid profile.

Emerging evidence suggests potential benefits in hormonal regulation, including reductions in androgen levels, as well as improvements in menstrual regularity and reproductive function. Furthermore, HIIT has demonstrated significant positive effects on mental health and quality of life.

Despite these encouraging findings, further research is required to establish the long-term efficacy of HIIT and its impact on hormonal and reproductive outcomes. Future studies should aim to standardize training protocols and include larger, more diverse populations.

In conclusion, HIIT represents a valuable adjunct to lifestyle modification strategies in women with PCOS and may play an important role in improving both physical and psychological health outcomes.

Disclosure

The authors report no disclosures.

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