*IOSR Journal of Nursing and Health Science (IOSR-JNHS)*
*e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 15, Issue 1 Ser. 2 (Jan. – Feb. 2026), PP 38-42*
*www.iosrjournals.org*

# Effects Of Physical Exercise On Insulin Sensitivity In Women With Polycystic Ovary Syndrome: Systematic Review And Meta-Analysis Protocol

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***Abstract:***
***Background****: Polycystic ovary syndrome is a prevalent endocrine–metabolic condition, frequently associated with insulin resistance and increased cardiometabolic risk. Physical exercise has been recommended as a non-pharmacological strategy for disease management; however, the available evidence remains heterogeneous.*
***Materials and Methods****: This study describes the protocol of a systematic review, with the possibility of meta-analysis, registered in PROSPERO. Randomized controlled trials evaluating the effects of physical exercise on insulin resistance in women with polycystic ovary syndrome will be included. Searches will be conducted in electronic databases, without language restriction. Risk of bias will be assessed using the Cochrane RoB 2 tool. When appropriate, a meta-analysis will be conducted using a random-effects model.*
***Results****: It is expected to identify and synthesize evidence from clinical studies investigating the effects of physical exercise on insulin resistance, preferably operationalized using the HOMA-IR index, as well as on body mass index.*
***Conclusion:*** *This protocol aims to guide the conduct of a methodologically rigorous systematic review, with the potential to support evidence-based clinical practice and guide future research.*
***Key Word:*** *Physical activity; insulin sensitivity; HOMA-IR; women; systematic review.*

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Date of Submission: 02-02-2026 Date of Acceptance: 12-02-2026

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## I. Introduction

Polycystic ovary syndrome (PCOS) is a multifactorial endocrine–metabolic condition, common among women of reproductive age, influenced by genetic and environmental factors. Its prevalence is estimated to range from 6% to 16%, depending on the diagnostic criteria adopted, representing a significant public health issue for women[1]. The clinical presentation is characterized by menstrual irregularities, hyperandrogenism, and the presence of polycystic ovaries, in addition to a significant predisposition to metabolic complications, such as insulin resistance, obesity, and increased cardiovascular risk[2].

Among the pathophysiological mechanisms involved in PCOS, insulin resistance plays a central role. Compensatory hyperinsulinemia stimulates excessive ovarian androgen secretion, which may negatively interfere with ovulation and increase the risk of infertility[3]. Pharmacological treatment of PCOS aims to control hyperandrogenic symptoms, regulate the menstrual cycle, and minimize metabolic alterations through the use of hormonal contraceptives, antiandrogenic agents, and medications aimed at glycemic control[4]. However, these interventions generally require prolonged use and continuous medical follow-up, reinforcing the need for complementary therapeutic strategies.

As an alternative or adjunct to pharmacological treatment, several studies have highlighted the benefits of regular physical exercise. Evidence indicates that exercise can improve insulin sensitivity, reduce body

adiposity, optimize ovulatory function, and decrease circulating levels of testosterone and other androgens[5,6]. In a recent randomized controlled trial, women with PCOS who underwent an eight-week resistance training protocol demonstrated a significant reduction in cholesterol levels and improvement in insulin resistance compared to the control group[7].

In addition to metabolic and reproductive repercussions, PCOS negatively impacts quality of life and mental health in affected women, being associated with higher rates of depression, anxiety, and impaired self-esteem[8]. These factors reinforce the importance of integrative approaches and non-pharmacological interventions, such as physical exercise, which may promote both metabolic and psychosocial benefits.

Despite the growing volume of primary studies investigating the effects of physical exercise in PCOS, the evidence remains fragmented. Existing systematic reviews address varied outcomes; however, many do not primarily focus on insulin resistance or do not provide quantitative synthesis of the available data[9,10]. Methodological heterogeneity among studies, including different exercise protocols and assessment methods, hinders the consolidation of robust evidence-based clinical recommendations.

Given this context, there is a clear need for a systematic review with rigorous methodology and the possibility of meta-analysis, specifically focused on evaluating the effects of physical exercise on insulin resistance in women with PCOS. Consolidating this evidence may contribute to evidence-based clinical practice and guide future research in the field. Therefore, this study describes the protocol of a systematic review, with the possibility of meta-analysis, aimed at evaluating the effects of physical exercise on insulin resistance, preferably operationalized using the HOMA-IR index, as well as other metabolic parameters, such as body mass index, in women with polycystic ovary syndrome.

## II. Material And Methods

**Study design and registration**

This is a systematic review protocol, with the possibility of meta-analysis, developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. The protocol was previously registered in the International Prospective Register of Systematic Reviews (PROSPERO), with the aim of ensuring methodological transparency, reproducibility, and reduction of selective reporting bias.

**Research question**

The research question was formulated based on the PICO strategy (Population, Intervention, Comparison, Outcome), as described below:

- **Population (P):** women diagnosed with polycystic ovary syndrome;
- **Intervention (I):** structured physical exercise, regardless of type, intensity, or duration;
- **Comparison (C):** control group without intervention or receiving usual care;
- **Outcome (O):** insulin resistance, preferably assessed using the HOMA-IR index.

**Eligibility criteria**

**Inclusion criteria**

Randomized controlled trials and controlled studies investigating the effects of physical exercise on insulin resistance in women diagnosed with polycystic ovary syndrome will be included. No restrictions will be applied regarding reproductive age range, type of exercise, intensity, frequency, or duration of the intervention. Studies must include a comparator group and provide quantitative data related to insulin resistance.

**Exclusion criteria**

Studies conducted in animal models; case reports; case series; systematic reviews; meta-analyses; editorials; and expert opinions will be excluded. Studies that combine physical exercise with other non-standardized interventions that preclude isolated assessment of the effects of exercise will also be excluded.

**Search strategy**

The literature search will be conducted systematically in the following electronic databases: PubMed, Scopus, PEDro, Web of Science, and LILACS. Controlled descriptors (MeSH and DeCS) and free-text terms related to polycystic ovary syndrome, physical exercise, and insulin resistance will be used.

Search terms will be combined using Boolean operators (AND, OR), and the search strategy will be adapted according to the specific characteristics of each database. No language restriction will be applied, and the search period will cover the last five years.

The complete search strategy for the PubMed database will be:
("polycystic ovary syndrome" OR "polycystic ovarian syndrome" OR PCOS) AND ("exercise" OR "physical activity" OR "exercise therapy" OR "training" OR "aerobic exercise" OR "resistance training") AND ("insulin resistance" OR "insulin sensitivity" OR "glucose tolerance" OR "hyperinsulinemia") AND ("randomized controlled trial" OR "controlled clinical trial" OR "clinical trial").

**Study selection process**

Study selection will be conducted independently by two reviewers, initially through screening of titles and abstracts. Potentially eligible studies will be assessed in full text to confirm inclusion criteria. In cases of disagreement, a third reviewer will be consulted. The selection process will be presented graphically using a PRISMA 2020 flow diagram.

**Data extraction**

Data from included studies will be extracted using a standardized form, including: authors and year of publication; sample characteristics; PCOS diagnostic criteria; type and protocol of physical exercise; comparator group; assessed outcomes; follow-up duration; main results; funding sources; and potential conflicts of interest.

**Risk of bias assessment**

Risk of bias will be assessed independently by two reviewers using the Cochrane Risk of Bias 2 (RoB 2) tool. Disagreements will be resolved by consensus or by a third reviewer. Assessment will be performed using Review Manager (RevMan) software.

**Data synthesis and analysis plan**

Initially, results will be presented through a qualitative descriptive synthesis. If sufficient clinical and methodological homogeneity is identified, a meta-analysis will be conducted using RevMan software.

For continuous variables, effect measures will be expressed as mean difference (MD) or standardized mean difference (SMD), with 95% confidence intervals. Statistical heterogeneity will be assessed using the chi-square ($\chi^2$) test and the $I^2$ statistic. When applicable, sensitivity analyses and publication bias assessment using funnel plots and Egger's test will be performed.

**Ethical aspects**

As this is a systematic review based exclusively on previously published secondary data, the study does not involve direct contact with human participants and therefore does not require approval from a Research Ethics Committee.

## III. Result

It is expected that the systematic review will identify and synthesize evidence from randomized controlled trials evaluating the effects of physical exercise on insulin resistance in women with polycystic ovary syndrome. Study selection will be presented using a PRISMA flow diagram detailing the stages of identification, screening, eligibility, and inclusion.

The results of the included studies will initially be organized into descriptive tables, including key methodological characteristics such as sample size, PCOS diagnostic criteria, type and protocol of physical exercise, comparator group, intervention duration, and assessed outcomes. This qualitative synthesis will allow comparison of approaches and identification of similarities and differences among studies.

When sufficient and comparable quantitative data are available, a meta-analysis will be conducted for the primary outcome, insulin resistance, preferably operationalized using the HOMA-IR index. Additionally, a meta-analysis may be performed for the secondary outcome, body mass index, provided that criteria for clinical and methodological homogeneity are met. Analyses will be presented using forest plots, with point estimates and corresponding 95% confidence intervals.

Statistical heterogeneity among studies will be assessed, and when substantial heterogeneity is identified, sensitivity analyses or complementary narrative synthesis will be considered. If the number of studies permits, potential publication bias will be explored using funnel plots.

It is expected that data synthesis will help clarify the overall effect of physical exercise on insulin resistance in women with PCOS, providing more precise estimates of the impact of this non-pharmacological intervention. The findings may assist in understanding the magnitude of the effects of physical exercise and support clinical decision-making and planning of future interventions and research.

## IV. Discussion

This article describes the protocol of a systematic review, with the possibility of meta-analysis, aimed at evaluating the effects of physical exercise on insulin resistance in women with polycystic ovary syndrome. The methodological proposal was developed based on international guidelines and previously registered in PROSPERO, ensuring transparency, reproducibility, and scientific rigor throughout the review process.

The adoption of clearly defined eligibility criteria, a comprehensive search strategy, systematic risk of bias assessment, and a quantitative data synthesis plan strengthens the robustness of the proposed protocol. Emphasis on the HOMA-IR index as the primary outcome is justified by its clinical relevance and widespread use in the literature, while inclusion of body mass index as a secondary outcome allows a broader understanding of the potential effects of physical exercise in this population.

Polycystic ovary syndrome is recognized as a complex endocrine–metabolic condition, whose pathophysiology centrally involves insulin resistance and its hormonal and metabolic repercussions[1,2]. The presence of insulin resistance directly contributes to compensatory hyperinsulinemia, which in turn stimulates ovarian androgen production, exacerbating clinical manifestations such as anovulation, menstrual irregularities, and infertility[3]. In this context, therapeutic interventions capable of improving insulin sensitivity are considered fundamental in the clinical management of PCOS.

Physical exercise has been widely recommended as a non-pharmacological strategy in the treatment of PCOS, particularly due to its ability to promote favorable metabolic adaptations, regardless of concomitant medication use[5,6]. Evidence from randomized controlled trials indicates that different exercise modalities, including aerobic, resistance, or combined training, may reduce insulin resistance, improve lipid profiles, and contribute to reductions in body mass index in women with PCOS[5,7]. These effects are especially relevant given that insulin resistance may be present even in normal-weight women, reinforcing the importance of physical exercise as a central component of treatment.

Despite these promising findings, the literature exhibits considerable methodological heterogeneity. Studies differ in diagnostic criteria, sample characteristics, exercise type and intensity, intervention duration, and methods used to assess insulin resistance[6,9]. This variability limits direct comparison of results and extrapolation to clinical practice, highlighting the need for rigorous systematic syntheses.

Previously published systematic reviews have addressed the effects of physical exercise in women with PCOS; however, many included varied outcomes without a specific focus on insulin resistance or lacked quantitative synthesis of available data[9,10]. The absence of meta-analysis in some reviews prevents estimation of the overall effect of physical exercise, reducing precision and limiting the development of robust evidence-based clinical recommendations.

Beyond metabolic and reproductive aspects, PCOS is associated with significant impacts on quality of life and mental health, including higher prevalence of depressive and anxiety symptoms[8]. In this context, physical exercise may provide additional benefits by improving not only physiological parameters but also psychological well-being and self-esteem, reinforcing its role as an integrative therapeutic intervention.

The present protocol proposes a systematic review with rigorous methodology and the possibility of meta-analysis, previously registered in PROSPERO, with a specific focus on evaluating the effects of physical exercise on insulin resistance, preferably assessed using the HOMA-IR index. Additionally, analysis of body mass index as a secondary outcome will allow exploration of potential effects of physical exercise on body composition, contributing to a more comprehensive understanding of the benefits of this intervention.

It is expected that conducting this systematic review will contribute to consolidating available evidence, providing more precise estimates of the effects of physical exercise on insulin resistance in women with PCOS. The results may assist healthcare professionals in clinical decision-making, guide the development of evidence-based intervention protocols, and identify knowledge gaps for future research.

## V. Conclusion

It is expected that the execution of this systematic review will contribute to consolidating available evidence, supporting healthcare professionals in clinical decision-making and planning evidence-based interventions. In addition, the results may identify knowledge gaps and guide future research related to the non-pharmacological management of polycystic ovary syndrome.

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