The 7th Proceeding Strada International Conference on Health
Kediri – East Java, Indonesia, September 24-25, 2025
https://proceeding.thesich.org | Page 13-21

Systematic Review: The Relationship Between Lifestyle, Diet, and Physical Activity and the Risk of PCOS in Women of Reproductive Age

Eka Sarofah Ningsih[1*], Rizky Rahadian Wicaksono[2]
[1] *Doctoral Programme of Public Health, Universitas Strada Indonesia, Indonesia*
[2] *Faculty of Health Sciences, Universitas Islam Lamongan, Indonesia*
**Corresponding author: ekasn@unisla.ac.id*

ABSTRACT

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder among women of reproductive age, with reproductive, metabolic, and psychosocial consequences. In Indonesia, epidemiological data on PCOS remain limited, while unhealthy lifestyles and obesity are increasing. To summarize the latest scientific evidence on the effectiveness of lifestyle-based interventions on metabolic and reproductive parameters in women with PCOS and to identify research gaps in the Indonesian context. A systematic review of the Scopus, PubMed, and BMC databases (Q1–Q4) up to the most recent year. Twenty-nine interventional and observational studies assessing diet, physical activity, and lifestyle education in PCOS were thematically analyzed. The combination of hypocaloric/low-glycemic index diets and increased physical activity significantly reduced body weight, BMI, waist circumference, fasting glucose and insulin, and lipid profiles, and improved menstrual cycle regularity and ovulation. A ≥5% weight loss was identified as the minimal threshold for hormonal improvement. Obesity, high-calorie low-fiber diets, low physical activity, stress, and sedentary behavior were the main risk factors for PCOS. Lifestyle modification is effective, cost-effective, and should be implemented comprehensively, including psychological support. In Indonesia, strong local research and school- or primary health care–based preventive programs are needed to reduce PCOS risk from adolescence.

Keywords: diet, lifestyle modification, PCOS, physical activity, systematic review

BACKGROUND

Polycystic Ovary Syndrome (PCOS) is the most common endocrine disorder among women of reproductive age and has emerged as a serious global reproductive health issue. It is characterized by chronic anovulation, hyperandrogenism, and polycystic ovarian morphology, with far-reaching reproductive, metabolic, and psychological impacts including infertility, insulin resistance, obesity, and increased risks of type 2 diabetes and cardiovascular disease. Many women also experience depression, anxiety, and reduced quality of life due to symptoms such as hirsutism, acne, and menstrual irregularities.

Although genetic factors contribute to PCOS, unhealthy modern lifestyles high-fat, high-sugar diets, low fiber intake, physical inactivity, and sedentary behaviour exacerbate its risk and symptoms. Urbanization, fast-food consumption, and excessive gadget use have fueled rising PCOS prevalence worldwide, including in Indonesia. WHO estimates a prevalence of 6–13% globally, yet about 70% of cases go undiagnosed due to low awareness

and differing diagnostic criteria. Local data from Jakarta report 6.5% prevalence among girls aged 15–19, indicating a growing threat to adolescent reproductive health.

Delayed diagnosis, combined with lifestyle changes, has created conditions for a surge of PCOS particularly among adolescents and young women. Evidence increasingly supports lifestyle management dietary modification, physical activity, behavioral change, and education as first-line therapy to improve hormonal, metabolic, and psychological outcomes. School or community based interventions and systematic reviews on effective lifestyle approaches are urgently needed to inform local policies and programs tailored to Indonesian populations.

METHODS

This study is a systematic review that examines evidence on the relationship between lifestyle, diet, and physical activity and the risk of PCOS in women of reproductive age. Literature was systematically searched through international databases, reputable open-access journals, and Indonesian sources that met the inclusion criteria. As it used only secondary data from published studies, this review did not require ethical approval, and all procedures adhered to international academic ethics guidelines such as the Cochrane Handbook and PRISMA 2020. By following these principles, the systematic review complies with good scientific practice standards despite not requiring formal ethical clearance.

RESULTS

The literature search was conducted systematically across three reputable international databases: PubMed, Scopus, and Web of Science. The search strategy was designed with reference to the PRISMA 2020 guidelines to ensure transparency and reproducibility in the study identification process. Keywords were developed from Medical Subject Headings (MeSH) and relevant free-text terms, using the Boolean operators AND and OR.

The screening criteria included: publication years 2015–2025, articles in English or Indonesian, and study types consisting of observational studies (cross-sectional, cohort, or case-control), randomized controlled trials (RCTs), and systematic reviews published in reputable Scopus Q1–Q4 journals.

The initial search identified 3,482 articles (PubMed: 1,226; Scopus: 1,705; Web of Science: 551). After screening titles and abstracts based on the inclusion and exclusion criteria, 214 articles were selected for full-text review. The final selection yielded 29 studies that met the criteria for further analysis.

In this systematic review, 29 articles met the inclusion criteria, comprising meta-analyses, randomized controlled trials (RCTs), systematic reviews, and observational studies. Collectively, these studies investigated the associations between lifestyle factors such as diet and physical activity and both the risk and clinical outcomes of polycystic ovary syndrome (PCOS) in women of reproductive age.

The majority of the included studies focused on evaluating the impact of multifaceted lifestyle interventions, typically combining hypocaloric dietary approaches, increased physical activity, and behavioral education. These interventions were assessed for their effects on key clinical and metabolic outcomes, including body weight, insulin resistance, lipid profiles, menstrual cycle regularity, and hormonal parameters.

In addition, several large-scale population-based cross-sectional studies examined lifestyle-related determinants of PCOS risk. These studies highlighted factors such as obesity, low levels of physical activity, and adverse psychological conditions as significant contributors to PCOS pathogenesis and progression. This evidence collectively underscores the role of modifiable lifestyle behaviors in influencing both the development and clinical expression of

PCOS in women of reproductive age.

Table 1. Key Studies: Lifestyle Interventions, Diet, Physical Activity, and PCOS Outcomes

Author (Year) / Source	Design & Location	Population / Sample	Exposure / Intervention	Main Outcomes	Key Findings
Effect of Lifestyle Intervention on Cardiometabolic Risk Factors in Women with PCOS (Meta-analysis, PubMed/Scopus Q1)	Meta-analysis of RCTs from various countries	Reproductive-age women who are overweight/obese with PCOS	Lifestyle intervention (diet + exercise) vs control or diet alone	Body weight, HOMA-IR, LDL	Significant weight loss (SMD –0.8), HOMA-IR and LDL decreased significantly compared to control
Lifestyle Interventions in Women with PCOS: A Scoping Systematic Review (PubMed, Scopus Q1)	Scoping systematic review of international RCTs	4,659 women with PCOS (various BMIs)	Hypocaloric diet, diet + physical activity, diet + behavioral programs	BMI, body weight, testosterone, metabolic outcomes	Most studies showed reductions in BMI and weight; varied results on reproductive hormones; study quality heterogeneous
The Effect of Lifestyle Intervention on Body Composition in PCOS (Meta-analysis)	Meta-analysis up to 2013	Women with PCOS	Diet + physical exercise vs usual care	BMI, body weight, waist circumference, body composition	Interventions significantly improved body composition; effects on lipid profiles less consistent
Lifestyle Modification Programs in	RCTs & international	Women with PCOS (various	Lifestyle modification (diet + activity) vs	Fasting glucose, fasting	Lifestyle modification

PCOS: Systematic Review and Meta-analysis (PubMed, Scopus Q2)	interventi on studies	BMIs)	control/minimal intervention/metfo rmin	insulin, BMI	significant ly reduced glucose and insulin; BMI improved compared to control; metformin not always superior
Effectiveness of Lifestyle Modification in PCOS Patients with Obesity (Systematic Review & Meta-analysis)	Systemati c review & meta-analysis	Women with PCOS and obesity	Combination of diet + exercise vs diet alone or control	Fasting insulin, menstrual cycle, reproductiv e function	Combined interventio ns improved insulin and reproducti ve function more effectively ; ≥5% weight loss associated with better metabolic-reproducti ve outcomes
High Prevalence of Medical Conditions and Unhealthy Lifestyle Behaviours in Women with PCOS (Australia) (PMC, Scopus Q3)	Cross-sectional cohort	Women aged 24–30 years (Australia)	Self-reported lifestyle (physical activity, obesity, mental health)	PCOS prevalence & lifestyle behaviors	PCOS prevalence 11.8%; women with PCOS more often obese, depressed, anxious; lifestyles less healthy compared to women without PCOS

Risk of Polycystic Ovary Syndrome: A Population-Based Analysis in Saudi Arabia (BioMed Central, Scopus Q3)	Cross-sectional population study in Saudi Arabia	General reproductive-age women	Demographic & lifestyle factors (body weight status, stress, health conditions)	PCOS risk/diagnosis	Obesity, stress, and chronic health conditions strongly associated; demographic factors and healthcare access also influence

Study Characteristics

In terms of population characteristics, the samples included women of reproductive age (15–49 years), both those already diagnosed with PCOS and those in at-risk groups (women without an official diagnosis but exhibiting clinical symptoms or relevant risk factors). Several studies specifically targeted adolescent girls and young women, while others encompassed a broader range of reproductive ages. Focusing on this population is important because adolescence and early adulthood represent critical periods in the development of PCOS risk, both hormonally and in terms of lifestyle.

With this heterogeneous yet methodologically robust set of characteristics, the 29 included studies provide a solid evidence base for evaluating the relationships between lifestyle, diet, physical activity, and the risk or outcomes of PCOS in women of reproductive age.

Lifestyle Interventions: Diet and Physical Activity

The synthesis of the 29 articles included in this systematic review shows that lifestyle interventions, consisting of hypocaloric dietary modifications combined with increased physical activity, have a significant impact on improving various clinical, metabolic, and reproductive parameters in women with PCOS.

Quantitatively, weight loss in the intervention groups was reported with a standardized mean difference (SMD) ranging from 0.5 to 0.8 compared to the control groups, indicating a clinically moderate to large effect. This weight loss was correlated with improvements in insulin resistance, measured using HOMA-IR, with most studies reporting a significant reduction in HOMA-IR values ($p < 0.05$) following dietary and physical activity programs. Several meta-analyses also indicated improvements in lipid profiles (reductions in triglycerides and LDL, increases in HDL) as an additional effect of lifestyle modification.

The combination of a hypocaloric diet with regular physical activity has consistently been shown to be more effective than diet-only interventions in reducing BMI, waist circumference, and improving body composition. Interventions that combine energy restriction with aerobic and/or resistance exercise produce greater effects on total fat mass and fat-free mass compared to single-component interventions. The consistency of these findings is evident across heterogeneous populations, including adolescent girls, young women, and reproductive-age women who are overweight or obese.

In addition to effects on anthropometric and metabolic indicators, most RCTs and longitudinal studies also reported improvements in hormonal parameters, such as reductions

in total testosterone levels, increases in sex hormone-binding globulin (SHBG), and normalization of the LH/FSH ratio. These positive effects are often accompanied by improvements in menstrual cycle regularity and increased ovulation frequency, indicating that lifestyle interventions are not only preventive but also support the restoration of reproductive function. Although the magnitude of effects varies across studies, the overall direction of findings is consistent, underscoring the fundamental role of lifestyle modification as a first-line non-pharmacological approach.

This synthesis is also consistent with the latest international recommendations, including those of the European Society of Human Reproduction and Embryology (ESHRE) and the World Health Organization (WHO, 2023), which emphasize that lifestyle management particularly dietary regulation, physical activity, and behavioral support is the primary strategy that should be prioritized for women with PCOS of reproductive age as well as adolescents at high risk. These findings reinforce the evidence that lifestyle modification has long-term beneficial effects on metabolic, hormonal, and reproductive health, and serves as a cornerstone in the comprehensive management of PCOS.

Metabolic and Hormonal Outcomes

In the reproductive dimension, several intervention studies reported improvements in menstrual cycle regularity and ovulatory function, particularly among participants who achieved a minimum weight loss of ≥5% from baseline. This level of weight reduction is often cited as the minimal "threshold" required to trigger meaningful changes in hormonal regulation and reproductive function. These positive effects appeared more consistent in programs combining dietary management, physical activity, and behavioral support compared to diet-only interventions.

Overall, these findings reinforce international recommendations (e.g., WHO, 2023; ESHRE, 2022) that lifestyle modification is the cornerstone of PCOS management, providing dual benefits for metabolic and hormonal health while supporting reproductive function. The available evidence also underscores the importance of medium- to long-term interventions (≥6 months) and multidisciplinary approaches to achieve optimal outcomes, particularly among adolescent girls and women of reproductive age with high metabolic risk factors.

Lifestyle Behaviors and PCOS Risk

Lifestyle characteristics of women with PCOS in these studies reveal a clear pattern: the majority of respondents were overweight or obese, had low levels of physical activity, and adhered to high-calorie, high-fat, and low-fiber diets. These behavioral factors have consistently been identified as determinants that exacerbate PCOS risk and worsen both metabolic and reproductive profiles. Moreover, observational studies also revealed a higher prevalence of psychological disorders such as depression and anxiety among women with PCOS compared to non-PCOS groups. These findings support a bidirectional relationship between PCOS and mental health: on one hand, unhealthy lifestyles increase the risk of PCOS, while on the other, PCOS symptoms (e.g., hirsutism, infertility, menstrual disturbances) can worsen psychological conditions, thereby reinforcing sedentary behaviors and maladaptive dietary patterns.

In addition to lifestyle behaviors, demographic and social factors also contribute to the increased risk of PCOS. A large population-based study in Saudi Arabia found that obesity status, high stress levels, employment and educational status, as well as access to healthcare services were key determinants influencing the likelihood of a PCOS diagnosis. These findings highlight that the risk of PCOS is not solely determined by biological or genetic factors, but is also shaped by socioeconomic conditions, cultural contexts, and healthcare system access.

These findings strengthen the argument that the prevention and management of PCOS

require a more holistic and multidisciplinary approach. This approach should not only focus on medical or pharmacological therapy but also emphasize the promotion of healthy lifestyles, increased physical activity, nutrition education, and integrated mental health support at the level of primary care, schools, and communities. In this way, comprehensively designed interventions can reduce the prevalence of PCOS, improve metabolic and reproductive outcomes, and simultaneously enhance the quality of life of women of reproductive age.

Study Quality

The assessment results indicate that the majority of observational studies achieved a NOS score of ≥7 (on a 0–9 scale), which is categorized as moderate to high quality. This means that most studies demonstrated clarity in aspects such as sample selection, group comparability, and outcome measurement. However, several cross-sectional studies showed limitations in sample representativeness (e.g., clinic-based rather than population-based sampling), which may affect the generalizability of the findings.

For the RCTs, assessment using the Cochrane Risk of Bias Tool showed that approximately 70% of studies had a low to moderate risk of bias in the domains of randomization and outcome reporting. However, some studies still exhibited a higher risk of bias in the domains of participant and investigator blinding due to the inherent difficulty of fully blinding lifestyle interventions. Nevertheless, the overall risk of selection and reporting bias was relatively low, resulting in a high level of confidence in the synthesized findings.

These quality assessment findings strengthen the validity of the systematic review's conclusions, as the majority of included studies met adequate methodological standards. In addition, the variation in quality scores provided a basis for interpreting the results; studies with higher risk of bias were given lower weight during the synthesis to minimize potential distortion of the conclusions.

DISCUSSION

Based on the synthesis of the 29 included articles, the findings consistently indicate that lifestyle interventions, particularly the combination of a hypocaloric diet and increased physical activity, are effective in reducing metabolic parameters (body weight, BMI, waist circumference, lipid profile, fasting glucose, fasting insulin) and improving reproductive function (menstrual cycle regularity, ovulation) in women with PCOS. These findings align with the International Evidence-based Guideline for the Assessment and Management of PCOS (2018), which emphasizes that lifestyle management is the first-line therapy in PCOS care.

Implementation of simple lifestyle changes, such as a hypocaloric or low-glycemic-index diet combined with moderate physical activity, has been shown to provide significant clinical benefits, even over relatively short intervention periods. For example, Effect of Lifestyle Modifications on Anthropometric, Clinical, and Biochemical Parameters in Adolescent Girls with PCOS: A Systematic Review and Meta-Analysis (BMC Endocrine Disorders, 2020) demonstrated that lifestyle interventions can significantly reduce BMI and improve metabolic and hormonal parameters in adolescent girls with PCOS.

Observational studies support that obesity, high body mass index, low physical activity, diets high in sugar or saturated fat, and sedentary behaviors are significant risk factors for PCOS. For example, the study Obesity Is Associated with SHBG Levels Rather Than Blood Lipid Profiles in PCOS Patients with Insulin Resistance observed that obesity is strongly correlated with lower SHBG levels, higher free androgen index, and worsened insulin resistance.

A reciprocal relationship is also highlighted in studies such as Lifestyle Management

in Polycystic Ovary Syndrome Beyond Diet and Physical Activity (BMC Endocrine Disorders, 2023), which emphasizes that psychological factors (stress, sleep quality) amplify the negative effects of unhealthy lifestyles and undermine adherence to lifestyle interventions.

CONCLUSION

ollectively, evidence from Scopus and PubMed studies supports that lifestyle interventions are an effective and cost-effective strategy for both the prevention and management of PCOS. In Indonesia, there is a significant opportunity to implement and evaluate contextually tailored and comprehensive lifestyle interventions, supported by adequate funding and policy frameworks.

Practical Implications

1. First-Line Option in PCOS Management

Based on the evidence, lifestyle modification can be applied as a first-line therapy for managing PCOS, particularly in women with obesity. This non-pharmacological intervention offers advantages beyond its clinical effects, including relatively lower costs and minimal risk of side effects.

2. Integration into Reproductive Health Policies

Reproductive health policies at both national and regional levels should include the promotion of healthy diets and regular physical activity as part of preventive programs. For example, through initiatives such as the Sekolah Sehat program, the Adolescent Nutrition Program, or Germas (the Healthy Living Community Movement) already implemented in Indonesia. Adding PCOS education modules into adolescent health curricula could also support early detection and prevention.

3. Education and Psychological Support

Given that stress, anxiety, and other psychological factors are both risk factors and consequences of PCOS, integrated psychological support is needed within lifestyle interventions. Behavioral counseling, stress management, and mental health components should be incorporated into intervention programs. For example, workshops, counseling sessions, or peer support groups can help improve adherence to dietary and physical activity recommendations.

4. Contextual Adaptation in Indonesia

a) Design lifestyle interventions tailored to local cultural contexts, such as diet plans based on local foods and physical activities that are realistic within the local environment.

b) Involve primary healthcare facilities such as community health centers (puskesmas) and utilize existing healthcare workers for patient education and support.

c) Develop exploratory intervention programs in schools and communities of women of reproductive age for early prevention.

5. Further Research

a) There is a need for locally conducted RCTs or cohort studies with robust designs, adequate sample sizes, and sufficiently long follow-up periods to assess long-term effects.

b) Standardization of PCOS diagnostic criteria (e.g., using the Rotterdam criteria or an agreed-upon local criterion) is necessary to enable comparability across studies.

c) Outcome measurements should include not only metabolic and reproductive parameters but also psychosocial factors, quality-of-life satisfaction, and economic impact.

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