REVIEW ARTICLE

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The Effects of Coffee Consumption and Green Coffee Supplementation on Clinical and Metabolic Outcomes in Polycystic Ovary Syndrome: A Systematic Review

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Polycystic ovary syndrome (PCOS) is a common endocrine-metabolic disorder affecting women of reproductive age and is associated with insulin resistance, hyperandrogenism, and dyslipidemia. Bioactive compounds in coffee, such as caffeine and chlorogenic acid, may have potential benefits in improving these conditions. Objective: This systematic review aimed to evaluate the effects of coffee consumption and green coffee extract supplementation on clinical and metabolic outcomes in women with PCOS. A systematic literature search was conducted in Scopus, Web of Science, PubMed, and Google Scholar. Studies meeting the PICOS inclusion criteria were selected and analyzed using a narrative synthesis approach. A total of 5 studies were included, comprising 3 randomized controlled trials and 2 case-control studies. Observational studies demonstrated an inverse association between coffee consumption and the risk of PCOS. Green coffee extract supplementation showed improvements in lipid profiles, reductions in androgen levels, and increased antioxidant capacity. However, no significant effects were observed on glycemic, anthropometric, or inflammatory parameters. Coffee consumption and supplementation with green coffee extract may offer potential benefits in the management of PCOS, particularly in improving metabolic and hormonal parameters. However, further well-designed studies are required to confirm their effectiveness.

Keywords: Polycystic ovary syndrome, coffee consumption, green coffee extract, chlorogenic acid, metabolic outcomes, hormonal parameters

Introduction

Polycystic Ovary Syndrome (PCOS) is a heterogeneous endocrine-metabolic disorder and one of the most common conditions affecting women of reproductive age. PCOS is characterized by hyperandrogenism and chronic anovulation.[1] The prevalence of PCOS ranges from 4% to 21% across different populations, with an average of approximately 11–13% among women of reproductive age.[2] Clinical manifestations typically emerge between the ages of 18 and 39; however, diagnosis is often delayed, resulting in a substantial proportion of undetected cases. Common clinical features include hirsutism, acne, insulin resistance, and irregular menstrual cycles.[3]

The pathophysiology of PCOS is heterogeneous and complex, as reflected by variations in clinical manifestations across different ethnic groups.[4] This condition involves interactions among insulin resistance, hyperandrogenism, hormonal dysfunction, and chronic low-grade inflammation, which mutually contribute

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to disease progression. These interactions may disrupt folliculogenesis and reproductive function and increase the risk of various long-term comorbidities, including type 2 diabetes mellitus and endometrial cancer.[5]

The development of PCOS is influenced by genetic and environmental factors. Genetic contributors associated with PCOS include family history of the condition, early sexual maturation, and accelerated fetal development. However, environmental influences are thought to contribute more substantially to its onset. These factors include physical inactivity, unhealthy dietary patterns high in fat, sugar, salt, and advanced glycation end products (AGEs), obesity, and exposure to environmental pollutants.[6–8] Individuals with a genetic predisposition may develop PCOS when exposed to these environmental influences.

According to international guidelines, the diagnosis of PCOS is established when at least two of the following three criteria are present: clinical and/or biochemical hyperandrogenism, polycystic ovarian morphology, and oligo- or anovulation. Although lifestyle modification and pharmacological therapy remain the mainstay of treatment, long-term adherence is often challenging, and pharmacological approaches may be limited by side effects and high costs.[2]

Coffee is one of the most widely consumed beverages worldwide and contains more than one thousand bioactive compounds, including caffeine and chlorogenic acid (CGA).[9] Green coffee beans represent the richest natural source of CGA, comprising approximately 6–12% of dry weight. CGA is recognized as a potent antioxidant with anti-inflammatory properties and the ability to improve insulin sensitivity. These mechanisms are particularly relevant to the pathophysiology of PCOS, which is characterized by oxidative stress, chronic inflammation, and insulin resistance.[10,11]

Despite emerging evidence suggesting potential benefits, there is currently a lack of comprehensive systematic reviews evaluating the role of coffee consumption in PCOS. Therefore, this systematic review aims to assess the effects of coffee consumption and supplementation with green coffee extract on metabolic and hormonal outcomes in women with PCOS.

Methods

Search Strategy and Selection Criteria

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The study selection process is illustrated in the PRISMA flow diagram (**Figure 1**).

Eligibility Criteria

The eligibility criteria for this systematic review were defined based on the PICOS framework. The population (P) included women of reproductive age diagnosed with polycystic ovary syndrome (PCOS) according to the Rotterdam criteria. The intervention/exposure (I) was defined as either coffee consumption or supplementation with green coffee extract. The comparison (C) included individuals without exposure, placebo groups, or control groups without intervention. The outcomes (O) comprised clinical and metabolic parameters relevant to PCOS, including hormonal parameters (e.g., testosterone levels), lipid profiles (triglycerides and total cholesterol), glycemic parameters (fasting blood glucose and insulin levels), inflammatory or oxidative stress biomarkers, and anthropometric measures. The study design (S) included randomized controlled trials and observational analytical studies, such as case-control studies.

Studies were excluded if they did not meet the PICOS criteria, did not evaluate coffee consumption or green coffee extract as the primary exposure or intervention, or involved participants with conditions that could influence the outcomes, such as pregnancy, lactation, other endocrine disorders, or the use of hormonal therapy within a defined period before the study. Additionally, non-primary articles, including reviews, editorials, and case reports, were excluded from the analysis.

Search Strategy

A systematic literature search was conducted across several electronic databases, including Scopus, Web of Science, PubMed, and Google Scholar, from January 1, 2026, to March 30, 2026. The search strategy was developed using a combination of relevant keywords, including “polycystic ovary syndrome” OR “PCOS” AND “caffeine” OR “coffee” OR “green coffee”. Boolean operators (“AND” and “OR”) were applied to combine the search terms systematically. The study selection process is presented in the PRISMA flow diagram (**Figure 1**).

Synthesis of Results

The synthesis of results was conducted narratively, summarizing findings from individual studies evaluating the association between coffee consumption and green coffee extract supplementation and clinical

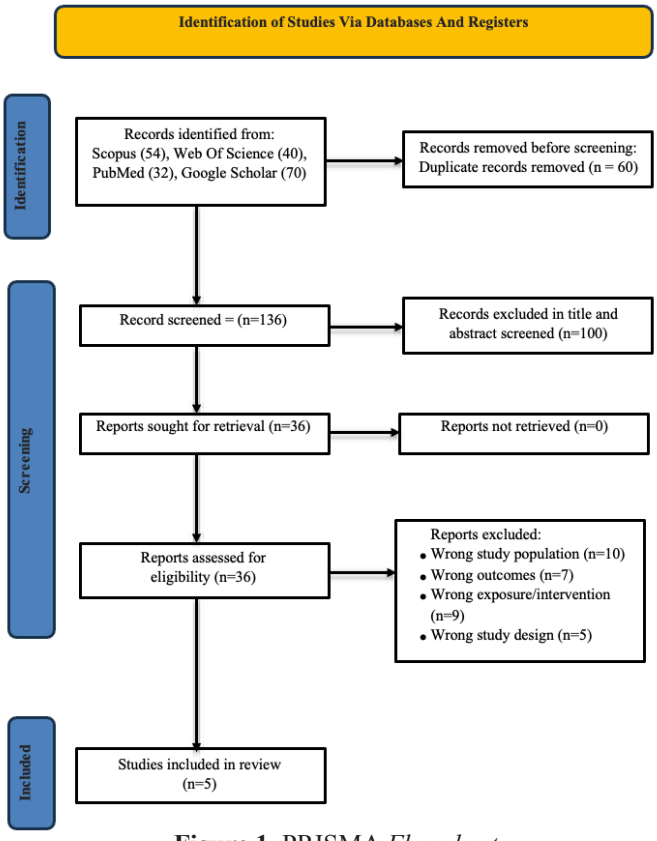


Figure 1. PRISMA *Flowchart*

and metabolic outcomes in women with PCOS. The included studies were grouped by exposure type: coffee consumption and green coffee extract supplementation. Observational studies with a case-control design were analyzed to assess the association between coffee consumption habits and the risk of PCOS. In contrast, randomized controlled trials were analyzed to evaluate the effects of green coffee extract supplementation on various parameters, including hormonal profiles, lipid profiles, oxidative stress, glycemic parameters, anthropometric measures, and inflammatory markers.

Quality and Risk of Bias Assessment

The methodological quality and risk of bias of the included studies were assessed according to study design. Randomized controlled trials (RCTs) were assessed using the PEDro Scale[12–14], whereas case-control studies were evaluated using the JBI Critical Appraisal Checklist for Case-Control Studies.[15,16] These two instruments were considered appropriate because RCTs and case-control studies have different methodological characteristics and potential sources of bias. Overall, the included studies showed moderate to good methodological quality. The RCTs were of good methodological quality, while the case-control studies were of moderate to good quality. Details of the methodological quality and risk of bias assessment for each study are presented in **Tables S1** and **Tables S2.**

Results and Discussion

Study Selection

A total of 196 records were identified from multiple databases. After duplicate removal and screening based on titles and abstracts, 36 studies were considered eligible for full-text assessment. Of these, 5 studies met the inclusion criteria and were included in this systematic review. The agreement between reviewers during the screening and selection process was 93%. The excluded studies and reasons for exclusion are presented in the PRISMA flow diagram (**Figure 1**).

Study Characteristics

The included studies were conducted in Iran[12–14], China[15] and Spain[16]. The sample sizes ranged from 34 to 206 participants, totaling 809 across all included studies. The participants' ages ranged from 18 to 40 years. Regarding study design, three studies were randomized controlled trials, while two studies employed a case-control design. Most studies defined PCOS based on established diagnostic criteria, particularly the Rotterdam criteria. All studies involved women with PCOS as the primary population. In randomized controlled trials, the comparison groups consisted of women with PCOS receiving a placebo, whereas in case-control studies, the comparison groups consisted of women without PCOS (healthy controls). The detailed characteristics of the included studies are presented in **Table 1.**

Coffee Consumption and Risk of PCOS

Two case-control studies demonstrated a consistent inverse association between coffee consumption and the risk of PCOS. Together, these studies included 332 women with PCOS and 365 women without PCOS as controls, with PCOS diagnosis primarily based on the Rotterdam criteria. Wang et al. (2021) reported a significant dose-response relationship, indicating that higher coffee consumption was associated with a lower risk of PCOS.[15] Consumption of more than three cups of coffee per week was associated with an odds ratio of 0.152 (p-trend < 0.001). Similarly, Meliani-Rodríguez et al. (2024) found that consuming at least one cup of coffee per day was associated with a reduced risk of PCOS (p-trend = 0.034)16. These findings are supported by other observational studies suggesting that coffee consumption, particularly ground coffee, may reduce the risk of gynecological disorders such as ovarian cancer and endometriosis.[17,18] The potential protective effects of coffee may be mediated by the combined actions of caffeine and polyphenols that remain after the roasting process. Although roasting reduces the content of CGA, other polyphenolic compounds may continue to contribute to antioxidant activity and hormonal modulation[18,19].Caffeine has been reported to increase sex hormone-binding globulin (SHBG) levels, thereby reducing free testosterone levels, which represent a key feature of hyperandrogenism in PCOS.[20,21] This mechanism is further supported by studies reporting a positive association between caffeinated coffee consumption and increased SHBG levels in both healthy women and women at metabolic risk.[21,22]

Effects of Green Coffee Extract Supplementation

Three RCTs evaluated green coffee extract supplementation at 400 mg/day for 6 weeks in women with PCOS. Overall, it appeared to offer more specific benefits than general coffee consumption, particularly for hormonal parameters, lipid profile, and oxidative stress. The studies assessed hormonal parameters, lipid profile, oxidative stress, glycemic parameters, anthropometric measures, and inflammatory biomarkers. Regarding hormonal parameters, green coffee extract supplementation showed a significant effect on androgen levels. A significant reduction in free testosterone in the intervention group compared with the placebo group, which is clinically relevant because hyperandrogenism is one of the major features of PCOS.[12] This effect may be mediated by caffeine-induced increases in sex hormone-binding globulin (SHBG), which may reduce circulating free testosterone levels. In addition, CGA in green coffee may contribute to suppression of gonadal steroidogenesis by reducing cholesterol availability and modulating the HIF-1α pathway.[20–23]. Consistent improvements were observed in lipid profiles. All included RCTs reported reductions in triglyceride and total cholesterol levels after green coffee extract supplementation compared with the control group.[12–14].This effect may be explained by the ability of CGA to inhibit intestinal glucose absorption, reduce insulin secretion through modulation of glucose-dependent insulinotropic polypeptide (GIP), and suppress hepatic very low-density lipoprotein (VLDL) synthesis.[24,25] Thus, green coffee extract may help improve dyslipidemia in women with PCOS. For oxidative stress parameters, the effects of green coffee extract supplementation appeared selective. Ildarabadi et al. (2024) reported a significant increase in paraoxonase-1 (PON-1) activity, but no significant change in malondialdehyde (MDA) levels.[14] Increased PON-1 activity indicates improved antioxidant capacity, as PON-1 protects lipoproteins from oxidative modification. This effect may relate to the antioxidant properties of CGA, which can protect the enzyme from oxidative inactivation.[14,26] These findings are also consistent with previous systematic reviews on plant-derived polyphenols, such as green tea, which have shown beneficial effects on lipid and hormonal parameters in PCOS.[21,27,28] In addition, CGA may improve pancreatic β-cell function and reduce oxidative stress.[23]

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Table 1. Characteristics of Included Studies

Author	Country	Study Design	PCOS Diagnosis	Population	Comparison	Exposure / Intervention	Duration	Main Findings
[12]	Iran	Randomized Controlled Trial	Diagnosed by gynecologist	34 PCOS	17 PCOS (placebo)	Green coffee supplementation 400 mg	6 weeks	Significant reduction in free testosterone, triglycerides, and total cholesterol; no significant changes in BMI, glucose, or insulin
[15]	China	Case-control	Rotterdam criteria	206 PCOS	206 non-PCOS (healthy controls)	Coffee consumption based on frequency	2018–2020	Coffee consumption associated with reduced risk of PCOS
[13]	Iran	Randomized Controlled Trial	Diagnosed by gynecologist	34 PCOS	17 PCOS (placebo)	Green coffee supplementation 400 mg	6 weeks	Significant reduction in total cholesterol and triglycerides; no significant changes in glucose, insulin, or inflammatory markers
[14]	Iran	Randomized Controlled Trial	Rotterdam criteria	44 PCOS	22 PCOS (placebo)	Green coffee supplementation 400 mg	6 weeks	Increased PON-1 activity and decreased cholesterol and triglycerides; no significant changes in glycemic parameters
[16]	Spain	Case-control	Rotterdam criteria	121 PCOS	155 non-PCOS (healthy controls)	Coffee consumption based on daily frequency	2014–2016	Consumption of at least one cup per day associated with reduced risk of PCOS

However, not all parameters improved significantly. The three RCTs reported no significant effect on glycemic parameters, including fasting blood glucose, insulin levels, and insulin resistance indices.[12–14]. Green coffee supplementation also did not produce significant changes in anthropometric measures, such as body weight, body mass index (BMI), waist circumference, and waist-to-hip ratio (WHR). Regarding inflammatory biomarkers, there is no significant differences in interleukin(IL)-6 and IL-10 levels between the intervention and control groups.[13] The lack of significant changes in glycemic, anthropometric, and inflammatory parameters may reflect the relatively short 6-week intervention and the small sample sizes of the included studies. Changes in more complex metabolic and inflammatory pathways may require longer intervention periods or higher doses. Previous studies suggest that the effects of polyphenols on inflammatory markers, such as reductions in IL-6 and increases in IL-10, generally require intervention durations of ≥8–12 weeks or higher doses.[29–32] Therefore, green coffee extract shows potential benefits for lipid profile, androgen levels, and antioxidant capacity, but evidence for glycemic, anthropometric, and inflammatory parameters remains limited.

Conclusion

This systematic review suggests that coffee consumption may be associated with a lower risk of Polycystic Ovary Syndrome, as indicated by consistent inverse associations observed in observational studies. In addition, green coffee extract supplementation appears to improve lipid profiles and reduce androgen levels, with some evidence indicating enhanced antioxidant capacity in women with PCOS. However, no significant effects were observed on glycemic parameters, anthropometric measures, or most inflammatory markers. Given the limited number of studies and the heterogeneity in study designs and outcomes, further well-designed randomized controlled trials with larger sample sizes and longer intervention durations are required to confirm these findings.

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Authors' Contribution

This article was written by PADN and IKS. Both authors contributed to all stages of manuscript preparation, including study conception, literature search, data extraction, analysis, and interpretation of the findings. PADN focused on the methods and results sections, while IKS focused on the discussion section and the development of subthemes. Both authors contributed to the conclusion, critically reviewed the manuscript, approved the final version, and agreed to be accountable for all aspects of the work.

Conflict of Interest

All of authors declare no conflict of interest.

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