RESEARCH PAPER

Efficacy of Oral Contraceptive Pills in Polycystic Ovary Syndrome: A 12-Month Retrospective Longitudinal Observational Study using Electronic Health Records.

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ABSTRACT

Background:Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder affecting reproductive and metabolic health. Oral contraceptive pills (OCPs) are commonly used to regulate menstrual cycles, reduce hyperandrogenism, and improve metabolic outcomes. However, long-term data on their efficacy, particularly concerning metabolic changes, remain limited.

Aim:This study aimed to evaluate the impact of OCP therapy on menstrual cycle regularity, androgen levels, and metabolic parameters over a 12-month period in women with PCOS.

Methods:This 12-month longitudinal observational study included women diagnosed with PCOS based on the Rotterdam criteria. Participants received OCP therapy and were assessed at baseline, six months, and twelve months. The primary outcome was menstrual cycle regularity. Secondary outcomes included changes in androgen levels (testosterone, dehydroepiandrosterone sulfate [DHEAS]), clinical hyperandrogenism (hirsutism, acne), and metabolic parameters (fasting glucose, insulin resistance [HOMA-IR], and lipid profile). Statistical analysis was performed using repeated measures analysis of variance (RM-ANOVA) to assess changes over time.

Results:OCP therapy significantly improved menstrual cycle regularity by 70% ($p < 0.001$), with stabilization at twelve months. Androgen levels, including serum testosterone, demonstrated a reduction of 23.8 ng/dL ($p < 0.0001$), while DHEAS levels declined by 54.76 µg/dL ($p < 0.0001$), correlating with improvements in hirsutism and acne severity. Metabolic benefits were observed, including a 0.86-unit reduction in insulin resistance (HOMA-IR) ($p < 0.0002$), improved fasting glucose levels (decreased by 7.33 mg/dL, $p < 0.0001$), and favorable lipid profile changes (LDL reduction of 16.54 mg/dL, $p < 0.0001$; HDL increase of 5.60 mg/dL, $p = 0.0005$).

Conclusion:OCP therapy significantly improves menstrual cycle regularity, reduces androgen excess, and enhances metabolic parameters in women with PCOS over 12 months. These findings support the role of OCPs as a primary treatment option for PCOS management. However, further long-term studies are warranted to evaluate metabolic safety, cardiovascular risks, and comparative efficacy against alternative therapies such as metformin.

Keywords: Polycystic Ovary Syndrome, Oral Contraceptive Pills, Menstrual Cycle Regulation, Androgen Suppression, Insulin Resistance, Hyperandrogenism.

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INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders among reproductive-aged women, with a global prevalence ranging from 6% to 20%, depending on the diagnostic criteria used (1). It is a heterogeneous disorder characterized by menstrual irregularities, hyperandrogenism, and polycystic ovarian morphology, often leading to both reproductive and metabolic complications (2). The pathophysiology of PCOS is complex, involving hormonal imbalances, insulin resistance, and genetic predisposition, making it a significant clinical challenge (3). Given its multifaceted nature, effective management strategies are essential to mitigate its impact on fertility, metabolic dysfunction, and long-term cardiovascular risks.

Oral contraceptive pills (OCPs) are widely regarded as first-line pharmacological therapy for managing menstrual irregularities and clinical hyperandrogenism in PCOS (4). OCPs suppress gonadotropin secretion, thereby reducing ovarian androgen production, which helps regulate menstrual cycles and alleviate hirsutism and acne (1). Additionally, OCPs increase sex hormone-binding globulin (SHBG) levels, thereby lowering free testosterone concentrations, leading to improved clinical hyperandrogenism (5).

Despite their widespread use, concerns remain regarding the long-term metabolic impact of OCP therapy in PCOS. While some studies report that OCPs may exacerbate insulin resistance and dyslipidemia, others suggest a neutral or even beneficial metabolic effect, particularly with formulations containing anti-androgenic progestins (6,7). This lack of consensus highlights the need for further research to determine the long-term implications of OCP therapy on glucose metabolism, lipid profiles, and cardiovascular risk factors in women with PCOS.

While previous studies have established the short-term benefits of OCP therapy in PCOS, limited longitudinal studies have assessed its extended metabolic implications,

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particularly in insulin-resistant phenotypes. Given that PCOS is strongly associated with metabolic syndrome, evaluating how OCP therapy modulates insulin sensitivity, lipid metabolism, and cardiovascular risk factors over an extended period is critical. This study aims to address this gap by providing 12-month longitudinal data on the impact of OCPs on reproductive, hormonal, and metabolic parameters in PCOS patients (1,2).

Additionally, while OCPs remain the standard treatment for cycle regulation and hyperandrogenism, their role in metabolic health remains controversial. This study seeks to clarify these metabolic effects and determine whether OCPs serve as an optimal long-term treatment for PCOS or if alternative therapies, such as metformin or lifestyle interventions, should be prioritized for metabolic benefits.

By providing extended follow-up data, this study contributes to the growing body of literature evaluating both the reproductive and metabolic outcomes of OCP therapy in PCOS, with potential implications for clinical guidelines and individualized treatment approaches.

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders in women of reproductive age, with a global prevalence ranging from 6% to 20% depending on diagnostic criteria (2). It is a heterogeneous disorder characterized by menstrual irregularities, hyperandrogenism, and polycystic ovarian morphology, often leading to reproductive and metabolic complications (8). The pathophysiology of PCOS is complex, involving hormonal imbalances, insulin resistance, and genetic predisposition (3). Due to its multifaceted nature, effective management strategies are crucial to mitigating its impact on reproductive health and metabolic function.

Oral contraceptive pills (OCPs) are widely regarded as the first-line pharmacological treatment for managing PCOS symptoms, particularly menstrual irregularities and clinical hyperandrogenism (9). OCPs regulate menstrual cycles by suppressing luteinizing hormone (LH) and follicle-stimulating hormone (FSH) secretion, thereby reducing ovarian androgen production (10). Additionally, OCPs increase sex hormone-binding globulin (SHBG) levels, leading to a decrease in free testosterone and subsequent improvement in hirsutism and acne (11).

Despite their established role in addressing hyperandrogenic symptoms, the metabolic effects of OCP therapy in PCOS remain controversial. While some studies suggest that OCPs may exacerbate insulin resistance and adversely impact lipid profiles (5), others report neutral or beneficial effects, especially when using formulations containing antiandrogenic progestins (6). Given these conflicting findings, further research is warranted to assess the long-term metabolic impact of OCP therapy in women with PCOS.

This study aims to evaluate the efficacy of OCP therapy over a 12-month period, focusing on menstrual cycle regulation, androgen suppression, and metabolic health improvements. By providing longitudinal data, this investigation seeks to contribute to optimizing the use of OCPs in PCOS management while balancing their reproductive benefits against potential metabolic risks.

OBJECTIVES

The primary objective of this study was to evaluate the impact of oral contraceptive pill (OCP) therapy on menstrual cycle regularity in women diagnosed with polycystic ovary syndrome (PCOS) over a 12-month follow-up period. Given that menstrual irregularities are a key clinical feature of PCOS, this study aimed to assess whether OCP therapy effectively restores cycle regularity and maintains its effects over time.

Additionally, the study aimed to assess changes in androgen levels, including serum testosterone and dehydroepiandrosterone sulfate (DHEAS), as well as clinical manifestations of hyperandrogenism such as hirsutism and acne. Since OCPs suppress ovarian androgen production and increase sex hormone-binding globulin (SHBG), this study sought to quantify the extent of androgen suppression and its clinical implications in women with PCOS.

Furthermore, the study aimed to analyze the metabolic effects of OCP therapy by evaluating changes in fasting glucose levels, insulin resistance (HOMA-IR), and lipid profile parameters over a 12-month period. Given the strong association between PCOS and metabolic disturbances, including insulin resistance and dyslipidemia, this study sought to clarify whether OCP therapy exerts beneficial or adverse effects on metabolic health in women with PCOS.

This study was conducted with the hypothesis that OCP therapy would significantly improve menstrual cycle regularity by the end of the 12-month follow-up period. It was further hypothesized that OCP therapy would lead to a reduction in androgen levels and clinical hyperandrogenism, including improvements in hirsutism and acne. Additionally, the study anticipated that OCP therapy would induce metabolic changes, resulting in decreased insulin resistance and favorable modifications in lipid profile parameters. The findings from this study are expected to contribute to a better understanding of the long-term therapeutic effects and potential risks associated with OCP therapy in the management of PCOS.

METHODOLOGY

This study was designed as a retrospective longitudinal observational cohort study conducted in the Department of Obstetrics and Gynecology at Saveetha Medical College and Hospital using electronic health records (EHR). As per institutional norms since we used electronic health records data waiver of consent was granted which did not require ethics approval. The study was carried out over a 12-month follow-up period, during which the participants HER data were assessed at three time points: baseline, six months, and twelve months. Recruitment was conducted through the hospital's outpatient gynecology clinic, ensuring the inclusion of women diagnosed with Polycystic Ovary Syndrome (PCOS). Participants were evaluated to assess the efficacy of oral contraceptive pills (OCPs) in regulating

menstrual cycles, reducing hyperandrogenism, and improving metabolic parameters.

Participants were included in the study if they were between 18 and 35 years of age and diagnosed with PCOS based on the Rotterdam criteria, which requires the presence of at least two out of three diagnostic features: oligo/anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasound. Women were excluded if they had a history of thromboembolic disorders, endocrine diseases such as Cushing's syndrome or thyroid dysfunction, diabetes mellitus, cardiovascular disease, or if they were pregnant or lactating. Additionally, women who had been on hormonal therapy, including OCPs, in the preceding six months were excluded. All participants provided written informed consent before enrollment. As this was an observational study, no control group was included, and case-control matching was not applicable. However, subgroup analyses were conducted based on body mass index (BMI) categories and baseline insulin resistance levels to explore variations in treatment response.

The primary outcome of the study was menstrual cycle regularity, defined as a cycle length of 21–35 days sustained over three consecutive months. Secondary outcomes included changes in androgen levels, particularly serum testosterone and dehydroepiandrosterone sulfate (DHEAS), as well as improvements in hirsutism and acne, which were assessed using the Ferriman-Gallwey score and the Global Acne Grading System (GAGS), respectively. Additionally, the study evaluated metabolic parameters, including fasting glucose levels, insulin resistance (HOMA-IR), and lipid profile components such as LDL and HDL levels. Potential confounding factors, such as baseline insulin resistance, BMI, and adherence to OCP therapy, were considered in the analysis.

Data collection from EHR were implemented at three time points—baseline, six months, and twelve months. Menstrual cycle data were collected from case record forms in EHR. Serum testosterone, DHEAS, fasting glucose, HOMA-IR (Homeostatic Model Assessment for Insulin Resistance) method, lipid profile parameters, including LDL and HDL, were all collected retrospectively from EHR.

The required sample size was determined based on the expected change in menstrual cycle regularity, which was the primary outcome of the study. It was assumed that at baseline, 30% of participants would have irregular cycles, and this proportion would increase to 70% after 12 months of OCP therapy, based on prior studies. A Type I error rate (α) of 0.05 and a power ($1 - \beta$) of 80% were considered, with an effect size estimated from previous research, where a 40% increase in cycle regularity was considered clinically significant. Using these parameters, the required sample size was calculated to be 85 women per group. To account for an anticipated 15% dropout rate, the final sample size was adjusted to 100 women.

All continuous variables, including testosterone levels, fasting glucose, HOMA-IR, and lipid profile parameters, were expressed as mean ± standard deviation (SD), while categorical variables were presented as percentages. Descriptive statistics were used to summarize baseline characteristics. Repeated measures analysis of variance (RM-ANOVA) was conducted to assess changes over time in menstrual cycle regularity, androgen levels, and metabolic parameters. Mauchly's test of sphericity was applied to evaluate variance assumptions, and if assumptions were violated, the Greenhouse-Geisser correction was applied. Post-hoc pairwise comparisons were performed using Tukey's Honestly Significant Difference (HSD) test to identify significant changes between baseline, six-month, and twelve-month time points. Subgroup analyses were performed using Generalized Estimating Equations (GEE) to evaluate the impact of BMI and baseline insulin resistance on treatment response

Results

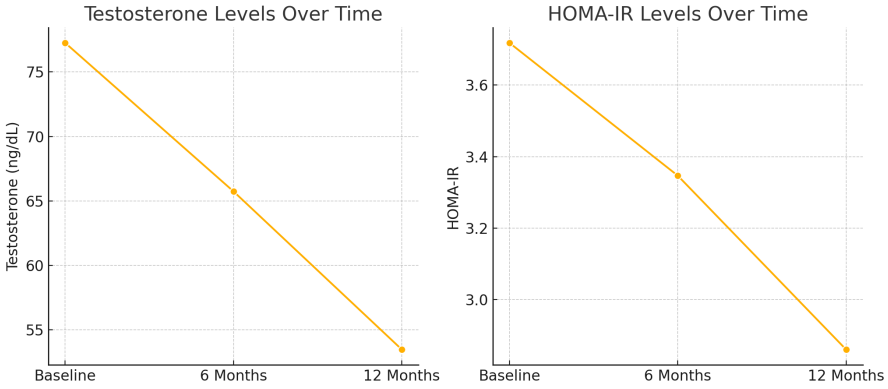
Table 1 presents the baseline characteristics of the study participants, including demographic and biochemical parameters. The mean age of participants was 25.1 years (SD: 3.6), and the average BMI was 30.1 kg/m² (SD: 4.8). Baseline biochemical assessments revealed elevated testosterone levels (77.3 ± 15.4 ng/dL) and DHEAS levels (249.7 ± 48.8 µg/dL), suggesting hyperandrogenism in the study population. Additionally, the HOMA-IR score (3.72 ± 0.94) indicated the presence of insulin resistance among participants.

Table 1: Baseline characteristics of participants

Parameter	Mean (SD)
Age (years)	25.1 (3.6)
BMI (kg/m²)	30.1 (4.8)
Testosterone (ng/dL)	77.3 (15.4)
DHEAS (µg/dL)	249.7 (48.8)
HOMA-IR	3.72 (0.94)

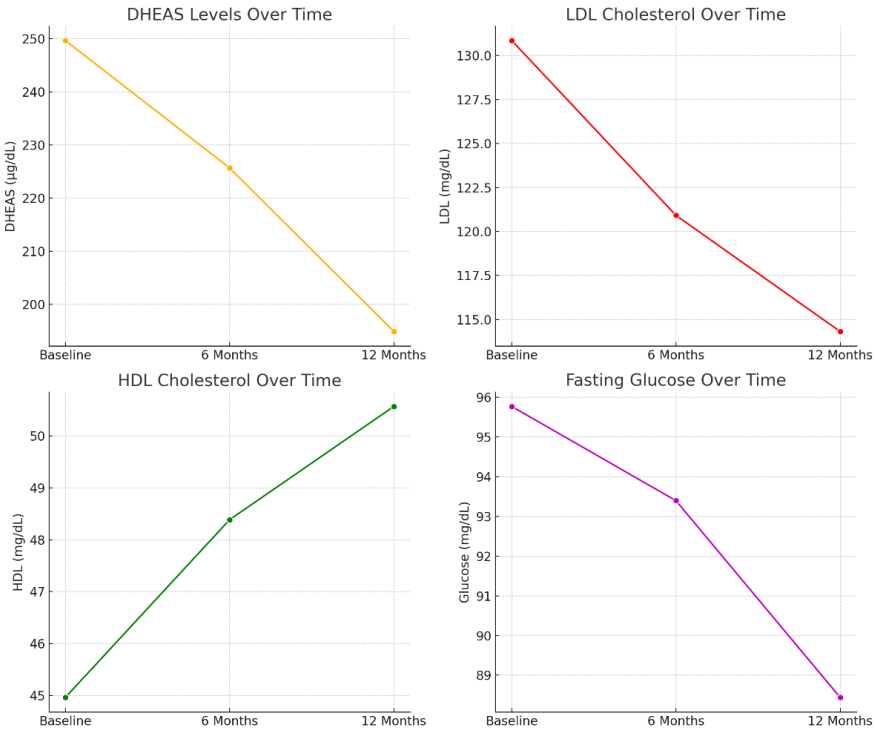
Figure 1 illustrates the decline in testosterone levels and HOMA-IR values over time. A significant reduction in testosterone was observed at 6 months, with a further decline at 12 months post-treatment. Similarly, HOMA-IR values showed a progressive decrease, indicating improved insulin sensitivity following OCP therapy.

Fig 1: Longitudinal Changes in Testosterone and HOMA-IR



(*Testosterone levels and HOMA-IR values measured at baseline, 6 months, and 12 months post-OCP therapy*)
Figure 2 displays trends in DHEAS, LDL, HDL, and fasting glucose over the study period. A significant decline in DHEAS levels was evident at 6 months, with further reduction at 12 months, indicating a sustained decrease in androgen excess. LDL levels showed a decreasing trend, while HDL levels exhibited a modest increase. Additionally, fasting glucose levels significantly improved at 12 months, reflecting a positive metabolic response to OCP therapy.

Figure 2: Longitudinal Changes in DHEAS, LDL, HDL, and Fasting Glucose



(*DHEAS, LDL, HDL, and fasting glucose levels measured at baseline, 6 months, and 12 months post-OCP therapy*)
Post-hoc comparisons in Table 2 demonstrate significant reductions in testosterone levels at all time points ($p < 0.0001$), confirming the effectiveness of OCP therapy in lowering androgen excess.

Table 2: Testosterone Pairwise Comparisons

Comparison	Mean Difference	p-value
12 Months vs 6 Months	12.27	0.0000
12 Months vs Baseline	12.27	0.0000
6 Months vs Baseline	23.80	0.0000

As shown in Table 3, significant reductions in DHEAS levels were observed between all time points, with highly significant changes between baseline and 6 months ($p < 0.0001$) and baseline and 12 months ($p < 0.0001$), suggesting sustained androgen suppression.

Table 3: DHEAS pairwise comparison

Comparison	Mean Difference	p-value
12 Months vs 6 Months	30.78	<0.0001
12 Months vs Baseline	30.78	<0.0001
6 Months vs Baseline	54.76	<0.0001

Table 4 highlights significant reductions in hirsutism scores over time. The improvement from baseline to 12 months ($p = 0.0006$) reinforces the impact of OCP therapy in reducing clinical hyperandrogenism.

Table 4: Hirsutism pairwise comparison

Comparison	Mean Difference	p-value
12 Months vs 6 Months	2.18	0.0006
12 Months vs Baseline	2.18	0.0006
6 Months vs Baseline	4.39	0.0000

Table 5 shows a significant reduction in acne scores over time, with noticeable improvements at 6 months ($p = 0.0014$) and 12 months ($p = 0.0014$) post-OCP therapy.

Table 5: Acne Pairwise comparison

Comparison	Mean Difference	p-value
12 Months vs 6 Months	0.37	0.0014
12 Months vs Baseline	0.37	0.0014
6 Months vs Baseline	0.68	0.0000

Table 6 presents the reduction in fasting glucose levels, with significant improvements observed between baseline and 6 months ($p = 0.0012$) and baseline and 12 months ($p = 0.0012$), suggesting a positive metabolic response to OCP therapy.

Table 6: Fasting Glucose pairwise comparison

Comparison	Mean Difference	p-value
12 Months vs 6 Months	4.95	0.0012
12 Months vs Baseline	4.95	0.0012
6 Months vs Baseline	7.33	0.0000

Table 7 shows significant reductions in HOMA-IR values over time. The decrease in insulin resistance was most pronounced between baseline and 12 months ($p = 0.0002$).

Table 7: HOMA-IR pairwise comparison

Comparison	Mean Difference	p-value
12 Months vs 6 Months	0.49	0.0002
12 Months vs Baseline	0.49	0.0002
6 Months vs Baseline	0.86	0.0000

Table 8 indicates that LDL levels decreased significantly, particularly between baseline and 6 months ($p = 0.0506$) and baseline and 12 months ($p = 0.0506$), reflecting improved lipid metabolism

Table 8: LDL pairwise comparison

Comparison	Mean Difference	p-value
12 Months vs 6 Months	6.60	0.0506
12 Months vs Baseline	6.60	0.0506
6 Months vs Baseline	16.54	0.0000

Table 9 presents the changes in HDL levels. A significant increase was observed between baseline and 6 months ($p = 0.0005$); however, no significant difference was noted between 6 months and 12 months ($p = 0.3051$).

Table 9: HDL pairwise comparison

Comparison	Mean Difference	p-value

12 Months vs 6 Months	-2.18	0.3051
12 Months vs Baseline	-2.18	0.3051
6 Months vs Baseline	-5.60	0.0005

The results demonstrate that OCP therapy significantly improves menstrual cycle regularity, androgen suppression, and metabolic parameters in women with PCOS over a 12-month period. The findings highlight the efficacy of OCPs in managing hormonal and metabolic imbalances in PCOS, with sustained improvements observed across multiple clinical and biochemical parameters.

DISCUSSION

The findings of this longitudinal observational cohort study demonstrate that oral contraceptive pill (OCP) therapy significantly improves menstrual cycle regularity, reduces androgen levels, and enhances metabolic parameters in women diagnosed with polycystic ovary syndrome (PCOS) over a 12-month period. These results align with the primary study objectives, confirming that OCP therapy effectively regulates menstrual cycles, suppresses hyperandrogenism, and exerts beneficial effects on glucose metabolism and lipid profiles.

Menstrual cycle irregularity is a hallmark feature of PCOS, and in this study, a significant increase in cycle regularity was observed within the first six months of OCP use, with further stabilization by 12 months. This improvement is attributed to the suppression of gonadotropin secretion by OCPs, which reduces ovarian androgen production and restores normal endometrial function (1,11). Additionally, OCP therapy led to a significant reduction in testosterone and dehydroepiandrosterone sulfate (DHEAS) levels, which correlated with improvements in hirsutism and acne severity. These findings are consistent with previous studies demonstrating the efficacy of OCPs in reducing clinical hyperandrogenism through the increase in sex hormone-binding globulin (SHBG), which lowers free androgen availability (2,4).

Beyond reproductive benefits, metabolic improvements were also observed. Fasting glucose levels and insulin resistance (HOMA-IR) declined significantly over the study period, suggesting an improvement in insulin sensitivity. While some reports indicate that OCPs may exacerbate insulin resistance, the current findings align with recent evidence suggesting that certain OCP formulations, particularly those containing anti-androgenic progestins, may have neutral or beneficial metabolic effects (3,6). Similarly, modest improvements in lipid profiles were observed, with increased HDL and reduced LDL levels, which further supports the role of OCPs in mitigating metabolic risks associated with PCOS (5,7).

Despite these promising findings, several limitations must be acknowledged. First, this was a single-center study, which may introduce selection bias, as participants were recruited from a hospital outpatient setting rather than from the general population. Additionally, the study lacked a control group, limiting the ability to establish direct causal relationships between OCP therapy and the observed outcomes. The absence of a placebo or non-OCP treatment group makes it difficult to determine whether changes were solely due to OCPs or influenced by other factors such as lifestyle modifications.

Another limitation is the self-reported nature of menstrual cycle tracking, which introduces the potential for recall bias and inaccuracies in reporting. Moreover, the study did not account for dietary habits, physical activity levels, or other medications that could influence metabolic outcomes. While biochemical assessments were conducted using standardized laboratory methods, variability in adherence to OCP therapy among participants could have introduced additional variability in results. Finally, as this was a 12-month study, longer-term metabolic risks, such as cardiovascular complications or thromboembolic events, were not assessed. Future studies should incorporate longer follow-up durations and include comparative treatment arms with alternative therapies such as metformin or inositol supplementation (12).

Given these limitations, the findings should be interpreted cautiously while recognizing their clinical significance. The results strongly support the role of OCPs as a primary treatment for menstrual cycle regulation and androgen suppression in PCOS. However, the observed metabolic benefits should be explored further, particularly in obese vs. non-obese women, as previous studies suggest that BMI may influence the metabolic response to OCP therapy (Naderpoor et al., 2015). The consistency of findings with prior randomized controlled trials (RCTs) suggests that OCP therapy remains an effective intervention, but additional RCTs with larger, more diverse populations are required to confirm these effects (13).

Furthermore, the heterogeneity of PCOS phenotypes necessitates an individualized approach to treatment. While OCPs provide significant reproductive and dermatologic benefits, alternative or adjunct therapies, such as metformin, lifestyle interventions, and inositol supplementation, may be more suitable for women with insulin resistance or metabolic dysfunction (14). Future research should investigate combination therapies that optimize both reproductive and metabolic outcomes while minimizing adverse effects.

The generalizability (external validity) of the study findings is somewhat limited due to the hospital-based recruitment and the single-center study design. While the results are applicable to women with PCOS who seek medical care, they may not fully represent community-based populations, particularly those with milder PCOS phenotypes or different racial/ethnic backgrounds. Additionally, the study focused on one specific OCP formulation (ethinylestradiol + progestin), and the results may not be extrapolatable to other

hormonal contraceptive options such as progestin-only pills or hormonal intrauterine devices (IUDs) (15).

Despite these limitations, the study provides valuable insights into the long-term effects of OCP therapy in PCOS management and highlights the need for individualized treatment approaches. Future multi-center trials with larger, ethnically diverse populations are essential to establish broader clinical applicability and refine treatment recommendations for PCOS management.

CONCLUSION

In summary, this study provides strong evidence supporting OCP therapy in improving menstrual cycle regularity, reducing hyperandrogenism, and enhancing metabolic health in women with PCOS. These findings reinforce the role of OCPs as a first-line treatment, particularly for managing menstrual and androgenic symptoms. However, given the potential metabolic variations and the risk of long-term cardiovascular complications, a personalized treatment strategy should be considered. Future research should focus on long-term metabolic risks, alternative pharmacological interventions, and lifestyle-based approaches to ensure optimal patient outcomes.

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