JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS

VOLUME 5, ISSUE 02
MOPNTHLY JOURNALS

ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

THE IMPACT OF POLYCYSTIC OVARY SYNDROME ON REPRODUCTIVE HEALTH

Matqurbonova Dilnoza Ro‘zmatovna

Asia International University

Abstract

This article presents a comprehensive analysis of the impact of polycystic ovary syndrome (PCOS) on reproductive health. PCOS is the most common endocrine disorder affecting women of reproductive age, with prevalence ranging from 6% to 20% depending on diagnostic criteria. The study examines the pathophysiology, clinical manifestations, and reproductive consequences of PCOS, including menstrual irregularities, anovulation, infertility, pregnancy complications, and long-term metabolic sequelae. A cross-sectional study of 320 women with PCOS was conducted, utilizing Rotterdam diagnostic criteria, comprehensive hormonal profiling, metabolic assessment, and fertility evaluation. Results demonstrate that 85% of PCOS patients experienced menstrual irregularities, 72% had ovulatory dysfunction, and 40% presented with infertility. Insulin resistance was present in 65% of cases, and anti-Müllerian hormone (AMH) levels were significantly elevated (8.4 ± 3.2 ng/mL vs 2.8 ± 1.1 ng/mL in controls, $p<0.001$). The discussion emphasizes the multifactorial etiology involving genetic, hormonal, and metabolic factors, and evaluates contemporary management strategies including lifestyle modifications, pharmacological interventions, and assisted reproductive technologies.

Keywords

polycystic ovary syndrome, PCOS, reproductive health, infertility, hyperandrogenism, insulin resistance, anovulation, metabolic syndrome.

INTRODUCTION

Polycystic ovary syndrome (PCOS) represents the most prevalent endocrinopathy affecting women of reproductive age, with global prevalence estimates ranging from 6% to 20% depending on the diagnostic criteria employed [1]. This complex heterogeneous disorder is characterized by chronic anovulation, hyperandrogenism, and polycystic ovarian morphology, resulting in significant reproductive, metabolic, and psychological consequences [2]. PCOS constitutes the leading cause of anovulatory infertility, accounting for approximately 70% of ovulation disorders in women seeking fertility treatment [3].

The diagnostic criteria for PCOS have evolved over time, with the Rotterdam consensus criteria (2003) being most widely adopted. According to Rotterdam criteria, PCOS diagnosis requires two of three features: oligo-ovulation or anovulation, clinical and/or biochemical hyperandrogenism, and polycystic ovaries on ultrasound [4]. Alternative diagnostic frameworks include the National Institutes of Health (NIH) criteria and the Androgen Excess and PCOS Society criteria, each emphasizing different aspects of the syndrome.

The pathophysiology of PCOS is multifactorial, involving genetic predisposition, neuroendocrine dysfunction, metabolic abnormalities, and environmental factors [5]. Insulin resistance, present in 50-70% of PCOS patients, plays a central role in pathogenesis by stimulating ovarian androgen production, disrupting folliculogenesis, and contributing to metabolic complications. Hyperandrogenism results from increased ovarian and adrenal

androgen synthesis, combined with reduced sex hormone-binding globulin (SHBG) levels [6]. The hypothalamic-pituitary-ovarian axis dysfunction is characterized by elevated luteinizing hormone (LH) and altered LH:FSH ratio, promoting androgen production and impairing follicular maturation.

PCOS significantly impacts reproductive health through multiple mechanisms. Chronic anovulation leads to irregular menstrual cycles and reduced fertility. When pregnancy occurs, PCOS patients face increased risks of gestational diabetes, pregnancy-induced hypertension, preeclampsia, and preterm delivery [7]. Long-term consequences extend beyond reproductive years, including increased risk of type 2 diabetes mellitus, cardiovascular disease, endometrial hyperplasia and cancer, and psychological disorders including depression and anxiety [8].

Despite extensive research, PCOS management remains challenging due to phenotypic heterogeneity and lack of definitive cure. Contemporary therapeutic approaches include lifestyle modifications (diet and exercise), pharmacological interventions (metformin, oral contraceptives, anti-androgens), ovulation induction agents (clomiphene citrate, letrozole), and assisted reproductive technologies for infertility treatment .

The aim of this research is to comprehensively evaluate the impact of PCOS on reproductive health, examining the spectrum of reproductive consequences, associated metabolic abnormalities, and effectiveness of contemporary management strategies. Specific objectives include: characterizing the clinical and hormonal profile of PCOS patients, assessing the prevalence of reproductive complications, evaluating metabolic parameters and associated comorbidities, and analyzing treatment outcomes in fertility management.

MATERIALS AND METHODS

Study design and participants. This cross-sectional observational study was conducted at the Reproductive Medicine Center from January 2021 to December 2024. The study enrolled 320 women diagnosed with PCOS according to Rotterdam criteria, aged 18-40 years. PCOS diagnosis required the presence of at least two of three criteria: oligo-ovulation or anovulation (cycles >35 days or <8 cycles per year), clinical hyperandrogenism (hirsutism, acne) and/or biochemical hyperandrogenism (elevated total testosterone or free androgen index), and polycystic ovarian morphology on ultrasound (≥12 follicles measuring 2-9 mm or ovarian volume >10 mL) . Exclusion criteria included: pregnancy, lactation, thyroid disorders, hyperprolactinemia, congenital adrenal hyperplasia, Cushing syndrome, androgen-secreting tumors, and recent use (<3 months) of hormonal medications. A control group of 100 healthy women with regular menstrual cycles and normal ovarian morphology was included for comparison. The institutional review board approved the study protocol (IRB #2020-678), and all participants provided written informed consent.

Clinical assessment. Comprehensive medical history was obtained, including menstrual pattern, fertility history, pregnancy complications, and family history of PCOS or metabolic disorders. Physical examination included measurement of height, weight, body mass index (BMI), waist circumference, blood pressure, and assessment of hyperandrogenic features. Hirsutism was evaluated using the modified Ferriman-Gallwey score, with scores ≥8 indicating clinical hyperandrogenism . Acne severity was graded using the Global Acne Grading System.

Hormonal evaluation. Venous blood samples were collected on days 2-5 of the menstrual cycle (or random in amenorrheic women) after overnight fasting. Hormone measurements included: follicle-stimulating hormone (FSH), luteinizing hormone (LH), total testosterone, sex hormone-binding globulin (SHBG), dehydroepiandrosterone sulfate (DHEAS), 17-

hydroxyprogesterone, thyroid-stimulating hormone (TSH), and prolactin. Free androgen index (FAI) was calculated as (total testosterone × 100)/SHBG. Anti-Müllerian hormone (AMH) levels were measured as an ovarian reserve marker. All hormonal assays were performed using electrochemiluminescence immunoassay (ECLIA) on automated analyzers .

Metabolic assessment. Metabolic evaluation included measurement of fasting glucose, insulin, HbA1c, and lipid profile (total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides). Insulin resistance was assessed using the homeostatic model assessment of insulin resistance (HOMA-IR), calculated as (fasting insulin [μU/mL] × fasting glucose [mmol/L])/22.5. HOMA-IR values ≥2.5 indicated insulin resistance . Oral glucose tolerance test (OGTT) with 75g glucose was performed in patients with BMI ≥25 kg/m² or other diabetes risk factors. Metabolic syndrome was diagnosed according to International Diabetes Federation criteria.

Ultrasound examination. Transvaginal ultrasound was performed using a 7.5 MHz transducer during the early follicular phase (days 2-5). Ovarian volume was calculated using the formula: length × width × thickness × 0.523. Antral follicle count (AFC) was determined by counting all follicles measuring 2-9 mm in both ovaries. Polycystic ovarian morphology was defined as ≥12 follicles or ovarian volume >10 mL in at least one ovary . Endometrial thickness was measured in the sagittal plane.

Fertility evaluation. For patients presenting with infertility, comprehensive fertility assessment was performed including partner semen analysis, hysterosalpingography or sonohysterography to evaluate tubal patency and uterine cavity, and ovulation monitoring using serial ultrasound and serum progesterone measurements. Time to pregnancy and response to ovulation induction were documented.

Statistical analysis. Data were analyzed using SPSS version 27.0. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) depending on distribution normality assessed by Shapiro-Wilk test. Categorical variables were presented as frequencies and percentages. Independent t-test or Mann-Whitney U test was used for comparing continuous variables between groups. Chi-square test or Fisher exact test was employed for categorical variables. Correlation analysis was performed using Pearson or Spearman correlation coefficients. Multiple logistic regression was used to identify independent predictors of reproductive outcomes. Statistical significance was set at $p<0.05$.

RESULTS

Demographic and clinical characteristics. The PCOS cohort had a mean age of 27.8 ± 5.4 years and mean BMI of 28.6 ± 6.2 kg/m², significantly higher than controls (24.2 ± 3.8 kg/m², $p<0.001$). Obesity (BMI ≥30 kg/m²) was present in 38% of PCOS patients versus 12% of controls ($p<0.001$). Menstrual irregularities affected 85% of PCOS patients, comprising oligomenorrhea (64%), amenorrhea (21%), and regular cycles (15%). Clinical hyperandrogenism was evident in 68% of cases: hirsutism (58%), acne (42%), and androgenic alopecia (18%). The mean Ferriman-Gallwey score was 12.4 ± 6.8 in PCOS patients with hirsutism. Family history of PCOS was reported in 42% of patients, and 36% had first-degree relatives with type 2 diabetes .

Hormonal profile. PCOS patients demonstrated significantly altered hormonal parameters compared to controls. Mean LH was elevated (8.6 ± 4.2 IU/L vs 4.8 ± 2.1 IU/L, $p<0.001$), while FSH was similar (5.2 ± 1.8 IU/L vs 5.6 ± 1.6 IU/L, $p=0.08$). The LH:FSH ratio was increased (1.78 ± 0.86 vs 0.88 ± 0.34, $p<0.001$), with 58% of PCOS patients having LH:FSH >2. Total testosterone was significantly elevated (2.8 ± 1.2 nmol/L vs 1.4 ± 0.6 nmol/L, $p<0.001$), with biochemical hyperandrogenism (testosterone >2.0 nmol/L) in 64% of PCOS patients. Free

androgen index was markedly increased (8.4 ± 4.6 vs 2.8 ± 1.4, p<0.001). AMH levels were substantially elevated (8.4 ± 3.2 ng/mL vs 2.8 ± 1.1 ng/mL, p<0.001), with 82% of PCOS patients having AMH >5 ng/mL .

Metabolic abnormalities. Insulin resistance (HOMA-IR ≥2.5) was present in 65% of PCOS patients compared to 18% of controls (p<0.001). Mean fasting insulin was 14.8 ± 8.6 μU/mL in PCOS versus 7.2 ± 3.4 μU/mL in controls (p<0.001). Impaired glucose tolerance was detected in 24% of PCOS patients on OGTT, and 8% had type 2 diabetes. Dyslipidemia was present in 58% of PCOS patients, characterized by elevated triglycerides (1.8 ± 0.9 mmol/L vs 1.1 ± 0.5 mmol/L, p<0.001), reduced HDL-cholesterol (1.2 ± 0.3 mmol/L vs 1.5 ± 0.4 mmol/L, p<0.001), and elevated LDL-cholesterol (3.4 ± 1.1 mmol/L vs 2.8 ± 0.8 mmol/L, p=0.002). Metabolic syndrome was diagnosed in 32% of PCOS patients, increasing to 48% in obese patients .

Ovarian morphology and reserve. Polycystic ovarian morphology was present in 88% of PCOS patients. Mean ovarian volume was significantly increased (12.4 ± 4.2 mL vs 6.8 ± 2.1 mL, p<0.001). Antral follicle count was markedly elevated (24.6 ± 8.4 vs 8.2 ± 3.6, p<0.001), correlating strongly with AMH levels (r=0.78, p<0.001). Endometrial thickness was variable, with 18% of patients showing thickened endometrium (>12 mm) suggestive of hyperplasia risk due to chronic anovulation.

Reproductive outcomes. Ovulatory dysfunction affected 72% of PCOS patients based on menstrual history and progesterone measurements. Among the 186 patients seeking fertility (58%), infertility was diagnosed in 40% after ≥12 months of unsuccessful conception attempts. Primary infertility accounted for 68% and secondary infertility 32% of infertility cases. Among patients who achieved pregnancy (n=94), complications included gestational diabetes (28%), pregnancy-induced hypertension (18%), preeclampsia (12%), preterm delivery (16%), and cesarean delivery (52%). Miscarriage rate was 22%, higher than the general population rate of 10-15% .

Treatment outcomes. Among infertile patients, 68% received ovulation induction. Clomiphene citrate achieved ovulation in 62% and pregnancy in 38% of treated patients. Letrozole demonstrated superior outcomes with 78% ovulation rate and 52% pregnancy rate (p=0.008 vs clomiphene). Metformin treatment in insulin-resistant patients improved ovulation rates (OR=2.4, p=0.004) and enhanced response to ovulation induction. Lifestyle intervention (diet and exercise) in overweight/obese patients achieving ≥5% weight loss resulted in spontaneous ovulation resumption in 34% and improved pregnancy rates . Among patients requiring assisted reproductive technology, in vitro fertilization achieved 42% live birth rate per cycle, though with increased risk of ovarian hyperstimulation syndrome (18% vs 3% in non-PCOS patients, p<0.001).

Predictors of reproductive outcomes. Multiple logistic regression analysis identified independent predictors of successful pregnancy. Favorable predictors included younger age (OR=0.92 per year, p=0.006), lower BMI (OR=0.88 per kg/m², p=0.002), presence of regular cycles (OR=3.6, p<0.001), and metformin use in insulin-resistant patients (OR=2.8, p=0.001). Adverse predictors included severe hyperandrogenism (FAI >8: OR=0.42, p=0.008), metabolic syndrome (OR=0.38, p=0.004), and advanced reproductive age >35 years (OR=0.34, p=0.001).

DISCUSSION

This comprehensive study demonstrates the profound impact of PCOS on reproductive health, confirming its status as the leading cause of anovulatory infertility and reproductive

dysfunction. Our findings highlight the complex interplay between hormonal, metabolic, and reproductive abnormalities that characterize this syndrome.

Pathophysiological mechanisms. The hormonal profile observed in our PCOS cohort reflects fundamental pathophysiological disturbances. Elevated LH and altered LH:FSH ratio result from increased gonadotropin-releasing hormone (GnRH) pulse frequency, stimulating ovarian theca cells to produce excess androgens . Hyperinsulinemia, present in 65% of our patients, synergistically stimulates androgen production by enhancing LH-stimulated theca cell steroidogenesis and inhibiting hepatic SHBG synthesis, thereby increasing free androgen levels. This creates a vicious cycle where hyperandrogenism and hyperinsulinemia perpetuate each other.

The markedly elevated AMH levels (8.4 ng/mL vs 2.8 ng/mL in controls) reflect the excessive number of small antral follicles characteristic of polycystic ovaries. AMH inhibits FSH-dependent follicular development and aromatase activity, contributing to anovulation by preventing selection and maturation of dominant follicles . The strong correlation between AMH and antral follicle count ($r=0.78$) confirms AMH as a reliable biomarker for PCOS diagnosis and severity assessment.

Metabolic implications. The high prevalence of insulin resistance (65%), metabolic syndrome (32%), and dyslipidemia (58%) in our PCOS cohort underscores the systemic metabolic derangements beyond reproductive manifestations. Insulin resistance in PCOS involves both intrinsic defects in insulin signaling pathways and obesity-related insulin resistance . The independent contribution of PCOS to insulin resistance is evidenced by its presence even in lean patients (40% in our cohort with BMI <25 kg/m^2).

The finding that 8% of PCOS patients had overt type 2 diabetes and 24% had impaired glucose tolerance aligns with meta-analyses showing 2-4 fold increased diabetes risk in PCOS. This highlights the critical importance of metabolic screening and diabetes prevention strategies in PCOS management. The elevated prevalence of dyslipidemia, particularly low HDL and high triglycerides, contributes to increased cardiovascular risk, which manifests clinically decades later but requires early intervention.

Reproductive consequences and fertility. The 40% infertility rate in our cohort seeking fertility confirms PCOS as the predominant cause of anovulatory infertility. Chronic anovulation results from arrested follicular development at the 5-8 mm stage, preventing selection of a dominant follicle and ovulation. The 22% miscarriage rate observed is attributed to multiple factors including poor oocyte quality, abnormal endometrial receptivity due to hormonal imbalances, obesity, insulin resistance, and hyperandrogenism .

Pregnancy complications were frequent in our PCOS patients, with gestational diabetes affecting 28% compared to 6-7% in the general population. This reflects underlying insulin resistance, which worsens during pregnancy due to placental hormones. Hypertensive disorders of pregnancy (preeclampsia 12%, pregnancy-induced hypertension 18%) occur more frequently in PCOS, potentially mediated by endothelial dysfunction, chronic inflammation, and metabolic abnormalities . The high cesarean delivery rate (52%) may reflect obstetric complications, increased fetal size due to gestational diabetes, or physician anxiety regarding PCOS-associated risks.

Therapeutic strategies. Our treatment outcome data support a stratified, personalized approach to PCOS management. Lifestyle modification remains first-line therapy for overweight/obese patients, with weight loss of $\geq 5\%$ improving ovulation rates, insulin sensitivity,

and pregnancy outcomes. The mechanism involves reduced insulin resistance, decreased androgen production, and improved hypothalamic-pituitary-ovarian axis function .

For ovulation induction, letrozole demonstrated superior efficacy compared to clomiphene citrate (78% vs 62% ovulation rate, p=0.008), consistent with recent meta-analyses establishing letrozole as first-line pharmacological therapy. Letrozole's mechanism involves aromatase inhibition, reducing estrogen negative feedback, increasing FSH secretion, and promoting follicular development without anti-estrogenic effects on endometrium. Metformin, while not primarily an ovulation induction agent, improved outcomes in insulin-resistant patients by reducing insulin levels, decreasing androgen production, and enhancing ovarian response to gonadotropins.

Prognostic factors and clinical implications. The identification of predictors for reproductive success enables risk stratification and personalized counseling. Younger age, lower BMI, less severe hyperandrogenism, and absence of metabolic syndrome emerged as favorable prognostic factors. These findings emphasize the importance of early diagnosis and intervention, weight management, and metabolic optimization in improving fertility outcomes .

The complex, lifelong nature of PCOS necessitates multidisciplinary management addressing reproductive, metabolic, and psychological aspects. Beyond fertility treatment, long-term management should include cardiovascular risk assessment, diabetes screening, endometrial surveillance in patients with chronic anovulation, and psychosocial support addressing body image concerns, anxiety, and depression.

Limitations and future directions. Study limitations include cross-sectional design precluding longitudinal outcome assessment, single-center setting potentially limiting generalizability, and inability to assess genetic factors. Future research should focus on identifying PCOS phenotype-specific treatment strategies, investigating novel therapeutic targets (e.g., AMH antagonists, insulin sensitizers), developing predictive biomarkers for treatment response, and implementing early prevention strategies in high-risk adolescents.

CONCLUSION

This comprehensive study elucidates the significant impact of PCOS on reproductive health and associated metabolic consequences. Principal conclusions include:

1) PCOS profoundly affects reproductive function, with 85% experiencing menstrual irregularities, 72% having ovulatory dysfunction, and 40% presenting with infertility. The condition represents the leading cause of anovulatory infertility, requiring specialized fertility management.

2) Hormonal abnormalities are characteristic, including elevated LH, increased LH:FSH ratio, hyperandrogenism, and markedly elevated AMH levels. These hormonal disturbances directly impair folliculogenesis and ovulation, contributing to reproductive dysfunction.

3) Metabolic abnormalities are prevalent, with 65% demonstrating insulin resistance, 32% meeting metabolic syndrome criteria, and 58% having dyslipidemia. These metabolic derangements increase long-term risks of type 2 diabetes and cardiovascular disease, necessitating comprehensive metabolic management.

4) Pregnancy in PCOS patients carries increased risks, including gestational diabetes (28%), hypertensive disorders (30%), miscarriage (22%), and preterm delivery (16%), requiring enhanced prenatal surveillance and management.

5) Treatment should be individualized based on patient goals, PCOS phenotype, and metabolic status. Lifestyle modification remains foundational, letrozole is first-line for ovulation induction, and metformin benefits insulin-resistant patients. Younger age, lower BMI, and metabolic optimization predict better reproductive outcomes.

PCOS requires lifelong, multidisciplinary management addressing reproductive, metabolic, and psychological aspects. Early diagnosis, prompt intervention, weight management, and metabolic optimization improve reproductive outcomes and reduce long-term health risks. Future research should focus on developing targeted therapies, identifying predictive biomarkers, and implementing prevention strategies in high-risk populations.

REFERENCES

1. Bozdag G., Mumusoglu S., Zengin D., et al. The prevalence and phenotypic features of polycystic ovary syndrome: a systematic review and meta-analysis // Human Reproduction. 2016. Vol. 31(12). P. 2841-2855. DOI: 10.1093/humrep/dew218

2. Azziz R., Carmina E., Chen Z., et al. Polycystic ovary syndrome // Nature Reviews Disease Primers. 2016. Vol. 2. P. 16057. DOI: 10.1038/nrdp.2016.57

3. Sirmans S.M., Pate K.A. Epidemiology, diagnosis, and management of polycystic ovary syndrome // Clinical Epidemiology. 2013. Vol. 6. P. 1-13. DOI: 10.2147/CLEP.S37559

4. Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome // Fertility and Sterility. 2004. Vol. 81(1). P. 19-25. DOI: 10.1016/j.fertnstert.2003.10.004

5. Rosenfield R.L., Ehrmann D.A. The pathogenesis of polycystic ovary syndrome (PCOS): the hypothesis of PCOS as functional ovarian hyperandrogenism revisited // Endocrine Reviews. 2016. Vol. 37(5). P. 467-520. DOI: 10.1210/er.2015-1104

6. Diamanti-Kandarakis E., Dunaif A. Insulin resistance and the polycystic ovary syndrome revisited: an update on mechanisms and implications // Endocrine Reviews. 2012. Vol. 33(6). P. 981-1030. DOI: 10.1210/er.2011-1034

7. Boomsma C.M., Eijkemans M.J., Hughes E.G., et al. A meta-analysis of pregnancy outcomes in women with polycystic ovary syndrome // Human Reproduction Update. 2006. Vol. 12(6). P. 673-683. DOI: 10.1093/humupd/dml036

8. Teede H.J., Misso M.L., Costello M.F., et al. Recommendations from the international evidence-based guideline for the assessment and management of polycystic ovary syndrome // Human Reproduction. 2018. Vol. 33(9). P. 1602-1618. DOI: 10.1093/humrep/dey256