

EVALUATION OF HORMONAL IMBALANCE IN PATIENTS WITH POLYCYSTIC OVARY SYNDROME (PCOS) IN PAKISTAN POPULATION

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DOI: <https://doi.org/10.5281/zenodo.20052379>

Keywords

PCOS, hormonal imbalance, insulin resistance, testosterone, LH/FSH ratio, Pakistan.

Article History

Received: 11 March 2026

Accepted: 21 April 2026

Published: 06 May 2026

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Abstract

Background: Polycystic Ovary Syndrome (PCOS) is the most common endocrine disorder in Female characterized by hormonal imbalance and metabolic disturbances.

Objective: To evaluate hormonal imbalances in women with PCOS and compare them with healthy controls.

Methods: A cross-sectional analytical study was conducted on 100 PCOS patients and 100 healthy controls. Hormonal parameters including LH, FSH, Total Testosterone (TT), SHBG, DHEAS, and fasting insulin were measured. Data were analyzed using SPSS v25. A p-value <0.05 was considered statistically significant.

Results: PCOS patients showed significantly higher LH, LH/FSH ratio, testosterone, FAI, DHEAS, and fasting insulin levels, while SHBG levels were significantly lower compared to controls ($p < 0.05$). suggesting insulin-mediated suppression. Hyperandrogenemia was present in 80% of PCOS patients.

Conclusion: PCOS is associated with significant hormonal disturbances, particularly hyperandrogenism and altered gonadotropins. Free androgen index (FAI) is a sensitive marker, and insulin resistance plays a key role in disease severity.

Introduction

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age worldwide (Teede *et al.*, 2023) It is characterized by ovulatory dysfunction, hyperandrogenism, and polycystic ovarian morphology. The prevalence of PCOS ranges from 6% to 20% depending on the diagnostic criteria and population studied (Helvacı & Yildiz, 2025). PCOS is associated with various reproductive, metabolic, and psychological complications. Women with PCOS commonly present with irregular menstrual cycles, infertility, acne, obesity, hirsutism, and insulin resistance

(Johnson *et al.*, 2025). In addition, PCOS increases the risk of type 2 diabetes mellitus, cardiovascular diseases, metabolic syndrome, and endometrial cancer (Escobar-Morreale, 2023). Hormonal imbalance is considered the hallmark feature of PCOS. Increased luteinizing hormone (LH), elevated testosterone levels, abnormal LH/FSH ratio, increased dehydroepiandrosterone sulfate (DHEAS), and reduced Sex Hormone Binding Globulin (SHBG) are commonly reported in affected women (Khan *et al.*, 2021). Hyperandrogenism contributes to the development of hirsutism, acne, alopecia, and menstrual disturbances.

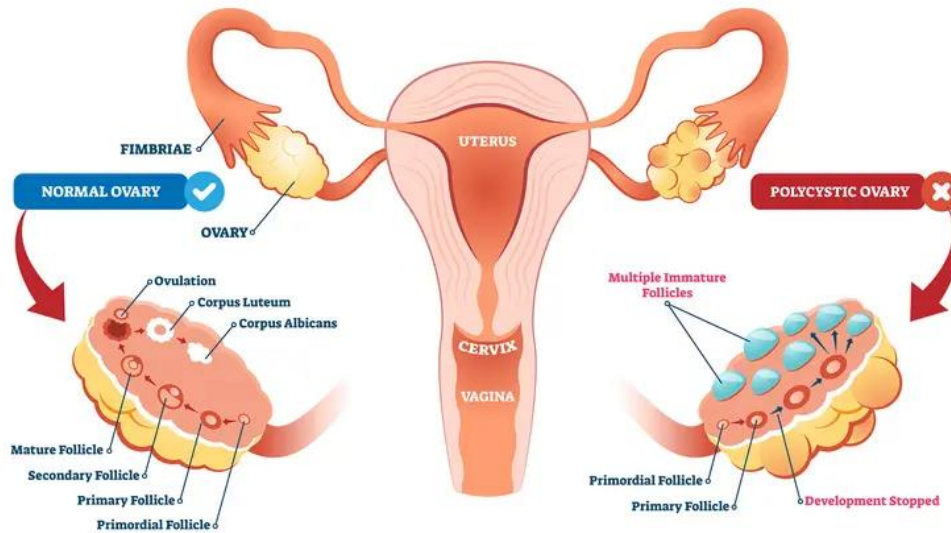


Figure 1: Polycystic ovaries are those that have lots of immature egg sac cysts (follicles). Not everyone with PCOS has ovarian cysts. (Deanna Altomara *et al*; 2023)

Insulin resistance also plays an important role in the pathogenesis of PCOS. Hyperinsulinemia stimulates ovarian androgen production and suppresses hepatic SHBG synthesis, thereby worsening free androgen levels (Lei *et al.*, 2025). Studies have demonstrated that insulin resistance is strongly associated with obesity and metabolic complications in women with PCOS (Maan *et al.*, 2025). PCOS is a multifactorial disorder influenced by endocrine, metabolic, genetic, and environmental factors (Goodarzi *et al.*, 2021). Obesity and metabolic syndrome are highly prevalent among women with PCOS and significantly worsen insulin resistance and hyperandrogenism (Barber & Franks, 2021; Lim *et al.*, 2022). Recent evidence suggests that chronic inflammation, gut microbiota imbalance, and circadian rhythm disruption may also contribute to the development and progression of PCOS (Senthilkumar & Arumugam, 2025; Heydari & Ramdass, 2025). Furthermore, advances in artificial intelligence and diagnostic technologies

are improving early detection and management of PCOS (Ghaderzadeh *et al.*, 2025).

The exact etiology of PCOS remains unclear; however, genetic, environmental, and lifestyle factors are believed to contribute significantly to disease development (Senthilkumar & Arumugam, 2025). Sedentary lifestyle, unhealthy dietary habits, stress, and obesity have increased the prevalence of PCOS in South Asian countries including Pakistan. In Pakistan, limited data are available regarding hormonal disturbances among women with PCOS. Therefore, the present study aimed to evaluate hormonal imbalance among women with PCOS and compare hormonal parameters with healthy controls.

Methodology

Study Design: A cross-sectional analytical study was conducted to evaluate hormonal imbalance among women diagnosed with Polycystic Ovary Syndrome (PCOS).

Study Setting: The study was conducted at different hospitals and diagnostic laboratories in Pakistan.

Study Population: A total of 200 participants were included in the study and divided into two. The group A consist of 100 diagnosed PCOS according to Rotterdam criteria patients and Group B group consist of 100 healthy controls. Females aged 18–35 years are included

Data Collection Procedure: The detailed demographic and clinical history was obtained from all participants. Information regarding menstrual irregularities, infertility, hirsutism, acne, obesity, and family history was recorded by Questionnaire. Further in Lab the Blood samples were collected after overnight fasting under aseptic conditions. Hormonal assays were performed in the laboratory using standardized methods.

Hormonal Parameters Assessed: The following parameters were measured:

- Luteinizing Hormone (LH)
- Follicle Stimulating Hormone (FSH)
- LH/FSH ratio
- Total Testosterone (TT)
- Sex Hormone Binding Globulin (SHBG)
- Dehydroepiandrosterone Sulfate (DHEAS)

- Fasting Insulin
- Free Androgen Index (FAI)

Statistical Analysis: Data were entered and analyzed using SPSS version 25. Mean and standard deviation were calculated for quantitative variables. Independent sample t-test was used to compare hormonal parameters between groups. A p-value less than 0.05 was considered statistically significant. Moreover Pearson correlation analysis was performed.

Results:

The present study evaluated hormonal and metabolic parameters among women diagnosed with PCOS and compared them with healthy controls. Significant differences were observed in several hormonal markers, particularly LH, LH/FSH ratio, testosterone, DHEAS, fasting insulin, SHBG, and FAI levels between both groups.

Demographic Characteristics: The mean age of PCOS patients was 26.8 ± 4.2 years, while the mean age of controls was 25.9 ± 3.9 years. Menstrual irregularities, obesity, acne, and hirsutism were more common among women with PCOS.

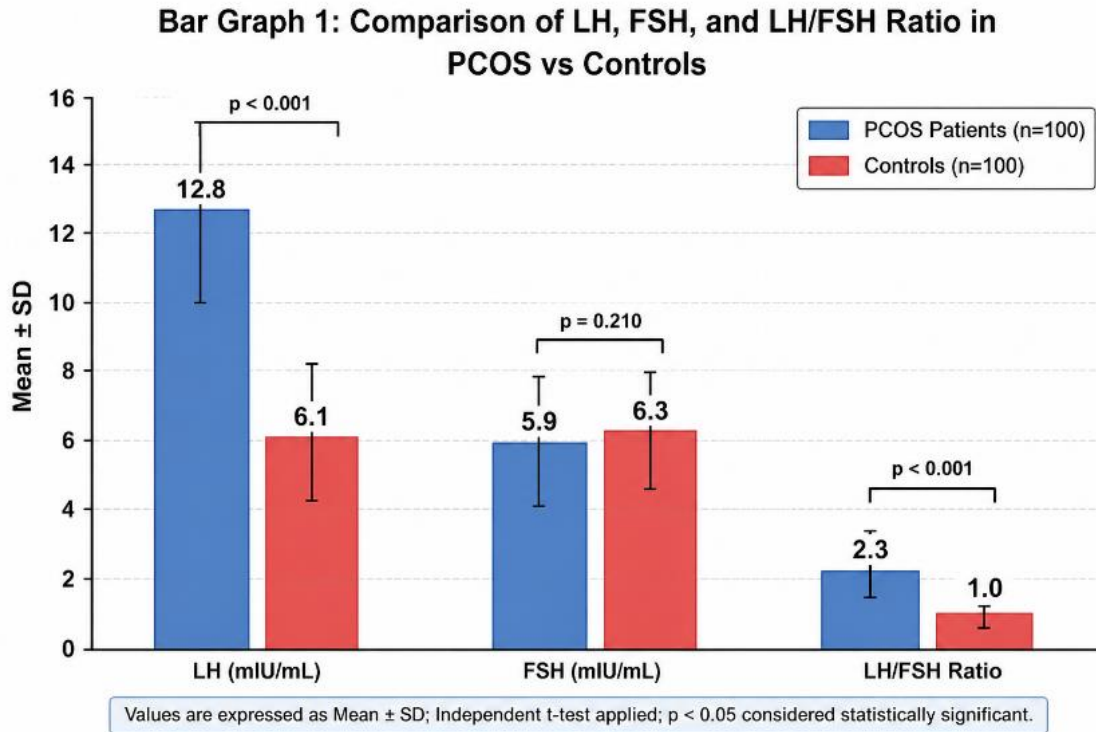
Table 1: Comparison of Hormonal Parameters Between PCOS Patients and Controls

Parameter	PCOS Patients (Mean ± SD)	Controls (Mean ± SD)	p-value
LH (mIU/mL)	12.8 ± 3.5	6.1 ± 2.0	<0.001
FSH (mIU/mL)	5.9 ± 1.8	6.3 ± 1.5	0.210
LH/FSH Ratio	2.3 ± 0.8	1.0 ± 0.3	<0.001
Total Testosterone (ng/dL)	78.5 ± 18.2	42.7 ± 10.4	<0.001
SHBG (nmol/L)	28.4 ± 9.2	55.6 ± 12.8	<0.001
DHEAS (µg/dL)	310.4 ± 65.7	185.2 ± 48.3	<0.001
Fasting Insulin (µIU/mL)	19.6 ± 5.4	8.7 ± 3.1	<0.001
FAI	8.9 ± 2.6	2.4 ± 1.1	<0.001

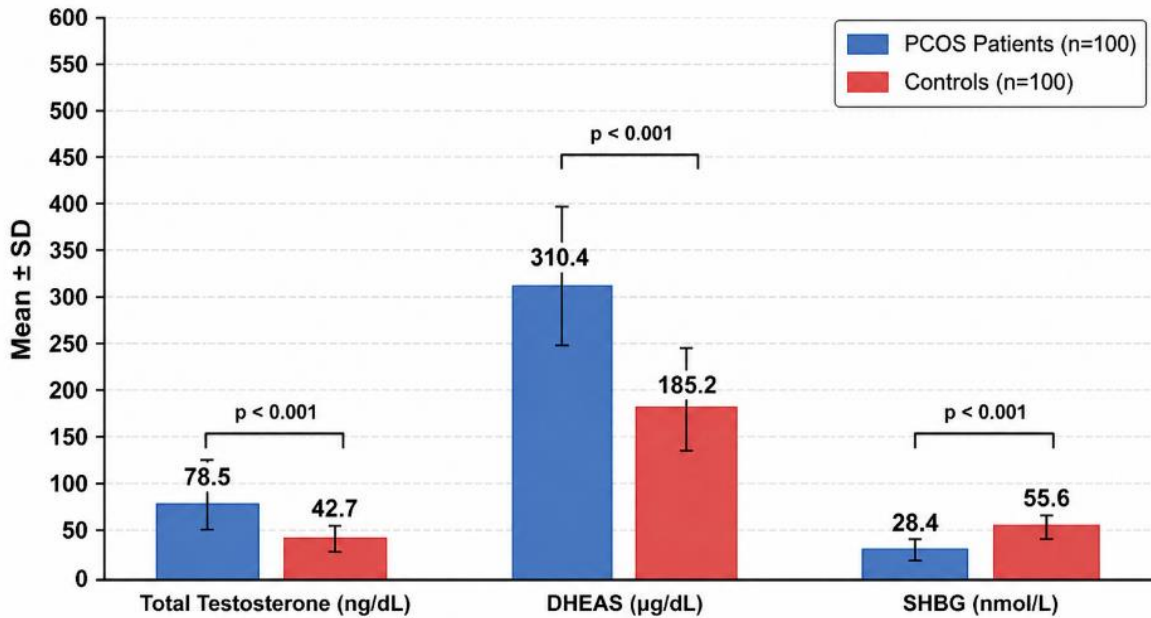
The results demonstrated significantly higher LH levels, LH/FSH ratio, testosterone, DHEAS, fasting insulin, and FAI among PCOS patients compared to healthy controls. SHBG levels were significantly lower in women with PCOS.

Hyperandrogenemia was observed in 80% of PCOS patients. Menstrual irregularities were present in 72% of patients, while hirsutism and acne were reported in 65% and 58% of cases

respectively. The graphical representation is given below.

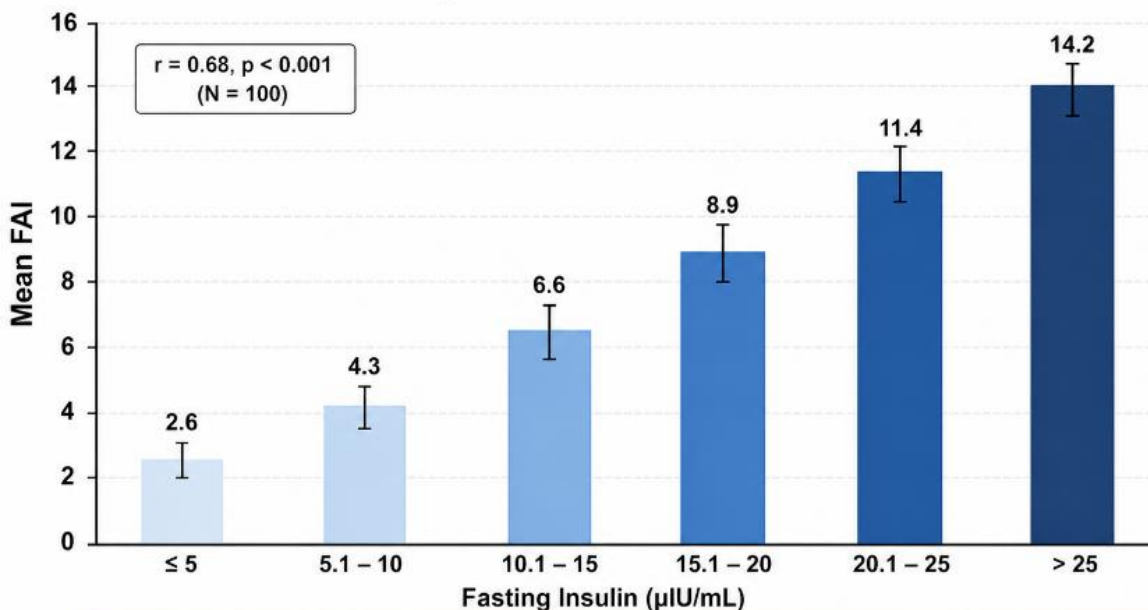


Bar Graph 2: Comparison of Testosterone, DHEAS, and SHBG Levels in PCOS vs Controls



Values are expressed as Mean ± SD; Independent t-test applied; $p < 0.05$ considered statistically significant.

Bar Graph: Relationship between FAI and Fasting Insulin in PCOS Patients



Values are expressed as Mean ± SD. Pearson correlation showed a significant positive relationship between FAI and fasting insulin in PCOS patients.

Discussion

The present study evaluated hormonal imbalance among women with Polycystic Ovary Syndrome in the Pakistani population. The findings demonstrated significant endocrine and metabolic abnormalities among women with PCOS compared to healthy controls. Elevated LH levels and increased LH/FSH ratio observed in this study are consistent with previous international studies (Teede *et al.*, 2023). Increased GnRH pulsatility causes preferential secretion of LH, which stimulates ovarian androgen production. Hyperandrogenism remains one of the most important features of PCOS. In the current study, testosterone, DHEAS, and FAI levels were significantly elevated among PCOS patients. Similar findings have been reported by Escobar-Morreale (2023) demonstrating that increased androgen production contributes to acne, hirsutism, and menstrual irregularities. The present study also found significantly lower SHBG levels in women with PCOS. Reduced SHBG increases circulating free testosterone levels and worsens clinical symptoms. Hyperinsulinemia suppresses SHBG synthesis in the liver, leading to increased androgen bioavailability. Fasting insulin levels were significantly elevated in women with PCOS, indicating insulin resistance. Insulin resistance is considered a major pathogenic factor in PCOS and contributes to obesity, metabolic syndrome, and type 2 diabetes mellitus (Johnson *et al.*, 2025).

The findings of elevated androgen levels in the present study are supported by Azziz *et al.* (2021), who reported hyperandrogenism as a central feature of PCOS pathophysiology. The increased prevalence of obesity and insulin resistance observed in this study is comparable with previous studies conducted in women with PCOS (Barber & Franks, 2021) Lim *et al.* (2022) further reported that metabolic syndrome is highly prevalent among women with PCOS and increases long-term cardiovascular risk.

Conclusion

PCOS is associated with significant hormonal and metabolic disturbances. Women with PCOS demonstrated elevated LH, LH/FSH ratio,

testosterone, DHEAS, fasting insulin, and FAI levels, while SHBG levels were significantly reduced. Hyperandrogenism and insulin resistance play a major role in disease severity and clinical manifestations. Early hormonal assessment and lifestyle management are essential for reducing complications and improving reproductive and metabolic outcomes in women with PCOS.

REFERENCES

- Teede HJ, Tay CT, Laven JJE, et al. Recommendations from the international evidence-based guideline for the assessment and management of PCOS. *Human Reproduction*. 2023;38(9):1607-1618.
- Helvaci N, Yildiz BO. Polycystic ovary syndrome as a metabolic disease. *Nature Reviews Endocrinology*. 2025;21:230-244.
- Johnson C, Garipoğlu G, Jeanes Y, Frontino G, Costabile A. The role of diet and glucose control in PCOS management. *Current Nutrition Reports*. 2025;14:8.
- Escobar-Morreale HF. Polycystic ovary syndrome: definition, diagnosis and treatment. *Nature Reviews Endocrinology*. 2023;19(4):195-210.
- Khan MJ, Ullah A, Basit S. Genetic basis of polycystic ovary syndrome. *Journal of Reproduction and Infertility*. 2021;22(1):1-7.
- Lei H, Ye T, Wang Y. Adipose-androgen crosstalk in PCOS. *Frontiers in Endocrinology*. 2025;16.
- Maan P, Gautam R, Vasudevan S, et al. Interventions for PCOS management. *Pharmaceuticals*. 2025;18(5):680.
- Senthilkumar H, Arumugam M. Gut microbiota and PCOS. *Journal of Translational Medicine*. 2025;23:443.
- Ghaderzadeh M, Garavand A, Salehnasab C. Artificial intelligence in PCOS diagnosis. *BMC Medical Informatics and Decision Making*. 2025;25:427.
- Heydari T, Ramdass P. Circadian rhythm disruption and PCOS. *AJOG Global Reports*. 2025;5(3):100479.

- Rosenfield RL, Ehrmann DA. Pathogenesis of PCOS. *Endocrine Reviews*. 2021;42(5):599-618.
- Azziz R, Carmina E, Chen Z, et al. Polycystic ovary syndrome. *Nature Reviews Disease Primers*. 2021;7(1):1-23.
- Peña AS, Witchel SF, Hoeger KM, et al. Adolescent PCOS guidelines. *Journal of Clinical Endocrinology & Metabolism*. 2020;105(9):e3366-e3387.
- Ibáñez L, Oberfield SE, Witchel S, et al. PCOS after puberty. *Nature Reviews Endocrinology*. 2020;16(9):519-534.
- Palomba S, Santagni S, Falbo A, et al. Complications of PCOS. *Human Reproduction Update*. 2020;26(2):251-281.
- Goodarzi MO, Dumesic DA, Chazenbalk G, et al. Polycystic ovary syndrome: etiology and pathogenesis. *Nature Reviews Endocrinology*. 2021;17(11):714-726.
- Ding T, Hardiman PJ, Petersen I, et al. The prevalence of PCOS. *Human Reproduction*. 2021;36(1):38-48.
- Barber TM, Franks S. Obesity and polycystic ovary syndrome. *Clinical Endocrinology*. 2021;95(4):531-541.
- Lim SS, Kakoly NS, Tan JWJ, et al. Metabolic syndrome in PCOS. *Endocrine Reviews*. 2022;43(3):421-450.
- Fauser BCJM, Tarlatzis BC, Rebar RW, et al. Consensus on women's health aspects of PCOS. *Fertility and Sterility*. 2020;113(2):251-267.

