

ORIGINAL ARTICLE

Prevalence and Clinical Factors Associated With Polycystic Ovary Syndrome Among Women Presenting With Menstrual Irregularities: A Cross-Sectional Study

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ABSTRACT

Objective: To determine the prevalence of polycystic ovary syndrome (PCOS) and identify clinical factors independently associated with PCOS among women presenting with menstrual irregularities.

Study design: Analytical cross-sectional study.

Setting and duration: Department of Obstetrics and Gynecology, Qazi Hussain Ahmad Medical Complex, Nowshera, Pakistan, from March 2023 to August 2023.

Material and Methods: Four hundred women aged 15–45 years presenting with menstrual irregularities were recruited by non-probability consecutive sampling. PCOS was diagnosed according to the 2023 International Evidence-based Guideline. In adults, diagnosis required at least two of three features after exclusion of relevant alternative disorders: ovulatory dysfunction, clinical and/or biochemical hyperandrogenism, and polycystic ovarian morphology (PCOM). PCOM was assessed by transvaginal ultrasonography performed by a radiologist, with follicle number per ovary (FNPO) ≥ 20 in at least one ovary used as the adult threshold. In adolescents, diagnosis required both ovulatory dysfunction and hyperandrogenism; ultrasound morphology and AMH were not used diagnostically. Biochemical hyperandrogenism was assessed using total and free testosterone measured in the hospital laboratory. AMH was an additional supportive investigation only. Associations with PCOS were evaluated using univariable and multivariable logistic regression; there were no missing data for variables included in the analyses.

Results: Of 400 women, 96 (24.0%) met the diagnostic criteria for PCOS. Mean BMI was higher in women with PCOS than in those without PCOS (27.9 ± 4.0 vs 25.4 ± 4.0 kg/m²; $p < 0.001$). On multivariable analysis, hirsutism (aOR 7.35, 95% CI 4.04–13.39), family history of PCOS (aOR 4.36, 95% CI 2.31–8.23), acne (aOR 4.20, 95% CI 2.21–7.99), infertility history (aOR 3.54, 95% CI 1.74–7.20), BMI ≥ 25 kg/m² (aOR 3.23, 95% CI 1.75–5.95), and menarche before 12 years (aOR 2.31, 95% CI 1.17–4.56) were independently associated with PCOS. Age was not independently associated with PCOS (aOR 1.03, 95% CI 0.97–1.08; $p = 0.338$).

Conclusion: Approximately one in four women presenting with menstrual irregularities met the 2023 guideline-based diagnostic criteria for PCOS. Hirsutism, family history of PCOS, acne, infertility history, BMI ≥ 25 kg/m² and early menarche were associated with PCOS after multivariable adjustment. These findings characterize a symptomatic hospital-based population and should not be interpreted as a validated diagnostic or prediction model.

Keywords: polycystic ovary syndrome; menstrual irregularities; oligomenorrhea; hyperandrogenism; hirsutism; cross-sectional study.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a heterogeneous endocrine disorder characterized by combinations of ovulatory dysfunction, hyperandrogenism and polycystic ovarian morphology. Menstrual irregularity, commonly oligomenorrhea or amenorrhea related to chronic anovulation, is a frequent presentation and often prompts clinical evaluation for PCOS.^{1,2}

Reported PCOS prevalence varies according to the population studied and the diagnostic criteria applied. Systematic reviews demonstrate substantial geographic and ethnic variation, including among South Asian populations.^{3,6–8} Pakistani studies have likewise reported variable frequencies in student and clinical populations, reflecting differences in sampling frames, diagnostic approaches and participant characteristics.^{9–11}

PCOS is also associated with important metabolic and reproductive consequences. Insulin resistance is common and is closely related to hyperandrogenism and ovulatory dysfunction.¹⁵ Women with PCOS have increased burdens of metabolic syndrome, non-alcoholic fatty liver disease and type 2 diabetes in published studies.^{16–18} Genetic susceptibility and environmental factors, including excess weight and sedentary lifestyle, contribute to the complex pathophysiology of the syndrome.¹⁹

Psychological morbidity is another important component of PCOS. Meta-analyses have reported higher burdens of depressive and anxiety symptoms among affected women, while

Pakistani data also suggest adverse effects on sexual functioning and quality of life.^{20–24}

Despite this broad clinical burden, there are limited local data describing which readily identifiable clinical characteristics are most strongly associated with PCOS specifically among women who present with menstrual irregularities. Identifying such features may support more focused assessment in resource-constrained gynecology services. This study therefore aimed to determine the prevalence of PCOS and evaluate clinical factors independently associated with PCOS among women presenting with menstrual irregularities at a tertiary-care hospital in Nowshera, Pakistan.

MATERIALS AND METHODS

This analytical cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Qazi Hussain Ahmad Medical Complex, Nowshera, Pakistan, from March 2023 to August 2023. The study was undertaken after approval from the Institutional Ethical Review Committee of Qazi Hussain Ahmad Medical Complex, Nowshera. Written informed consent was obtained from adult participants. For participants younger than 18 years, consent was obtained from the accompanying mother, parent, or legal guardian in accordance with the approved institutional protocol.

Sample size and sampling: Using the WHO approach for estimation of a single proportion, with an anticipated PCOS prevalence of approximately 20% based on regional data, a 95% confidence level and 5% absolute precision, the minimum required sample was approximately 246 women.^{9,28} The achieved sample comprised 400 women, exceeding the minimum calculated

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requirement. Participants were enrolled using non-probability consecutive sampling.

Eligibility criteria: Women aged 15–45 years presenting to the outpatient gynecology clinic with menstrual irregularities were eligible. Menstrual irregularity included cycle intervals of <21 days or >35 days, a cycle interval of at least 90 days, or an unpredictable menstrual pattern, as recorded in the prespecified study proforma. Pregnant or lactating women and women using hormonal contraceptives or ovulation-regulating medication within the preceding three months were excluded. Women with an alternative disorder considered to mimic PCOS, including primary hypothyroidism, hyperprolactinemia, non-classic congenital adrenal hyperplasia, androgen-secreting tumors and premature ovarian insufficiency, were also excluded.

Data collection and PCOS assessment: Demographic information, menstrual and reproductive history, age at menarche, duration and pattern of menstrual irregularity, anthropometric measurements (height, weight, body mass index [BMI] and waist circumference), and clinical features including hirsutism, acne and androgenic alopecia were recorded on a structured proforma. Hirsutism was assessed using the modified Ferriman-Gallwey (mFG) score; an mFG score ≥ 8 was used in the study analysis.

PCOS was diagnosed according to the 2023 International Evidence-based Guideline for the Assessment and Management of PCOS.²⁶ In adult participants, diagnosis required at least two of the following three features after exclusion of relevant alternative disorders: (1) ovulatory dysfunction; (2) clinical and/or biochemical hyperandrogenism; and (3) polycystic ovarian morphology (PCOM). Adult PCOM was assessed by transvaginal ultrasonography performed by a radiologist and was defined as a follicle number per ovary (FNPO) ≥ 20 in at least one ovary.²⁶ Biochemical hyperandrogenism was assessed using serum total testosterone and free testosterone measured in the hospital laboratory and interpreted according to the laboratory reference ranges. Androstenedione and dehydroepiandrosterone sulfate (DHEAS) were not routinely available and were not included in the biochemical assessment. Clinical hyperandrogenism was assessed using the modified Ferriman-Gallwey score, with a score ≥ 8 used as the study threshold for hirsutism. Serum anti-Müllerian hormone (AMH) was included only as an additional supportive investigation where indicated and was not used independently to define PCOM or establish the diagnosis of PCOS.

For adolescent participants, the 2023 International Evidence-based Guideline adolescent diagnostic criteria were applied.²⁶ Diagnosis required both ovulatory dysfunction and clinical and/or biochemical hyperandrogenism after exclusion of relevant alternative disorders. Menstrual irregularity was interpreted in relation to time since menarche. Ultrasound-defined PCOM and serum AMH were not used for diagnosis in adolescents.

Statistical analysis: Data were analyzed using SPSS version 26.0. Continuous variables are presented as mean $\pm$ standard deviation and were compared using the independent-samples t-test. Categorical variables are presented as frequencies and percentages and were compared using the chi-square test or Fisher's exact test, as appropriate. Variables with a univariable p-value <0.25 were considered for inclusion in the multivariable binary logistic regression model. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) are reported. All tests were two-sided and p<0.05 was considered statistically significant. There were no missing data for variables included in the primary analyses; therefore, all 400 participants were included in the relevant analyses.

RESULTS

A total of 400 women with menstrual irregularities were enrolled. The mean age was 25.3 ± 5.6 years and the mean BMI was 26.0 ± 4.1 kg/m². Ninety-six women (24.0%) met the diagnostic criteria for PCOS, while 304 (76.0%) did not (Figure 1).

Among the 96 women diagnosed with PCOS, 40 (41.7%) had phenotype A (oligo/anovulation + hyperandrogenism +

polycystic ovarian morphology), 22 (22.9%) had phenotype B (oligo/anovulation + hyperandrogenism), 19 (19.8%) had phenotype C (hyperandrogenism + polycystic ovarian morphology), and 15 (15.6%) had phenotype D (oligo/anovulation + polycystic ovarian morphology) (Figure 2).

Women with PCOS had a higher mean BMI and higher frequencies of BMI ≥ 25 kg/m², family history of PCOS, hirsutism, acne, menarche before 12 years and a positive infertility history than women without PCOS (Table 1). Age did not differ significantly between groups.

In univariable analysis, hirsutism showed the largest crude odds ratio for PCOS (OR 8.56, 95% CI 5.11–14.33), followed by BMI ≥ 25 kg/m² and family history of PCOS. All six evaluated factors were statistically associated with PCOS (Table 2).

Table 1: Baseline demographic and clinical characteristics stratified by PCOS status (n=400).

Variable	PCOS (n=96)	Non-PCOS (n=304)	p-value
Age (years), mean $\pm$ SD	25.9 $\pm$ 6.0	25.1 $\pm$ 5.4	0.245
BMI (kg/m ²), mean $\pm$ SD	27.9 $\pm$ 4.0	25.4 $\pm$ 4.0	<0.001
Age <25 years, n (%)	43 (44.8)	146 (48.0)	0.580
BMI ≥ 25 kg/m ² (overweight/obesity), n (%)	71 (74.0)	121 (39.8)	<0.001
Family history of PCOS, n (%)	44 (45.8)	52 (17.1)	<0.001
Hirsutism (mFG score ≥ 8), n (%)	58 (60.4)	46 (15.1)	<0.001
Acne, n (%)	39 (40.6)	58 (19.1)	<0.001
Menarche <12 years, n (%)	31 (32.3)	49 (16.1)	<0.001
Positive infertility history, n (%)	27 (28.1)	38 (12.5)	<0.001

Table 2: Univariable analysis of factors associated with PCOS (n=400).

Variable	Odds ratio (OR)	95% CI	p-value
BMI ≥ 25 kg/m ² (overweight/obesity)	4.30	2.58–7.16	<0.001
Family history of PCOS	4.10	2.49–6.76	<0.001
Hirsutism (mFG score ≥ 8)	8.56	5.11–14.33	<0.001
Acne	2.90	1.76–4.77	<0.001
Menarche <12 years	2.48	1.47–4.20	<0.001
Infertility history	2.74	1.56–4.79	<0.001

Table 3: Multivariable logistic regression analysis of factors associated with PCOS after adjustment (n=400).

Factor	Adjusted OR	95% CI	p-value
Hirsutism (mFG score ≥ 8)	7.35	4.04–13.39	<0.001
Family history of PCOS	4.36	2.31–8.23	<0.001
Acne	4.20	2.21–7.99	<0.001
Infertility history	3.54	1.74–7.20	<0.001
BMI ≥ 25 kg/m ² (overweight/obesity)	3.23	1.75–5.95	<0.001
Menarche <12 years	2.31	1.17–4.56	0.015
Age (years, continuous)	1.03	0.97–1.08	0.338

Prevalence of PCOS Among Women Presenting With Menstrual Irregularities (n=400)

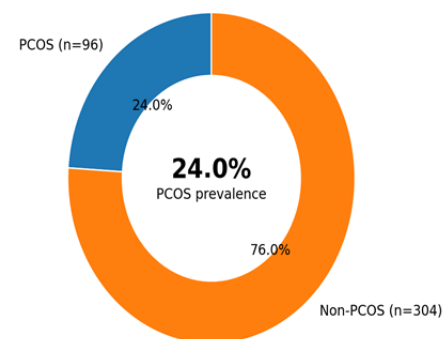


Figure 1: Prevalence of PCOS among women presenting with menstrual irregularities (n=400).

Distribution of Rotterdam PCOS Phenotypes Among Diagnosed Cases

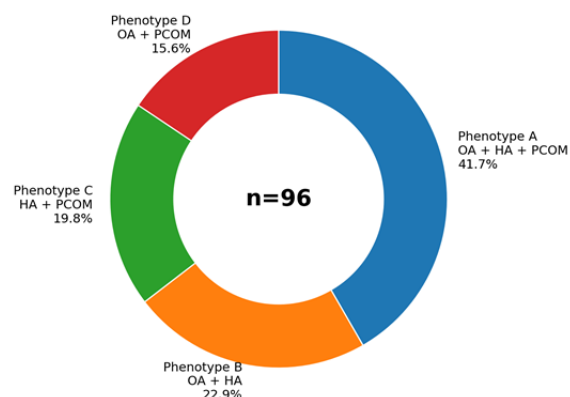


Figure 2: Distribution of PCOS phenotypes among diagnosed cases (n=96). OA, oligo/anovulation; HA, hyperandrogenism; PCOM, polycystic ovarian morphology.

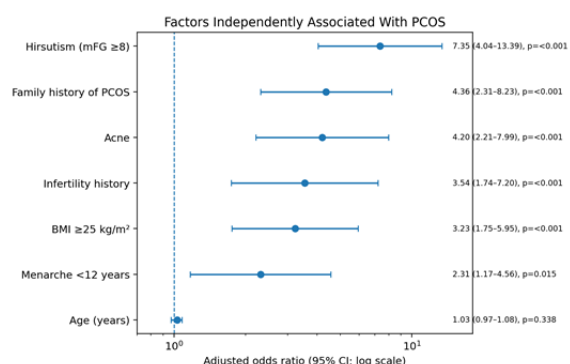


Figure 4: Forest plot of adjusted associations with PCOS in multivariable logistic regression (n=400).

In the multivariable model, hirsutism, family history of PCOS, acne, infertility history, BMI ≥ 25 kg/m² and menarche before 12 years remained statistically associated with PCOS after adjustment. Hirsutism had the largest adjusted odds ratio (aOR 7.35, 95% CI 4.04–13.39). Age was not independently associated with PCOS (Table 3; Figure 4).

DISCUSSION

In this cross-sectional study of women presenting with menstrual irregularities, 24.0% met the diagnostic criteria for PCOS. The principal finding was that several readily identifiable clinical characteristics remained independently associated with PCOS after adjustment: hirsutism, family history of PCOS, acne, infertility history, BMI ≥ 25 kg/m² and menarche before 12 years. Age itself was not independently associated with PCOS.

The observed prevalence should be interpreted within the study's symptomatic, hospital-based sampling frame rather than as a population prevalence estimate. Published prevalence estimates vary substantially according to diagnostic criteria, ethnicity and recruitment setting.^{3–8} Pakistani studies have likewise reported heterogeneous frequencies across student and clinical populations.^{9–11,13}

Hirsutism showed the largest odds ratio in both univariable and multivariable analyses. However, hirsutism is a clinical manifestation of hyperandrogenism and therefore contributed to one component of the guideline-based diagnostic framework used to define PCOS in this study. The magnitude of this association is consequently subject to incorporation bias and should not be interpreted as the diagnostic performance of an independent

predictor. Clinically, assessment of hirsutism remains an important component of the evaluation of women with menstrual irregularities.¹²

A family history of PCOS was also strongly associated with PCOS in this cohort, consistent with the recognized genetic and familial contribution to the syndrome.¹⁹ In clinical practice, eliciting a family history may therefore provide useful contextual information when evaluating women with irregular cycles.

Acne and a positive infertility history remained associated with PCOS after multivariable adjustment. Acne may reflect androgen excess, whereas infertility history is clinically consistent with chronic ovulatory dysfunction. These findings do not establish causality but provide contextual information during comprehensive assessment of women with menstrual irregularities.

BMI ≥ 25 kg/m² remained associated with PCOS after multivariable adjustment, and mean BMI was significantly higher among women with PCOS. This finding is consistent with the established relationship between PCOS, excess adiposity and insulin resistance.¹⁵ Published evidence also documents increased metabolic comorbidity among women with PCOS, including metabolic syndrome, non-alcoholic fatty liver disease and type 2 diabetes.^{16–18} These broader metabolic risks were not directly measured in the present study and should therefore be regarded as clinical context rather than outcomes demonstrated by our data.

Menarche before 12 years remained associated with PCOS after multivariable adjustment (aOR 2.31, 95% CI 1.17–4.56). Because the cross-sectional design cannot establish temporal or causal pathways, this finding should be interpreted as an association requiring confirmation in prospective studies.

Psychological health was not measured in this study, but it remains an important component of contemporary PCOS care. Systematic reviews have reported increased depressive and anxiety symptoms among women with PCOS, and Pakistani studies have described adverse effects on sexual functioning and quality of life.^{20–24} These considerations support comprehensive care once PCOS is diagnosed, although they should not be interpreted as outcomes of the present dataset.

The present study applied the 2023 International Evidence-based Guideline for the Assessment and Management of PCOS during the June–December 2023 study period.²⁶ In adults, the guideline uses a two-of-three diagnostic framework comprising ovulatory dysfunction, hyperandrogenism and PCOM after exclusion of alternative etiologies. In this study, PCOM was assessed by radiologist-performed transvaginal ultrasonography using FNPO ≥ 20 in at least one ovary as the adult threshold, while biochemical hyperandrogenism was assessed using total and free testosterone in the hospital laboratory. Although the 2023 guideline permits serum AMH as an alternative method for defining PCOM in adults, AMH was used only as an additional supportive investigation in this study and did not replace ultrasonography or independently establish the diagnosis. In adolescents, the 2023 adolescent criteria were applied: both ovulatory dysfunction and hyperandrogenism were required, while ultrasound morphology and AMH were excluded from the diagnostic assessment.²⁶

STRENGTHS AND LIMITATIONS: The study included a larger achieved sample than the calculated minimum and evaluated a clinically relevant group of women presenting with menstrual irregularities. The use of multivariable analysis allowed assessment of factors independently associated with PCOS within the measured dataset.

Several limitations should be considered. First, the cross-sectional design precludes causal inference. Second, this was a single-centre tertiary-care study using non-probability consecutive sampling of women already presenting with menstrual irregularities; the 24.0% estimate therefore applies to this symptomatic clinical sample and should not be generalized as population prevalence. Third, clinical assessment of hirsutism using the modified Ferriman–Gallwey score is subject to observer variability, and the study threshold of ≥ 8 should be interpreted

within the population and methods used. Fourth, androstenedione and DHEAS were not available in the hospital laboratory; however, total and free testosterone, the principal biochemical measures recommended for assessment of hyperandrogenism, were measured.²⁶ Fifth, although the 2023 guideline-based age-appropriate diagnostic framework was applied, adolescents were not analysed as a separate subgroup, limiting age-specific inference. Sixth, clinical hirsutism contributed to assessment of hyperandrogenism within the diagnostic framework, so its association with PCOS is subject to incorporation bias and should not be interpreted as independent diagnostic or predictive performance. Finally, the study did not assess sensitivity, specificity, predictive values, discrimination, calibration or external validation of a clinical prediction model. Multicentre prospective studies using probability-based sampling are warranted.

CONCLUSION

Among women presenting with menstrual irregularities at this tertiary-care centre, 24.0% met the 2023 guideline-based diagnostic criteria for PCOS. Hirsutism, family history of PCOS, acne, infertility history, BMI ≥ 25 kg/m² and menarche before 12 years were associated with PCOS after multivariable adjustment, whereas age was not. These findings describe the clinical profile of PCOS within a symptomatic hospital-based population and may inform comprehensive assessment; they should not be interpreted as a validated diagnostic or prediction model. The findings should be interpreted in the context of the study's cross-sectional, single-centre design.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTIONS: Mehwish Syed: Conceptualization, study design, data collection, data analysis and interpretation, manuscript drafting, critical revision, and final approval of the manuscript.

Javeria Saleem: Literature review, data collection, data interpretation, manuscript review and editing, critical revision, and final approval of the manuscript.

Both authors agree to be accountable for all aspects of the work and to ensure the accuracy and integrity of the research.

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