Clinico-sonographic Correlation and Predictors of Polycystic Ovarian Syndrome

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Abstract

Background:
The clinico-sonographic correlation of PCOS involves linking a patient's clinical symptoms with ultrasound findings of polycystic ovarian morphology (PCOM).

Objective:
This study aimed to assess the relationship between clinical features with ultrasound findings to identify predictors of PCOS severity.

Methods:
The cross-sectional study was conducted in Outpatient Department (OPD) of Obstetrics & Gynecology, Bangladesh Medical University, Dhaka, Bangladesh from July 2024 to June 2025on PCOS women aged 18-40 years as diagnosed by the Rotterdam criteria. All the subjects were put through extensive clinical examination, including menstrual history, anthropometric measurements, and inquiry regarding hyperandrogenic signs. Pelvic ultrasonography was performed to assess ovarian volume, stromal echogenicity, and follicular morphology. The associations between clinical presentation and ultrasonographic features were performed on SPSS version 26, including chi-square tests, Pearson correlation, and multivariable logistic regression.

Results:
Bilateral polycystic ovarian morphology was observed in 70% of the subjects. Strong positive correlations were observed between oligomenorrhea (77%; p=0.014), amenorrhea (72%; p=0.018), and infertility (85.7%, p=0.013) with bilateral PCO. Similarly, acne (82.8%, p=0.009), hirsutism (80%, p=0.04) and BMI ≥30 (82.4%; p=0.021) showed moderate correlations with bilateral PCO. Oligomenorrhea was the strongest predictor (aOR=3.8, 95% CI: 1.6-9.0, p=0.002), followed by infertility (aOR=3.2, p=0.004), amenorrhea (aOR=2.9, p=0.015), acne (aOR=2.4, p=0.028), and obesity (aOR=2.1, p=0.047). Hirsutism was of borderline significance (aOR=1.9, p=0.073).

Conclusion:
Clinical symptoms are strongly correlated with ultrasonographic presentation in PCOS. Menstrual irregularities, especially oligomenorrhea and amenorrhea, and infertility strongly predict bilateral polycystic ovarian morphology, exemplifying the combined hormonal-morphological pathogenesis of PCOS.

Keywords: Polycystic ovarian syndrome, Clinical features, Ultrasonography, Clinical predictor

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Introduction:

Polycystic ovary syndrome (PCOS) is a very common endocrine disorder in women of childbearing age, with an overall prevalence of between 5% and 18% worldwide.[1] PCOS is a multifaceted interaction of reproductive, metabolic, and psychological characteristics that significantly impact women's health-related quality of life and long-term health outcomes.[2] Ever since the Rotterdam criteria were established in 2003, a diagnosis of PCOS should have a minimum of two of three cardinal features:

oligo-anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on scan after excluding other etiologies.[3] The Rotterdam consensus defined polycystic ovaries as the presence of 12 or more follicles measuring 2-9 mm in diameter and/or ovarian volume >10mL in at least one ovary, though newer guidelines suggest amending these criteria in the light of advances in ultrasound technology.[4] Clinical presentation of PCOS is extremely variable, ranging from mild menstrual disturbance to severe reproductive and metabolic morbidity.[5] Menstrual abnormalities, oligomenorrhea, and amenorrhea are the most common presenting features, seen in 75-85% of women with PCOS.[6] Hyperandrogenic signs of hirsutism, acne, and androgenic alopecia occur in approximately 60-80% of patients and are directly responsible for psychological morbidity and reduced quality of life.[7] Infertility occurs in 30-40% of PCOS, usually due to chronic anovulation, and is therefore one of the leading causes of female infertility worldwide.[8] The association of obesity with PCOS has also been well established, and approximately 40-60% of the affected women are obese or overweight, thus further exacerbating insulin resistance as well as metabolic dysfunction.[9] Ultrasonography plays a pivotal role in the diagnostic evaluation of PCOS, providing crucial morphologic details about ovarian architecture and follicular development.[10] Apart from simple follicle counting, certain ultrasonographic measurements have gained diagnostic importance, like ovarian volume, stromal echogenicity, stromal-to-total area ratio, and endometrial thickness.[11] However, the correlation between some clinical presentations and ultrasonographic appearances remains unclear, with extreme variability between individuals. While some studies report close correlations between ultrasound abnormality and clinical severity, others show discordant results and reiterate the need for correlation studies in varying populations. The clinical relevance of these correlations is multifaceted: it would permit earlier diagnosis in minimally affected women, guide therapeutic decisions based on phenotypic classification, and provide prognostic assertions regarding fertility and metabolic complications. Although the literature is replete with works on PCOS, few studies have investigated systematically the association of the entire range of clinical presentations with minutely detailed ultrasonographic measures employing sound statistical techniques. This study aimed to comprehensively examine the correlation between clinical signs, anthropometric measurements, and ultrasonographic features in women with PCOS in a bid to determine clinical predictors of ultrasonographic severity and help elucidate the multicentric nature of the heterogeneous disorder.

Methods:

This cross-sectional analytical study was conducted in Outpatient Department (OPD) of Obstetrics & Gynecology, Bangladesh Medical University, Dhaka, Bangladesh from July 2024 to June 2025 among 150 reproductive-age women (18–40 years) who were clinically diagnosed with polycystic ovarian disease (PCOS) according to the Rotterdam criteria.[4] Participants were enrolled from the outpatient and diagnostic departments of a tertiary care hospital after obtaining informed consent. Women presenting with menstrual irregularities, infertility, or symptoms suggestive of hyperandrogenism (e.g., acne, hirsutism) were evaluated. Exclusion criteria included thyroid dysfunction (except subclinical hypothyroidism), Cushing's syndrome, adrenal hyperplasia, pituitary pathology, or use of hormonal medication within the preceding six months. Detailed socio-demographic, menstrual, and clinical data were recorded using a structured case record form (CRF). Clinical assessment included anthropometric measurements such as height, weight, and body mass index (BMI). Menstrual patterns (regular, oligomenorrhea, amenorrhea) and symptoms like acne, hirsutism, and infertility were documented. Venous blood samples were collected during the early follicular phase (day 2–5 of the menstrual cycle) to estimate serum LH, FSH, prolactin, and thyroid-stimulating hormone (TSH) levels using standard immunoassay techniques. Pelvic ultrasonography was performed using a high-resolution transabdominal probe, assessing ovarian volume, stromal echogenicity, and follicular morphology. Ethical approval was obtained from the institutional review board before data collection. Data were entered into a structured database and analyzed using SPSS version 26. Continuous variables were presented as mean ± standard deviation (SD), and categorical variables were expressed as frequencies and percentages. The Chi-square test was applied to

examine associations between clinical features and ultrasonographic findings. Correlation analysis (Pearson's r) was performed to assess the strength of relationships between clinical parameters and ultrasonographic measures. Variables showing significant univariate association ($p < 0.05$) were entered into a multivariable logistic regression model to identify independent predictors of bilateral polycystic ovarian morphology, with results presented as adjusted odds ratios (aORs) and 95% confidence intervals (CIs).Data visualization included heatmaps for correlation strength, bar charts for symptom distribution across ultrasonographic categories, and a forest plot summarizing logistic regression predictors. A p-value of <0.05 was considered statistically significant.

Results:

Most participants (91.3%) were aged 18-30, 42% were graduates, 68% were married, and 52% were students. About 34% were obese and 28% were overweight, indicating a link between PCOS and high BMI (Table-I).

Table-I: Socio-demographic and anthropometric characteristics of study participants (N= 150)

Variable	no. (%)
Age (years)	
18–30	137(91.3)
>30	13(8.7)
Education level	
None/Primary	6(4)
Secondary	69(46)
Graduate & above	63(42)
Occupation	
Student	78(52)
Housewife	57(38)
Service holder	15(10)
Marital status	
Married	102(68)
Unmarried	48(32)
Socioeconomic class	
Lower/Lower middle	45(30)
Middle	90(60)
Upper	15(10)
BMI (kg/m)	
<25 (Normal)	57(38)
25–29.9 (Overweight)	42 (28)
≥30 (Obese)	51(34)

The average age of first menstruation was 12.9±1.1 years. Most women (72%) were oligomenorrheic, with 50% experiencing amenorrhea, and menstrual flow varied widely among them. Most women (74%) experienced menstrual duration of 3-7 days, but menstrual flow patterns were very variable, with 32% having scanty flow and 20% having heavy flow. 78% of patients developed oligomenorrhea followed by acne (58%), and amenorrhea (50%). Infertility was more common in primary infertility (30%) than secondary infertility (12%). Hirsutism is also common (30%) (Table-II).

Table-II: Distribution of patients according to treatment timelines (N=30)

Timelines	no. (%)
Time interval (days)	
1–5	2(6.67)
6–10	13(43.33)
11–15	15(50.00)
Mean ± SD	10.77±3.13
Range	4–14
Duration of hospital stay (days)	
6–10	4(13.33)
11–15	12(40.00)
16–20	13(43.33)
21–25	1(3.33)
Mean ± SD	14.97±4.21
Range	7–25
Time at which full weight bearing is achieved (weeks)	
11–13	11(36.67)
14–16	16(53.33)
17–19	3(10.00)
Duration of radiological union (weeks)	
16–18	17(56.70)
19–20	7(23.30)
21–22	6(20.00)

Table-III revealed ultrasonographic characteristics of the study population, showing bilateral polycystic ovarian morphology (70%), increased ovarian volume (>10 cm) (68%), increased stromal echogenicity (74%), and heterogeneous endometrial thickness, with endometrium ≥7mm (56%). Only 8% had normal or non-specific results.

Table-III: Ultrasonographic findings among PCOS patients (N=150)

Ultrasonographic Findings	no. (%)
Ovarian morphology	
Bilateral polycystic	105(70)
Unilateral polycystic	33(22)
Normal/Non-specific	12(8)
Ovarian volume (cm)	
>10 cm	102(68)
≤10 cm	48(32)
Endometrial thickness (mm)	
<7	66(44)
≥7	84(56)
Stromal echogenicity	
Increased	111(74)
Normal	39(26)

Table-IV showed that clinical features are significantly correlated with bilateral polycystic ovarian morphology. Oligomenorrhea women have 77% bilateral PCO (p=0.014), while amenorrhea has 72% (p=0.018). Light menstrual flow is associated with bilateral PCO (81.3%, p=0.035), while heavy flow has a heterogeneous ultrasonographic presentation (50% bilateral). Infertility correlated best with bilateral PCO (85.7%, p=0.013), followed by acne (82.8%, p=0.009) and hirsutism (80%, p=0.04). Women with BMI ≥30 exhibited 82.4% prevalence of bilateral PCO (p=0.021).

Table-IV: Correlation of clinical features with ultrasonographic findings (N=150)

Clinical features	Ultrasonographic Findings			X	P value
	Bilateral PCO no. (%)	Unilateral PCO no. (%)	Normal USG no. (%)		
Oligomenorrhea	90(77)	20(17.1)	7(5.9)	8.52	0.014
Amenorrhea	54(72)	15(20)	6(8)	7.98	0.018
Scanty flow	39(81.3)	7(14.6)	2(4.1)	6.72	0.035
Heavy flow	15(50)	10(33.3)	5(16.7)	5.24	0.046
Hirsutism	36(80.0)	6(13.3)	3(6.7)	5.86	0.04
Acne	72(82.8)	10(11.5)	5(5.7)	9.37	0.009
Infertility	54(85.7)	6(9.5)	3(4.8)	8.61	0.013
BMI ≥30	42(82.4)	6(11.8)	3(5.8)	7.42	0.021

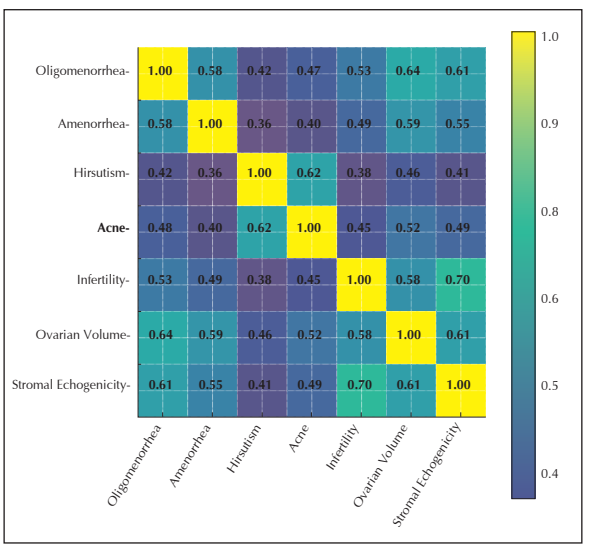

Figure-1: Heatmap of correlations between clinical, and ultrasonographic parameters in PCOS patients.

The heatmap in Figure 1 showed strong positive correlations (darker cells) were observed between oligomenorrhea, amenorrhea, and infertility with both ovarian volume and stromal echogenicity, while acne and hirsutism show moderate correlations with ultrasound parameters. The severity of clinical and menstrual abnormalities parallels the degree of ultrasonographic alteration, highlighting the interlinked endocrine and morphological spectrum of PCOS.

Table-V compared ultrasonographic parameters between regular and oligomenorrheic cycles. Oligomenorrheic women had notably greater

mean ovarian volume (12.4±2.1 cm vs. 9.8±1.5 cm , p<0.001), greater stromal echogenicity (75% vs. 35.7%), and bilateral PCO (86.1% vs. 28.6%) than women with regular cycles.

Table-V: Distribution of ultrasonographic abnormalities by type of menstrual irregularity

Menstrual Pattern	no. (%)	Mean Ovarian Volume (cm)±SD	Increased Stromal Echogenicity no. (%)		p-velue
Regular cycle	42(28.0)	9.8±1.5	15(35.7)	12(28.6)	<0.001
Oligomenorrhea	108(72.0)	12.4±2.1	81(75.0)	93(86.1)	

Table-VI summarized independent predictors of bilateral polycystic ovarian morphology adjusted for confounders. Oligomenorrhea was the strongest predictor (aOR=3.8, 95% CI: 1.6-9.0, p=0.002), followed by infertility (aOR=3.2, p=0.004), amenorrhea (aOR=2.9, p=0.015), acne (aOR=2.4, p=0.028), and obesity (aOR=2.1, p=0.047). Hirsutism was of borderline significance (aOR=1.9, p=0.073).

Table-VI: Multivariable logistic regression of clinical predictors of ultrasonographic abnormality (Bilateral PCO=1)

Predictor	Adjusted OR	95% CI	no. (%)
Oligomenorrhea	3.8	1.6 – 9.0	0.002
Amenorrhea	2.9	1.2 – 6.9	0.015
Acne	2.4	1.1 – 5.1	0.028
Hirsutism	1.9	0.9 – 4.0	0.073
Infertility	3.2	1.4 – 7.1	0.004
BMI ≥ 30 kg/m	2.1	1.0 – 4.3	0.047

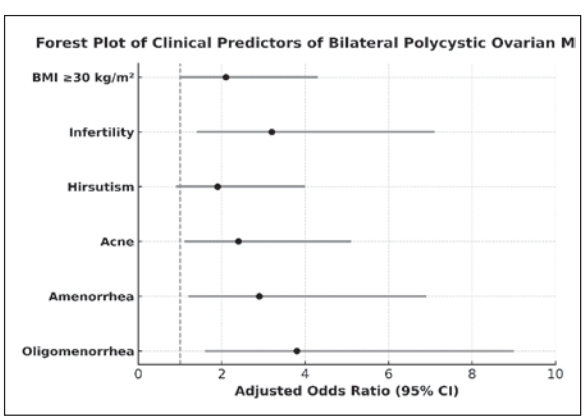

Figure-2: Forest plot of clinical predictors of bilateral polycystic ovarian morphology

Oligomenorrhea, amenorrhea, and infertility showed the highest adjusted odds ratios for bilateral PCO on ultrasonography. Acne and elevated BMI were also significant contributors, highlighting that menstrual and reproductive symptoms are strong independent indicators of ultrasonographic abnormality in PCOS.

Discussion:

The study systematically evaluated the correlation between clinical presentation and ultrasonographic features in patients with PCOS, revealing significant correlations. 70% of diagnosed patients showed bilateral polycystic ovarian morphology on ultrasound, consistent with Salari et al,with bilateral disease in 60-75% of PCOS cases.[12] The extremely high prevalence of both increased stromal echogenicity (74%) and enlarged ovarian volume (68%) in the study group underlines the morphologic heterogeneity characteristic of PCOS and substantiates the utility of several ultrasonographic parameters in assessment.[13] These findings are supplemented by Patel et al. that comprehensive ultrasonographic analysis, rather than the employment of isolated parameters, provides better accuracy.[14] The strong association between menstrual irregularity and bilateral polycystic ovarian morphology in this study is a key result with important clinical implications. Oligomenorrhea, which was observed in 78% of women, was the strongest independent predictor of bilateral PCO (adjusted OR=3.8, p=0.002), aligning with Balen et al., who demonstrated that the severity of menstrual cycle irregularity is associated with the severity of ovarian dysfunction.[15] Amenorrhea is linked to bilateral PCO (adjusted OR=2.9, p=0.015), indicating a greater impairment of the hypothalamic-pituitary-ovarian axis function. This is due to hormonal dysregulation involves abnormal ratios of luteinizing hormone (LH) to follicle-stimulating hormone (FSH) in PCOS, disrupting follicular development, causing menstrual irregularity and characteristic ultrasonographic appearances.[16] Ultrasonographic examination is crucial for women with menstrual irregularities, even without obvious hyperandrogenic symptoms, as they may display ovarian morphologic abnormality. The close relationship between hyperandrogenic symptoms and ultrasonographic findings supports the association between clinical and morphologic phenotypes. Acne, seen in 58% of the patients, was

also strongly associated with bilateral PCO (adjusted OR=2.4, p=0.028), and hirsutism (30% frequency) was borderline significant (adjusted OR=1.9, p=0.073). These findings align with Rosenfield et al.'s findings, that hyperandrogenic features are related to ovarian stromal hyperplasia and increased androgen secretion.[17] The relatively lower prevalence of hirsutism in our population compared to Western cohorts may be due to ethnic variation in androgen sensitivity and responsiveness of the hair follicles, a previously described phenomenon in South Asian populations.[18] Surprisingly, infertility was a very strong predictor for bilateral PCO (adjusted OR=3.2, p=0.004), which is clinically plausible because bilateral ovarian involvement occurs more frequently with more severe anovulation and reduced fertility potential.The association between rising BMI and bilateral polycystic ovarian morphology (adjusted OR=2.1, p=0.047) in our study adds to the complex understanding of metabolic etiopathogenesis in PCOS. Our population consisted of about 62% of participants who were overweight or obese, and this is consistent with worldwide prevalence that cites greater adiposity in PCOS populations.[19] Obesity and PCOS are in a bidirectional reinforcing relationship: obesity worsens insulin resistance and hyperinsulinemia, stimulating ovarian androgen secretion and LH release in a cycle of hormonal abnormalities and ovarian morphological abnormalities.[20] Recent research suggests that visceral fat, rather than total body fat, can be more directly linked to ultrasonographic severity. This finding supports lifestyle changes and weight control as central therapeutic interventions in PCOS treatment. The study also found positive correlations between menstrual aberrations, ovarian volume, and stromal echogenicity, supporting the theory of phenotypic heterogeneity in PCOS classification systems.[21] This heterogeneity is important for treatment, allowing personalized options based on clinical features. Women with metabolic issues may benefit from insulin-sensitizing drugs, while those with severe hyperandrogenism might need anti-androgenic treatment. The model from this analysis aims to help stratify patients for tailored therapies, pending further validation.

Limitations:

The study was conducted in one tertiary care center, which may limit generalizability to more varied populations with other sociodemographic characteristics and access to healthcare. The cross-sectional design of the study precludes temporal associations and causality between ultrasonographic changes and clinical features. In addition, hormonal assays beyond screening were not performed, limiting the complete endocrine phenotyping of the study subjects.

Conclusion:

This study demonstrates strong correlations between clinical presentation and ultrasonographic features in PCOS patients. Menstrual dysfunction, particularly amenorrhea and oligomenorrhea, and infertility and hyperandrogenic traits are good predictors of bilateral polycystic ovarian morphology. The strong correlation between the severity of clinical symptoms and ultrasonographic abnormality emphasizes the comprehensive hormonal-morphological character of PCOS. The findings highlight the need for detailed clinical and ultrasonographic evaluations for accurate PCOS diagnosis and classification. Future studies should explore long-term changes and ethnic-specific phenotypic differences using advanced imaging techniques for better assessment.

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