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Hormonal and Ultrasonographic Characteristics of Polycystic Ovarian Syndrome

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ABSTRACT

Introduction: Polycystic ovary syndrome is a common endocrine disorder in reproductive-age women, diagnosed through menstrual dysfunction, excess androgen levels, and polycystic ovaries. This study was designed to investigate the hormonal and ultrasound features of women suffering from PCOS. **Methods & Materials:** This cross-sectional observational study was conducted in the Department of Obstetrics and Gynaecology at the 250 Bedded General Hospital, Manikganj, Bangladesh, from July 2023 to June 2025. The study included a total of 140 women of reproductive age (18–40 years) who were clinically suspected or diagnosed with polycystic ovary syndrome (PCOS). Data were entered and analysed using Statistical Package for the Social Sciences (SPSS) version 26.0. **Result:** Oligomenorrhea was the most common clinical feature (65.7%), followed by hirsutism (54.3%), acne (43.6%), and obesity (35.0%). Hormonal assessment showed elevated LH levels (11.8 ± 4.2 mIU/mL), reduced FSH levels (5.6 ± 2.1 mIU/mL), an increased LH/FSH ratio (2.3 ± 0.9), raised total testosterone (72.5 ± 18.4 ng/dL), and elevated serum insulin (18.7 ± 6.5 µIU/mL), indicating combined endocrine and metabolic dysfunction. Ultrasonography revealed bilateral polycystic ovaries in 72.9% of cases, increased ovarian volume in 68.6%, and peripheral follicular arrangement in 78.6%. A significant association was also observed between elevated testosterone levels and polycystic ovarian morphology (81.3% vs 60.0%, p = 0.002). **Conclusion:** Polycystic ovary syndrome involves hormonal imbalance and characteristic ultrasound findings. It commonly affects women in early reproductive years, causing menstrual irregularities and hyperandrogenism symptoms. Key biochemical markers include elevated LH, LH/FSH ratio, testosterone, and insulin. Ultrasound often shows bilateral polycystic ovaries, enlarged ovaries, and peripheral follicles.

Keywords: *Hormonal Characteristics, Ultrasonography, Polycystic Ovarian Syndrome*

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INTRODUCTION

PCOS or Polycystic Ovary Syndrome is a common hormonal disorder most often found in women during their reproductive years. It is also one of the major causes of anovulatory infertility worldwide. Depending on the group of people studied and the diagnostic standards used, the prevalence of PCOS varies between 8% and 13% [1]. PCOS is an intricate and varied disorder with a range of symptoms that may include irregular periods, excessive production of male hormones, and changes in body metabolism. The different causes of the disease, such as changes in genes, environment, and lifestyle, lead to its varied symptoms and make it difficult to diagnose and treat [2]. Several diagnostic criteria have been suggested for PCOS over the years, but the Rotterdam criteria are the ones that are still most widely accepted in clinics and research. These criteria state that a diagnosis can be made when two of the following are present at least: oligo- or anovulation, clinical or biochemical signs of hyperandrogenism, polycystic ovarian morphology on ultrasonography, after other related disorders have been ruled out [3,4]. Because of how it's grouped, we see various forms of PCOS that show differing levels of issues tied to reproduction and metabolism - this shows just how varied the condition can be [5]. At its core, PCOS involves disruptions in hormone function. A key sign? Too much male hormone activity, seen either on the body as excess hair growth, skin breakouts, or hair loss, or found in blood tests showing high androgen numbers [6]. On top of that, shifts in pituitary hormones play a part - especially when LH rises compared to FSH, leading to poor egg development and long-term lack of ovulation [7]. Insulin resistance is another main issue closely linked with PCOS that can occur even without obesity. Excess insulin results in the ovaries making more androgens and, in contrast, it stops the liver from producing sex hormone-binding globulin (SHBG), which results in a higher level of free androgens in the blood [8]. These hormonal imbalances not only impair the reproductive system but also expose the patient to the risk of developing the following long-term complications: type 2 diabetes mellitus, dyslipidemia, and cardiovascular disease [1,8]. Ultrasonography is very useful for diagnosing PCOS and especially recognising polycystic ovarian morphology (PCOM). Typical ultrasonographic signs are an increased size of the ovaries and a large number of small antral follicles that are often located at the periphery, which results in the "string of pearls" appearance [9]. Progress in imaging techniques has led to the setting of higher follicle number thresholds in the updated criteria, aiming at a more accurate diagnosis [9]. Besides, PCOM presence by itself does not diagnose PCOS, because such manifestations may be found in healthy women, particularly in adolescents and young adults [10]. For this reason, sonographic results should be analysed together with clinical and hormonal parameters.

METHODS & MATERIALS

This cross-sectional observational study was carried out at the Department of Obstetrics and Gynaecology of 250 Bedded General Hospital, Manikganj, Bangladesh, during July 2023 to June 2025. The study population consisted of 140 women in the reproductive age group (18-40 years) who were either clinically suspected or diagnosed with polycystic ovary syndrome (PCOS) and were visiting the outpatient and inpatient departments during the study period. We used a purposive sampling technique for participant selection based on the predefined inclusion and exclusion criteria. The women who met the Rotterdam criteria (having at least two of the following: oligo/anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasonography) were admitted to the study group. Patients with other endocrine disorders such as thyroid dysfunction, hyperprolactinemia, congenital adrenal hyperplasia, Cushing's syndrome or androgen-secreting tumours were not considered in the study. Pregnant

women and those on hormonal therapy in the last three months were also excluded. Following the acquisition of their informed written consent, a detailed clinical history was taken, including age, menstrual pattern, and symptoms indicative of hyperandrogenism such as hirsutism and acne. Blood samples for hormonal analysis were collected in the early follicular phase (day 2-5 of the menstrual cycle) or at a random time in amenorrheic patients. Serum levels of luteinizing hormone (LH), follicle-stimulating hormone (FSH), total testosterone, and fasting insulin were determined by using standard laboratory methods. The LH/FSH ratio was measured for all individuals in the study. Each person underwent either a transabdominal or a transvaginal pelvic ultrasound performed by an expert sonologist. Polycystic ovarian morphology was recognised when there were at least 12 follicles of 2-9 mm in diameter and/or ovarian volume >10 mL in at least one ovary, in addition to follicular distribution pattern assessment. Data entry and analysis were done with the Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were reported as mean standard deviation (SD), while categorical variables were presented as frequency and percentage. Associations between hormone levels and ultrasound features were tested by the chi-square test; a p-value <0.05 was considered statistically significant. Ethics approval was received from the participants.

RESULTS

The majority of participants were in the 26–30 years age group (41.4%), followed by 18–25 years (30.0%). Women above 35 years constituted the smallest proportion (10.0%) *Table I*.

Table I
Age Distribution of the Study Population (*n* = 140).

Age Group (years)	Frequency (n)	Percentage (%)
18–25	42	30.0
26–30	58	41.4
31–35	26	18.6
>35	14	10.0
Total	140	100.0

Oligomenorrhea was the most common clinical presentation (65.7%), followed by hirsutism (54.3%) and acne (43.6%). Amenorrhea was observed in 20.0% of cases, while 35.0% of participants were obese (*Table II*).

Table II
Clinical Characteristics of the Study Population (*n* = 140).

Clinical Feature	Frequency (n)	Percentage (%)
Oligomenorrhea	92	65.7
Amenorrhea	28	20.0
Hirsutism	76	54.3
Acne	61	43.6
Obesity (BMI ≥30 kg/m²)	49	35.0

The mean serum luteinizing hormone (LH) level was elevated (11.8 ± 4.2 mIU/mL), while the mean follicle-stimulating hormone (FSH) level remained within the lower-normal range (5.6 ± 2.1 mIU/mL), resulting in an increased LH/FSH ratio (2.3 ± 0.9). This disproportion reflects disrupted hypothalamic–pituitary–ovarian axis function, a hallmark of PCOS. Additionally, the mean total testosterone level (72.5 ± 18.4 ng/dL) was elevated, indicating biochemical hyperandrogenism in a substantial proportion of participants. Serum insulin levels were also raised (18.7 ± 6.5 µIU/mL) *Table III*.

Table III
Hormonal Profile of the Study Population (*n* = 140).

Hormonal Parameter	Mean ± SD
LH (mIU/mL)	11.8 ± 4.2
FSH (mIU/mL)	5.6 ± 2.1
LH/FSH Ratio	2.3 ± 0.9
Total Testosterone (ng/dL)	72.5 ± 18.4
Serum Insulin (µIU/mL)	18.7 ± 6.5

The distribution of LH/FSH ratios demonstrated that a majority of the participants (67.1%) had an elevated ratio (≥2), while only 32.9% had a ratio below 2. This indicates that most women in the study exhibited abnormal gonadotropin secretion patterns (*Table IV*).

Table IV
Distribution of LH/FSH Ratio Among Participants (*n* = 140).

LH/FSH Ratio	Frequency (n)	Percentage (%)
<2	46	32.9
≥2	94	67.1
Total	140	100.0

Ultrasonographic assessment revealed that bilateral polycystic ovarian morphology was the predominant finding, observed in 72.9% of participants, whereas 17.1% exhibited unilateral involvement. Increased ovarian volume was noted in 68.6% of cases (*Table V*).

Table V
Ultrasonographic Findings (*n* = 140).

Ultrasonographic Feature	Frequency (n)	Percentage (%)
Bilateral Polycystic Ovaries	102	72.9
Unilateral Polycystic Ovary	24	17.1
Increased Ovarian Volume	96	68.6
Peripheral Follicle Arrangement	110	78.6

Among participants with elevated testosterone levels, a markedly higher proportion (81.3%) exhibited polycystic ovarian morphology compared to those with normal testosterone levels (60.0%). Conversely, the absence of polycystic morphology was more common among women with normal testosterone levels (40.0%) than those with elevated levels (18.7%). The observed association (p = 0.002) indicates that biochemical hyperandrogenism is strongly linked with structural ovarian changes in PCOS (*Table VI*).

Table VI
Association Between Elevated Testosterone and Polycystic Ovarian Morphology (*n* = 140).

Testosterone Level	PCOM Present n (%)	PCOM Absent n (%)	p-value
Elevated	78 (81.3)	18 (18.7)	0.002
Normal	48 (60.0)	32 (40.0)	

DISCUSSION

Most of the people involved in this research were 26-30 years old (41.4%), then 18-25 years (30.0%). In other words, PCOS was most often diagnosed in early reproductive age. On the other hand, a very big community study by Lauritsen et al. found that the largest number of PCOS cases was between 25 and 34 years, with almost half of the cases coming from this age group [10]. Lizneva et al. also pointed out that the highest rate of the condition is in the third decade of life (20-30 years), which is the time when a lot of people start worrying about reproduction [5]. As for the signs, 65.7% of the women showed signs of oligomenorrhea, 54.3% had hirsutism, 43.6% had acne, and 35.0% were obese. On the other hand, Azziz et al. mentioned that approximately 70 to 80% of the PCOS patients had menstrual dysfunction and 60 to 70% showed hirsutism [2]. Likewise, Teede et al. documented hyperandrogenic features in nearly 60% and obesity in 38–50% of cases, depending on the population studied [1]. Compared to these reports, our study demonstrates slightly lower rates of hirsutism but comparable rates of menstrual irregularities, suggesting a predominance of ovulatory dysfunction with moderate hyperandrogenic expression in our study population. The hormonal profile in our study showed elevated LH (11.8 ± 4.2 mIU/mL), relatively lower FSH (5.6 ± 2.1 mIU/mL), and an increased LH/FSH ratio (2.3 ± 0.9). Total testosterone (72.5 ± 18.4 ng/dL) and insulin (18.7 ± 6.5 µIU/mL) levels were also elevated. In comparison, Rosenfield and Ehrmann reported mean LH levels ranging from 10–15 mIU/mL and LH/FSH ratios typically >2 in PCOS patients [7]. Similarly, Diamanti-Kandarakis and Dunaif documented elevated insulin levels averaging 15–20 µIU/mL in insulin-resistant PCOS individuals [8]. Another study by Pinola et al. demonstrated mean testosterone levels around 65–80 ng/dL in affected women [11]. In our study, 67.1% of participants had an LH/FSH ratio ≥2. Comparable findings were reported by Begum et al., who observed elevated LH/FSH ratios in 62% of PCOS patients in a South Asian population [12]. However, Banaszewska et al. found a slightly lower prevalence, with approximately 55% of patients exhibiting an increased ratio [13]. We performed an ultrasonographic assessment, which revealed bilateral polycystic ovaries in 72.9% of cases, heightened ovarian volume in 68.6%, and follicle arrangement at the ovarian periphery in 78.6% in our study. Dewailly et al. found that approximately 70-75% of women diagnosed with PCOS by modern ultrasound criteria had polycystic ovarian morphology [9]. On the same lines, Hart et al. reported an enlarged ovarian volume (>10 mL) in 65% and a typical follicular pattern in about 80% of cases [14]. Our data showed that 81.3% women with elevated testosterone levels exhibited polycystic ovarian morphology as compared to only 60.0% of women with normal testosterone levels (p = 0.002). Similarly, Carmina et al. found that 85% of hyperandrogenic phenotypes had polycystic ovarian morphology, as opposed to only 55-60% of non-hyperandrogenic phenotypes [15]. Likewise, Yildiz et al. documented a very important relationship between raised androgen levels and the number of follicles, with around 80% of hyperandrogenic women having PCOM [16].

LIMITATIONS

This study has some limitations. First of all, the cross-sectional design of the study limits the possibility of establishing causality between the hormonal and ultrasonographic changes. The study was done at one secondary care hospital with a relatively small number of participants; the findings cannot be generalised to the larger population. Also, the possible confounding factors such as diet, lifestyle, and genetic factors were not thoroughly assessed.

CONCLUSION

This study highlights that polycystic ovary syndrome is a result of both major hormonal disturbances and particular ultrasonographic features. Most patients came from the young reproductive age group and frequently had menstrual irregularities and signs of hyperandrogenism as the main symptoms. Biochemically, elevated LH levels, a raised LH/FSH ratio, higher testosterone, and elevated insulin levels point to an underlying endocrine and metabolic disorder. Ultrasound examination confirmed that bilateral ovarian polycystic morphology was common, along with increased ovarian volume and peripheral follicular distribution.

RECOMMENDATION

Women who experience menstrual irregularities, infertility, or show symptoms of hyperandrogenism are advised to undergo a complete disease evaluation, comprising hormonal testing and pelvic ultrasonography for diagnosis and also early detection of Polycystic Ovary Syndrome (PCOS). Patients with PCOS undergoing regular follow-up visits should be offered tests for metabolic disorders, such as insulin

resistance, as part of their routine care. To lessen the impact of this disease on the community, it is very important to educate people and also bring about healthy lifestyle changes with an emphasis on weight control and exercise. At the same time, it is advisable to conduct more extensive, multicentric research to ascertain the different features of this syndrome among populations and to come up with more personalised management plans.

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CONFLICT OF INTEREST
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