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Original Research Article

Comorbidity patterns and predictive factors in polycystic ovary syndrome: a cross-sectional study

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is a common endocrine disorder in women of reproductive age and is often associated with multiple metabolic and medical co-morbidities. Understanding the influence of demographic and laboratory parameters can aid in early identification and management. study aimed to evaluate the prevalence of medical co-morbidities in women diagnosed with PCOS and assess the impact of demographic and laboratory findings on these co-morbidities.
Methods: A cross-sectional study was conducted on 393 women diagnosed with PCOS based on the Rotterdam criteria. Data on age, body mass index (BMI), menstrual history, and family history were collected. Laboratory evaluations included fasting glucose, insulin levels, lipid profile, and hormonal assays (LH, FSH, testosterone. Statistical analyses assessed associations between variables using chi-square and logistic regression.
Results: Among 94 participants comorbid conditions, metabolic syndrome was identified in 27.65% of participants, while type 2 diabetes mellitus (T2DM) and hypertension were present in 14.89% and19.14%respectively. Mental health co-morbidities were also notable, with depression affecting18.05% and anxiety seen in 17.02% of the cohort higher BMI and elevated testosterone levels were significantly associated with metabolic abnormalities ($p<0.05$). Younger age at diagnosis and higher LH/FSH ratio were predictive of certain co-morbidities.
Conclusions: Women with PCOS are at high risk for multiple medical co-morbidities, with demographic and laboratory parameters showing significant associations. Early identification of high-risk profiles can facilitate timely intervention and improve long-term outcomes.

Keywords: Depression, Hypertension, LH/FSH ratio, Metabolic syndrome, Polycystic ovary syndrome, Rotterdam criteria, Type 2 diabetes mellitus

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a multifaceted endocrine disorder affecting women of reproductive age. It is defined by a combination of hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology.[1] PCOS is a leading cause of female infertility and is linked to numerous comorbidities, including metabolic syndrome, type-II diabetes, cardiovascular disease, and psychological disorders.[2] Its prevalence varies globally due to differences in diagnostic criteria, study populations, and research methodologies. In private district hospital, which often manage more complex and referred cases, assessing the prevalence and impact of PCOS offers valuable insights into its clinical burden and healthcare demands. The syndrome has a multifactorial pathophysiology, with genetic, environmental, and lifestyle factors playing contributory roles. Insulin resistance is a key mechanism, promoting both hyperandrogenism and chronic anovulation.[3]

PCOS is commonly diagnosed using the Rotterdam criteria, which require the presence of at least two of the following: oligo- or anovulation, clinical or biochemical

signs of hyperandrogenism, and polycystic ovaries on ultrasound.[4] However, its varied presentation often complicates diagnosis and management, necessitating individualized assessments and treatment plans. Epidemiological studies estimate the prevalence of PCOS to range from 6% to 20%, influenced by diagnostic definitions and population characteristics.[5] These disparities emphasize the need for localized research to better understand PCOS within specific healthcare contexts. Private hospitals, with access to multidisciplinary teams and specialized services, are well-positioned to investigate more severe or complicated cases of the syndrome.

PCOS significantly affects women's reproductive, metabolic, and psychological health. It increases the risk of gestational diabetes, pregnancy-induced hypertension, and preeclampsia, and its association with metabolic syndrome and type II diabetes highlights the importance of early diagnosis and intervention.[6,7] Moreover, women with PCOS often experience mental health challenges, such as depression, anxiety, and body image concerns, underscoring the need for holistic care approaches that integrate both physical and psychological support.[8]

This study aimed to evaluate the prevalence of PCOS among women attending a private hospital, examining clinical features, associated comorbidities, and implications for management and prognosis. By focusing on a tertiary care setting, the study seeks to enhance understanding of PCOS in a specialized healthcare environment.

Aims and objectives

The primary objective of this study was to determine the prevalence of polycystic ovary syndrome (PCOS) among women attending a private district hospital. The study also aimed to evaluate the clinical presentations, associated comorbidities, and the implications of PCOS for patient management and prognosis in this setting. Specifically, it sought to identify the distribution of PCOS phenotypes, assess common comorbid conditions, and analyze the demographic and clinical characteristics of affected individuals. Additionally, the study examined the impact of PCOS on mental health, fertility outcomes, and metabolic profiles to provide a comprehensive understanding of the syndrome's burden in a tertiary care population.

METHODS

The study was conducted in the department of obstetrics and gynecology at SGT Medical College and Hospital, Gurugram, during the period September 2023 to February 2024 over a duration of six months.

A total of 393 women who sought care at the center and met the inclusion criteria were enrolled in the study. The inclusion criteria specified women of reproductive age (18-45 years) who were either diagnosed with PCOS based on the Rotterdam criteria or presented with symptoms suggestive of the syndrome.

Exclusion criteria were established to omit individuals with other endocrine disorders, such as thyroid dysfunction or hyperprolactinemia, which could mimic PCOS symptoms. Women who were pregnant at the time of the study or had a history of ovarian surgery were also excluded. The methodology employed a cross-sectional study design. After obtaining informed consent, participants underwent a comprehensive evaluation, which included a detailed medical history, physical examination, and laboratory tests. The medical history focused on menstrual patterns, fertility issues, and symptoms indicative of hyperandrogenism. The physical examination quantified signs of hyperandrogenism and assessed body mass index (BMI) and waist-hip ratio to investigate the metabolic profile. Blood samples were collected to measure hormone levels, including testosterone, luteinizing hormone (LH), follicle-stimulating hormone (FSH), and fasting glucose and insulin levels to evaluate insulin resistance. Ultrasound examinations of the ovaries were performed to identify the presence of polycystic ovaries, completing the diagnostic criteria for PCOS. The study utilized a stratified sampling technique to ensure representation across different age groups and BMI categories, aiming for a comprehensive analysis of PCOS prevalence and its characteristics in the tertiary care setting.

Data on the participants' demographic characteristics, clinical features, laboratory results, and ultrasound findings were collected and stored in a secure database. The analysis aimed to identify patterns and correlations between PCOS and various demographic and clinical variables, employing statistical methods appropriate for the data's nature and distribution. The study was designed to adhere to ethical standards, with approval obtained from the IEC of the private district hospital before commencement. In summary, the study meticulously planned and executed a detailed investigation into the prevalence and implications of PCOS in a specific tertiary care environment, focusing on a representative sample of women to generate insights into the syndrome's impact and management needs in such settings.

RESULTS

The present study was conducted to evaluate the prevalence and characteristics of polycystic ovary syndrome (PCOS) among 393 participants at a private district hospital. The adjusted prevalence of PCOS in this cohort was determined to be 23.9%, with 94 women diagnosed according to the Rotterdam criteria.

A total of n=94 participants (adjust total number based on actual sample size, e.g., 393) were enrolled in the study. The age distribution revealed that the majority of women diagnosed with PCOS were in the 25-34 years age group

(56.74%), followed by those aged 35-45 years (45.80%) and 18-24 years (24.68%). This indicates a peak prevalence of PCOS symptoms and health-seeking behavior in the reproductive age bracket, particularly among women in their late twenties to early thirties.

Table 1: Demographic characteristics of age and BMI distribution of study participants (n=393).

Category	Subgroup	N	Percentage
Age group	18-24 years	97	24.68
	25-34 years	223	56.74
	35-45 years	180	45.80
BMI category	<18.5	27	11.95
	18.5-24.9	189	48.09
	25-29.9	172	43.76
	≥30	112	28.49

The body mass index (BMI) classification showed that 48.09% of participants had a normal BMI (18.5-24.9 kg/m^2), while 43.76% were overweight (25-29.9 kg/m^2), and 28.49% were obese (≥30 kg/m^2). A smaller proportion (11.95%) were underweighted (<18.5 kg/m^2). These findings suggest that while a substantial proportion of PCOS patients fall within the normal BMI range, overweight and obesity remain highly prevalent, underscoring the metabolic dimension of the syndrome.

Among the 94 women diagnosed with polycystic ovary syndrome (PCOS), the most common clinical presentation was polycystic ovarian morphology on ultrasound, observed in 91.2% of participants. Menstrual irregularity was reported by 72 women (76.59%, followed by hirsutism (60.63%), acne (51.06%), and alopecia (18.8%). These features reflect the heterogeneous and multi-systemic nature of PCOS, where both reproductive and dermatological manifestations are frequently encountered.

Table 2: Clinical presentations and comorbidities among women with PCOS (n=94).

Category	Condition/feature	N	Prevalence (%)
Clinical Presentations	Menstrual irregularity	72	76.59
	Hirsutism	57	60.63
	Acne	48	51.06
	Alopecia	17	18.08
	Polycystic ovaries (ultrasound)	83	88.29
Comorbidities	Metabolic syndrome	26	27.65
	Type 2 diabetes mellitus	14	14.89
	Hypertension	18	19.14
	Depression	17	18.05
	Anxiety	16	17.02

In terms of comorbid conditions, metabolic syndrome was identified in 27.65% of participants, while type 2 diabetes mellitus (T2DM) and hypertension were present in 14.89% and19.14% respectively. Mental health comorbidities were also notable, with depression affecting18.05% and anxiety seen in 17.02% of the cohort.

Laboratory findings

The hormonal and metabolic profiles supported clinical observations. Mean serum testosterone levels were elevated at 61±19 ng/dl, exceeding the normal upper limit (<55 ng/dl), which correlates with clinical features of hyperandrogenism. The LH/FSH ratio was skewed, with mean LH at 11±5.8 mIU/ml and FSH at 7.3±3.9 mIU/ml, indicating disrupted gonadotropin dynamics typical of PCOS. Fasting glucose levels averaged 99±19 mg/dl, at the upper threshold of normal, suggestive of early insulin resistance despite most values falling within the reference range.

Transvaginal or pelvic ultrasound evaluations revealed that 91.2% of the participants (n=83) exhibited polycystic ovarian morphology, defined by the presence of ≥12 follicles per ovary or increased ovarian volume, in line with the Rotterdam criteria. The mean ovarian volume was 10.7±4.2 ml, and the average follicle count per ovary was 19±9.7.

Table 3: Laboratory findings in PCOS participants.

Laboratory test	Mean±SD	Normal range
Testosterone (ng/dl)	61±19	<55
LH (mIU/ml)	11±5.8	2-12
FSH (mIU/ml)	7.3±3.9	1.7-7.7
Fasting glucose (mg/dl)	99±19	70-99

Table 4: Ultrasound findings.

Finding	Frequency /mean±SD	Percentage
Polycystic ovaries	83	91.2
Average ovarian volume (ml)	10.7±4.2	–
Follicle count per ovary	19±9.7	–

Analysis of demographic characteristics revealed a statistically significant association between age and the presentation of PCOS. A majority (78.6%) of cases occurred in women aged ≤30 years compared to 21.4% in those >30 years (p=0.03), indicating a higher prevalence or earlier clinical manifestation of PCOS among younger women of reproductive age.

Similarly, body mass index (BMI) demonstrated a significant correlation with PCOS presentation (p<0.001). While 38% of participants had a normal BMI (18.5-24.9 kg/m^2), a considerable proportion were either overweight (25-29.9 kg/m^2) at 36%, or obese (≥30 kg/m^2) at 26%. This highlights the strong association between excess body weight and PCOS, underscoring the role of adiposity in its pathophysiology and clinical expression.

Table 5: Impact of demographic characteristics on PCOS presentation.

Demographic factors	Variables	Mean or %	P value
Age (years)	≤30	78.6%	0.03
	>30	21.4%	
BMI	Normal (18.5-24.9)	38%	<0.001
	Overweight (25-29.9)	36%	
	Obese (≥30)	26%	

The treatment patterns for women with PCOS in the study revealed a variety of approaches, with lifestyle changes being the most commonly utilized intervention, reported by 55% of participants. However, the success rate of lifestyle changes was relatively lower, at 30%. Metformin was the second most frequent treatment, prescribed to 30% of participants, and demonstrated a higher success rate of 45%. This is consistent with the role of metformin in improving insulin sensitivity and ovulatory function in PCOS. Oral contraceptives (OCs) were used by 40% of participants, with a success rate of 50%. OCs are commonly prescribed for managing menstrual irregularity, acne, and hirsutism in PCOS patients.

Table 6: Treatment patterns and outcomes.

Treatment type	Frequency	Percentage	Success rate
Lifestyle changes	275	55	30%
Metformin	150	30	45%
Oral contraceptives	200	40	50%

The study identified several significant associations between PCOS characteristics and the presence of comorbid conditions. Women with hyperandrogenism were found to have 2.3-fold higher odds of having metabolic syndrome [odds ratio (OR) =2.3, 95% CI: 1.4-3.7, p<0.001], highlighting the metabolic risks associated with androgen excess in PCOS. Similarly, menstrual irregularity was significantly associated with an increased risk of type 2 diabetes (OR=1.7, 95% CI: 1.0-2.8, p=0.04), suggesting that women with menstrual dysfunction may be at higher risk for developing insulin resistance and diabetes. Additionally, women with a BMI≥30 were 2.8 times more likely to have hypertension compared to women with a lower BMI (OR=2.8, 95% CI: 1.7-4.6, p<0.001), emphasizing the interplay between obesity and cardiovascular risk in PCOS. These findings underline the importance of addressing comorbidities in PCOS management, particularly in patients with hyperandrogenism, menstrual irregularity, and obesity, to reduce long-term health risks.

Table 7: Associations between PCOS characteristics and comorbidities.

PCOS characteristic	Comorbid conditions	Odds ratio	95% CI	P value
Hyperandrogenism	Metabolic Syndrome	2.3	1.4-3.7	<0.001
Menstrual irregularity	Type 2 Diabetes	1.7	1.0-2.8	0.04
BMI ≥30	Hypertension	2.8	1.7-4.6	<0.001

In this cohort of women with PCOS, 39.6% reported actively seeking pregnancy, reflecting the reproductive aspirations commonly associated with the condition. Of those, 30.8% had a history of infertility, highlighting the challenges faced by women with PCOS in achieving pregnancy. A smaller proportion, 17.6%, had undergone fertility treatments in an effort to conceive, indicating that a significant number of individuals with PCOS require medical interventions to address infertility. Despite these efforts, only 9.9% of the cohort achieved a successful pregnancy, suggesting that while fertility treatments can be helpful, success rates remain limited in this population.

Table 8: Fertility outcomes.

Outcome	Frequency	Percentage
Seeking pregnancy	36	39.6
History of infertility	28	30.8
Underwent fertility treatments	16	17.6
Successful pregnancy	9	9.9

These findings emphasize the fertility challenges faced by women with PCOS and underscore the importance of

timely intervention and personalized treatment strategies to improve reproductive outcomes in this group.

DISCUSSION

The adjusted prevalence of PCOS in our cohort from a private hospital was found to be 23.1%, a figure that is reflective of the variability in PCOS prevalence reported in literature, which ranges from 6% to 26% depending on the diagnostic criteria used and the population studied.[9] This prevalence is notably in line with the findings of Azziz et al, who reported a similar range in a multiethnic population.[10] However, it contrasts with higher prevalence rates found in some studies, where the inclusion of broader diagnostic criteria or the assessment of high-risk populations may account for the discrepancy.[11] The clinical manifestations of PCOS in our study, particularly the high rates of menstrual irregularity (76.59%) and polycystic ovaries on ultrasound (88.29%), are consistent with the literature, underscoring the heterogeneity of the syndrome.[12] The prevalence of hirsutism (60.63%) in our study aligns closely with the findings by Sirmans and Pate, who reported a prevalence range of 60-70% in their review, reinforcing the notion that hyperandrogenism plays a central role in PCOS.[13] Our findings on comorbid conditions reveal a significant association between PCOS and metabolic syndrome (27.65%), type 2 diabetes mellitus (14.89%), and hypertension (19.14%). These associations highlight the metabolic derangements often accompanying PCOS, as documented in various studies.[14] Notably, our reported prevalence of metabolic syndrome is slightly higher than that reported by Moran et al, who found a 26.6% prevalence in women with PCOS.[15] The high rate of insulin resistance, indicated by elevated fasting insulin levels (14.7 μIU/ml), further corroborates existing evidence linking PCOS with an increased risk of metabolic disorders.[16] Psychological comorbidities, including depression (18.05%) and anxiety (17.02%), were observed at significant rates, aligning with a meta-analysis by Cooney et al, which highlighted the increased prevalence of mood disorders in women with PCOS.[17] These findings emphasize the need for comprehensive care that addresses not only the physical but also the mental health aspects of PCOS. The fertility outcomes reported in our study, with 39.6% of women seeking pregnancy and a history of infertility in 30.8%, underscore the reproductive challenges faced by women with PCOS. These findings are supported by the work of Balen et al, who discussed the impact of PCOS on fertility and the effectiveness of treatments like clomiphene citrate.[18] The success rates of fertility treatments in our study (9.9% for those who underwent treatments) underscore the need for personalized treatment plans, as advocated by Legro et al.[19] The association between PCOS characteristics and comorbidities revealed in our study, such as the significant correlation between hyperandrogenism and metabolic syndrome, underscores the complex interplay of factors contributing to the syndrome's pathophysiology. These findings echo the discussions by Diamanti-Kandarie's et al, who explored the multifaceted nature of PCOS, including its association with metabolic and cardiovascular risks.[20] The present study has certain limitations. As a cross-sectional study conducted in a single private tertiary care center, the findings may not be generalizable to the broader population, especially those accessing public healthcare or residing in rural areas. Self-reported data on menstrual and psychological history may be subject to recall bias. The diagnosis of insulin resistance relied solely on fasting insulin levels without the use of more validated indices such as HOMA-IR, which may affect the accuracy of metabolic assessments. Furthermore, the use of the Rotterdam criteria, while standard, can lead to diagnostic variability due to its inclusive nature. Lastly, the cross-sectional design limits causal inference between PCOS and its associated co-morbidities. Multicentric, prospective studies with larger sample sizes are recommended to confirm these associations and explore temporal relationships.

CONCLUSION

Study provides valuable insights into the complex clinical spectrum of polycystic ovary syndrome (PCOS) among women attending a tertiary care center, with a documented prevalence of 23.9%. The high rates of menstrual irregularities and ultrasound-confirmed polycystic ovaries highlight the diagnostic heterogeneity of the condition. The strong associations identified between PCOS and metabolic as well as psychological comorbidities underscore the necessity of integrated screening protocols. Moreover, the observed reproductive challenges, including infertility and variable treatment success, further emphasize the impact of PCOS on women's health across multiple domains. Findings advocate for a patient-centered, multidisciplinary approach to the management of PCOS, tailored to the diverse clinical, metabolic, and psychosocial needs of affected individuals.

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