A study of the prevalence and evaluation of metabolic syndrome in reproductive age women with polycystic ovarian syndrome – A cross-sectional study.

Ipsita Praharaj[1], Bhabani Shankar Nayak[2], Sujata Misra[3]*
[1]Post graduate, Department of Obstetrics & Gynecology, PGIMER and Capital Hospital, Bhubaneswar, India,
[2]Associate Professor, Department of Obstetrics & Gynecology, PGIMER and Capital Hospital, Bhubaneswar, India,
[3]Professor, Department of Obstetrics & Gynecology, PGIMER and Capital Hospital, Bhubaneswar, India,

Abstract
Background
Polycystic Ovarian Syndrome (PCOS) is a multisystem endocrinopathy predominantly affecting women of reproductive age. It is frequently associated with metabolic abnormalities and carries a high risk of developing diabetes, cardiovascular disorders, and infertility if left unmanaged.
Methods
A cross-sectional study was conducted on a total of 200 PCOS women in the Obstetrics & Gynecology Department of PGIMER and Capital Hospital, Bhubaneswar. Detailed history, anthropometric measurements, and biochemical investigations were performed. The data were subsequently analysed using appropriate statistical methods.
Results
The incidence rates of metabolic syndrome in PCOS women were 34.5% showing an increasing trend with increasing age and obesity. Women with metabolic syndrome had significantly higher weight, BMI, waist circumference, triglycerides, LDL, and fasting glucose, and lower HDL than those without. Waist circumference (92%) and HDL (95%) were the most sensitive indicators of metabolic abnormalities. LDL (100%) and triglycerides (96%) were highly specific in identifying metabolic syndrome in PCOS.
Conclusion
The study highlights a strong association between obesity, unfavourable metabolic abnormalities, and PCOS. Waist circumference and HDL can serve as useful, non-invasive indicators for identifying metabolic syndrome in women with PCOS.
Recommendation
Future studies should include larger, diverse samples, longitudinal follow-up, hormonal profiling, lifestyle factors, and intervention-based assessments to strengthen findings.

Corresponding Author: Ipsita Praharaj, Post graduate,
Email: ipraharaj98@gmail.com
Department of Obstetrics & Gynecology, PGIMER and Capital Hospital, Bhubaneswar, India

Introduction

Polycystic ovarian syndrome (PCOS) is a multisystem endocrinopathy predominantly affecting women of reproductive age and is classically associated with symptoms such as infertility, obesity, and hyperandrogenism. It is a complex condition influenced by both genetic and environmental factors and is frequently intertwined with a range of metabolic abnormalities, including diabetes, hypertension, and cardiovascular disorders [1]. The incidence rates of PCOS varies globally (2.2% - 26%) and it is recognized to manifest through a combination of ovarian dysfunction and metabolic disturbances [2]. Furthermore, women with PCOS are at a considerably larger predisposition of developing complications like insulin resistance, hypercholesterolemia, atherosclerotic disease, and endometrial abnormalities, alongside a range of psychological disorders, reflecting its extensive health implications [1].

Metabolic syndrome (MetS), a collection of abnormalities stemming from marked insulin resistance, is frequently present alongside PCOS and compounds its health risks. It comprises central obesity, hypertriglyceridemia, reduced HDL cholesterol, raised LDL, hyperglycaemia, and elevated blood pressure — factors collectively contributing to the pathogenesis of atherosclerotic disorders [3-6]. The International Diabetes Federation (IDF) criteria, which consider ethnic-specific cut-offs, are particularly useful in identifying metabolic abnormalities in women with PCOS, reflecting a greater susceptibility within certain ethnic groups [5]. Therefore, this study aims to determine the prevalence of metabolic syndrome in women of reproductive age with PCOS and to comprehensively evaluate their anthropometric, and biochemical profiles in a tertiary care hospital setting.

Methods

Study Design and Setting

This is a cross-sectional observational study was carried out in the Outpatient Department (OPD) of Obstetrics and Gynaecology at PGIMER and Capital Hospital, Bhubaneswar, from May 2023 to January 2025.

Study Population

The study population consisted of 200 women aged 18 to 45 years who attended the gynecology OPD with symptoms suggestive of PCOS.

Sample Size Determination

The sample size of 200 participants was determined based on previous studies showing the prevalence of metabolic syndrome in PCOS women ranging from 30% to 40%, with a 95% confidence level and 7% margin of error, accounting for a 10% non-response rate.

Inclusion and Exclusion Criteria

Women who presented with complaints of oligomenorrhea, amenorrhea, clinical hyperandrogenism (such as hirsutism or acne), biochemical hyperandrogenism, polycystic ovarian morphology on ultrasound, overweight or obesity, or a history of infertility were a part of this study. Patients previously diagnosed with Cushing's syndrome, thyroid dysfunction, hyperprolactinaemia, drug or alcohol abuse, adrenal hyperplasia, diabetes, those currently taking oral contraceptive pills, or with other factors affecting carbohydrate metabolism were not included in this study.

Bias

To reduce selection bias, consecutive sampling was applied. Standardized tools and protocols were used for clinical assessments and laboratory tests to minimize measurement bias. Data collection was performed by trained personnel to ensure consistency.

Data Collection Procedure

A detailed history was taken, and a physical and anthropometric examination was performed. Infertility was defined as the failure to conceive after 1 year of unprotected sex in married women; And cases with male factor or other factors of infertility were excluded. A thorough menstrual history was documented, alongside a family history of diabetes and hypertension. Height and weight were measured to calculate the BMI. Hirsutism was assessed using the Ferriman-Gallwey scoring system, while acne and acanthosis nigricans were also evaluated. Ultrasound criteria were applied to assess ovarian morphology and dimensions. Free testosterone and other biochemical parameters were measured to aid in the confirmation of hyperandrogenism.

Statistical Analysis

The data was analysed using appropriate statistical methods. The incidence rates of metabolic abnormalities and associated factors were described in the form of proportions and percentages.

Ethical Considerations

Approval from the institutional ethical committee of PGIMER was taken prior to the initiation of the study. Written informed consent was obtained from all participants after explaining the study's purpose and procedures. Confidentiality and privacy were maintained throughout, with data anonymized for analysis.

Results

A total of 240 women attending the Obstetrics and Gynaecology OPD with symptoms suggestive of PCOS were initially screened during the study period. Out of these, 220 women were examined for eligibility after applying preliminary screening criteria. Among them, 20

women were excluded due to exclusion criteria, including existing diabetes (n=8), thyroid dysfunction (n=5), hyperprolactinemia (n=3), Cushing's syndrome (n=2), and current use of oral contraceptives (n=2). Thus, 200 women were confirmed eligible and included in the study. All 200 participants completed the clinical, anthropometric, and biochemical assessments, and their data were analysed. There were no dropouts or losses to follow-up as this was a cross-sectional study.

In this study, the majority of PCOS cases were middle-aged (20-40 years), with an average age of 26.64 yrs. Most participants had abnormal BMI, with 37% using pre-obese and 15% obese. Central obesity was common, seen in 57.5% of women. Nearly half were nulligravida, and irregular menstrual cycles was the most frequent complaint (54%), followed by primary infertility (36%). Clinical signs of hyperandrogenism such as hirsutism and acanthosis nigricans were noted in 17% and 20% of participants, respectively (Table 1).

Table 1: Demographic Profile of PCOS Patients (N = 200)

Variable	Category	N	%
Age Group	<20 years	58	29%
	20–40 years	110	55%
	>40 years	32	16%
	Mean age: 26.64 ± 3.5 years (range 18–34)		
BMI Category	Normal	56	28%
	Overweight	34	17%
	Pre-obese	74	37%
	Obese	30	15%
	Morbidly obese	6	3%
Waist Circumference	≥80 cm	115	57.5%
	<80 cm	85	42.5%
Parity Status	Nulligravida	92	46%
	P1L1	24	12%
	P2L2	34	17%
	Unmarried	50	25%
Presenting Complaints	Primary infertility	72	36%
	Secondary infertility	20	10%
	Irregular cycles	108	54%
Hirsutism	Present	34	17%
	Absent	166	83%

Acanthosis Nigricans	Present	40	20%
	Absent	160	80%

Table 2: Prevalence of Metabolic Syndrome Among Women with PCOS According to Age Groups

Age Group (yrs)	Total (N)	MetS Present (N)	MetS (%)	Chi-Squared	p-value
<25	58	12	20.7	13.657	0.001 (HS)
25–30	110	38	34.5		
>30	32	19	59.3		
Total	**200**	**69**	**34.5**		

The incidence rates of MetS in women with PCOS was 34.5% which increased with age, from 20.7% in women under 25 years to 59.3% in those above 30 years, emphasizing a strong association between age and metabolic abnormalities in PCOS cases (Table 2).

The comparative evaluation shows that women with MetS have significantly higher weight, BMI, waist circumference, triglycerides, LDL, and fasting blood sugar than those without MetS. Serum HDL was significantly lower in the MetS group. These findings indicate the strong association of obesity and unfavorable metabolic abnormalities with metabolic syndrome in PCOS women (Table 3).

Table 3: Comparative Evaluation of various Parameters among the study cohorts

Parameter	MetS (Present)	MetS (Absent)	t-Test	p-Value
Height (cm)	161.5 ± 5.1	160.3 ± 4.9	1.66	0.109 (NS)
Weight (Kg)	82.8 ± 10.9	62.9 ± 8.5	14.24	0.001 (HS)
BMI (Kg/m²)	36.4 ± 8.6	26.7 ± 3.4	11.35	0.001 (HS)
Waist Circumference (cm)	98.6 ± 8.7	86.5 ± 7.6	10.17	0.001 (HS)
Systolic BP (mmHg)	121.3 ± 14.7	117.4 ± 11.8	1.45	0.149 (NS)
Diastolic BP (mmHg)	79.7 ± 10.7	77.1 ± 8.5	1.88	0.062 (NS)
Serum TG (mg/dl)	135.5 ± 16.3	112.6 ± 9.5	12.55	0.001 (HS)
Serum HDL (mg/dl)	56.8 ± 7.6	50.6 ± 3.5	7.9	0.001 (HS)
Serum LDL (mg/dl)	110.3 ± 16.3	95.3 ± 12.9	7.12	0.001 (HS)
Serum Cholesterol (mg/dl)	167.4 ± 23.5	163.0 ± 12.2	1.74	0.083 (NS)
Fasting Blood Sugar (mg/dl)	109.1 ± 13.4	92.1 ± 9.6	10.34	0.001 (HS)

The diagnostic utility of anthropometric and biochemical parameters in identifying MetS in women with PCOS has also been examined. Waist circumference (cutoff of 80 cm) demonstrated the highest sensitivity at 92% but a lower specificity of 65%. BMI (cutoff of 25) was also a strong indicator with 90% sensitivity and 60% specificity. Among biochemical parameters, low HDL ($\leq$ 50 mg/dl) was the most sensitive (95%) while elevated LDL ($\geq$ 130 mg/dl) was highly specific (100%) for metabolic syndrome. Serum triglycerides ($\geq$ 150 mg/dl) were less sensitive (35%) but strongly specific (96%) in identifying metabolic abnormalities. Fasting hyperglycaemia ($\geq$ 100 mg/dl) displayed 70% sensitivity and 85% specificity. These cut-offs may aid in the early and accurate identification of metabolic abnormalities in women with PCOS in a tertiary care setting (Table 4).

Table 4: Diagnostic Prediction of Anthropometric and Biochemical parameters for MetS in Women with PCOS

Parameter	Cutoff	Sensitivity (%)	Specificity (%)
Waist Circumference	$\geq$ 80 cm	92	65
BMI	$\geq$ 25	90	60
HDL	<= 50 mg/dl	95	78
LDL	$\geq$ 130 mg/dl	75	100
Triglycerides	$\geq$ 150 mg/dl	35	96
Fasting Hyperglycaemia	$\geq$ 100 mg/dl	70	85

Discussion

The present study demonstrated a 34.5% prevalence of Metabolic Syndrome (MetS) among women with PCOS, highlighting a considerable burden of metabolic risk in this population. The data showed that MetS prevalence increased significantly with age, rising from 20.7% in women under 25 years to 59.3% in women above 30 years, suggesting that age is a strong contributor to worsening metabolic health in PCOS. Moreover, higher BMI and central obesity (waist circumference $\geq$80 cm) were strongly associated with MetS, indicating that adiposity and fat distribution are crucial risk factors. In this cohort, menstrual irregularities (54%) were the most common presenting symptom, followed by primary infertility (36%) and hirsutism (17%). Notably, nearly half of the participants were nulligravida (46%), pointing toward a significant reproductive health impact in this group.

When compared with previous studies, these findings are consistent. Hildrum et al. (2007) reported similar MetS prevalence rates of 29.6% and 25.9% under different diagnostic criteria, supporting the observed burden in this study. The high frequency of menstrual irregularities aligns with earlier reports [8,9]. Similarly, infertility rates and multigravidity closely matched Ramanand et al. [8], who also noted a high infertility prevalence among PCOS women. The trend of increasing MetS prevalence with rising BMI and waist circumference observed here mirrors findings from Kalra et al. [10] and Radwan et al. [11], underlining the central role of obesity, particularly abdominal fat, in metabolic dysfunction among PCOS women. The high mean waist circumference (98.6 cm) among MetS cases reflects greater central obesity, in line with earlier research.

Biochemical abnormalities such as hypertriglyceridemia, low HDL, and elevated fasting glucose were prominent in this study, reinforcing the metabolic vulnerability of PCOS women. The high prevalence of low HDL and hypertriglyceridemia particularly points to dyslipidaemia as a key issue, consistent with studies by Mandrelle et al. [12] and Mamaghani et al. [13]. The rising glucose abnormalities with age, evident from elevated fasting glucose levels, were also supported by findings from Sidra et al. [9] and Radwan et al. [14]. Thus, this study establishes that increasing age, higher BMI, and central obesity are strongly linked with worsening metabolic profiles in PCOS women. The significant differences in

lipid and glucose parameters between MetS and non-MetS groups emphasize the importance of early metabolic screening and lifestyle intervention in this high-risk population to prevent long-term cardiovascular complications.

Conclusion

The present study concludes that metabolic syndrome is a significant health concern in women with PCOS, affecting about 34.5% of the population. The prevalence of metabolic abnormalities, such as obesity, low HDL, hypertriglyceridemia, and hyperglycaemia, increases with age and BMI, reflecting a strong association between metabolic dysfunction and PCOS. Furthermore, lifestyle factors and anthropometric measures, particularly waist circumference, appear to be key contributors to the development of metabolic abnormalities in these women. Early identification and intervention are crucial to reducing future health risks, emphasizing the need for routine metabolic screening and lifestyle modifications in women with PCOS.

Generalizability

The findings are applicable to women with PCOS attending tertiary care hospitals, particularly in urban Indian settings. However, results may not fully represent rural populations or other ethnic groups.

Limitation

This was a single-center, hospital-based study with limited sample size, potentially affecting external validity. Lifestyle factors such as diet and exercise were not assessed.

Recommendations

Routine metabolic screening is recommended for all women with PCOS to enable early detection of MetS. Lifestyle modification programs focusing on weight reduction should be integrated into PCOS management.

Acknowledgment

List of Abbreviations

PCOS – Polycystic ovarian syndrome
MetS – Metabolic Syndrome
BMI – Body Mass Index
WC – Waist Circumference
HDL – High-Density Lipoprotein
LDL – Low-Density Lipoprotein
TG – Triglycerides
OPD – Outpatient Department
BP – Blood Pressure
IDF – International Diabetes Federation

Source of Funding

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Availability of Data

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Authors' Contribution

All authors contributed to the study conception and design. Data collection and analysis were performed by the first author, while manuscript drafting and critical revisions were done jointly by all authors.

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PUBLISHER DETAILS

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