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EXPLORING METABOLIC PROFILE, AND ASSOCIATED RISK FACTORS AMONG WOMEN DIAGNOSED WITH POLYCYSTIC OVARY SYNDROME

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Abstract

Background: *Polycystic ovary syndrome (PCOS) is among the most prevalent endocrine disorders in women of reproductive age, often associated with metabolic disturbances that may lead to long-term cardiovascular and metabolic complications. Common features include obesity, insulin resistance, dyslipidemia and impaired glucose metabolism that have a negative impact on reproductive and overall health. The aim of this study was to investigate the metabolic profile and associated risk factors in women with diagnosed PCOS in tertiary care hospital.*

Methods: *A cross sectional study involving 120 women suffering from PCOS was performed in the hospital from July to December 2022. Participants were recruited using a non-probability consecutive sampling technique. Demographic data, clinical history, anthropometric data, metabolic parameters, and lifestyle related data were obtained from a structured questionnaire and medical records. Assessment of fasting blood glucose, glycated hemoglobin (HbA1c), lipid profile, body mass index (BMI), waist circumference, and insulin resistance status were done. Data were analyzed using SPSS version 26.0. Participants' characteristics were estimated by descriptive statistics and Chi-square tests were used to explore factors related to metabolic syndrome. A p-value < 0.05 was deemed to be statistically significant.*

Results: *The mean age of participants was 27.8 ± 5.6 years, and the mean BMI was 29.3 ± 5.2 kg/m². One in four women (44.2%) were obese and 55% (55.0%) were insulin resistant and 28% (28.3%) had metabolic syndrome. Most frequently observed clinical features were menstrual irregularity (86.7%), hirsutism (65.0%) and acne (57.5%). Obesity, insulin resistance, sedentary lifestyle, family history of diabetes, age ≥30 years and disease duration ≥10 years were significant associated factors with metabolic syndrome (p<0.05).*

Conclusion: *Women with PCOS had high burden of metabolic abnormalities and modifiable lifestyle risk factors. To minimize future metabolic and reproductive complications, early metabolic screening, routine cardiovascular risk assessment and targeted lifestyle interventions should be made an essential component of ongoing clinical care for this patient population.*

Keywords: *Dyslipidemia, Insulin resistance, Metabolic profile, Metabolic syndrome, Obesity, PCOS, Polycystic ovary syndrome*

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a condition affecting metabolism and the endocrine system of women during fertile age and has an estimated prevalence of 6% to 20% around the globe, depending on the diagnostic criteria used (1). It represents a heterogeneous clinical entity defined by the presence of oligo-anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasound (2). PCOS is a disorder described as a reproductive condition, but it is now recognized as a multisystem disorder with very significant metabolic consequences for the future health of women (3). Affected persons suffer from a greater propensity to obesity, insulin resistance, dyslipidaemia, impaired glucose tolerance, type 2 diabetes mellitus, hypertension and cardiovascular disease, which underscore the importance of early diagnosis and treatment of metabolic abnormalities (4).

Insulin resistance is a core pathophysiological process of PCOS in the both reproductive and metabolic components and is thought to be a key problem (5). Women with PCOS tend to be overweight or obese (about half of women), and have an increased central adiposity (central fat distribution) that worsens

insulin resistance and increases risk for metabolic syndrome (6). Furthermore, this population often has abnormal lipid profile levels, high glycemic indices, and elevated inflammatory markers, thus underscoring the need to profile the metabolism along with a regular gynecological assessment (7). These metabolic changes are exacerbated by modifiable and non-modifiable risk factors, such as lack of exercise, poor dietary habits and familial diabetes (8).

Metabolic disturbances are common and severe in women with PCOS, but their prevalence and severity vary within the different populations related to genetic, environmental and socio-economic factors. In developing countries, delayed diagnosis, limited awareness, and inadequate screening for metabolic complications remain significant public health concerns (9). Early identification of women at increased metabolic risk provides an opportunity for timely lifestyle modification, weight management, and preventive interventions that may reduce future cardiovascular morbidity and improve reproductive outcomes.

Although PCOS is a burgeoning condition, little local data is available that describes the metabolic profile and associated risk factors among women with PCOS. The aim of this study was to delineate metabolic profile and to identify clinical and lifestyle related risk factors among women with PCOS who visited a tertiary care teaching hospital, thereby providing evidence to support early risk assessment and comprehensive patient management.

METHODOLOGY

A cross-sectional study of women with polycystic ovary syndrome (PCOS) was conducted in the Department of Gynecology and Obstetrics of a tertiary care Shaikh Zayd Hospital hospital Lahore between 1st July 2022 and 1st December 2022 with the aim of assessing the metabolic profile and its associated risk factors.

This study involved a total 120 women (age 18–40 years), that were diagnosed as having PCOS according to the Rotterdam criteria (at least two of the following: Oligo/Anovulation, clinical or biochemical Hyperandrogenism, and Poly Cystic Ovarian Morphology seen on Ultrasonography). The women who attended the outpatient department were selected by non-probability consecutive sampling.

Patients with pregnancy and lactation, and those who had undergone hormonal therapy within the last three months, or had thyroid disease, Cushing's syndrome, congenital adrenal hyperplasia were excluded. Patients who had chronic systemic disorders which in themselves may have a negative impact on metabolic parameters were also excluded.

The data was collected by face-to-face interview and reviewing medical records utilizing a structured and pretested questionnaire. Socio-demographic, menstrual history, clinical features, family history, dietary habits and physical activity were obtained. The anthropometric measurements were taken using standardized methods: weight, height, body mass index (BMI), and waist circumference.

Biochemical parameters assessed were fasting blood glucose, glycated haemoglobin (HbA1c), total cholesterol, triglycerides, high density lipoprotein (HDL) cholesterol, low density lipoprotein (LDL) cholesterol and fasting insulin. Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) was calculated as an index of insulin resistance and metabolic syndrome was defined by standard clinical definitions.

Data were entered and analyzed using IBM SPSS version 26.0 (10). Data for continuous variables were reported as mean ± standard deviation and for categorical variables as frequency and percentage. The association between metabolic syndrome and selected risk factors were evaluated by the chi-square test and a p-value of < 0.05 was taken as statistically significant.

RESULTS

The total number of women who had been diagnosed with Polycystic Ovary Syndrome (PCOS) from July to December, 2022, were 120. The mean age of the participants was 27.8 ± 5.6 years, while the mean BMI was 29.3 ± 5.2 kg/m². Most of the women were overweight or obese, were aged 25–34 years and

complained of irregular menses. Metabolic abnormalities such as insulin resistance, dyslipidaemia and impaired fasting glucose were common, reflecting the known relationship between PCOS and cardiometabolic risk, which was significant in women with PCOS.

Demographic and clinical characteristics of the study population are given in Table 1. The majority of women were aged 25-34 years (46.7%) and 44.2% were classified as obese (BMI ≥30 kg/m2), which is indicative of high prevalence of excess body weight among women with PCOS. The majority of participants were married (60.0%) and almost a third (32.5%) had a positive family history of PCOS, indicating that there may be a familial predisposition. In addition, 43.3% of them had had PCOS for 2-5 years, suggesting that PCOS is a chronic condition.

Table I. Demographic and clinical characteristics of women with PCOS (n = 120)

Variable	Category	n (%)
Age (years)	18–24	38 (31.7)
	25–34	56 (46.7)
	≥35	26 (21.6)
Marital Status	Married	72 (60.0)
	Unmarried	48 (40.0)
Educational Status	Primary or below	22 (18.3)
	Secondary	46 (38.3)
	Graduate or above	52 (43.4)
BMI (kg/m²)	Normal (<25)	24 (20.0)
	Overweight (25–29.9)	43 (35.8)
	Obese (≥30)	53 (44.2)
Family History of PCOS	Yes	39 (32.5)
	No	81 (67.5)
Duration Since Diagnosis	<2 years	41 (34.2)
	2–5 years	52 (43.3)
	>5 years	27 (22.5)

The metabolic parameters of the subjects are shown in table 2. Overweight and central obesity, as shown by the mean BMI (29.3 ± 5.2 kg/m²) and waist circumference (91.8 ± 11.4 cm) were prevalent. The elevated levels of fasting blood glucose, triglycerides and LDL cholesterol and the low HDL level showed the presence of bad metabolic changes. Over half of participants (55.0%) were insulin resistant, and 28.3% met the criteria for metabolic syndrome, indicating a higher cardiometabolic risk in women with PCOS.

Table II. Metabolic profile of women with PCOS (n = 120)

Variable	Category/Mean	Value
BMI (kg/m²)	Mean ± SD	29.3 ± 5.2
Waist Circumference (cm)	Mean ± SD	91.8 ± 11.4
Fasting Blood Glucose (mg/dL)	Mean ± SD	102.6 ± 18.5
HbA1c (%)	Mean ± SD	5.9 ± 0.8
Total Cholesterol (mg/dL)	Mean ± SD	201.4 ± 36.8
Triglycerides (mg/dL)	Mean ± SD	176.5 ± 58.7
HDL Cholesterol (mg/dL)	Mean ± SD	43.2 ± 8.4
LDL Cholesterol (mg/dL)	Mean ± SD	128.7 ± 29.6
Insulin Resistance (HOMA-IR >2.5)	Yes	66 (55.0)
Metabolic Syndrome	Yes	34 (28.3)

Table III shows the typical clinical and lifestyle findings in women with PCOS. The most common manifestation was menstrual irregularity (86.7%), followed by hirsutism (65.0%), acne (57.5%) and infertility (42.5%). Lifestyle assessment showed that 60.0% of these subjects were sedentary and 61.7% had unhealthy dietary habits that can lead to aggravation of metabolic abnormalities and progression of disease.

Table III. Clinical manifestations and lifestyle factors among women with PCOS (n = 120)

Variable	Category	n (%)
Menstrual Irregularity	Yes	104 (86.7)
Hirsutism	Yes	78 (65.0)
Acne	Yes	69 (57.5)
Alopecia	Yes	33 (27.5)
Infertility	Yes	51 (42.5)

Sedentary Lifestyle	Yes	72 (60.0)
Regular Physical Activity	Yes	48 (40.0)
Unhealthy Dietary Habits	Yes	74 (61.7)
Family History of Diabetes	Yes	47 (39.2)
Hypertension	Yes	18 (15.0)

The relationship between certain clinical and lifestyle factors and the existence of metabolic syndrome is shown in Table 4. Obesity, insulin resistance, sedentary lifestyle, family history of diabetes, age ≥30 years, and longer duration of PCOS were all found to be statistically significantly associated with metabolic syndrome ($p < 0.05$). Obesity and insulin resistance showed the highest correlation among these, highlighting their crucial role in the emergence of metabolic problems in PCOS. These results highlight the significance of lifestyle adjustment and early metabolic screening as essential elements of all-encompassing PCOS therapy.

Table IV. Factors associated with metabolic syndrome among women with PCOS (n = 120)

Variable	Metabolic Syndrome n (%)	No Metabolic Syndrome n (%)	p-value
Obesity (BMI ≥30 kg/m²)	26 (76.5)	27 (31.4)	<0.001
Insulin resistance	29 (85.3)	37 (43.0)	<0.001
Sedentary lifestyle	27 (79.4)	45 (52.3)	0.009
Family history of diabetes	20 (58.8)	27 (31.4)	0.011
Age ≥30 years	22 (64.7)	31 (36.0)	0.006
Duration of PCOS >5 years	14 (41.2)	13 (15.1)	0.003

These tables reflect common metabolic abnormalities reported among women with PCOS, including obesity, insulin resistance and dyslipidemia.

DISCUSSION

The present study offers comprehensive insights into the metabolic profile and its associated risk factors among women with polycystic ovary syndrome (PCOS) in a tertiary care setting. The results show there is a very high metabolic burden in this population, as well as high prevalence of obesity (44.2 %), insulin-resistant (55.0 %) and metabolic syndrome (28.3 %). Menstrual irregularities (86.7%), hirsutism (65.0%) and acne (57.5%) were the most common clinical features, which are consistent with the classic phenotypic presentation of PCOS. In particular, modifiable lifestyle risk factors such as sedentary behavior (60.0%) and unhealthy eating (61.7%) were very common, and urgently need prevention interventions. The increase incidence of metabolic syndrome in PCOS patients is associated with obesity, insulin resistance, sedentary lifestyle, family history of diabetes, age of ≥30 years and longer duration of the disease (11).

These results concur with the existing literature that shows increased metabolic risk in PCOS populations. Our overall prevalence rate of metabolic syndrome (28.3%) was within the range of reported prevalence rates in past studies, ranging from 20-35% depending on the population sampled and diagnostic criteria used (12). Our prevalence of metabolic syndrome (30%) is very close to the prevalence rate reported in the USA for women with PCOS (30%) and similar to the reported prevalence rates in Australia (29–33%) (13,14). The prevalence of insulin resistance (55.0%) in this study is significant and in line with the already known central role of insulin resistance in PCOS pathophysiology that is well summarized by a study, who stated that insulin resistance is a leading player in the metabolic alterations of women with PCOS (15).

Also, the findings demonstrated a strong association between obesity and the presence of metabolic syndrome (76.5% vs 31.4%, $p<0.001$), which is also consistent with the study on Asian population, who have shown that central adiposity significantly enhances metabolic risk in PCOS (16). The strong association for sedentary lifestyle and metabolic complications is similar to the importance of exercise in reducing cardiovascular risks in PCOS (17). Our findings also align with a meta-analysis that determined lifestyle to be important modifiable factors of long-term metabolic outcomes (18). It is to be noted though that the prevalence of metabolic abnormalities in this cohort seems slightly higher than reported by some European studies, which may explain some difference in genetic predisposition, diet and healthcare accessibility in developing country settings (19).

These results have important clinical implications for the holistic approach to women who suffer from PCOS. Metabolic abnormalities are a prevalent issue, and this highlights the importance of having

metabolic testing done in addition to the reproductive testing (20). It is recommended that annually measure fasting blood glucose, lipid profile, HbA1c, and insulin resistance as part of routine management of PCOS, so that early diagnosis and intervention is possible (21). The strong links between lifestyle modification and metabolic syndrome, underline its importance as an integral part of the management of PCOS (22). It is important to counsel patients on weight loss for effective weight management, exercise, and dietary modification, even modest weight loss (5-10%) can lead to significant improvements in metabolic parameters and reproductive outcome (23).

There were some limitations that need to be considered. Due to the cross-sectional study design, it is not possible to infer causal links between risk factors and metabolic outcomes. Relatively small sample size and single-center setting may preclude the generalizability to larger populations. In addition, it also may be affected by recall bias because the lifestyle data was reported, and detailed dietary assessment was not conducted, which makes it difficult to understand specific nutritional determinants of metabolic risk. Furthermore, the absence of a control group comprising women without PCOS limited the scope for comparative analysis.

Longitudinal study designs are requested to improve understanding of the effect of risk factors on the temporal process of metabolic deterioration in PCOS. More detailed dietary pattern, physical activity evaluation, and genetics would be valuable for larger and multi-centre studies. Intervention studies for effectiveness of structured lifestyle changes, pharmaceutical treatment and multimodal treatment on reducing metabolic risk are well needed. Further, studies investigating emerging biomarkers, inflammatory markers, and adipose tissue dysfunction in metabolic complications of PCOS could lead to new therapeutic targets and optimize risk stratification methods for more personalized interventions to women with PCOS.

CONCLUSION

In conclusion, a significant burden of metabolic abnormality observed in women with PCOS including obesity, insulin resistance, dyslipidemia and metabolic syndrome. The unhealthy lifestyle behaviors (inactivity and non-healthy eating habits) were strongly associated with poor metabolic outcomes. The strong associations between metabolic syndrome and obesity, insulin resistance, age ≥30 years, and longer disease duration underscore the importance of early identification and comprehensive management. Cardiometabolic screening, cardiovascular risk assessment and targeted lifestyle interventions should be an integral part of PCOS management to reduce the risk of long-term cardiometabolic complications and help improve the health of this high-risk group.

Conflict of interest:

Authors declared no conflict of interest.

Authors' contribution:

AA, DD & MK Substantial contributions to the conception and design, data analysis, drafting the work and revising it critically for important intellectual content and final approval of the version to be published.

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