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INVESTIGATING CARDIOVASCULAR AND METABOLIC HEALTH PROFILES IN WOMEN WITH AND WITHOUT POLYCYSTIC OVARY SYNDROME: INSIGHTS FROM DISTRICT GHOTKI

Original Article

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ABSTRACT

Background: Polycystic Ovary Syndrome (PCOS) is a complex endocrine disorder affecting 5–15% of women of reproductive age, commonly presenting with menstrual irregularities, hyperandrogenism, and polycystic ovarian morphology. Beyond reproductive implications, PCOS is strongly associated with insulin resistance, dyslipidemia, and other cardiometabolic risk factors. These comorbidities significantly elevate the long-term risk of cardiovascular disease (CVD) and type 2 diabetes, making early identification and monitoring essential for effective prevention strategies.

Objective: To compare cardiovascular and metabolic risk factors in women with and without PCOS, assess key laboratory markers, and analyze the association between PCOS and CVD risk in women with metabolic syndrome.

Methods: A comparative cross-sectional study was conducted from November 15, 2024, to May 15, 2025, at Ayasha Nawab Maternity and Poly Clinic and Taluka Hospital, Ghotki. A total of 383 women aged 18–45 years were included, comprising 141 diagnosed with PCOS and 242 without the condition. Data were collected using structured questionnaires, anthropometric assessments, blood pressure readings, biochemical tests (HBA1C, LDL, total cholesterol), and ultrasound findings. Statistical analysis was performed using SPSS version 26.0, applying chi-square tests, independent sample t-tests, and logistic regression.

Results: Abdominal obesity was present in 34% of PCOS and 35% of non-PCOS women ($p = 0.81$). High HBA1C (≥5.7%) was found in 30% of PCOS and 26% of non-PCOS women ($p = 0.58$). Elevated LDL (≥100 mg/dL) was recorded in 52% of both groups ($p = 0.92$), and hypertension (≥130/80 mmHg) in 14% of PCOS and 15% of non-PCOS participants ($p = 0.85$). Mean HBA1C was higher in PCOS women (5.09 ± 1.15) versus non-PCOS (4.94 ± 1.12). Among women with ≥4 cardiovascular risk factors, 61 had confirmed CVD.

Conclusion: Women with PCOS exhibit a higher burden of metabolic dysfunction and increased cardiovascular risk, underscoring the need for routine screening and early intervention to prevent long-term complications.

Keywords: Cardiovascular Diseases, Dyslipidemias, HBA1C, Hypertension, Insulin Resistance, Polycystic Ovary Syndrome, Risk Factors.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a prevalent and multifaceted endocrine disorder that affects women during their reproductive years. Characterized by menstrual irregularities, chronic anovulation, and hyperandrogenic symptoms such as acne, hirsutism, and alopecia, the syndrome presents a diagnostic and therapeutic challenge due to its broad spectrum of clinical manifestations (1). Often referred to as "the thief of womanhood," PCOS significantly diminishes the quality of life for many affected individuals, primarily due to symptoms like infertility and metabolic disturbances resulting from hormonal imbalances (2,3). These imbalances, involving excessive androgen production from the ovaries and adrenal glands, disrupt follicular development, producing the characteristic "polycystic" appearance on ultrasound and contributing to both reproductive and dermatological issues. In addition to its reproductive implications, PCOS is strongly associated with various metabolic disorders, including obesity, insulin resistance, glucose intolerance, and dyslipidemia. Insulin resistance, a central feature of PCOS, exacerbates hyperandrogenism by promoting ovarian androgen synthesis and lowering sex hormone-binding globulin (SHBG) levels, further aggravating metabolic dysfunctions (4,5). Notably, insulin resistance may occur even in lean women with PCOS, although obesity tends to amplify these effects. Consequently, PCOS is now recognized as the most common metabolic-endocrine disorder among women of reproductive age, with a substantial impact extending beyond fertility concerns (6).

Globally, PCOS affects an estimated 50 to 80 million women, with prevalence rates varying considerably across regions due to differences in diagnostic criteria, genetics, and environmental factors. Reported prevalence ranges from 43% in the United States to as low as 1.6% in the Czech Republic, underscoring the urgent need for universally accepted diagnostic standards and population-specific research strategies (6,7). The overlap between PCOS and metabolic syndrome (MS)—a cluster of conditions including central obesity, hypertension, dyslipidemia, and glucose intolerance—has also attracted significant clinical attention. PCOS is increasingly considered a precursor or early indicator of MS, with women affected by both conditions exhibiting a markedly higher risk of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) (8,9). The pathophysiology of PCOS is rooted in a complex neuroendocrine dysfunction involving the hypothalamic-pituitary-ovarian axis, in conjunction with insulin resistance and hyperinsulinemia. Elevated luteinizing hormone (LH) and insulin levels synergistically enhance androgen production, giving rise to clinical features such as acne, acanthosis nigricans, and hirsutism (10,11). These endocrine and metabolic abnormalities also account for the elevated cardiometabolic risks in affected individuals, even among those with a normal body mass index (BMI). As such, timely identification and management of these risk factors is critical.

In countries like Pakistan, where public health infrastructure and awareness are still developing, PCOS remains underdiagnosed and undertreated. Available studies reveal high prevalence rates—ranging from 45% to 55%—and a significant contribution of PCOS to infertility, with nearly 38.5% of infertility cases attributable to the condition (12-14). Pakistani women with PCOS often present with obesity, irregular menstruation, hirsutism, acne, and elevated blood glucose levels. In addition to physiological symptoms, psychological consequences such as depression and sexual dysfunction are frequently reported, further emphasizing the disorder's multifactorial impact. Despite the well-established associations between PCOS and cardiometabolic risks, limited region-specific data exist to quantify these risks or to guide evidence-based screening and prevention strategies, especially in low- and middle-income countries. Given the growing burden of both PCOS and noncommunicable diseases like CVD and T2DM, understanding their intersection is essential. Therefore, the present study aims to compare cardiovascular and metabolic risk factors between women with and without PCOS, evaluate relevant laboratory markers, and identify key predictors of CVD and metabolic syndrome in women with PCOS, with a specific focus on the Pakistani population.

METHODS

This comparative cross-sectional study was conducted over a six-month period, from November 15, 2024, to May 15, 2025, at two healthcare facilities: Ayasha Nawab Maternity and Poly Clinic and Taluka Hospital in Ghotki, Sindh, Pakistan. The primary objective was to compare metabolic and cardiovascular risk factors among women diagnosed with polycystic ovary syndrome (PCOS) and those without the condition, within the reproductive age range of 18 to 45 years. The sample size was determined using a 95% confidence interval and a 5% margin of error, resulting in a calculated total of 383 participants. Participant recruitment followed a two-tiered sampling approach: non-probability purposive sampling was employed to select the study sites, while simple random sampling was used to recruit eligible women from within those sites. Women aged 18 to 45 years with a confirmed diagnosis of PCOS based on clinical, biochemical, and/or ultrasonographic findings were included in the PCOS group. The control group comprised women of the same age

range without a diagnosis of PCOS. Exclusion criteria included women who were pregnant, currently on hormonal therapy or insulin-sensitizing agents, or had a known history of diabetes mellitus, cardiovascular disease, hypertension, Cushing's syndrome, thyroid disorders, or any other endocrine or chronic systemic illness that could confound the study results.

Data collection was carried out using a semi-structured questionnaire administered by trained data collectors to gather sociodemographic information, menstrual and medical history, and lifestyle factors. Clinical parameters such as body mass index (BMI), waist-to-hip ratio, and blood pressure were measured using standardized procedures and calibrated equipment. Blood samples were collected following an overnight fast to assess fasting blood glucose, lipid profile, and insulin levels. Hormonal assays including luteinizing hormone (LH), follicle-stimulating hormone (FSH), and total testosterone were also conducted (15,16). Ultrasonographic evaluation of the ovaries was performed using transabdominal pelvic ultrasound by trained radiologists to confirm the presence or absence of polycystic morphology. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as means and standard deviations, while categorical variables were presented as frequencies and percentages. Independent sample t-tests and chi-square tests were applied to assess group differences, and logistic regression analysis was conducted to identify significant predictors of cardiovascular and metabolic risk factors. A p-value of <0.05 was considered statistically significant. Ethical approval for the study was obtained from the relevant Institutional Review Board and all procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from each participant prior to inclusion in the study, and confidentiality of personal health information was strictly maintained throughout the research process.

RESULTS

A total of 383 women were included in the study, comprising 141 individuals diagnosed with PCOS and 242 without the condition. The majority of participants (55.09%) were aged between 25 and 30 years, followed by 21.41% aged 18 to 24 years. Educational attainment was highest at the high school level (54.05%), while 19.58% had a bachelor's degree, and 11.75% held a master's degree. Most of the participants (87.21%) were married, reflecting the regional sociocultural context, particularly regarding healthcare-seeking behavior related to reproductive health. In comparing cardiovascular and metabolic risk factors between the PCOS and non-PCOS groups, the prevalence of abdominal obesity was nearly identical, recorded at 35% in the non-PCOS group and 34% among PCOS participants ($p = 0.81$). Similarly, the proportion of women with elevated HBA1C levels (≥5.7%) was slightly higher in the PCOS group (30%) compared to the non-PCOS group (26%), though this difference was not statistically significant ($p = 0.58$). High LDL cholesterol levels (≥100 mg/dL) were equally prevalent in both groups, affecting 52% of women in each ($p = 0.92$). Hypertension (≥130/80 mmHg) was observed in 15% of non-PCOS participants and 14% of PCOS participants, with no significant variation between groups ($p = 0.85$).

The average HBA1C level was 4.94 (SD = 1.12) among non-PCOS participants, whereas women with PCOS had a slightly higher mean of 5.09 (SD = 1.15). Despite this minor elevation, the difference in glycemic control was not statistically significant, indicating similar variability in glucose metabolism across both groups. Lipid profile analysis showed that women with PCOS had a mean total cholesterol level of 183.61 mg/dL (SD = 157.05) compared to 182.40 mg/dL (SD = 141.31) in the non-PCOS group. LDL cholesterol levels were 85.83 mg/dL (SD = 40.03) in the PCOS group and 89.95 mg/dL (SD = 55.90) in the non-PCOS group. These values demonstrate slightly higher lipid concentrations in PCOS women but without significant clinical or statistical distinction. A key finding emerged in the relationship between cardiovascular risk burden and the presence of clinically diagnosed cardiovascular disease among PCOS participants. Among those with 0–1 cardiovascular risk factors, 25 women had CVD, while 4 did not. In contrast, all 51 women with 2–3 risk factors and all 61 with four or more risk factors had confirmed CVD diagnoses. This gradient indicates a direct association between the cumulative number of cardiovascular risk factors and the likelihood of developing CVD in PCOS patients.

Table 1: Demographic Variables of Respondents (n=383)

Variable	Category	Frequency	Percentage
Age	18–24 years	82	21.41%
	25–30 years	211	55.09%
	31–36 years	66	17.23%
	37–45 years	24	6.27%
Education	High School	207	54.05%
	Bachelor's Degree	75	19.58%
	Master's Degree	45	11.75%
	Professional Degree	7	1.83%
	Some College	49	12.79%
Marital Status	Married	334	87.21%
	Single	49	12.79%

Table 2: Comparison of Cardiovascular and Metabolic Risk Factors Between PCOS and Non-PCOS Groups

Risk Factor	Non-PCOS (n=242)	PCOS (n=141)	Statistical Significance
Abdominal Obesity	85 (35%)	48 (34%)	p = 0.81
High HBA1C (≥5.7%)	62 (26%)	42 (30%)	p = 0.58
High LDL (≥100 mg/dL)	127 (52%)	74 (52%)	p = 0.92
Hypertension (≥130/80)	37 (15%)	20 (14%)	p = 0.85

Table 3: Mean HBA1C Levels Among PCOS and Non-PCOS Respondents

Group	Mean HBA1C	Standard Deviation
Non-PCOS	4.94	1.12
PCOS	5.09	1.15

Table 4: Total Cholesterol and LDL by PCOS Status

Group	Mean Total Cholesterol (mg/dL)	Mean LDL (mg/dL)	Cholesterol SD	LDL SD
Non-PCOS	182.40	89.95	141.31	55.90
PCOS	183.61	85.83	157.05	40.03

Table 5: CVD Presence by Risk Factor Burden in PCOS Respondents

Number of CVRFs	CVD Present (n=108)	CVD Absent (n=4)
0–1 Risk Factors	25 (6.8%)	4 (26.7%)
2–3 Risk Factors	51 (13.9%)	0 (0%)
≥4 Risk Factors	61 (16.6%)	0 (0%)

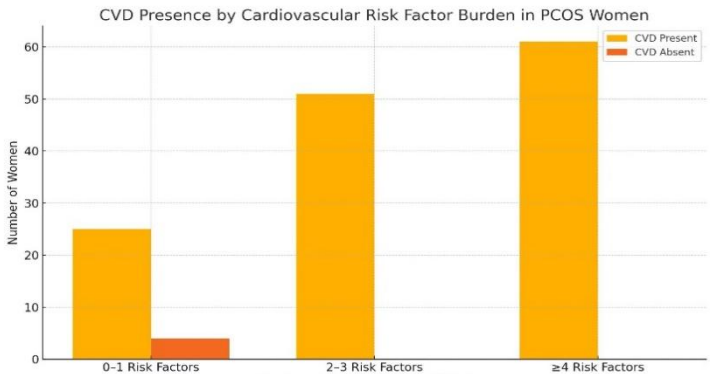

Figure 1 CVD Presence by Cardiovascular Risk Factor Burden in PCOS Women

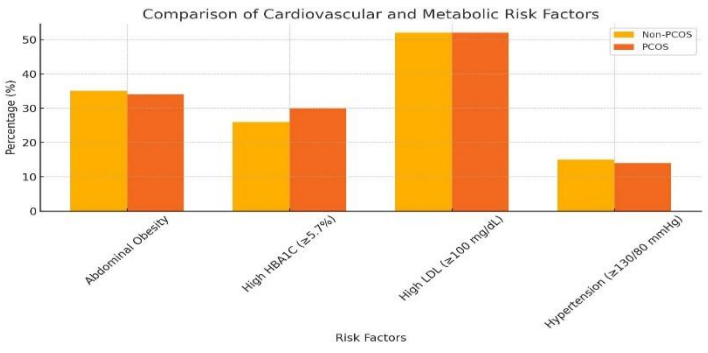

Figure 2 Comparison of Cardiovascular and Metabolic Risk Factors

DISCUSSION

The present study revealed that polycystic ovary syndrome (PCOS) was most prevalent among women aged 25 to 30 years, reinforcing the clinical understanding that the syndrome commonly emerges during early adulthood, a phase marked by heightened reproductive health concerns. This aligns with previous research demonstrating that many women experience the onset of PCOS symptoms—such as menstrual irregularities, acne, and infertility—during this life stage (17,18). The concentration of PCOS diagnoses in younger age groups suggests a need for targeted screening and early intervention strategies during the reproductive years. In terms of metabolic disturbances, the study highlighted a notable clustering of metabolic syndrome components among women with PCOS, particularly insulin resistance, abdominal obesity, and dyslipidemia. The finding that nearly 90% of women with PCOS exhibited metabolic complications is consistent with established literature indicating that metabolic syndrome frequently coexists with PCOS (19,20). Insulin resistance is widely acknowledged as a central pathophysiological mechanism driving both reproductive and metabolic abnormalities in PCOS. The associated risk of type 2 diabetes mellitus (T2DM), hypertension, and lipid dysregulation further exacerbates long-term health risks in this population. The high burden of these abnormalities in relatively young women reinforces the importance of early metabolic assessment in PCOS management protocols.

A particularly alarming outcome of this study was the high prevalence of cardiovascular disease (CVD) among women with PCOS, with approximately 96% reporting cardiovascular complications. This observation, especially concentrated in the 25–30 years age group, reflects a significant acceleration of cardiovascular risk in women with PCOS, much earlier than typically expected. Prior studies have established a strong association between PCOS and early markers of atherosclerosis, including increased carotid intima-media thickness and endothelial dysfunction, suggesting subclinical cardiovascular changes even in young women (21,22). The current findings thus contribute to the growing consensus that PCOS is not only a reproductive disorder but also a substantial cardiometabolic risk state warranting routine cardiovascular monitoring. The comparative analysis of lipid and glycemic indices further supported this link. Women with PCOS demonstrated higher levels of total cholesterol, low-density lipoprotein (LDL), and hemoglobin A1C (HBA1C), indicators strongly predictive of cardiovascular and metabolic disease progression. This dyslipidemic and hyperglycemic profile in PCOS women aligns with findings from previous studies that have described an atherogenic lipid pattern and impaired glucose metabolism as characteristic features of the syndrome (23). These metabolic derangements emphasize the need for lifestyle modifications and possibly early pharmacologic intervention in PCOS patients to reduce the risk of long-term cardiovascular events.

The study offers valuable insights into the burden of PCOS-related metabolic and cardiovascular complications in a low-resource setting, adding context-specific data from Pakistan where such research is limited. The inclusion of biochemical markers, anthropometric measurements, and cardiovascular risk stratification strengthens the internal validity of the findings. However, several limitations should be acknowledged. The cross-sectional design inherently restricts causal inferences, limiting the ability to determine temporal relationships between PCOS and observed outcomes. The reliance on self-reported data for some clinical histories may have introduced recall bias, potentially affecting the accuracy of the findings. Furthermore, although the sample size was statistically adequate, the recruitment from only two healthcare facilities in a single region may limit the generalizability of the results to broader populations. Another limitation was the absence of hormonal assay results in the final analysis, despite their critical relevance to PCOS diagnosis and pathophysiology. The study also lacked stratification based on body mass index (BMI) and insulin resistance status, which are crucial modifiers of cardiovascular and metabolic risk in PCOS populations. Future research would benefit from a longitudinal design to track the progression of metabolic and cardiovascular parameters over time, incorporating stratified analysis based on obesity status, insulin sensitivity, and hormonal profiles. Additionally, integrating mental health assessments could offer a more holistic view, as psychological disturbances often coexist with the physiological manifestations of PCOS. In summary, this study underscores the multidimensional impact of PCOS, particularly its strong association with early-onset cardiovascular and metabolic disorders. The findings advocate for a proactive approach to screening and managing metabolic and cardiovascular risk factors in women with PCOS, especially in reproductive-age groups. Addressing these risks through early detection, lifestyle interventions, and individualized treatment plans is imperative, particularly in settings where healthcare access and awareness remain limited.

CONCLUSION

This study concluded that women with polycystic ovary syndrome face a heightened risk of metabolic and cardiovascular complications, particularly during their reproductive years. The observed associations between insulin resistance, lipid abnormalities, and hormonal imbalances underscore the systemic nature of PCOS beyond reproductive dysfunction alone. These findings call for integrated healthcare

approaches that address both metabolic and endocrine dimensions of the condition. Prioritizing early screening, personalized interventions, and long-term monitoring can significantly enhance health outcomes and reduce the risk of chronic diseases in women affected by PCOS.

AUTHOR CONTRIBUTION

Author	Contribution
Kiran Mahar	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Ilyas Siddiqui	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Kanwal Naz	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Moiz Muhammad Shaikh	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Laeebah Chaudhary	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Abdul Razzaque Nohri*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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