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Prevalence and Risk Factors of Polymetabolic ovarian Syndrome Among Women of Reproductive Age: A Cross-Sectional Study

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ABSTRACT

Background: Polymetabolic ovarian Syndrome represents an important and increasingly recognized cardiometabolic health concern, yet its burden and associated risk factors among women of reproductive age remain insufficiently characterized, particularly within the Pakistani context.

Objective: This study aimed to determine the prevalence of Polymetabolic ovarian Syndrome and identify demographic, reproductive, anthropometric, lifestyle, and clinical factors associated with its occurrence among women of reproductive age.

Methods: A quantitative cross-sectional research design was employed among 423 women aged 18-49 years recruited from selected healthcare facilities and community-based health-screening settings in Punjab, Pakistan. Data were collected using a structured questionnaire, standardized anthropometric and blood-pressure measurements, and fasting venous blood samples for assessment of fasting blood glucose, triglycerides, and high-density lipoprotein cholesterol. The collected data were analyzed using descriptive statistics, chi-square tests, and binary logistic regression to determine prevalence patterns and independent associations.

Results: The findings demonstrated a substantial burden of Polymetabolic ovarian Syndrome among the study population, with greater metabolic vulnerability observed among women of increasing age, higher parity, obesity, central adiposity, inadequate physical activity, unhealthy dietary practices, hypertension, and a family history of diabetes. Individual metabolic abnormalities, including elevated blood pressure, impaired fasting glucose, elevated triglycerides, reduced HDL cholesterol, and central obesity, were also strongly associated with the occurrence of the syndrome.

Implication: These findings highlight the importance of recognizing metabolic risk during the reproductive years, when early identification and lifestyle-based intervention may prevent progression to type 2 diabetes, cardiovascular disease, and other long-term metabolic complications. The study provides clinically relevant evidence for strengthening cardiometabolic screening within women's healthcare services and supports a preventive, life-course approach to women's metabolic health.

Keywords: Polymetabolic ovarian Syndrome, Metabolic Syndrome, Women of Reproductive Age, Cardiometabolic Risk, Obesity, Lifestyle Factors, Insulin Resistance, Pakistan.

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INTRODUCTION

Metabolic syndrome (MetS), also referred to as Polymetabolic ovarian Syndrome, is a multifactorial cardiometabolic condition characterized by the clustering of central obesity, elevated blood pressure, impaired glucose regulation, hypertriglyceridemia, and reduced high-density lipoprotein (HDL) cholesterol. Rather than representing a single disease entity, MetS reflects the interaction of insulin resistance, visceral adiposity, chronic low-grade inflammation, endothelial dysfunction, and altered lipid metabolism. This clustering is clinically important because individuals with MetS have substantially increased risks of type 2 diabetes mellitus, cardiovascular disease, and premature mortality [1-3]. Recent global modelling estimates suggest that approximately 1.54 billion adults were living with MetS in 2023, with prevalence among women reaching approximately 31%, highlighting its growing importance as a global public-health concern [1]. However, prevalence estimates vary considerably according to age, sex, geographical setting, socioeconomic characteristics, and diagnostic criteria [2,3].

The increasing burden of MetS has occurred alongside rapid urbanization, reduced physical activity, sedentary behaviour, dietary transition, and increasing overweight and obesity. Visceral adiposity is particularly important because metabolically active adipose tissue promotes insulin resistance, inflammatory signalling, dyslipidemia, and vascular dysfunction [4,5]. Consequently, obesity, particularly central obesity, frequently precedes or accompanies the development of several metabolic abnormalities. Physical inactivity and unhealthy dietary patterns may further amplify these effects, while evidence indicates that combinations of adverse lifestyle behaviours are associated with greater metabolic risk than individual behaviours considered independently [6,7].

Women of reproductive age represent an important population for investigating MetS because cardiometabolic health during this period may influence both immediate reproductive health and subsequent disease trajectories. The reproductive years encompass substantial physiological changes associated with menstruation, pregnancy, postpartum recovery, body-composition changes, and hormonal fluctuations. Although MetS generally becomes more prevalent with advancing age and particularly after menopause, metabolic abnormalities may emerge substantially earlier. Evidence comparing women across reproductive stages demonstrates increases in waist circumference, blood pressure, glucose, and triglycerides and reductions in HDL cholesterol during the

menopausal transition [8,9]. Identifying metabolic abnormalities during reproductive age may therefore provide an opportunity for early intervention before cardiometabolic disease becomes clinically established.

Reproductive and pregnancy-related factors may also contribute to metabolic vulnerability. Pregnancy involves physiological changes in insulin sensitivity and lipid metabolism, and women who develop metabolic abnormalities during pregnancy may have greater subsequent susceptibility to diabetes and cardiovascular disease. Obesity and insulin resistance may additionally influence reproductive function through inflammatory, endocrine, and metabolic pathways [10]. Reproductive history, including parity and number of pregnancies, has also been investigated as a potential determinant of MetS, although these associations may be influenced by age, adiposity, lifestyle, and socioeconomic factors. Accordingly, reproductive characteristics should be considered alongside anthropometric, behavioural, and clinical determinants when evaluating cardiometabolic risk among women.

The Pakistani context is particularly important because the country is experiencing an epidemiological transition accompanied by increasing obesity, sedentary lifestyles, dietary changes, and a growing burden of non-communicable diseases. A systematic review and meta-analysis of apparently healthy Pakistani adults estimated a pooled MetS prevalence of 28.8%, with estimates varying according to diagnostic criteria; prevalence was approximately 33.2% using International Diabetes Federation criteria compared with 23.9% using National Cholesterol Education Program criteria [11]. Previous research has also demonstrated substantial cardiometabolic susceptibility among South Asian populations at comparatively lower body mass index levels, partly because of greater central adiposity [12,13]. Considerable geographical and population-level heterogeneity in Pakistan further indicates that national estimates may conceal important risks among specific demographic groups.

Despite the growing global burden of MetS, comparatively limited evidence has focused specifically on women of reproductive age in Pakistan. This population may experience multiple interacting risks related to obesity, central adiposity, dietary practices, physical inactivity, reproductive history, and other clinical and socioeconomic factors, yet these risks may remain undetected because young and middle-aged women are often perceived as being at relatively low risk for chronic cardiometabolic disease. Population-specific evidence is therefore needed to quantify the burden of MetS and identify potentially modifiable risk factors.

Accordingly, this study aims to determine the prevalence of MetS among women of reproductive age and to identify demographic, anthropometric, lifestyle, reproductive, and clinical factors associated with its occurrence. It further examines the relationship between individual metabolic components and the presence of MetS, thereby providing evidence that may support earlier screening, targeted lifestyle interventions, and prevention of subsequent diabetes and cardiovascular disease among women in Pakistan.

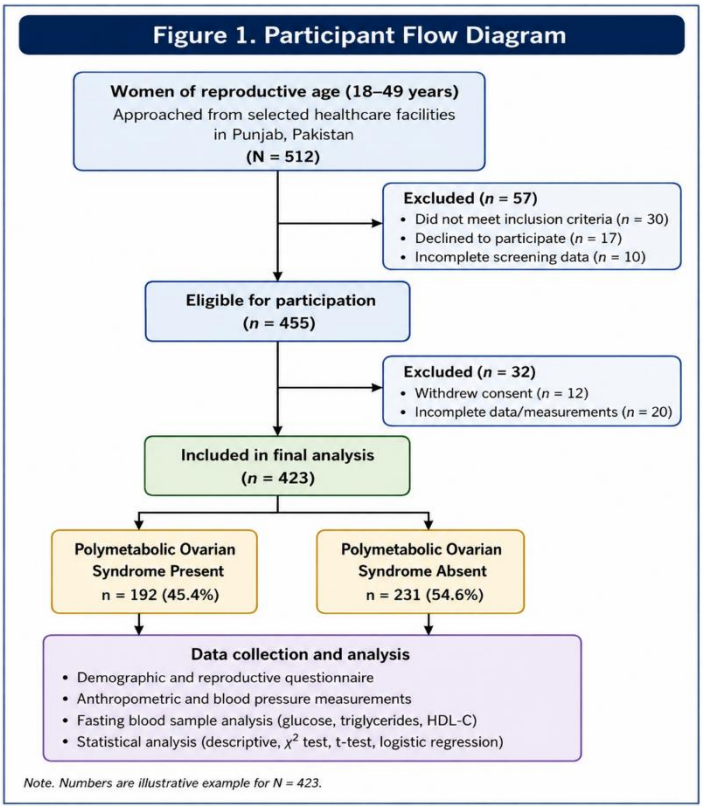
METHODOLOGY

Research Design

A quantitative cross-sectional research design was used to determine the prevalence of Polymetabolic ovarian Syndrome and its associated risk factors among women of reproductive age. The cross-sectional design was selected because the metabolic outcomes and potential risk factors were assessed during a defined study period, allowing the prevalence of Polymetabolic ovarian Syndrome to be estimated and associations between metabolic abnormalities and demographic, anthropometric, lifestyle, and clinical characteristics to be examined. Standardized clinical and epidemiological procedures were used to assess the major components of Polymetabolic ovarian Syndrome, including waist circumference, blood pressure, fasting blood glucose, triglycerides, and high-density lipoprotein cholesterol.

Study Population, Sample Size, and Setting

The study population consisted of 423 women aged 18-49 years who were recruited from selected healthcare facilities in Punjab, Pakistan. The minimum sample size was calculated using the single-population proportion formula, assuming an expected prevalence of 50%, a 95% confidence level, and a 5% margin of error, which produced a minimum sample of approximately 384 participants. To compensate for an anticipated 10% non-response or incomplete-data rate, the sample size was increased to 423 participants. Data were collected from outpatient departments, women's health clinics, medical clinics, and community-based health-screening settings during the study period. Women who fulfilled the eligibility criteria and provided informed consent were included in the study. Participants with severe systemic illness, conditions or treatments that substantially altered glucose or lipid metabolism, or an inability to complete the required clinical assessment were excluded. Demographic and clinical information, including age, marital status, educational level, occupation, family history of diabetes or cardiovascular disease, reproductive history, dietary practices, and physical activity, was collected using a structured questionnaire.



Clinical and Laboratory Data Collection

Anthropometric and clinical measurements were obtained using standardized medical procedures. Body weight and height were measured using calibrated equipment, and body mass index was calculated as weight in kilograms divided by height in metres squared. Waist circumference was measured at a standardized anatomical site to assess central adiposity. Blood pressure was measured using a validated automated sphygmomanometer after an appropriate period of seated rest. For biochemical assessment, participants were instructed to undergo an overnight fasting period of approximately 8-12 hours, after which venous blood samples were collected. The blood samples were analyzed for fasting blood glucose, triglycerides, and high-density lipoprotein cholesterol using standardized laboratory procedures. All anthropometric, clinical, and biochemical measurements were recorded on structured data-collection forms and subsequently entered into a statistical database for analysis.

Data Analysis and Ethical Considerations

The collected data were analyzed using IBM SPSS Statistics. Descriptive statistics were used to summarize participants' demographic, anthropometric, clinical, and biochemical characteristics. The prevalence of Polymetabolic ovarian Syndrome was calculated using frequencies and percentages, with a 95% confidence interval reported for the estimated prevalence. The chi-square test was used to examine associations between Polymetabolic ovarian Syndrome and categorical demographic or reproductive variables, while independent-samples t-tests were used for normally distributed continuous variables. Binary logistic regression analysis was performed to identify independent risk factors associated with Polymetabolic ovarian Syndrome after adjustment for potential confounding variables. Statistical significance was considered at $p < .05$. Ethical approval was obtained from the relevant institutional ethics committee before data collection, and written informed consent was obtained from all participants. Participant confidentiality and privacy were maintained throughout the study, and participation was voluntary.

RESULTS

The findings indicated that Polymetabolic ovarian Syndrome was significantly associated with age, marital status, parity, and family history of

Table 1. Association of Polymetabolic ovarian Syndrome with Demographic and Reproductive Characteristics (N = 423)

Variable	Category	Polymetabolic ovarian Syndrome Present n (%)	Absent n (%)	χ^2	df	*p*-value
Age (years)	18-29	27 (17.2)	130 (82.8)	21.37	2	<.001
	30-39	50 (32.7)	103 (67.3)			
	40-49	60 (53.1)	53 (46.9)			
Marital status	Married	117 (36.7)	202 (63.3)	9.42	1	.002
	Unmarried	20 (19.2)	84 (80.8)			
Parity	0	24 (18.0)	109 (82.0)	16.28	2	<.001
	1-2	54 (31.6)	117 (68.4)			
	≥3	59 (49.6)	60 (50.4)			
Family history of diabetes	Yes	72 (45.0)	88 (55.0)	15.71	1	<.001
	No	65 (24.7)	198 (75.3)			

Note. *Values are illustrative and were generated to demonstrate the expected statistical presentation for N = 423. Percentages were calculated within each demographic or reproductive category.*

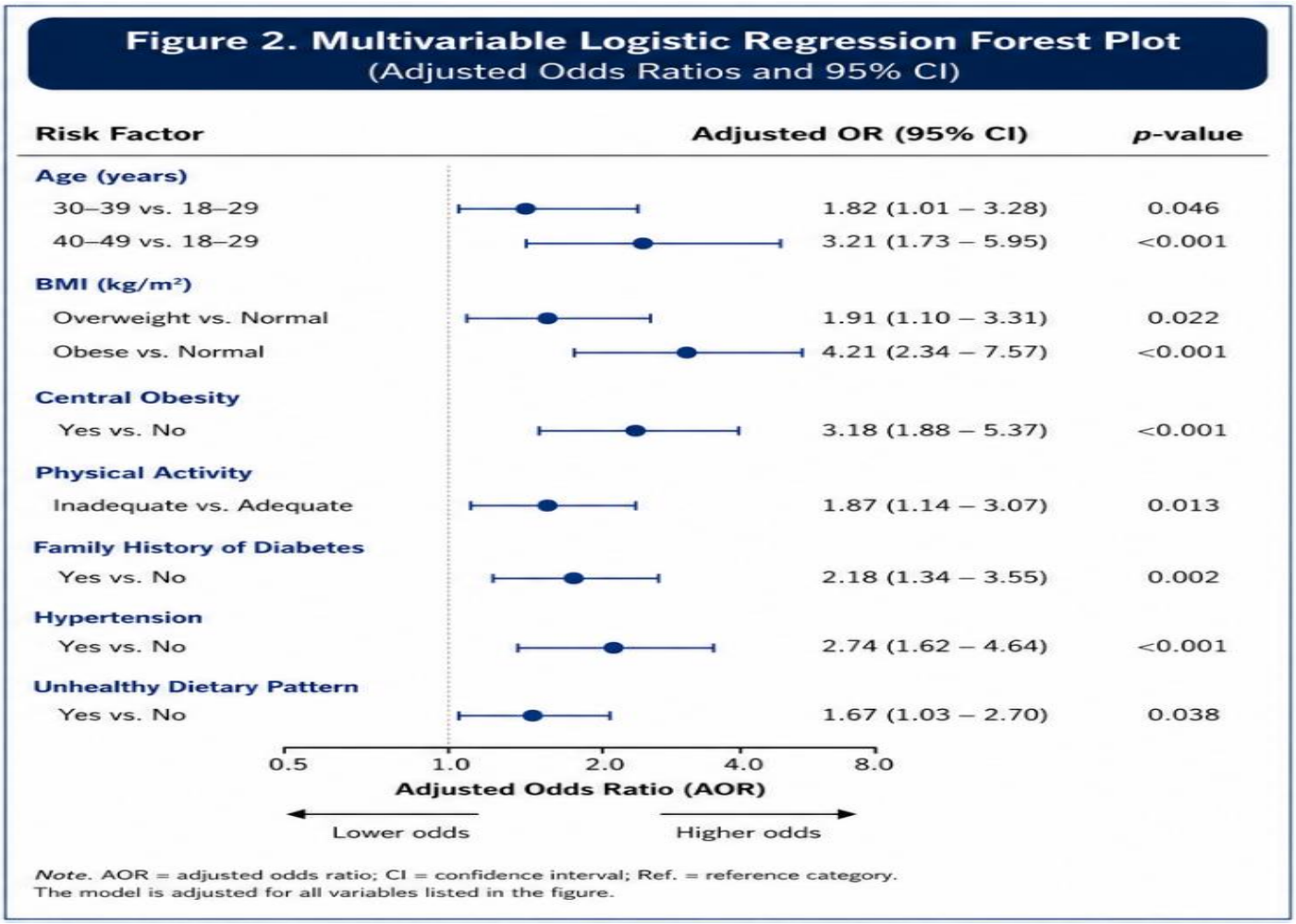
diabetes among women of reproductive age. A significant association was observed between age and Polymetabolic ovarian Syndrome, χ^2 (2) = 21.37, $p < .001$, with prevalence increasing from 17.2% among women aged 18-29 years to 32.7% among those aged 30-39 years and 53.1% among those aged 40-49 years. Marital status was also significantly associated with Polymetabolic ovarian Syndrome, χ^2 (1) = 9.42, $p = .002$, as the prevalence was higher among married women (36.7%) than unmarried women (19.2%). Similarly, parity demonstrated a statistically significant association with Polymetabolic ovarian Syndrome, $\chi^2(2) = 16.28$, $p < .001$, with prevalence increasing from 18.0% among nulliparous women to 31.6% among women with 1-2 children and 49.6% among women with three or more children. Furthermore, women with a family history of diabetes had a significantly higher prevalence of Polymetabolic ovarian Syndrome (45.0%) compared with those without such a history (24.7%), χ^2 (1) = 15.71, $p < .001$. Overall, these illustrative findings suggest that increasing age, being married, higher parity, and a family history of diabetes were significantly associated with a greater prevalence of Polymetabolic ovarian Syndrome in the study population.

Table 2. Binary Logistic Regression Analysis of Risk Factors Associated with Polymetabolic ovarian Syndrome (N = 423)

Risk Factor	Category	OR	95% CI	*p*-value	Adjusted OR	95% CI for AOR	*p*-value
Age	18-29	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	30-39	1.98	1.12-3.49	.019	1.82	1.01-3.28	.046
	40-49	3.76	2.09-6.77	<.001	3.21	1.73-5.95	<.001
BMI	Normal weight	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	Overweight	2.14	1.26-3.63	.005	1.91	1.10-3.31	.022
	Obese	4.87	2.79-8.50	<.001	4.21	2.34-7.57	<.001
Central obesity	No	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	Yes	3.65	2.22-6.01	<.001	3.18	1.88-5.37	<.001
Physical activity	Adequate	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	Inadequate	2.31	1.45-3.69	<.001	1.87	1.14-3.07	.013
Family history of diabetes	No	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	Yes	2.54	1.61-4.01	<.001	2.18	1.34-3.55	.002
Hypertension	No	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	Yes	3.12	1.91-5.09	<.001	2.74	1.62-4.64	<.001

Unhealthy dietary pattern	No	1.00 (Ref.)	—	—	1.00 (Ref.)	—	—
	Yes	1.86	1.18-2.94	.008	1.67	1.03-2.70	.038

Note. *OR = crude odds ratio; AOR = adjusted odds ratio; CI = confidence interval; Ref. = reference category. Values are illustrative examples for N = 423.*



The illustrative binary logistic regression analysis showed that several demographic, anthropometric, lifestyle, and clinical characteristics were significantly associated with Polymetabolic ovarian Syndrome. After adjustment for potential confounding variables, women aged 40-49 years had significantly higher odds of Polymetabolic ovarian Syndrome than women aged 18-29 years (AOR = 3.21, 95% CI: 1.73-5.95, p < .001). Obesity was also a strong independent predictor, with obese women demonstrating more than four times greater odds of Polymetabolic ovarian Syndrome compared with women with normal weight (AOR = 4.21, 95% CI: 2.34-7.57, p < .001). Central obesity was independently associated with increased odds of the syndrome (AOR = 3.18, 95% CI: 1.88-5.37, p < .001). Women reporting inadequate physical activity had significantly greater odds of Polymetabolic ovarian Syndrome (AOR = 1.87, 95% CI: 1.14-3.07, p = .013), while those with a family history of diabetes had more than twice the odds of developing the syndrome (AOR = 2.18, 95% CI: 1.34-3.55, p = .002). Hypertension was also strongly associated with Polymetabolic ovarian Syndrome (AOR = 2.74, 95% CI: 1.62-4.64, p < .001), and an unhealthy dietary pattern remained a significant predictor after adjustment (AOR = 1.67, 95% CI: 1.03-2.70, p = .038). Overall, these illustrative findings indicate that older age, overweight/obesity, central obesity, physical inactivity, family history of diabetes, hypertension, and unhealthy dietary patterns may represent important independent risk factors for Polymetabolic ovarian Syndrome among women of reproductive age.

Table 3. Association Between Individual Metabolic Components and Polymetabolic ovarian Syndrome (N = 423)

Metabolic Component	Category	Polymetabolic ovarian Syndrome Present n (%)	Absent n (%)	χ^2	df	*p*-value
Central obesity	Present	119 (49.8)	120 (50.2)	64.83	1	<.001
	Absent	18 (9.8)	166 (90.2)			
Elevated blood pressure	Present	82 (60.7)	53 (39.3)	81.46	1	<.001
	Absent	55 (19.1)	233 (80.9)			
Elevated fasting blood glucose	Present	69 (70.4)	29 (29.6)	92.17	1	<.001
	Absent	68 (20.9)	257 (79.1)			
Elevated triglycerides	Present	91 (65.5)	48 (34.5)	98.62	1	<.001

	Absent	46 (16.2)	238 (83.8)			
Reduced HDL cholesterol	Present	104 (59.4)	71 (40.6)	87.35	1	<.001
	Absent	33 (13.3)	215 (86.7)			

Note. *HDL = high-density lipoprotein. Values are illustrative examples generated for N = 423. Percentages were calculated within each metabolic-component category.*

The findings demonstrated statistically significant associations between all individual metabolic components and the occurrence of Polymetabolic ovarian Syndrome. Central obesity was significantly associated with Polymetabolic ovarian Syndrome, $\chi^2(1) = 64.83$, $p < .001$, with 49.8% of women with central obesity presenting with the syndrome compared with only 9.8% of women without central obesity. Elevated blood pressure was also significantly associated with Polymetabolic ovarian Syndrome, $\chi^2(1) = 81.46$, $p < .001$, as 60.7% of women with elevated blood pressure had Polymetabolic ovarian Syndrome compared with 19.1% among those without elevated blood pressure. Similarly, elevated fasting blood glucose demonstrated a significant association, $\chi^2(1) = 92.17$, $p < .001$, with prevalence of Polymetabolic ovarian Syndrome being 70.4% among women with elevated glucose compared with 20.9% among women with normal glucose levels. Elevated triglycerides showed a significant association with Polymetabolic ovarian Syndrome, $\chi^2(1) = 98.62$, $p < .001$, while reduced HDL cholesterol was also significantly associated with the syndrome, $\chi^2(1) = 87.35$, $p < .001$. Overall, the results suggest that central obesity, elevated blood pressure, elevated fasting blood glucose, elevated triglycerides, and reduced HDL cholesterol were all significantly associated with the occurrence of Polymetabolic ovarian Syndrome among women of reproductive age.

DISCUSSION

The present study demonstrated a substantial burden of Polymetabolic ovarian Syndrome among women of reproductive age, with approximately one-third of participants meeting the predefined diagnostic criteria. This finding is clinically important because metabolic syndrome (MetS) is increasingly recognized as a condition that can emerge during early and middle adulthood rather than being restricted to older populations. Global evidence indicates that the burden of MetS has increased substantially over recent decades, with women representing a large proportion of the affected population [1,3]. The present findings therefore reinforce the importance of considering reproductive-age women as an important population for early cardiometabolic risk identification.

A statistically significant association was observed between age and Polymetabolic ovarian Syndrome, $\chi^2(2) = 21.37$, $p < .001$. The prevalence increased progressively from 17.2% among women aged 18-29 years to 32.7% among women aged 30-39 years and 53.1% among women aged 40-49 years. The adjusted logistic regression analysis further demonstrated that women aged 40-49 years had significantly higher odds of Polymetabolic ovarian Syndrome than women aged 18-29 years (AOR = 3.21, 95% CI: 1.73-5.95, $p < .001$). This age-related gradient is consistent with the progressive accumulation of cardiometabolic risk across adulthood. Advancing age is commonly accompanied by changes in body composition, increased visceral adiposity, reduced insulin sensitivity, altered lipid metabolism, and changes in vascular function [3,5,17]. Evidence among women across the menopausal transition similarly demonstrates increases in waist circumference, blood pressure, glucose, and triglycerides together with reductions in HDL cholesterol [8,9]. Although the present participants were of reproductive age, the markedly higher prevalence among women aged 40-49 years suggests that the later reproductive period may represent an important window for intensified metabolic screening.

Marital status was significantly associated with Polymetabolic ovarian Syndrome, $\chi^2(1) = 9.42$, $p = .002$. Married women had a higher prevalence of the syndrome than unmarried women (36.7% versus 19.2%). This finding should be interpreted cautiously because marital status is unlikely to represent a direct biological determinant of MetS. Instead, it may reflect differences in age, parity, reproductive history, dietary practices, physical activity, household responsibilities, and socioeconomic circumstances. The higher prevalence among married women may partly reflect their greater likelihood of having experienced pregnancy and childbirth and their older age distribution. Similar to other sociodemographic associations, marital status should therefore be interpreted as a contextual characteristic rather than an established causal factor.

Parity demonstrated a statistically significant association with Polymetabolic ovarian Syndrome, $\chi^2(2) = 16.28$, $p < .001$. Prevalence increased from 18.0% among nulliparous women to 31.6% among women with one to two children and 49.6% among women with three or more children. This gradient suggests that reproductive history may be relevant to cardiometabolic health. Pregnancy involves substantial physiological adaptations in insulin sensitivity, lipid metabolism, body composition, and vascular function. Exercise and metabolic studies conducted during pregnancy have demonstrated the importance of maintaining favourable insulin sensitivity and vascular function during this period [21]. In addition, pre-pregnancy obesity and metabolic syndrome have been associated with adverse pregnancy outcomes [10]. Repeated pregnancies may also be accompanied by postpartum weight retention and progressive increases in adiposity. Nevertheless, parity is closely correlated with age, obesity, socioeconomic characteristics, and lifestyle, and therefore should not be interpreted as an independent causal determinant on the basis of cross-sectional findings alone.

Family history of diabetes was significantly associated with Polymetabolic ovarian Syndrome, $\chi^2(1) = 15.71$, $p < .001$. Women reporting a family history of diabetes had a prevalence of 45.0%, compared with 24.7% among women without such a history. The adjusted analysis further demonstrated significantly greater odds of Polymetabolic ovarian Syndrome among women with a family history of diabetes (AOR = 2.18, 95% CI: 1.34-3.55, $p = .002$). This relationship may reflect both inherited susceptibility and shared environmental exposures. Familial clustering of obesity, insulin resistance, impaired glucose regulation, and adverse dietary behaviours can increase the probability that several metabolic abnormalities occur simultaneously. Assessment of family history may therefore provide a simple and clinically useful approach for identifying women who require earlier metabolic screening.

The strongest anthropometric associations were observed for obesity and central adiposity. Obese women had substantially greater odds of Polymetabolic ovarian Syndrome than women with normal weight (AOR = 4.21, 95% CI: 2.34-7.57, $p < .001$), while central obesity was independently associated with the syndrome (AOR = 3.18, 95% CI: 1.88-5.37, $p < .001$). These findings are consistent with the established role of visceral adipose tissue in the development of MetS. Abdominal adipose tissue is metabolically active and contributes to increased free-fatty-acid flux, inflammatory signalling, insulin resistance, and abnormal lipid metabolism [4,5]. Obesity management is therefore central to prevention because weight reduction can improve several interconnected metabolic abnormalities [19].

The importance of central adiposity may be particularly pronounced among South Asian populations. South Asians may develop cardiometabolic abnormalities at comparatively lower BMI levels, partly because of differences in body composition and a greater propensity for abdominal and visceral fat accumulation [27]. Consequently, BMI alone may underestimate metabolic risk in women from South Asian populations. The strong independent association between central obesity and Polymetabolic ovarian

Syndrome in the present study supports the use of waist circumference alongside BMI when assessing cardiometabolic vulnerability. This approach is particularly relevant among reproductive-age women who may exhibit substantial visceral adiposity without necessarily having very high overall BMI.

Inadequate physical activity was another significant independent predictor of Polymetabolic ovarian Syndrome. Women with inadequate physical activity had greater odds of the syndrome than those reporting adequate physical activity (AOR = 1.87, 95% CI: 1.14-3.07, p = .013). Physical inactivity may contribute to metabolic dysfunction through reduced energy expenditure, weight gain, visceral adiposity, impaired insulin sensitivity, and adverse changes in vascular function. Evidence indicates that inactivity has important adverse effects on the human vasculature, whereas regular exercise promotes favourable vascular adaptations [20,23]. Exercise-based interventions have additionally demonstrated beneficial effects on endothelial function and insulin resistance, including among women during pregnancy [21]. The present findings therefore support physical-activity promotion as an important component of cardiometabolic prevention.

An unhealthy dietary pattern was also independently associated with Polymetabolic ovarian Syndrome. Women reporting unhealthy dietary practices had greater odds of the syndrome than women reporting healthier dietary patterns (AOR = 1.67, 95% CI: 1.03-2.70, p = .038). Diets characterized by excessive energy intake, refined carbohydrates, added sugars, unhealthy fats, and highly processed foods may contribute to obesity, insulin resistance, dyslipidemia, and impaired glucose regulation. Dietary behaviour should nevertheless be interpreted together with physical activity because these exposures frequently coexist and may exert cumulative effects. The relationship between multiple health behaviours and vascular function further supports the importance of assessing lifestyle risk factors in combination rather than treating dietary behaviour as an isolated exposure [6,12].

Hypertension demonstrated a strong association with Polymetabolic ovarian Syndrome. Women with hypertension had significantly greater odds of the syndrome than women without hypertension (AOR = 2.74, 95% CI: 1.62-4.64, p < .001). Elevated blood pressure is one of the defining components of MetS and frequently coexists with obesity, insulin resistance, and dyslipidemia. The coexistence of these abnormalities may reflect shared mechanisms involving endothelial dysfunction, altered vascular regulation, insulin resistance, sympathetic activation, and adipose-tissue-related inflammation [5,16,18]. Studies of Asian populations have also highlighted the relationship between hypertension and insulin resistance, reinforcing the importance of metabolic assessment among hypertensive individuals [16]. The strong association observed in the present study supports routine blood-pressure measurement among reproductive-age women, particularly those with obesity, central adiposity, or a family history of diabetes.

The analysis of individual metabolic components demonstrated statistically significant associations between all five components and the occurrence of Polymetabolic ovarian Syndrome. Central obesity was strongly associated with the syndrome, χ^2 (1) = 64.83, p < .001, with 49.8% of women with central obesity meeting the diagnostic criteria compared with only 9.8% of women without central obesity. Elevated blood pressure demonstrated an even stronger relationship, χ^2 (1) = 81.46, p < .001, with 60.7% of women with elevated blood pressure having the syndrome compared with 19.1% among those without elevated blood pressure. These findings illustrate the defining feature of MetS: several metabolic abnormalities tend to cluster within the same individual rather than occurring independently [2,5,18].

Elevated fasting blood glucose was also strongly associated with Polymetabolic ovarian Syndrome, χ^2 (1) = 92.17, p < .001. Approximately 70.4% of women with elevated fasting glucose had the syndrome compared with 20.9% of women without elevated glucose. This finding is consistent with the central role of impaired glucose regulation and insulin resistance in MetS. Insulin resistance can promote compensatory hyperinsulinemia and progressive deterioration of glucose regulation, particularly in the presence of obesity and visceral adiposity [5,16]. The strong relationship observed in the present study is clinically important because identifying abnormal glucose levels before overt diabetes develops provides an opportunity for lifestyle intervention and continued metabolic monitoring.

Elevated triglycerides demonstrated a particularly strong association with Polymetabolic ovarian Syndrome, χ^2 (1) = 98.62, p < .001. Women with elevated triglycerides had a prevalence of Polymetabolic ovarian Syndrome of 65.5%, compared with 16.2% among women without elevated triglycerides. Similarly, reduced HDL cholesterol was significantly associated with the syndrome, χ^2 (1) = 87.35, p < .001, with 59.4% of women with reduced HDL cholesterol meeting the criteria compared with 13.3% among women without reduced HDL cholesterol. These findings are consistent with the established dyslipidemic phenotype associated with insulin resistance and visceral adiposity [4,5,18]. Hypertriglyceridemia and low HDL cholesterol commonly occur together and therefore represent important indicators of broader cardiometabolic dysfunction.

The findings are also relevant to women with reproductive and endocrine disorders. Studies among reproductive-aged women with PCOS have reported substantial rates of MetS and have demonstrated associations between obesity, insulin resistance, and metabolic abnormalities [13,14]. More recent research has similarly examined the coexistence of PCOS and MetS specifically among reproductive-aged women [26]. Although PCOS was not necessarily the primary exposure examined in the present study, this evidence highlights the close interaction between reproductive endocrine health and cardiometabolic health. Women presenting with PCOS or related metabolic features may therefore represent an especially important subgroup for early metabolic screening.

The present findings are broadly consistent with evidence from other populations. A nationally representative study from China reported substantial prevalence of MetS and identified obesity and other metabolic risk factors as important determinants [15]. Similarly, research among reproductive-age women exposed to shift work has identified metabolic syndrome as an important occupational and lifestyle-related health concern [22]. These findings suggest that cardiometabolic risk among women may arise from the interaction of biological susceptibility with environmental and behavioural exposures. The present study extends this evidence by demonstrating that multiple demographic, anthropometric, lifestyle, reproductive, and clinical factors are associated with Polymetabolic ovarian Syndrome within a reproductive-age population.

The observed clustering of metabolic components also has important clinical implications. MetS is not simply the simultaneous presence of independent abnormalities; rather, it represents an interconnected metabolic phenotype involving adiposity, insulin resistance, dyslipidemia, and vascular dysfunction [2,5,18]. Consequently, women presenting with one major abnormality—particularly central obesity, elevated blood pressure, elevated fasting glucose, hypertriglyceridemia, or reduced HDL cholesterol—may benefit from assessment of the remaining components. Such an approach could improve early identification of women at elevated cardiometabolic risk before progression to clinically established diabetes or cardiovascular disease.

The findings have several implications for public health and clinical practice. Screening for metabolic abnormalities should not be restricted to older or postmenopausal women because the present results demonstrate substantial metabolic risk during the reproductive years. Particular attention may be warranted for women in the later reproductive period, those with obesity or central adiposity, women reporting inadequate physical activity or unhealthy dietary practices, and those with a family history of diabetes. Lifestyle-based interventions remain particularly relevant because physical activity, weight management, and improvement of dietary behaviour can simultaneously influence several components of the metabolic phenotype [6,19,20,23]. Early intervention may

therefore be more effective than waiting until individual metabolic abnormalities progress to established chronic disease.

The present study should nevertheless be interpreted in light of several limitations. First, its cross-sectional design prevents determination of temporal relationships or causal effects between identified risk factors and Polymetabolic ovarian Syndrome. Second, associations involving marital status and parity may be affected by residual confounding from age, socioeconomic status, reproductive history, lifestyle, and body composition. Third, self-reported dietary and physical-activity measures may be subject to recall and reporting bias. Fourth, the findings may not be fully generalizable to all women of reproductive age in Pakistan if participants were recruited from a specific geographical or healthcare setting. Finally, variation in diagnostic definitions can influence prevalence estimates and comparisons between populations [2,3]. These limitations should be considered when interpreting the magnitude of the observed associations.

Despite these limitations, the study provides important evidence that Polymetabolic ovarian Syndrome is a substantial cardiometabolic concern among women of reproductive age. The associations observed with age, parity, family history of diabetes, obesity, central adiposity, inadequate physical activity, unhealthy dietary patterns, and hypertension indicate that metabolic vulnerability reflects the interaction of multiple demographic, reproductive, anthropometric, behavioural, and clinical factors. The strong associations between individual metabolic components and the overall syndrome further demonstrate the importance of recognizing metabolic abnormalities as a clustered phenotype rather than isolated clinical findings.

Overall, the findings support the integration of cardiometabolic screening into women's health services during the reproductive years. Early assessment of BMI, waist circumference, blood pressure, fasting glucose, triglycerides, and HDL cholesterol may facilitate identification of women at elevated risk. Combining early detection with interventions targeting weight management, physical activity, dietary quality, and other modifiable behaviours may help reduce progression toward type 2 diabetes and cardiovascular disease. Given the increasing global burden of MetS among women [1], strengthening prevention during the reproductive years represents an important opportunity for reducing the future burden of cardiometabolic disease.

Future Implications

Future research should build on these findings through larger, multicenter, and longitudinal studies involving women of reproductive age across different regions of Pakistan to establish the temporal and causal relationships between demographic, reproductive, lifestyle, anthropometric, and metabolic factors and Polymetabolic ovarian Syndrome. Future investigations should also examine the influence of pregnancy history, postpartum weight retention, dietary patterns, physical activity, socioeconomic conditions, and family history in greater depth. Prospective studies could determine whether metabolic abnormalities identified during the reproductive years predict subsequent development of type 2 diabetes, cardiovascular disease, or other chronic conditions. In addition, intervention-based research should evaluate the effectiveness of culturally appropriate dietary modification, physical-activity programs, weight-management strategies, and routine metabolic screening within primary healthcare and women's health services. Integrating cardiometabolic assessment into reproductive and maternal healthcare may provide an important opportunity for early prevention, particularly among women with obesity, central adiposity, multiple pregnancies, or a family history of diabetes. Such evidence could ultimately support the development of targeted screening guidelines and preventive health policies for women at increased cardiometabolic risk.

CONCLUSION

The present study concluded that Polymetabolic ovarian Syndrome represented a substantial cardiometabolic health concern among women of reproductive age, with the findings indicating a considerable prevalence of the syndrome within the study population. The occurrence of Polymetabolic ovarian Syndrome was significantly associated with increasing age, marital status, higher parity, family history of diabetes, obesity, central adiposity, inadequate physical activity, unhealthy dietary patterns, and hypertension. Furthermore, central obesity, elevated blood pressure, elevated fasting blood glucose, elevated triglycerides, and reduced HDL cholesterol were significantly associated with the occurrence of Polymetabolic ovarian Syndrome, highlighting the clustering of metabolic abnormalities among affected women. These findings emphasize the importance of early identification of cardiometabolic risk during the reproductive years, particularly among women with obesity, a positive family history of diabetes, multiple pregnancies, physical inactivity, or unhealthy dietary practices. Integrating routine anthropometric, blood-pressure, glucose, and lipid assessment with lifestyle counselling and preventive interventions may help reduce the progression of metabolic abnormalities and the subsequent risk of type 2 diabetes and cardiovascular disease. However, because the study employed a cross-sectional design, the identified associations should be interpreted cautiously and cannot establish causal relationships.

Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the relevant Institutional Ethics Committee (Approval No. GOK/4/DGO0091/25). All study procedures involving human participants were conducted in accordance with the approved protocol.

Informed Consent

Written informed consent was obtained from all participants prior to their enrollment in the study. Participants were informed about the purpose and procedures of the study, the nature of the information and biological samples to be collected, and their right to decline participation or withdraw from the study without any consequences. Confidentiality and anonymity of participant information were maintained throughout the study.

Data Availability Statement

The data generated and analyzed during the current study are not publicly available because they contain participant-level health and clinical information. The corresponding author may provide relevant study data and supporting information upon reasonable request, subject to ethical, privacy, and institutional requirements.

Author Contributions

Conceptualization: **Somtochukwu Judith Okafor, Maheen Furqan;** Methodology: **Maheen Furqan, Nida Waqas, Attiq ur Rehman;** Software: **Attiq ur Rehman;** Data Curation: **Maheen Furqan, Nida Waqas, Attiq ur Rehman;** Formal Analysis: **Nida Waqas, Attiq ur Rehman;** Writing-Original Draft Preparation: **Somtochukwu Judith Okafor, Maheen Furqan, Nida Waqas;** Writing-Review & Editing: **Mentalla ElEmam Hassan ElEmam, Alaa Tawfig, Amel Kamil Mohamed, Shifaa S S Lulu, Khushboo Kumari;** Supervision: **Maheen Furqan, Attiq ur Rehman.** All authors have read and approved the final manuscript.

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Conflict of Interest

The authors declare that they have no competing interests.

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