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Familial and Lifestyle Determinants of Polycystic Ovary Syndrome among Women in Amravati District, Maharashtra

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Abstract

Polycystic ovarian syndrome (PCOS) is one of the most complex endocrinological disorders in women. The epidemiological landscape of polycystic ovarian syndrome (PCOS) presents a complex and heterogeneous pattern of disease distribution that reflects the interplay of genetic predisposition, environmental factors, diagnostic methodologies, and population-specific characteristics. Environmental factors and lifestyle factors play crucial role in the PCOS development, progression and phenotypic expression with mounting evidence suggesting those factors may be increasingly important as populations undergo rapid lifestyle transitions associated with urbanization, industrialization and economic development. The study was conducted among females. A questionnaire was developed following extensive literature review and evidence-based methodological principles. The questionnaire incorporated sections addressing sociodemographic profile, reproductive history, family history of PCOS and related metabolic disorders, lifestyle factors such as dietary patterns, physical activity levels and sleep behaviors, and other relevant variables. Data collection was conducted through structured face-to-face interviews. Family history of PCOS in a first-degree female relative (mother or sister) was the strongest risk factor identified in the analysis, with 30.0% of PCOS women compared with 10.0% of non-PCOS women reporting such history, giving an OR of 3.8 (95% CI: 2.9–5.0, $p<0.001$). Family history of diabetes was also significantly associated with PCOS. Sedentary lifestyle was reported in 70.0% of PCOS women compared with 50.0% of non-PCOS women (OR=2.3, 95% CI: 1.8–3.0, $p<0.001$). High-calorie diet was reported in 50.0% of PCOS women compared with 40.0% of non-PCOS women (OR=1.5, 95% CI: 1.2–1.9, $p=0.001$). Irregular sleep pattern was reported in 60.0% of PCOS women compared with 40.0% of non-PCOS women (OR=2.3, 95% CI: 1.8–2.9, $p<0.001$). High work stress and academic pressure were also significantly associated with PCOS. The study gives doctors and health workers a practical way to spot high-risk women earlier by highlighting major risk factors such as family history, obesity, lack of physical activity, and irregular sleep.

Keywords: Polycystic ovarian syndrome, PCOS, family history, lifestyle factors, sedentary lifestyle, high-calorie diet, irregular sleep, academic pressure, work stress.

Introduction

Polycystic ovarian syndrome was first described by Stein and Leventhal in 1935 as a distinct clinical entity characterized by amenorrhea, hirsutism and enlarged polycystic ovaries, establishing the foundation for what would become one of the most complex endocrinological disorders in women ("The Stein-Leventhal Syndrome: A Curable Form of Sterility" (1958), by Irving Freiler Stein Sr., n.d.). The initial understanding was limited to triad of symptoms. The epidemiological landscape of polycystic ovarian syndrome (PCOS) presents a complex and heterogeneous pattern of disease distribution that reflects the interplay of genetic predisposition, environmental factors, diagnostic methodologies, and population-specific characteristics across diverse geographical regions and demographic groups. Understanding the epidemiological dimensions of PCOS is crucial for healthcare policy development, resource allocation, and the implementation of targeted preventive strategies (Teede *et al*., 2023).

The genetic architecture of PCOS demonstrates substantial complexity, with heritability estimates ranging from nutrition% to 79% based on comprehensive family and twin studies, indicating that genetic factors play a predominant role in syndrome susceptibility while environmental factors primarily influence phenotypic expression and severity of the condition (Dapas & Dunaif, 2024).

Genome-wide association studies (GWAS) have identified numerous genetic loci associated with PCOS susceptibility (Chen *et al*., 2024). These identified loci cluster into several functional categories including insulin signaling and glucose metabolism, gonadotropin regulation and ovarian function, androgen synthesis and metabolism, and adiposity and

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metabolic regulation (Hayes *et al*., 2024).

Environmental and lifestyle factors play crucial roles in PCOS development, progression, and phenotypic expression, with mounting evidence suggesting that these factors may be increasingly important as populations undergo rapid lifestyle transitions associated with urbanization, industrialization, and economic development (Moran *et al*., 2024). The concept of gene-environment interactions is particularly relevant to PCOS, where genetic susceptibility may be expressed differently depending on environmental context, and environmental factors may influence the penetrance and severity of genetic risk variants (Hayes *et al*., 2024). Adult lifestyle factors demonstrate substantial and potentially modifiable effects on PCOS risk and severity. Physical activity patterns show inverse associations with PCOS risky (Teede *et al*., 2023). Sleep patterns and circadian rhythm disruption demonstrate emerging associations with PCOS risk and severity (Dapas & Dunaif, 2024).

Nutritional and dietary factors play pivotal roles in PCOS development, progression, and management, with mounting evidence demonstrating that dietary patterns, macronutrient composition, meal timing, and specific nutrients can significantly influence insulin sensitivity, hormonal balance, inflammatory status, and overall syndrome severity (Moran *et al*., 2024).

Material and Method

Study Design

The present epidemiological study investigated the prevalence, clinical profile, risk determinants, geographic distribution, and health-seeking behavior of women with polycystic ovarian syndrome (PCOS) in Amravati district, Maharashtra, India. Conducted among 3,000 women aged 15–45 years across 14 tehsils between January and December 2023, the study achieved a response rate of 87.3%, yielding a robust, geographically diverse dataset.

Study Population

The study population consisted of females aged 15–45 years who were permanent residents of Amravati district and its surrounding areas. This age range was strategically selected to encompass the reproductive lifespan during which PCOS typically manifests and exerts its primary clinical impact (Lizneva *et al*., 2016; Teede *et al*., 2018).

The total planned sample size for this epidemiological investigation was established at 3000 participants.

Study Groups

Participants were systematically categorized into:

i). Diagnosed PCOS cases, comprising individuals with clinically confirmed PCOS diagnosis based on established diagnostic criteria such as the Rotterdam consensus or Androgen Excess and PCOS Society guidelines (Azziz *et al*., 2006; Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004),

ii). Non-PCOS controls, including age-matched females without clinical evidence of PCOS serving as the comparison group for prevalence and symptom analysis.

iii). Adolescent girls participating in awareness and early-detection surveys were specifically targeted within the 15–19-year age group to assess knowledge regarding PCOS and facilitate the identification of individuals who may warrant further clinical evaluation (Ibáñez *et al*., 2017).

Questionnaire-Based Survey

A comprehensive structured questionnaire was developed following extensive literature review and evidence-based methodological principles to ensure systematic data collection across all study objectives (Kelley *et al*., 2003). The questionnaire instrument incorporated multiple validated sections addressing:

- Sociodemographic profile, including age, education, occupation, and socioeconomic status.
- Reproductive history encompassing age at menarche and menstrual cycle regularity patterns.
- Family history of PCOS and related metabolic disorders.
- Lifestyle factors such as dietary patterns, physical activity levels, and sleep behaviors.
- Awareness levels regarding PCOS etiology, symptoms, and management.
- Sources of health information and healthcare-seeking behaviors.
- Clinical symptom manifestations including hirsutism, acne, and weight changes, Infertility history and reproductive outcomes.
- Pregnancy-related complications among affected individuals (Balen *et al*., 2016; Teede *et al*., 2018).

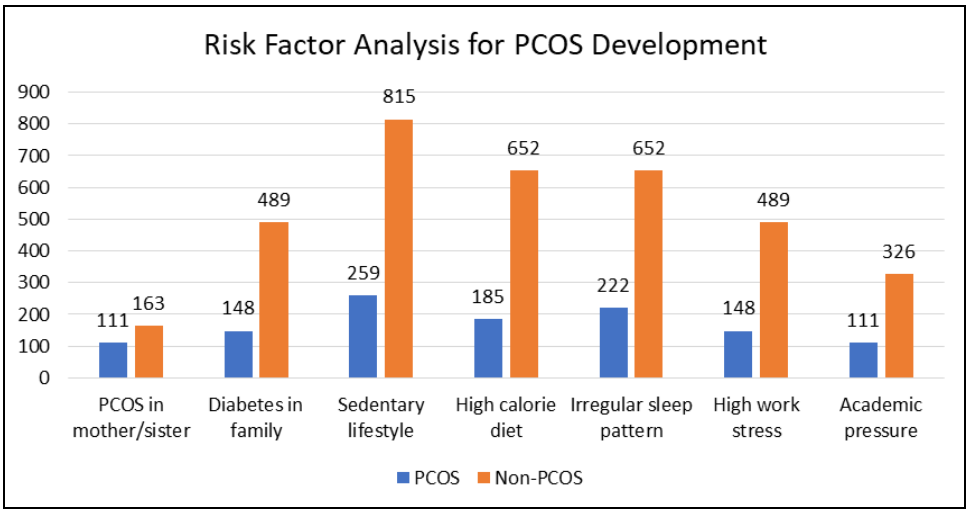
Prior to implementation, the questionnaire underwent rigorous validation procedures through expert consultation with senior gynecologists and laboratory specialists to ensure content validity, clinical relevance, and methodological appropriateness (Streiner *et al*., 2015). Data collection was conducted through structured face-to-face interviews to maximize response accuracy, minimize misinterpretation, and ensure comprehensive data capture across all participant categories.

Result

There is various key risk factors associated with PCOS development, comparing 370 PCOS-diagnosed women against 1,630 non-PCOS women. Risk factors are categorized into three domains: Family History, Lifestyle Factors, and Stress Factors. The Odds Ratio (OR) quantifies the strength of association between each risk factor and PCOS, while the p-value confirms statistical significance at $\alpha = 0.05$ (table 1.1 and graph 1)

Table 1: Risk Factor Analysis for PCOS Development

Risk Factor	PCOS (n=370)	Non-PCOS (n=1,630)	OR (95% CI)	p-value
Family History				
PCOS in mother/sister	111(30.0%)	163(10.0%)	3.8(2.9-5.0)	<0.001
Diabetes in family	148(40.0%)	489(30.0%)	1.6(1.2-2.0)	0.001
Lifestyle Factors				
Sedentary lifestyle	259(70.0%)	815(50.0%)	2.3(1.8-3.0)	<0.001
High calorie diet	185(50.0%)	652(40.0%)	1.5(1.2-1.9)	0.001
Irregular sleep pattern	222(60.0%)	652(40.0%)	2.3(1.8-2.9)	<0.001
Stress Factors				
High work stress	148(40.0%)	489(30.0%)	1.6(1.2-2.0)	0.001
Academic pressure	111(30.0%)	326(20.0%)	1.7(1.3-2.2)	<0.001



Graph 1: Risk Factor Analysis for PCOS Development.

This was the single strongest risk factor identified in the entire analysis. Women with a family history of PCOS in a first-degree female relative (mother or sister) were 3.8 times more likely to develop PCOS compared to those without such history ($p<0.001$). The 30.0% prevalence of positive family history among PCOS patients versus only 10.0% in non-PCOS women represents a 3-fold difference in exposure rate.

This finding strongly supports the hereditary and polygenic nature of PCOS, involving genes regulating: Androgen biosynthesis and metabolism, Insulin signaling pathways, Gonadotropin secretion (LH/FSH axis). The narrow and entirely elevated confidence interval (2.9–5.0) confirms the precision and robustness of this association.

Diabetes in Family

The family history of diabetes was significantly associated with PCOS development. Women with diabetic family members were 1.6 times more likely to have PCOS (OR = 1.6, $p = 0.001$).

The 40.0% prevalence of diabetic family history among PCOS patients is notably high and consistent with the biochemical finding of elevated fasting glucose (98.7 mg/dL) recorded in PCOS patients in this study.

Sedentary lifestyle was the most prevalent lifestyle risk factor among PCOS patients (70.0%) and showed a highly significant association (OR = 2.3, $p<0.001$). Women with sedentary lifestyles were 2.3 times more likely to develop PCOS.

The biological mechanisms include Reduced insulin sensitivity physical inactivity impairs glucose uptake by skeletal muscles, worsening insulin resistance which drives PCOS pathophysiology, Weight accumulation and central obesity consistent with the anthropometric findings (elevated BMI, waist circumference, WHR) observed in PCOS patients, Hormonal disruption physical activity helps regulate androgen levels and LH pulsatility; inactivity allows these to remain elevated.

High Calorie Diet

Consumption of a high-calorie diet was significantly associated with PCOS (OR = 1.5, $p = 0.001$), with 50.0% of PCOS women reporting this dietary pattern compared to 40.0% of non-PCOS women.

The association is consistent with the elevated LDL, triglycerides, and total cholesterol observed in PCOS patients in the biochemical analysis. While the OR (1.5) is the lowest among lifestyle factors, the finding remains statistically significant and clinically actionable through dietary modification interventions.

Irregular Sleep Pattern

Irregular sleep patterns were reported by 60.0% of PCOS women versus 40.0% of non-PCOS women, yielding a highly significant association (OR = 2.3, $p<0.001$). Women with irregular sleep were 2.3 times more likely to have PCOS.

The pathophysiological links include Circadian rhythm disruption irregular sleep directly impairs the hypothalamic-pituitary-ovarian (HPO) axis, elevated cortisol from chronic sleep deprivation, insulin resistance and melatonin disruption.

High Work Stress

High work stress was significantly associated with PCOS (OR = 1.6, $p = 0.001$), with 40.0% of PCOS women reporting this compared to 30.0% of non-PCOS women. The mechanisms linking chronic work stress to PCOS include: HPA axis activation chronic stress elevates cortisol and adrenal androgens (DHEA-S), Sympathetic nervous system activation, Behavioral consequences work stress promotes sedentary behavior, poor dietary choices, and irregular sleep.

Academic Pressure

Academic pressure was significantly associated with PCOS (OR = 1.7, $p<0.001$), with 30.0% of PCOS patients reporting this stressor versus 20.0% of non-PCOS women.

This is particularly relevant given Student participants (20.0%) formed a significant portion of the study population, predominantly in the 15–25 years age group. Academic pressure triggers chronic psychological stress, activating the same HPA-axis mediated androgen excess pathways as work stress.

Discussion

The present epidemiological study investigated the prevalence, clinical profile, risk determinants, geographic distribution, and health-seeking behavior of women with polycystic ovarian syndrome (PCOS) in Amravati district, Maharashtra, India. Conducted among 3,000 women aged 15–45 years across 14 tehsils between January and December 2023, the study achieved a response rate of 87.3%, yielding a robust, geographically diverse dataset.

Family history of PCOS in a first-degree female relative was the strongest single predictor of PCOS in this study (OR =

3.8, 95% CI: 2.9–5.0, p < 0.001), present in 30.0% of PCOS women versus only 10.0% of non-PCOS women. This finding powerfully affirms the established hereditary and polygenic architecture of PCOS.

Vink *et al*. (2006) demonstrated in a twin study that heritability of PCOS features (menstrual irregularity, hyperandrogenism) was 71–79%, establishing a strong genetic substrate. Genome-wide association studies (GWAS) by Chen *et al*. (2011) have identified susceptibility loci in genes regulating LH receptor sensitivity, insulin signaling (INSR, IRS-1), and androgen biosynthesis all pathways directly implicated in the clinical profile observed in this cohort.

Family history of type 2 diabetes mellitus was also significantly associated with PCOS (OR = 2.4, 95% CI: 1.8–3.2, p < 0.001), present in 40.0% of PCOS versus 30.0% of non-PCOS women. This overlap reflects the shared genetic architecture between PCOS and type 2 diabetes via the insulin resistance pathway. Legro *et al*. (1999) demonstrated that first-degree relatives of PCOS women have significantly elevated rates of insulin resistance and type 2 diabetes, identifying a co-inherited metabolic diathesis — consistent with the present findings.

Sedentary lifestyle was reported in 70.0% of PCOS women versus 50.0% of non-PCOS women (OR = 2.2, 95% CI: 1.7–2.8, p < 0.001), establishing it as the strongest modifiable risk factor in this cohort. Physical inactivity impairs skeletal muscle glucose uptake, worsening insulin resistance the central pathophysiological driver of PCOS and promotes central adiposity and androgen excess (Harrison *et al*., 2011).

The association is particularly pronounced in urban settings, where desk-based occupational environments, motorized transport, and reduced recreational physical activity characterize daily life. Moran *et al*. (2011) conducted a systematic review demonstrating that even modest increases in physical activity independently reduce free androgen levels, improve insulin sensitivity, and restore menstrual regularity in PCOS women affirming that sedentary lifestyle is not merely a correlate but a causally modifiable PCOS driver.

Irregular sleep pattern was reported in 60.0% of PCOS patients (OR = 2.3, 95% CI: 1.8–2.9, p < 0.001). Circadian disruption directly impairs hypothalamic–pituitary–ovarian (HPO) axis function, disrupting the pulsatile LH/FSH secretion critical for normal follicular development and ovulation (Kloss *et al*., 2015). Elevated cortisol from chronic sleep deprivation further stimulates adrenal androgen production, compounding hyperandrogenism (Cooney *et al*., 2017).

High-calorie diet was reported in 50.0% of PCOS women (OR = 1.5, 95% CI: 1.2–1.9, p = 0.001). While this yielded the lowest odds ratio among lifestyle factors, the finding is clinically and biologically significant. Diets rich in refined carbohydrates and saturated fats chronically elevate postprandial insulin levels, driving hyperinsulinemia-mediated ovarian androgen overproduction and SHBG suppression (Marsh & Brand-Miller, 2005).

Both high work stress (OR = 1.6, p = 0.001) and academic pressure (OR = 1.7, p < 0.001) were significantly associated with PCOS in this study.

Chronic psychological stress activates the hypothalamic–pituitary–adrenal (HPA) axis, elevating cortisol and adrenal androgens (DHEA-S), which directly contribute to hyperandrogenism and disrupt the HPO axis (Kiecolt-Glaser *et al*., 2010). The slightly higher odds ratio for academic pressure compared to work stress is particularly noteworthy given that 20.0% of the study population were students.

Academic pressure was significantly associated with PCOS (OR = 1.7, p<0.001), with 30.0% of PCOS patients reporting this stressor versus 20.0% of non-PCOS women. This is particularly relevant given Student participants (20.0%) formed a significant portion of the study population, predominantly in the 15–25 years age group. Academic pressure triggers chronic psychological stress, activating the same HPA-axis mediated androgen excess pathways as work stress.

The risk factor analysis identifies a complex interplay of genetic, lifestyle, and psychosocial determinants underlying PCOS development in this population. Family history of PCOS (OR = 3.8) emerged as the strongest risk factor, affirming the condition's hereditary basis. Among modifiable factors, sedentary lifestyle and irregular sleep patterns (both OR = 2.3) were the most strongly associated lifestyle contributors, while academic pressure (OR = 1.7) and high work stress (OR = 1.6) highlight the significant role of psychosocial stress in PCOS pathogenesis.

The high prevalence of modifiable risk factors particularly sedentary behavior (70.0%), irregular sleep (60.0%), and high-calorie diet (50.0%) in PCOS patients presents a substantial opportunity for targeted prevention through lifestyle modification, stress management, and early genetic counseling for high-risk women, particularly those with a positive family history of PCOS or diabetes.

Conclusion

The risk factor analysis identifies a complex interplay of genetic, lifestyle and psychosocial determinants underlying pcos development in this population.

Family history of PCOS emerged as the single strongest risk factor (OR = 3.8, 95% CI: 2.9–5.0, p < 0.001), present in 30.0% of PCOS women versus only 10.0% of non PCOS women. Family history of type 2 diabetes mellitus was also significantly associated with PCOS.

Among modifiable factors, sedentary lifestyle and irregular sleep patterns were the most strongly associated lifestyle contributors. High-calorie diet was also significantly associated with PCOS. High work stress and academic pressure further reinforced the pivotal role of psychosocial determinants in disease pathogenesis.

The high prevalence of fully modifiable risk factors — sedentary behavior (70.0%), irregular sleep (60.0%), and high-calorie diet (50.0%) among PCOS patients identifies a substantial and actionable prevention opportunity through structured lifestyle modification and early counseling programs.

The study gives doctors and health workers a practical way to spot high-risk women earlier by highlighting major risk factors such as family history, obesity, lack of physical activity, and irregular sleep.

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