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# Sociodemographic and Lifestyle Factors Associated with Clinical Symptoms of Polycystic Ovary Syndrome among Female Students at Ibb University, Yemen: An Analytical Cross-Sectional Study

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## Abstract

# Background

Polycystic ovary syndrome (PCOS) is a prevalent endocrinopathy affecting reproductive-aged women, yet comprehensive epidemiological data from conflict-affected settings like Yemen remain scarce.

# Objective

This study examined sociodemographic and lifestyle factors associated with PCOS-related clinical manifestations among female students at Ibb University, Yemen.

# Methods

In this analytical cross-sectional study, 386 female students were enrolled via simple random sampling. Data were collected using a self-administered questionnaire assessing sociodemographics, lifestyle factors (stress, sleep, physical activity), and six self-reported PCOS symptoms. The data were analyzed using SPSS 27 software. Results: Symptom prevalence: hair loss (68.4%), acne (46.6%), hormonal disorders (43.0%), hirsutism (32.6%), weight gain (31.3%), and menstrual irregularity (26.2%). Family history demonstrated a significant negative association with menstrual irregularity (aOR = 0.342, 95% CI: 0.207–0.566, p < 0.001), acne (aOR = 0.597, 95% CI: 0.390–0.915, p = 0.018), weight gain (aOR = 0.286, 95% CI: 0.179–0.459, p < 0.001), and hormonal disorders (aOR = 0.386, 95% CI: 0.245–0.608, p < 0.001). This counterintuitive protective association is potentially attributable to earlier health-seeking behaviors and heightened symptom awareness among students with affected relatives. Sleep difficulties were associated with hormonal disorders (aOR = 0.493, 95% CI: 0.320–0.759, p = 0.001). Rural residency protected against acne (aOR = 0.457, 95% CI: 0.225–0.925, p = 0.030) and hormonal disorders (aOR = 0.446, 95% CI: 0.204–0.974, p = 0.043). College affiliation was a predictor of menstrual irregularity (aOR = 3.242, 95% CI: 1.252–8.396, p = 0.015), weight gain (aOR = 2.734, 95% CI: 1.025–7.291, p = 0.044), and hormonal disorders (aOR = 2.582, 95% CI: 1.114–5.985, p = 0.027).

# Conclusion

Family history, sleep disturbances, and academic affiliation significantly predict PCOS symptomatology. The paradoxical protective effect of family history points out the urgent need for targeted screening and lifestyle interventions addressing sleep, stress, and health literacy in Yemeni university settings.

## Introduction

Polycystic ovary syndrome (PCOS) represents one of the most prevalent endocrine disorders affecting women of reproductive age globally, with profound implications for reproductive, metabolic, and psychological health. Characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology, PCOS affects an estimated 5% to 20% of women worldwide, depending upon the diagnostic criteria employed and the population under investigation. The condition is associated with a substantial burden of long-term health consequences, including type 2 diabetes mellitus, cardiovascular disease, infertility, and endometrial malignancy, rendering it a critical public health priority [1–2]. Recent global systematic reviews and meta-analyses have underscored the considerable heterogeneity in PCOS prevalence across geographical regions and ethnic groups, with estimates ranging from 6% to 26% among reproductive-aged women [3–]. The Global Burden of Disease Study has further documented the rising incidence of PCOS worldwide, emphasizing the urgent requirement for context-specific epidemiological research to inform prevention and management strategies [4].

Furthermore, PCOS constitutes a particularly significant reproductive health challenge in the Middle East and North Africa (MENA) region, with an overall rate of 11.9% and notably higher estimates of 18.8% observed among women in the Gulf Cooperation Council countries [5]. In Kuwait, a cross-sectional study among female health sciences university students reported a physician-diagnosed PCOS prevalence of 16.3%, with hyperprolactinemia, menstrual irregularities, family history, hirsutism, and male-pattern baldness emerging as significant associated factors [6]. The strong association between PCOS and obesity/overweight among reproductive-aged women in Saudi Arabia [7], the prevalence of PCOS was reported at 14.2% among female medical students at Taif University [8]. A

recent study from the United Arab Emirates documented a period prevalence of 1.6% among women aged 15–45 years attending a major women's hospital in Dubai [9]. In Egypt, Ibrahim et al. [10] examined phenotype characteristics and risk factors among nursing students at Zagazig University, identifying family history, obesity, and fast-food dietary habits as significant predisposing factors for PCOS. These regional findings collectively indicate that PCOS represents a substantial and growing burden among young women in the Arab world, yet considerable gaps remain in understanding the condition's epidemiology across diverse sociodemographic and cultural contexts.

In the Republic of Yemen, the epidemiological landscape of PCOS remains critically understudied, a situation compounded by the country's protracted armed conflict, collapsing healthcare infrastructure, and severe humanitarian crisis. Since 2014, Yemen has experienced one of the world's most severe humanitarian emergencies, with an estimated 18.2 million people requiring humanitarian assistance and 17.8 million individuals in need of health services [11]. The healthcare system is on the verge of collapse, and gender inequality severely restricts women's access to healthcare services [12]. Maternal mortality has reached 183 deaths per 100,000 live births—a devastating regression in maternal health outcomes—while malnutrition and anaemia remain rampant among women of reproductive age [13]. An estimated 75,000 pregnant Yemeni women are at risk of developing complications due to the dire state of health services in the country [14]. Within this fragile context, non-communicable endocrine disorders such as PCOS receive minimal attention, and the condition is likely to be underdiagnosed and undertreated, with affected women facing substantial barriers to accessing appropriate reproductive health care.

In Yemen, there is little available data showing the prevalence of PCOS, which was recorded at 26.7% among female students in Aden, highlighting the substantial burden of the condition in this population [15]. Additionally, in Sana'a, a 35% prevalence of metabolic syndrome was documented among PCOS patients, along with the identification of the most prevalent metabolic risk factors in this population [16]. These findings, while valuable, are limited by small sample sizes and restricted geographic scope. Notably, no published studies have examined the prevalence, clinical symptomatology, or associated sociodemographic and lifestyle factors of PCOS among female university students in Ibb Governorate, a region in central Yemen with distinct sociocultural and economic characteristics.

The clinical presentation of PCOS is heterogeneous, encompassing menstrual irregularities, hirsutism, acne, androgenetic alopecia, weight gain, and metabolic disturbances [17]. Understanding the factors associated with specific clinical symptoms is essential for developing targeted screening and intervention strategies, particularly in resource-limited settings where comprehensive diagnostic workup may be unavailable. Emerging evidence suggests that lifestyle factors—including dietary patterns, physical activity, sleep quality, and psychological stress—may play a significant role in the manifestation and severity of PCOS symptoms [15]. Specifically, sleep disturbances such as obstructive sleep apnea and excessive daytime sleepiness are notably more frequent among women with PCOS, with associated psychological and behavioral factors including anxiety and depression partly contributing to this relationship [18]. However, the relationship between these modifiable factors and specific PCOS symptomatology remains inadequately characterised, particularly in conflict-affected populations where nutritional transitions, psychological distress, and disrupted daily routines are prevalent.

Therefore, this study aims to examines the sociodemographic and lifestyle factors associated with clinical symptoms of polycystic ovary syndrome among female students at Ibb University, Yemen. Specifically, the study seeks to: (1) identify the prevalence of self-reported PCOS clinical symptoms among the study population; (2) examine the associations between these symptoms and sociodemographic factors; and (3) evaluate the relationships between lifestyle factors and the manifestation of specific PCOS symptoms.

## Methods

# Study Design, Setting, and Duration

This is an analytical cross-sectional study design that was conducted at Ibb University, located in Ibb Governorate, Yemen, over eight months, from January 1 to August 10, 2026. Ibb University is one of the largest public universities in the country, encompassing multiple colleges and attracting a diverse student body from both urban and rural areas. This design is particularly suitable for assessing the prevalence of clinical symptoms and identifying associated factors within a defined population at a single point in time [19].

## Study Population and Selection Criteria

The target population comprised 6,000 female undergraduate students officially enrolled at Ibb University for the 2025/2026 academic year, drawn from eight colleges: Human Medicine, Dentistry, Engineering, Education, Arts, Administrative Sciences, Computer Science, and Sharia and Law. Inclusion criteria required current enrollment in a bachelor's program, age between 19 and 28 years, and provision of informed consent. Students enrolled in postgraduate studies or two-year diploma programs were excluded.

## Sample Size

The minimum sample size was calculated using Cochran's formula for categorical data, assuming a 95% confidence level (Z = 1.96) and a 5% margin of error (d = 0.05) [20–21], yielding an initial estimate of 384 participants. Given the finite population (N = 6,000), the finite population correction (FPC) was applied [22], adjusting the sample to 361. To compensate for anticipated incomplete or invalid responses, the sample was oversampled by approximately 6.9%, establishing the final sample size at 386 eligible participants. This figure aligns with the Krejcie and Morgan [23] table for comparable populations and ensures a realized margin of error below 5% [24–25].

## Sampling technique

Simple random sampling (SRS) was employed as the primary probability sampling strategy. Participants were selected using an electronic questionnaire distributed to the target population. This method ensures that every individual has an equal and independent probability of selection, thereby minimizing selection bias and facilitating robust generalization of findings to the entire female student population at Ibb University [20, 26].

## Data Collection Tool

A structured, self-administered electronic questionnaire, requiring approximately 7–10 minutes for completion, was developed in English and subsequently translated into Arabic for final distribution. The instrument comprised three sections: (1) sociodemographic and academic characteristics (age, residence, marital status, family history, income, college, and academic level); (2) lifestyle factors (stress, sleep disturbances, and physical activity); and (3) self-reported PCOS-related clinical symptoms—including menstrual irregularity, hirsutism, acne, alopecia, weight gain, and hormonal disorders operationalized in alignment with National Institutes of Health (NIH) criteria and drawing upon previously validated instruments [6, 10, 27–29]. Items were formatted as dichotomous (yes/no) and multiple-choice questions. The final Arabic version was administered via a secure Google Forms link; unique personalized invitations were distributed through email, WhatsApp, and Telegram to uphold confidentiality and ensure independent participation.

# Validity and Reliability

# Validity

Content validity was established through a comprehensive review by a panel of three academic experts specializing in obstetrics, gynecology, and internal medicine. The panel assessed the relevance and representativeness of each item to the construct under investigation. The Content Validity Index (CVI) was calculated for all items, and only those achieving a CVI greater than 0.80 were retained, following the established criterion that new instruments should demonstrate at least 80% agreement among expert judges [30–31].

**Pilot Study**

a pilot study was conducted with a convenience sample of 30 female students from non-participating college(Agriculture) to evaluate the clarity, comprehensibility, and practicality of the instrument. Based on the pilot feedback, minor linguistic refinements were implemented. The pilot study responses were excluded from the final dataset to avoid any potential bias in the primary analysis.

## Reliability

The internal consistency of the seven-item dichotomous scale (coded as 0 = No, 1 = Yes) was assessed using Cronbach's alpha coefficient. The analysis, performed on the primary study sample (N = 386), yielded a Cronbach's alpha of 0.749. This value indicates acceptable internal consistency, as it exceeds the generally recommended threshold of 0.70 [32]. Given the binary nature of the responses, Cronbach's alpha in this context is statistically equivalent to the Kuder-Richardson Formula 20 (KR-20).

To further examine the scale's homogeneity, corrected item-total correlations were computed. The correlation coefficients between each individual item and the total summed score ranged from 0.442 to 0.691, and all were statistically significant at the $P < 0.01$ level. These robust correlations confirm that each item contributes meaningfully to the overall construct being measured. Collectively, these findings provide substantial evidence that the clinical symptoms scale possesses adequate reliability for use within the current study population.

# Date Analysis

Data were retrieved from Google Forms, exported to Microsoft Excel for initial validation, and subsequently imported into the Statistical Package for the Social Sciences (SPSS) for Windows, version 26.0 (IBM Corp., USA). The dataset underwent rigorous screening and cleaning to exclude erroneous entries and incomplete responses prior to formal analysis. Descriptive statistics, presented as frequencies and proportions, were computed to characterize the sample and summarize the prevalence of self-reported clinical symptoms. Bivariate associations between sociodemographic/lifestyle factors and each clinical symptom were assessed using the Chi-square test ($\chi^2$). Variables yielding a p-value < 0.20 in bivariate analysis were considered candidates for inclusion in multivariable logistic regression models to identify independent predictors of each symptom, following the purposeful selection method [33]. This relatively liberal entry threshold was adopted to minimize Type II errors, account for potential confounding, and maintain model parsimony without compromising predictive accuracy [33–34]. Variables exceeding this criterion were excluded to prevent overfitting and ensure model stability. The final models were derived using a backward stepwise elimination procedure, retaining only factors with $p < 0.05$. Results are reported as adjusted odds ratios (aOR) with 95% confidence intervals (95% CI) and corresponding p-values, with statistical significance set at $p < 0.05$ for all tests.

## Results

# Characteristics of participants

A total of 386 female students participated in this study. The predominant age group was 21–23 years (46.9%, n = 181); the majority resided in urban areas (90.4%, n = 349) and were single (89.1%, n = 344). Over one-third (35.2%, n = 136) reported a positive family history of PCOS, while moderate income was the most common (62.4%, n = 241). The College of Human Medicine constituted the largest proportion (28.0%, n = 108), followed by Administrative Sciences (18.4%, n = 71); second-year students were the most prevalent academic level (32.6%, n = 126). Psychosocial stress was nearly ubiquitous: 84.9% (n = 328) reported frequent (always/sometimes) experiences. Additionally, 42.5% (n = 164) of participants reported experiencing insomnia or difficulty sleeping. Physical activity levels were predominantly moderate (64.2%, n = 248). (Table 1).

Table 1
Characteristics of participants enrolled in this study (N = 386)

| Characteristics of Participants Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age Group | < 21 years | 141 | 36.5 |
| | 21–23 years | 181 | 46.9 |
| | > 23 years | 64 | 16.6 |
| Residence | Urban | 349 | 90.4 |
| | Rural | 37 | 9.6 |
| Marital Status | Single | 344 | 89.1 |
| | Married | 42 | 10.9 |
| Family History of PCOS | No | 250 | 64.8 |
| | Yes | 136 | 35.2 |
| Monthly Family Income | Low | 77 | 19.9 |
| | Moderate | 241 | 62.4 |
| | High | 68 | 17.6 |
| College | Human Medicine | 108 | 28.0 |
| | Dentistry | 36 | 9.3 |
| | Engineering | 13 | 3.4 |
| | Education | 33 | 8.5 |
| | Arts | 17 | 4.4 |
| | Administrative Sciences | 71 | 18.4 |
| | Computer Science | 48 | 12.4 |
| | Sharia and Law | 60 | 15.5 |
| Academic Level | Level 1 | 66 | 17.1 |
| | Level 2 | 126 | 32.6 |
| | Level 3 | 101 | 26.2 |
| | Level 4 | 93 | 24.1 |
| Lifestyle | | | |
| Stress and psychological pressure | Rarely | 58 | 15.0 |
| | Sometimes | 170 | 44.0 |
| | Always | 158 | 40.9 |
| Difficulty sleeping or insomnia | No | 222 | 57.5 |
| | Yes | 164 | 42.5 |
| Daily physical activity | Sedentary (sitting) | 78 | 20.2 |
| | Moderate | 248 | 64.2 |
| | Active (high effort) | 60 | 15.5 |

## Clinical symptoms of polycystic ovary syndrome

Among clinical manifestations, hair loss was the most prevalent symptom (68.4%, n = 264), followed by acne (46.6%, n = 180), hormonal disorders (43.0%, n = 166), hirsutism (32.6%, n = 126), excessive weight gain (31.3%, n = 121), and menstrual irregularities (26.2%, n = 101) (Fig. 1).

## Associations between Factors and PCOS-Related Symptoms

Menstrual Irregularity: Significant associations were observed with age group ($p = 0.024$), family history of PCOS ($p < 0.001$), and college affiliation ($p < 0.001$). Students aged > 23 years reported the highest prevalence (34.4%), while those with a positive family history had significantly higher rates (40.4% vs. 18.4%). Education college students reported the highest prevalence (60.6%), while dentistry students reported the lowest (11.1%). Hirsutism: Significant associations were found with age group ($p = 0.023$), family history ($p = 0.016$), and difficulty sleeping ($p = 0.038$). Students aged 21–23 years reported the highest prevalence (39.2%). Those with a positive family history had higher rates (40.4% vs. 28.4%). Difficulty sleeping was associated with higher hirsutism prevalence (38.4% vs. 28.4%). Acne: Significant associations were observed with residence ($p = 0.046$) and family history ($p = 0.024$). Rural residents reported higher acne prevalence (62.2% vs. 45.0%). Students with a positive family history had significantly higher rates (54.4% vs. 42.4%). Hair Loss: Significant associations were found with stress ($p = 0.006$) and difficulty sleeping ($p = 0.016$). Students who always experienced stress reported the highest prevalence (74.7%), while those who rarely experienced stress reported the lowest (51.7%). Difficulty sleeping was associated with higher hair loss prevalence (75.0% vs. 63.5%). Excessive Weight Gain: Family history showed the strongest association ($p < 0.001$), with students who had a positive family history reporting nearly double the prevalence (49.3% vs. 21.6%). The age group approached significance ($p = 0.086$). Hormonal Disorders: Significant associations were observed with residence ($p = 0.039$), family history ($p < 0.001$), college affiliation ($p = 0.039$), and difficulty sleeping ($p < 0.001$). Urban residents reported higher prevalence (44.7% vs. 27.0%). Students with a positive family history had significantly higher rates (57.4% vs. 35.2%). Administrative Sciences students reported the highest prevalence (60.6%). Difficulty sleeping was associated with higher hormonal disorder prevalence (53.7% vs. 35.1%) (Table 2).

Table 2
Factors associated with the clinical symptoms of polycystic ovary syndrome

| Variable Category | Menstrual Irregularity | | Hirsutism | | Acne | | Hair Loss | | Weight Gain | | Hormonal Disorders | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) |
| Age Group | | | | | | | | | | | | |
| < 21 years | 115 (81.6) | 26 (18.4) | 106 (75.2) | 35 (24.8) | 80 (56.7) | 61 (43.3) | 45 (31.9) | 96 (68.1) | 105 (74.5) | 36 (25.5) | 80 (56.7) | 61 (43.3) |
| 21–23 years | 128 (70.7) | 53 (29.3) | 110 (60.8) | 71 (39.2) | 90 (49.7) | 91 (50.3) | 52 (28.7) | 129 (71.3) | 122 (67.4) | 59 (32.6) | 105 (58.0) | 76 (42.0) |
| > 23 years | 42 (65.6) | 22 (34.4) | 44 (68.8) | 20 (31.3) | 36 (56.3) | 28 (43.8) | 25 (39.1) | 39 (60.9) | 38 (59.4) | 26 (40.6) | 35 (54.7) | 29 (45.3) |
| p-value | **0.024** | | **0.023** | | 0.402 | | 0.310 | | 0.086 | | 0.896 | |
| Residence | | | | | | | | | | | | |
| Urban | 253 (72.5) | 96 (27.5) | 232 (66.5) | 117 (33.5) | 192 (55.0) | 157 (45.0) | 112 (32.1) | 237 (67.9) | 236 (67.6) | 113 (32.4) | 193 (55.3) | 156 (44.7) |
| Rural | 32 (86.5) | 5 (13.5) | 28 (75.7) | 9 (24.3) | 14 (37.8) | 23 (62.2) | 10 (27.0) | 27 (73.0) | 29 (78.4) | 8 (21.6) | 27 (73.0) | 10 (27.0) |
| p-value | 0.066 | | 0.256 | | **0.046** | | 0.529 | | 0.180 | | **0.039** | |
| Marital Status | | | | | | | | | | | | |
| Single | 255 (74.1) | 89 (25.9) | 233 (67.7) | 111 (32.3) | 180 (52.3) | 164 (47.7) | 110 (32.0) | 234 (68.0) | 240 (69.8) | 104 (30.2) | 196 (57.0) | 148 (43.0) |
| Married | 30 (71.4) | 12 (28.6) | 27 (64.3) | 15 (35.7) | 26 (61.9) | 16 (38.1) | 12 (28.6) | 30 (71.4) | 25 (59.5) | 17 (40.5) | 24 (57.1) | 18 (42.9) |
| p-value | **0.707** | | **0.653** | | **0.240** | | **0.654** | | **0.177** | | **0.984** | |
| Family History | | | | | | | | | | | | |
| No | 204 (81.6) | 46 (18.4) | 179 (71.6) | 71 (28.4) | 144 (57.6) | 106 (42.4) | 81 (32.4) | 169 (67.6) | 196 (78.4) | 54 (21.6) | 162 (64.8) | 88 (35.2) |
| Yes | 81 (59.6) | 55 (40.4) | 81 (59.6) | 55 (40.4) | 62 (45.6) | 74 (54.4) | 41 (30.1) | 95 (69.9) | 69 (50.7) | 67 (49.3) | 58 (42.6) | 78 (57.4) |
| p-value | **< 0.001** | | **0.016** | | **0.024** | | 0.649 | | **< 0.001** | | **< 0.001** | |
| Monthly Income | | | | | | | | | | | | |
| Low | 56 (72.7) | 21 (27.3) | 52 (67.5) | 25 (32.5) | 41 (53.2) | 36 (46.8) | 18 (23.4) | 59 (76.6) | 55 (71.4) | 22 (28.6) | 42 (54.5) | 35 (45.5) |
| Moderate | 177 (73.4) | 64 (26.6) | 158 (65.6) | 83 (34.4) | 129 (53.5) | 112 (46.5) | 76 (31.5) | 165 (68.5) | 167 (69.3) | 74 (30.7) | 134 (55.6) | 107 (44.4) |
| High | 52 (76.5) | 16 (23.5) | 50 (73.5) | 18 (26.5) | 36 (52.9) | 32 (47.1) | 28 (41.2) | 40 (58.8) | 43 (63.2) | 25 (36.8) | 44 (64.7) | 24 (35.3) |
| p-value | 0.855 | | 0.465 | | 0.996 | | **0.071** | | 0.535 | | 0.363 | |
| College | | | | | | | | | | | | |
| Human Medicine | 87 (80.6) | 21 (19.4) | 79 (73.1) | 29 (26.9) | 65 (60.2) | 43 (39.8) | 43 (39.8) | 65 (60.2) | 78 (72.2) | 30 (27.8) | 71 (65.7) | 37 (34.3) |
| Dentistry | 32 (88.9) | 4 (11.1) | 25 (69.4) | 11 (30.6) | 15 (41.7) | 21 (58.3) | 13 (36.1) | 23 (63.9) | 28 (77.8) | 8 (22.2) | 18 (50.0) | 18 (50.0) |

| Variable Category | Menstrual Irregularity | | Hirsutism | | Acne | | Hair Loss | | Weight Gain | | Hormonal Disorders | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) |
| Engineering | 7 (53.8) | 6 (46.2) | 8 (61.5) | 5 (38.5) | 7 (53.8) | 6 (46.2) | 5 (38.5) | 8 (61.5) | 7 (53.8) | 6 (46.2) | 8 (61.5) | 5 (38.5) |
| Education | 13 (39.4) | 20 (60.6) | 15 (45.5) | 18 (54.5) | 15 (45.5) | 18 (54.5) | 13 (39.4) | 20 (60.6) | 16 (48.5) | 17 (51.5) | 18 (54.5) | 15 (45.5) |
| Arts | 13 (76.5) | 4 (23.5) | 14 (82.4) | 3 (17.6) | 9 (52.9) | 8 (47.1) | 2 (11.8) | 15 (88.2) | 10 (58.8) | 7 (41.2) | 11 (64.7) | 6 (35.3) |
| Administrative Sciences | 52 (73.2) | 19 (26.8) | 44 (62.0) | 27 (38.0) | 35 (49.3) | 36 (50.7) | 17 (23.9) | 54 (76.1) | 47 (66.2) | 24 (33.8) | 28 (39.4) | 43 (60.6) |
| Computer Science | 37 (77.1) | 11 (22.9) | 33 (68.8) | 15 (31.3) | 26 (54.2) | 22 (45.8) | 12 (25.0) | 36 (75.0) | 35 (72.9) | 13 (27.1) | 31 (64.6) | 17 (35.4) |
| Sharia and Law | 44 (73.3) | 16 (26.7) | 42 (70.0) | 18 (30.0) | 34 (56.7) | 26 (43.3) | 17 (28.3) | 43 (71.7) | 44 (73.3) | 16 (26.7) | 35 (58.3) | 25 (41.7) |
| p-value | **< 0.001** | | 0.100 | | 0.590 | | 0.130 | | 0.116 | | **0.039** | |
| Academic Level | | | | | | | | | | | | |
| Level 1 | 51 (77.3) | 15 (22.7) | 41 (62.1) | 25 (37.9) | 39 (59.1) | 27 (40.9) | 24 (36.4) | 42 (63.6) | 46 (69.7) | 20 (30.3) | 36 (54.5) | 30 (45.5) |
| Level 2 | 93 (73.8) | 33 (26.2) | 79 (62.7) | 47 (37.3) | 67 (53.2) | 59 (46.8) | 42 (33.3) | 84 (66.7) | 83 (65.9) | 43 (34.1) | 79 (62.7) | 47 (37.3) |
| Level 3 | 70 (69.3) | 31 (30.7) | 73 (72.3) | 28 (27.7) | 47 (46.5) | 54 (53.5) | 30 (29.7) | 71 (70.3) | 68 (67.3) | 33 (32.7) | 54 (53.5) | 47 (46.5) |
| Level 4 | 71 (76.3) | 22 (23.7) | 67 (72.0) | 26 (28.0) | 53 (57.0) | 40 (43.0) | 26 (28.0) | 67 (72.0) | 68 (73.1) | 25 (26.9) | 51 (54.8) | 42 (45.2) |
| p-value | 0.620 | | 0.250 | | 0.354 | | 0.658 | | 0.698 | | 0.471 | |
| Stress | | | | | | | | | | | | |
| Rarely | 44 (75.9) | 14 (24.1) | 44 (75.9) | 14 (24.1) | 30 (51.7) | 28 (48.3) | 28 (48.3) | 30 (51.7) | 42 (72.4) | 16 (27.6) | 41 (70.7) | 17 (29.3) |
| Sometimes | 123 (72.4) | 47 (27.6) | 109 (64.1) | 61 (35.9) | 86 (50.6) | 84 (49.4) | 54 (31.8) | 116 (68.2) | 120 (70.6) | 50 (29.4) | 95 (55.9) | 75 (44.1) |
| Always | 118 (74.7) | 40 (25.3) | 107 (67.7) | 51 (32.3) | 90 (57.0) | 68 (43.0) | 40 (25.3) | 118 (74.7) | 103 (65.2) | 55 (34.8) | 84 (53.2) | 74 (46.8) |
| p-value | 0.829 | | 0.256 | | 0.494 | | **0.006** | | 0.459 | | 0.065 | |
| Difficulty Sleeping | | | | | | | | | | | | |
| No | 169 (76.1) | 53 (23.9) | 159 (71.6) | 63 (28.4) | 127 (57.2) | 95 (42.8) | 81 (36.5) | 141 (63.5) | 159 (71.6) | 63 (28.4) | 144 (64.9) | 78 (35.1) |
| Yes | 116 (70.7) | 48 (29.3) | 101 (61.6) | 63 (38.4) | 79 (48.2) | 85 (51.8) | 41 (25.0) | 123 (75.0) | 106 (64.6) | 58 (35.4) | 76 (46.3) | 88 (53.7) |
| p-value | 0.233 | | **0.038** | | 0.079 | | **0.016** | | 0.144 | | **< 0.001** | |
| Physical Activity | | | | | | | | | | | | |
| Sedentary | 57 (73.1) | 21 (26.9) | 50 (64.1) | 28 (35.9) | 36 (46.2) | 42 (53.8) | 26 (33.3) | 52 (66.7) | 50 (64.1) | 28 (35.9) | 39 (50.0) | 39 (50.0) |
| Moderate | 181 (73.0) | 67 (27.0) | 165 (66.5) | 83 (33.5) | 138 (55.6) | 110 (44.4) | 78 (31.5) | 170 (68.5) | 168 (67.7) | 80 (32.3) | 146 (58.9) | 102 (41.1) |

| Variable Category | Menstrual Irregularity | | Hirsutism | | Acne | | Hair Loss | | Weight Gain | | Hormonal Disorders | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) | No n (%) | Yes n (%) |
| Active | 47 (78.3) | 13 (21.7) | 45 (75.0) | 15 (25.0) | 32 (53.3) | 28 (46.7) | 18 (30.0) | 42 (70.0) | 47 (78.3) | 13 (21.7) | 35 (58.3) | 25 (41.7) |
| p-value | 0.689 | | 0.359 | | 0.342 | | 0.913 | | 0.177 | | 0.376 | |

# Multivariable Logistic Regression

## Factors Associated with Menstrual Symptoms

For menstrual symptoms, family history demonstrated a significant negative association (*B* = -1.111, p < 0.001, OR = 0.329, 95% CI [0.201, 0.539]), indicating reduced odds of menstrual symptoms among participants with a positive family history. Regarding academic discipline, compared to the Sharia College reference group, Dentistry College students exhibited significantly lower odds (*B* = -1.269, p = 0.040, OR = 0.281, 95% CI [0.083, 0.946]), whereas Education College students demonstrated significantly higher odds (*B* = 1.313, p = 0.006, OR = 3.719, 95% CI [1.462, 9.461]). No significant associations were observed for Human Medicine, Engineering, Arts, Administrative Sciences, or Computer Science colleges (p > 0.05 for all).

## Factors Associated with Excessive Facial Hair and Spread

For excessive facial hair, family history was negatively associated (*B* = -0.531, p = 0.021, OR = 0.588, 95% CI [0.375, 0.924]). Age groups (< 21 years and 21–23 years) did not demonstrate significant associations when compared to the > 23 years' reference group (p = 0.478 and p = 0.199, respectively). Difficulty sleeping approached but did not reach statistical significance (p = 0.076). For symptom spread, urban residence was associated with decreased odds (*B* = -0.787, p = 0.029, OR = 0.455, 95% CI [0.225, 0.921]), and family history also demonstrated a negative association (*B* = -0.533, p = 0.014, OR = 0.587, 95% CI [0.383, 0.898]).

## Factors Associated with Hair Symptoms, Weight Gain, and General Symptoms

For hair symptoms, low monthly family income was positively associated compared to high income (*B* = 0.815, p = 0.027, OR = 2.260, 95% CI [1.095, 4.666]). Stress levels demonstrated significant associations: participants reporting rarely experiencing stress had lower odds compared to those always experiencing stress (*B* = -1.008, p = 0.002, OR = 0.365, 95% CI [0.194, 0.688]). The moderate income group and sometimes stress category did not reach statistical significance (p = 0.110 and p = 0.182, respectively). For weight gain, family history showed a strong negative association (*B* = -1.260, p < 0.001, OR = 0.284, 95% CI [0.181, 0.446]). For general symptoms, family history was negatively associated (*B* = -0.860, p < 0.001, OR = 0.423, 95% CI [0.273, 0.656]), and difficulty sleeping demonstrated a negative association (*B* = -0.752, p = 0.001, OR = 0.472, 95% CI [0.309, 0.720]). Residence did not reach statistical significance for general symptoms (p = 0.080) (Table 3).

Table 3
Factors associated with the clinical symptoms of PCOS (Multivariable Logistic Regression)

| Dependent Variable | Retained Predictor (Category) | B | p-value | OR (Exp(B)) | 95% CI for OR |
|---|---|---|---|---|---|
| Menstrual (N = 386) | Family history (Yes vs NO) | -1.111 | < 0.001 | 0.329 | [0.201, 0.539] |
| | College (Human Medicine vs Sharia) | -0.407 | 0.297 | 0.666 | [0.310, 1.431] |
| | College (Dentistry vs Sharia) | -1.269 | 0.040 | 0.281 | [0.083, 0.946] |
| | College (Engineering vs Sharia) | 0.925 | 0.154 | 2.523 | [0.707, 9.006] |
| | College (Education vs Sharia) | 1.313 | 0.006 | 3.719 | [1.462, 9.461] |
| | College (Arts vs Sharia) | -0.073 | 0.911 | 0.929 | [0.255, 3.384] |
| | College (Admin. Sci. vs Sharia) | -0.090 | 0.827 | 0.914 | [0.410, 2.039] |
| | College (Comp. Sci. vs Sharia) | -0.234 | 0.614 | 0.791 | [0.319, 1.965] |
| Excessive facial | Age group (< 21 vs > 23) | -0.241 | 0.478 | 0.786 | [0.404, 1.528] |
| | Age group (21–23 vs > 23) | 0.408 | 0.199 | 1.503 | [0.807, 2.802] |
| | Family history (Yes vs NO) | -0.531 | 0.021 | 0.588 | [0.375, 0.924] |
| | Difficulty sleeping (Yes vs NO) | -0.396 | 0.076 | 0.673 | [0.434, 1.043] |
| Spread | Residence (Urban vs Rural) | -0.787 | 0.029 | 0.455 | [0.225, 0.921] |
| | Family history (Yes vs NO) | -0.533 | 0.014 | 0.587 | [0.383, 0.898] |
| Hair | income (Low vs High) | 0.815 | 0.027 | 2.260 | [1.095, 4.666] |
| | income (Moderate vs High) | 0.461 | 0.110 | 1.585 | [0.901, 2.790] |
| | Stress (Rarely vs Always) | -1.008 | 0.002 | 0.365 | [0.194, 0.688] |
| | Stress (Sometimes vs Always) | -0.332 | 0.182 | 0.717 | [0.440, 1.169] |
| Weight gain | Family history (Yes vs NO) | -1.260 | < 0.001 | 0.284 | [0.181, 0.446] |
| General | Residence (Urban vs Rural) | 0.692 | 0.080 | 1.997 | [0.920, 4.335] |
| | Family history (Yes vs NO) | -0.860 | < 0.001 | 0.423 | [0.273, 0.656] |
| | Difficulty sleeping (Yes vs NO) | -0.752 | 0.001 | 0.472 | [0.309, 0.720] |

**B**: Unstandardized regression coefficient; **p-value**: Probability value; **OR**: Odds Ratio; **Exp(B)**: Exponentiated B (Odds Ratio); **CI**: Confidence Interval.

## Discussion

The principal findings of this study reveal that family history of PCOS emerged as the most consistent predictor across multiple symptom domains; however, paradoxically, it demonstrated significant negative associations with menstrual symptoms (aOR = 0.329, p < 0.001), excessive facial hair (aOR = 0.588, p = 0.021), symptom spread (aOR = 0.587, p = 0.014), weight gain (aOR = 0.284, p < 0.001), and general hormonal symptoms (aOR = 0.423, p < 0.001). This counterintuitive finding, while seemingly contradictory to the established literature identifying family history as a major risk factor [6, 35], may be attributed to several methodological and contextual factors specific to our study population. First, students with a positive family history are likely to possess greater health literacy and heightened awareness of PCOS symptomatology, which may prompt earlier healthcare-seeking behaviors, lifestyle modifications, and adherence to treatment—ultimately attenuating symptom severity at the time of survey completion. Second, the cross-sectional nature of our design precludes the assessment of temporal causality; it is plausible that students who developed severe symptoms in the context of a positive family history may have already sought medical care and were either less accessible for participation or had their symptoms effectively managed prior to enrollment. Third, the phenomenon of "healthy volunteer bias" cannot be excluded, whereby asymptomatic individuals with a family history may have been more willing to participate compared to those experiencing debilitating symptoms. Similar paradoxical protective associations have been documented in other chronic disease

epidemiology, where increased awareness within affected families leads to earlier diagnosis and secondary prevention [36]. Future prospective studies employing clinically confirmed diagnoses and objective symptom measures are warranted to disentangle these complex relationships.

Academic discipline demonstrated differential associations, with Education College students exhibiting significantly elevated odds of menstrual symptoms compared to the Sharia College reference group (aOR = 3.719, p = 0.006), while Dentistry students demonstrated reduced odds (aOR = 0.281, p = 0.040). These findings are consistent with emerging evidence indicating that the psychosocial demands and academic stressors inherent to specific disciplines may influence PCOS symptom expression through hypothalamic-pituitary-ovarian (HPO) axis dysregulation [37]. Teacher education programmes typically involve substantial practicum requirements, high-stakes performance evaluations, and significant emotional labor, all of which may contribute to chronic psychological stress and subsequent menstrual irregularities. In contrast, Dentistry students, who receive extensive biomedical training, may possess enhanced health literacy and self-management capacities, facilitating earlier symptom recognition and intervention.

Low monthly family income was significantly associated with increased odds of hair symptoms (aOR = 2.260, p = 0.027), reinforcing the role of socioeconomic disadvantage in PCOS morbidity. This aligns with the broader literature demonstrating that lower socioeconomic status exacerbates PCOS symptom burden through restricted access to nutritious food, reduced opportunities for physical activity, heightened psychological distress, and limited healthcare accessibility [38–39]. Within the Yemeni context characterized by protracted armed conflict, economic collapse, and pervasive food insecurity—these socioeconomic pathways are substantially amplified, rendering female students from low-income households particularly vulnerable to severe symptom manifestations.

Difficulty sleeping was significantly associated with general hormonal symptoms (aOR = 0.472, p = 0.001) and approached significance for excessive facial hair (p = 0.076). These findings are robustly supported by a growing body of evidence linking sleep disturbance to PCOS pathophysiology. Sleep deprivation activates the hypothalamic-pituitary-adrenal (HPA) axis, elevating cortisol levels, which subsequently stimulates adrenal androgen production and exacerbates insulin resistance key drivers of PCOS metabolic and reproductive disturbances [18, 41]. Furthermore, sleep disturbance is associated with reduced melatonin secretion, circadian misalignment, and increased sympathetic nervous system activity, all of which may contribute to the metabolic and endocrine aberrations characteristic of PCOS [42].

Urban residence was associated with reduced odds of symptom spread (aOR = 0.455, p = 0.029), suggesting that rural students experience more extensive acne manifestations. This finding is consistent with studies demonstrating that rural populations face greater barriers to dermatological and endocrine care, leading to delayed diagnosis and more advanced symptom progression [8]. In Yemen, the armed conflict has disproportionately affected rural areas, where healthcare infrastructure has collapsed and access to specialists remains severely limited. The high prevalence of clinical symptoms observed—particularly hair loss (68.4%), acne (46.6%), and hormonal disorders (43.0%)—reflects a substantial burden of PCOS-related morbidity in this population and underscores the urgent need for integrated reproductive health services within Yemeni universities.

Clinical and Public Health Implications: These findings carry several critical implications. First, family history assessment should be integrated into routine university health screenings to identify at-risk students who may benefit from early lifestyle counseling. Second, the strong associations between stress, sleep disturbance, and PCOS symptoms highlight the necessity of incorporating mental health services and sleep hygiene programs into university wellness initiatives. Third, the differential vulnerability observed across academic disciplines suggests that targeted screening and health education campaigns may be warranted for students in high-stress faculties (e.g., Education and Administrative Sciences). Fourth, socioeconomic disadvantage must be addressed through institutional policies that ensure equitable access to nutritional resources and healthcare services.

# Strengths and Limitations

This study possesses several notable strengths, including the use of a probability sampling strategy (simple random sampling), which enhances the generalizability of findings to the broader female student population at Ibb University, and the application of rigorous multivariable logistic regression to adjust for potential confounders. Furthermore, to the best of our knowledge, this is the first investigation to systematically examine the sociodemographic and lifestyle determinants of PCOS-related symptomatology among study subjects, thereby addressing a critical evidence gap in the Yemeni context.

However, several limitations must be acknowledged when interpreting these findings. The cross-sectional design precludes any causal inference, and the reliance on self-reported clinical symptoms—rather than physician-performed clinical or biochemical assessments—may introduce recall bias, social desirability bias, and potential misclassification of symptom status. Additionally, the study was conducted at a single university, which may limit the generalizability of findings to other regions or non-university populations in Yemen. The paradoxical protective association observed for family history warrants cautious interpretation and underscores the need for prospective cohort studies utilizing clinical diagnostic confirmation to elucidate the underlying mechanisms.

## Conclusions

In conclusion, this study demonstrates that modifiable lifestyle factors particularly stress management and sleep hygiene are significantly associated with PCOS symptomatology among female university students in Yemen, alongside non-modifiable factors such as family history and academic discipline. The counterintuitive protective effect of family history observed in this population likely reflects heightened health awareness and early treatment-seeking behaviors rather than a genuine biological protection, highlighting the critical role of health literacy in mitigating symptom burden. The alarmingly high prevalence of self-reported PCOS symptoms (especially hair loss, acne, and hormonal disorders) underscores the substantial, yet largely unrecognized, burden of this condition within Yemeni university settings. These findings collectively emphasize that PCOS should be prioritized within reproductive health agendas in conflict-affected, resource-limited settings, moving beyond a purely clinical entity to a public health priority requiring integrated, multi-sectoral interventions. Based on these findings, the following evidence-informed recommendations are proposed: (1) integrate routine, low-cost PCOS screening and lifestyle counseling (focusing on stress reduction, sleep hygiene, and nutritional guidance) into existing university health clinics, with particular attention to students in high-stress academic faculties; (2) develop and implement health education campaigns aimed at increasing PCOS awareness, symptom recognition, and health-seeking behaviors among female students and their families, leveraging peer-to-peer networks and digital platforms; (3) establish referral pathways between university health services and specialized endocrine and gynecological care within the local healthcare system; and (4) urgently conduct prospective cohort studies and randomized controlled trials with clinically confirmed PCOS diagnoses to establish causality, evaluate the long-term effectiveness of lifestyle interventions, and inform evidence-based clinical guidelines tailored to the Yemeni context.

## Abbreviations

**FPC**
Finite Population Correction
**WHO**
World Health Organization
**MENA**
Middle East and North Africa
**PCOS**
Polycystic Ovary Syndrome
**SRS**
Simple Random Sampling
**CVI**
Content Validity Index
**aOR**
Adjusted Odds Ratios
**95% CI**
95% Confidence Intervals
**p-value**
Probability Value
**HPO**
Hypothalamic-Pituitary-Ovarian
**HPA**
Hypothalamic-Pituitary-Adrenal
**SPSS**

Statistical Package for Social Sciences

## Declarations

# Ethics Declarations

**Ethics approval and consent to participate**

The study protocol and data collection instrument were approved by the Ibb University's Faculty of Medicine and Health Sciences (Approval No. IRB-IU-2025-042).It was conducted in accordance with Yemeni public health laws and regulations and the Declaration of Helsinki. an exemption from the requirement for informed consent was obtained from the committee. The questionnaire included a consent form that explained the purpose of the study and clarified that participation is completely voluntary. It also stated that personal information was not required, and data collection was anonymous to ensure the confidentiality of collected data. Moreover, no negative consequences would result if the prospective participant does not choose to participate.

# Clinical trial number

Not applicable.

# Consent for publication

Not applicable.

**Competing Interests**

Not applicable

**Conflict of interest**

The author declare that they have no competing interests

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# Author Contribution

Alrashed O and Shomais A conceived the study; Moqbel M, Edrees W, and Al-Shehari W collected and processed the data; Shomais A, Alrashed O, and Al-Shehari W analyzed and interpreted the data. Alrashed O, Moqbel M, and Shomais A wrote the first draft manuscript. Edrees W and Al-Shehari W reviewed and edited the final manuscript. All authors revised and approved the manuscript for submission.

# Data Availability

The datasets used and analyzed during the current study available from the corresponding author on reasonable request.

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## Figures

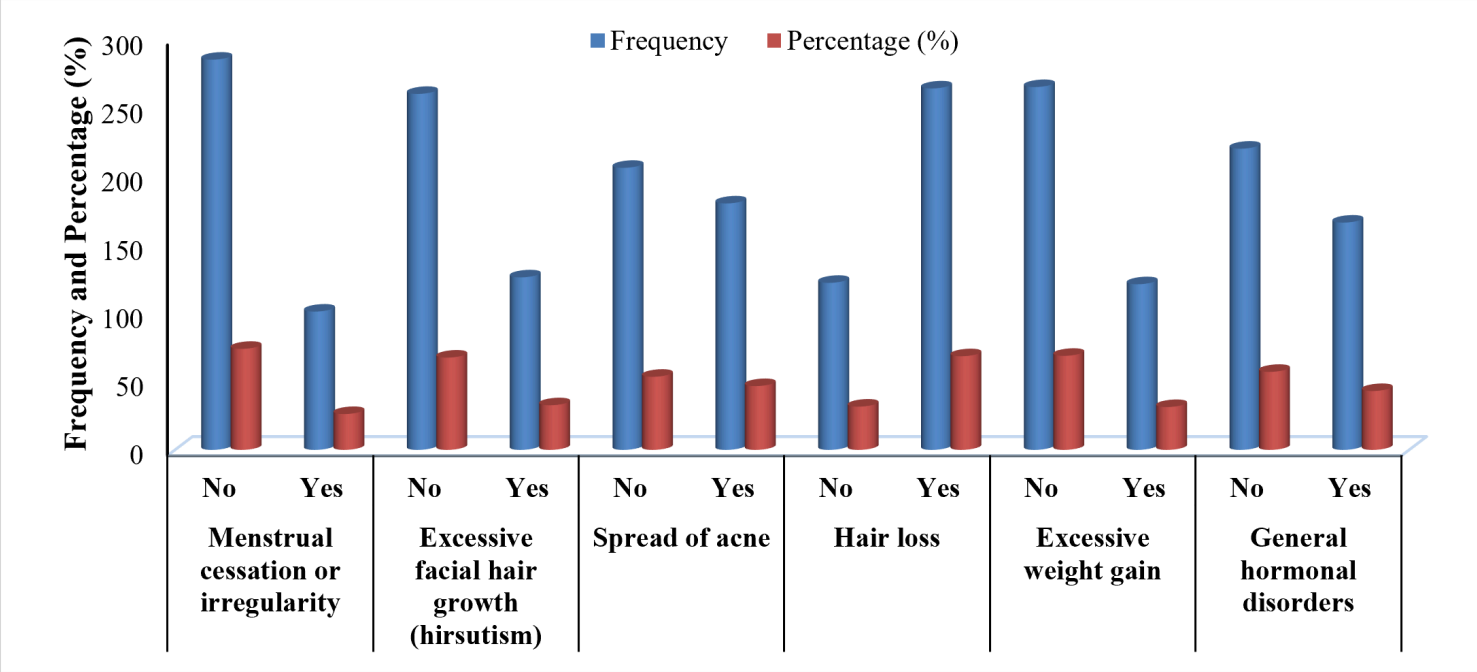



**Figure 1**

Clinical symptoms of polycystic ovary syndrome among participants (N = 386)

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile1.pdf