



Body mass index and its correlation with polycystic ovarian syndrome: Insights from a cross-sectional study among MBBS females at a tertiary care hospital.

Dr. Shailaja Moutam¹, Dr. Varada A. Hasamnis^{2*}, Dr. Chaganti Vijaya²

¹Postgraduate, Department of Obstetrics and Gynecology, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

²Assistant Professor, Department of Obstetrics and Gynecology, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India.

Abstract

Background:

Polycystic ovarian syndrome (PCOS) is a multifactorial endocrine disorder with rising global prevalence among reproductive-aged women. Body Mass Index (BMI) plays a significant role in modulating its clinical presentation.

Objectives:

To evaluate the correlation between BMI and PCOS prevalence and to determine the impact of BMI on clinical and anthropometric features among female medical students.

Methods:

A cross-sectional observational study was conducted at the Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, from November 2023 to November 2024. Two hundred female MBBS students aged ≥ 18 years were enrolled. PCOS was diagnosed using the Rotterdam criteria. Anthropometric parameters, including BMI, waist/hip ratio, and mid-arm circumference, were recorded, and clinical features such as hirsutism (mFG score), acne, alopecia, and acanthosis nigricans were assessed. Statistical analysis was performed using SPSS version 22.

Results:

The mean age of participants was 23.7 ± 3.6 years, with most belonging to the 18–25 year age group. Among 200 students, 74 (37%) were diagnosed with PCOS. The mean BMI, waist/hip ratio, mFG score, and mid-arm circumference were significantly higher in PCOS individuals. A high waist/hip ratio (>0.85) was seen in 70.2% of PCOS participants versus 33.3% of non-PCOS participants. Prevalence was greatest in obese individuals ($\text{BMI} \geq 30 \text{ kg/m}^2$), with features including menstrual irregularities, hirsutism (17.9% vs. 5.0%, $p = 0.025$), alopecia, and polycystic ovarian morphology. Some lean participants ($\text{BMI} 18.5\text{--}24.9 \text{ kg/m}^2$) also manifested PCOS, suggesting additional contributing factors.

Conclusion:

The prevalence of PCOS in this cohort was 37%, indicating a considerable burden among young female medical students. Increased BMI correlated strongly with PCOS severity, though normal-weight individuals also exhibited features, highlighting the roles of genetic and metabolic factors.

Recommendations:

Routine BMI screening and lifestyle interventions are essential for reproductive-aged women, irrespective of BMI, to reduce PCOS-related complications and long-term risks.

Keywords: Body Mass Index, Polycystic Ovarian Syndrome, Hirsutism, Hyperandrogenism, Waist-Hip Ratio, Polycystic Ovarian Morphology

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Corresponding Author: Dr. Varada A. Hasamnis

Email: drvaradahasamnis@gmail.com

Assistant Professor, Department of Obstetrics and Gynecology, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India.

Introduction

Polycystic Ovarian Syndrome (PCOS) is among the most common endocrine-metabolic conditions, affecting

nearly 6–10% of women in the reproductive age group worldwide, with a rising trend in younger populations, especially in academic and urban settings [1,2]. The

disorder is defined by the Rotterdam 2003 criteria, which require the presence of ovulatory dysfunction, evidence of hyperandrogenism (clinical or biochemical), and characteristic polycystic ovarian morphology [3].

Body Mass Index (BMI) has been recognized as a key, modifiable factor influencing both the onset and severity of PCOS. Central obesity promotes insulin resistance and compensatory hyperinsulinemia, which drive ovarian androgen excess and contribute to reproductive disturbances such as menstrual irregularities, hirsutism, and infertility [4,5]. These mechanisms illustrate the amplifying role of adiposity in PCOS expression.

Epidemiological data indicate that 38–88% of women with PCOS are overweight or obese, confirming the strong link between body weight and disease prevalence [5]. Nevertheless, the syndrome is not restricted to overweight individuals; a considerable proportion of lean women also display classic PCOS features, suggesting the contribution of genetic susceptibility and metabolic diversity [2].

In view of the changing epidemiology and the increasing burden of obesity in younger demographics, medical students represent an important group for early evaluation. The present study was therefore designed to assess the association between BMI and PCOS among female students pursuing the Bachelor of Medicine, Bachelor of Surgery (MBBS) degree, with emphasis on anthropometric markers and clinical features of hyperandrogenism, to guide timely preventive and therapeutic strategies.

Materials and Methods

Study Design and Setting

A hospital-based, cross-sectional observational study was conducted over 12 months from November 2023 to November 2024 at the Department of Obstetrics and Gynecology, Konaseema Institute of Medical Sciences and Research Foundation (KIMS & RF), Amalapuram, Andhra Pradesh, India.

Study Population

The study included 200 female MBBS students aged 18 years and above. Participants were recruited through convenience sampling after obtaining written informed consent. All participants underwent clinical evaluation and anthropometric measurements.

Sample Size

The sample size of 200 was chosen based on feasibility, considering the number of eligible female MBBS students available during the study period. This size was deemed adequate to detect meaningful differences in BMI and

PCOS prevalence with sufficient statistical power for cross-sectional analysis.

Inclusion Criteria

Females aged ≥ 18 years
Willingness to provide informed consent
Diagnosed with PCOS based on Rotterdam criteria (for case group)
Healthy individuals with no PCOS features (for the control group)

Exclusion Criteria

Pregnant or lactating women
Women with diagnosed thyroid disorders
Women with diabetes mellitus
Those on hormonal treatment in the last six months

Data Collection Tool

A semi-structured, pre-validated questionnaire was used to collect demographic details, medical and menstrual history, and lifestyle habits. The questionnaire included variables such as:

Age, age of menarche

Menstrual cycle characteristics

Clinical features: hirsutism (assessed by Modified Ferriman-Gallwey score), acne, alopecia, and acanthosis nigricans

Presence of obstructive sleep apnea symptoms

Diagnostic status of PCOS

Ongoing medications and comorbid conditions

Anthropometric Measurements

Height and **Weight** were recorded using a standard stadiometer and calibrated scale, respectively.

BMI was calculated using the formula:

$$BMI = \text{Weight (kg)} / \text{Height (m}^2\text{)}$$

Waist and Hip Circumference were measured using non-stretchable measuring tape, and the **Waist/Hip Ratio (WHR)** was computed.

Mid-arm Circumference (MAC) was measured at the midpoint between the acromion and olecranon process.

Diagnosis of PCOS

PCOS diagnosis was established using the Rotterdam 2003 criteria, requiring at least two of the following three features:

Oligo/anovulation

Clinical or biochemical hyperandrogenism

Polycystic ovarian morphology on ultrasonography

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY). Continuous variables were expressed as mean \pm standard deviation (SD), and categorical variables as frequencies and percentages. Chi-square test and independent t-test were used to determine associations between groups. A p -value of <0.05 was considered statistically significant.

Bias

To minimize bias, uniform protocols were followed for anthropometric measurements, and all participants were assessed using the same diagnostic criteria (Rotterdam 2003). Clinical features such as hirsutism and acanthosis nigricans were evaluated by a single trained investigator to reduce inter-observer variability. Data entry was cross-checked by two independent reviewers to ensure accuracy.

Ethical Approval

Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of KIMS & RF, Amalapuram, before commencement of the study. All participants were assured of confidentiality and the voluntary nature of participation.

Results

A total of 225 female MBBS students were initially approached for participation. Of these, 15 declined consent and 10 did not meet eligibility criteria (5 with known thyroid disorders, 3 on hormonal therapy within the last six months, and 2 with diabetes mellitus). Thus, 200 students were finally enrolled and analyzed. All participants completed the required clinical assessments, anthropometric measurements, and questionnaire, with no attrition during data collection.

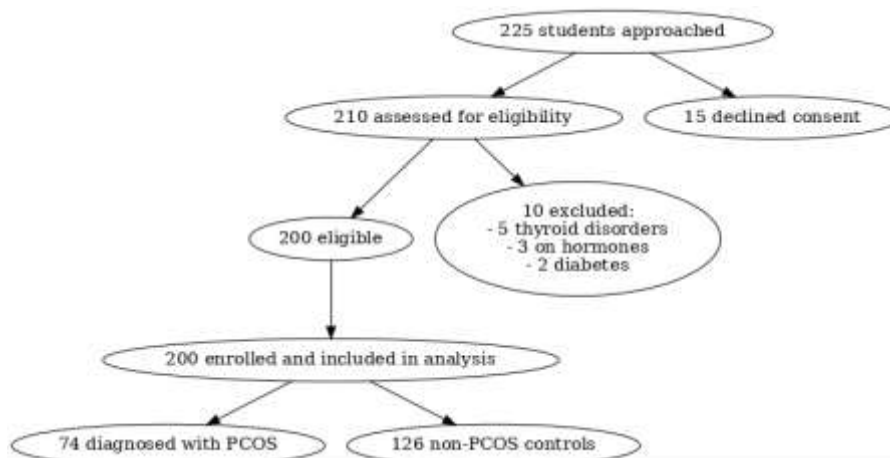


Figure 1. Participant Flow Diagram

A total of 200 female medical students participated in the study, of whom 74 (37%) were diagnosed with Polycystic Ovary Syndrome (PCOS) and 126 (63%) were classified

as non-PCOS controls. The comparison of anthropometric and demographic characteristics between these two groups is presented in **Table 1**.

Table 1: Comparison of Anthropometric and Demographic Parameters Between PCOS and Non-PCOS Participants (Mean \pm SD)

Parameter	Non-PCOS (n = 126)	PCOS (n = 74)
Height (m)	1.59 \pm 1.2	1.59 \pm 1.2
Weight (kg)	60.31 \pm 6.65	65.54 \pm 8.32
Age (years)	23.26 \pm 3.56	24.35 \pm 3.69
Waist/Hip Ratio	0.82 \pm 0.05	0.87 \pm 0.05
Modified Ferriman-Gallwey (mFG) Score	2.0 \pm 2.2	4.3 \pm 3.0
Mid Arm Circumference (cm)	28.5 \pm 2.2	29.5 \pm 2.6

There was no significant difference in height between groups (1.59 ± 1.2 m). However, participants with PCOS had a higher mean body weight (65.54 ± 8.32 kg) compared to the non-PCOS group (60.31 ± 6.65 kg). Similarly, the mean waist/hip ratio was markedly higher in the PCOS group (0.87 ± 0.05) versus non-PCOS participants (0.82 ± 0.05). The modified Ferriman-Gallwey (mFG) score, a clinical indicator of hirsutism, was also elevated among those with PCOS (4.3 ± 3.0) in contrast to the non-PCOS group (2.0 ± 2.2), suggesting

greater clinical hyperandrogenism. Mid-arm circumference, another indicator of central adiposity, was higher in the PCOS group (29.5 ± 2.6 cm) than in non-PCOS participants (28.5 ± 2.2 cm).

Distribution of waist/hip ratio further revealed a significant shift toward central adiposity in the PCOS cohort. As shown in **Table 2**, a majority (70.2%) of participants with PCOS had a high waist/hip ratio (>0.85), while only 33.3% of non-PCOS participants fell in this category.

Table 2: Distribution of Waist/Hip Circumference Ratio Among Participants

Waist/Hip Ratio Category	Non-PCOS (n = 126)	PCOS (n = 74)
Normal (≤ 0.85)	84 (66.6%)	22 (29.7%)
High (> 0.85)	42 (33.3%)	52 (70.2%)

Conversely, a normal waist/hip ratio (≤ 0.85) was observed in 66.6% of non-PCOS participants compared to just 29.7% in those with PCOS.

Assessment of Body Mass Index (BMI) categories revealed a compelling association between increasing

BMI and the prevalence of PCOS (Table 3). While a subset of individuals with normal BMI ($18.5\text{--}24.9$ kg/m²) exhibited PCOS features, the prevalence was more pronounced among overweight ($25\text{--}29.9$ kg/m²) and obese (≥ 30 kg/m²) participants.

Table 3: Association Between BMI Categories and PCOS Occurrence

BMI Category (kg/m ²)	PCOS Observation
Normal ($18.5\text{--}24.9$)	PCOS is present in a subset; non-obese phenotypes
Overweight ($25\text{--}29.9$)	Increased risk of PCOS features
Obese (≥ 30)	The highest PCOS prevalence is associated with menstrual and hormonal abnormalities

Notably, PCOS was most prevalent in the obese category, with frequent manifestations of menstrual irregularities and hyperandrogenic features.

The clinical features commonly observed among PCOS participants are summarized in **Table 4**. Menstrual irregularities were predominant among obese PCOS

individuals. Hirsutism, defined as mFG score ≥ 7 , was observed in 17.9% of PCOS participants compared to 5.0% of those without PCOS, a statistically significant difference ($p = 0.025$). Alopecia was notably associated with a high waist/hip ratio.

Table 4: Prevalence of Clinical Features Among PCOS Participants

Clinical Feature	Observation in PCOS Group
Menstrual Irregularities	Frequently reported in BMI >30
Hirsutism (mFG Score ≥ 7)	17.9% vs. 5.0% in non-PCOS ($p = 0.025$)
Alopecia	Linked with a high waist/hip ratio
Acanthosis Nigricans	A common indicator of insulin resistance
Polycystic Ovarian Morphology	Found predominantly in obese PCOS

Acanthosis nigricans, an established marker of insulin resistance, was frequently reported among PCOS participants. Moreover, polycystic ovarian morphology was predominantly found among individuals with higher BMI.

Discussion

This study evaluated the relationship between body mass index (BMI) and the clinical manifestations of polycystic ovarian syndrome (PCOS) among young female medical students. The results reinforce growing evidence that elevated BMI plays a decisive role in amplifying the



severity and spectrum of PCOS features. Overweight and obese participants exhibited a greater prevalence of menstrual disturbances, hyperandrogenic traits such as hirsutism and alopecia, and metabolic indicators, including acanthosis nigricans, confirming the contribution of excess adiposity to disease expression.

The observed findings are consistent with previous reports indicating that BMI is positively associated with worsening phenotypic features of PCOS, particularly in Asian populations [6]. Elevated BMI has also been shown to adversely affect reproductive outcomes, with higher rates of treatment failure in assisted reproductive techniques such as ICSI and IVF [7]. This underscores the broader reproductive health implications of obesity among women with PCOS.

A noteworthy observation from this study was the presence of PCOS manifestations in individuals within the normal BMI category, suggesting that the syndrome cannot be attributed solely to weight status. Hormonal dysregulation and genetic predispositions may underlie this lean phenotype, highlighting the heterogeneous nature of PCOS [8].

The academic context of the present study offers an additional perspective. Evidence has demonstrated that medical and dental students experience a high prevalence of PCOS, largely attributed to sedentary habits, irregular sleep cycles, and heightened academic stress, all of which are known to aggravate hormonal and metabolic imbalance [9].

Emerging data also support the existence of distinct metabolic and endocrine pathways in lean versus obese PCOS phenotypes. Differential profiles of Anti-Müllerian Hormone, insulin resistance, and androgen activity have been reported, reinforcing the importance of phenotype-specific diagnostic and therapeutic approaches [10]. From a clinical standpoint, many women with PCOS, regardless of BMI status, encounter persistent challenges related to fertility, weight management, and long-term metabolic risk, emphasizing the need for individualized and multidisciplinary management strategies [11].

The results of this study are further validated by evidence correlating cutaneous markers such as acanthosis nigricans with higher BMI in PCOS patients, supporting their value as simple, non-invasive markers of insulin resistance and metabolic dysfunction [12].

Generalizability

The findings of this study are directly applicable to young adult women in medical academic settings, where lifestyle and stress factors may exacerbate hormonal and metabolic disturbances. However, as this was a single-center study using convenience sampling, external validity is limited. Despite this, the observed associations between BMI,

central adiposity, and PCOS manifestations are consistent with broader regional and international data, suggesting applicability to similar populations. Larger multicenter studies across diverse groups are needed to strengthen generalizability.

Conclusion

This study identified a prevalence of 37% for polycystic ovarian syndrome among young female medical students, indicating a substantial burden in this population. A significant association was observed between increased body mass index and the severity of PCOS manifestations, with obesity and central adiposity closely linked to hyperandrogenism, menstrual irregularities, and metabolic disturbances such as acanthosis nigricans. The occurrence of PCOS in lean individuals highlights the contribution of genetic and hormonal factors beyond adiposity. Early recognition and management of BMI are particularly important in high-risk groups like medical students, and routine screening with timely lifestyle interventions should be prioritized irrespective of BMI status to reduce long-term reproductive and metabolic complications.

Limitations

This study was limited by its cross-sectional design, which precludes establishing causal relationships between BMI and PCOS. Hormonal and biochemical parameters such as serum insulin, LH/FSH ratio, and testosterone levels were not included, which could have provided deeper metabolic insights. Additionally, reliance on self-reported data for some clinical symptoms may introduce recall or reporting bias.

Recommendations

Early screening for polycystic ovarian syndrome should be integrated into routine health checkups for all reproductive-aged women, irrespective of BMI. Medical institutions should implement awareness programs focused on healthy lifestyle practices, targeting students and young professionals prone to sedentary habits and stress-induced metabolic disturbances. Interventions should include structured guidance on balanced nutrition, physical activity, and stress management. Waist/hip ratio and clinical markers such as hirsutism and acanthosis nigricans should be routinely assessed alongside BMI. Furthermore, longitudinal studies incorporating hormonal and metabolic profiling are recommended to better understand the complex interplay of genetic, environmental, and anthropometric factors influencing PCOS development.



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Abbreviations

PCOS – polycystic ovarian syndrome

BMI – Body Mass Index

mFG – Modified Ferriman-Gallwey

WHR – Waist-Hip Ratio

MAC – Mid Arm Circumference

KIMS & RF – Konaseema Institute of Medical Sciences and Research Foundation

IEC – Institutional Ethics Committee

SPSS – Statistical Package for the Social Sciences

LH – Luteinizing Hormone

FSH – Follicle Stimulating Hormone

MBBS-Bachelor of Medicine, Bachelor of Surgery

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

SM-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. VH-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. CV-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability

Data available on request

Author Biography

Dr. Shailaja Moutam is a dedicated postgraduate in Obstetrics and Gynaecology at Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India. She completed her MBBS at Maharaja Institute of Medical Sciences, Vizianagaram. With a deep passion for infertility treatment and women's reproductive health, Dr. Moutam is committed to advancing care for women facing fertility challenges. She strives to integrate the latest medical advancements with compassionate patient care, making a meaningful impact in the field of reproductive medicine. ORCID iD: <https://orcid.org/0009-0000-6796-3272>

Dr. Varada Hasamnis is currently serving as an Assistant Professor in the Department of Obstetrics and Gynaecology at the Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India. She obtained her MBBS degree from Dr. D.Y. Patil Medical College, Navi Mumbai, Maharashtra, followed by a Diploma in Obstetrics and Gynaecology from Lokmanya Tilak Municipal Medical College, Mumbai. She further enhanced her academic and clinical expertise by completing a Fellowship in Midwifery and a Diploma in Family Planning from the College of Physicians and Surgeons, Mumbai. With over two decades of extensive clinical experience in women's health, Dr. Hasamnis has developed a strong academic and research portfolio. She has authored 25 scientific publications in reputed medical journals, reflecting her commitment to evidence-based practice and continuous professional development. ORCID iD: <https://orcid.org/0009-0002-8860-7183>

Dr. Chaganti Vijaya is an Assistant Professor of Obstetrics and Gynaecology at Konaseema institute of Medical sciences & Research foundation, Amalapuram, Andhra Pradesh, India. She completed her MBBS from Rangaraya Medical College, Kakinada, and M.S. in Obstetrics and Gynaecology from S V Medical College, Tirupati. ORCID iD: <https://orcid.org/0009-0007-9141-5656>

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