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Original Research Article

Correlation of Menstrual Irregularities with Metabolic Syndrome in Patients with PCOS: A Cross-Sectional Study at a Tertiary Care Centre in North India

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Abstract

Background: PCOS, or polycystic ovarian syndrome, is a diverse endocrine condition that primarily affects women who are fertile. Clinical features include polycystic ovarian morphology, ovulatory failure, and hyperandrogenism. The severity of menstruation irregularity in PCOS is strongly correlated with Metabolic Syndrome (MetS), a group of risk factors that dramatically raises the chance of developing type 2 diabetes mellitus and cardiovascular disease.

Objective: The primary objectives of this study were to determine the incidence of metabolic syndrome in PCOS patients and investigate the association between the different components of metabolic syndrome and the specific menstrual irregularity phenotype (regular, oligomenorrhea, or amenorrhea) in a tertiary care environment in Bihar.

Methods: Over the course of eleven months, the Department of Obstetrics and Gynecology at Darbhanga Medical College and Hospital (DMCH), Leheriasarai, carried out this observational cross-sectional study. A total of 125 women who met the Rotterdam criteria for PCOS diagnosis were included. Biochemical profiles (fasting blood glucose and fasting lipid profile) and anthropometric parameters were evaluated. The NCEP ATP III criteria were utilized to diagnose metabolic syndrome. For comparative study, menstrual patterns were divided into three groups: regular, oligomenorrheic, and amenorrheic.

Results: The study population's average age was 24.6 ± 4.2 years. 38.4% (n=48) of people had metabolic syndrome. The degree of menstrual disruption and metabolic risk were found to be significantly positively correlated; patients with amenorrhea had a MetS prevalence of 54.2%, while those with oligomenorrhea had a prevalence of 32.8% and those with regular cycles had a prevalence of 15.4% ($p < 0.05$). The most prevalent metabolic abnormalities found were central adiposity and low HDL cholesterol.

Conclusion: Menstrual irregularities are a clinical indicator of underlying metabolic dysfunction in PCOS and are not just reproductive symptoms. According to the study, in order to reduce long-term cardiovascular consequences, women who exhibit amenorrhea should undergo prompt and thorough screening for metabolic syndrome.

Introduction

Background and Epidemiology: The most prevalent endocrinopathy affecting women of reproductive age is Polycystic Ovary Syndrome (PCOS), which is thought to affect 6% to 20% of women worldwide, depending on the diagnostic criteria used [1]. The incidence is noticeably increasing across the Indian subcontinent, a development that is frequently linked to fast urbanization and the ensuing changes in lifestyle.

The distinct "Asian Indian Phenotype," which is genetically inclined to larger percentages of body fat and central adiposity at lower Body Mass Index (BMI) levels compared to Western populations, further complicates this [2]. Indian women are considerably more likely to experience metabolic problems linked to PCOS due to this ethnic propensity.

The Diagnostic Framework: The Rotterdam criteria (2003) are presently used to diagnose PCOS, which is a clinical diagnosis of exclusion. According to this consensus, at least two of the following three characteristics must be present: polycystic ovaries seen on ultrasonography, clinical and/or biochemical indicators of hyperandrogenism (such as hirsutism, acne, or elevated testosterone), and oligo-anovulation (which manifests as irregular menstruation) [3]. The medical profession is becoming more concerned about the silent, long-term metabolic repercussions, even if the immediate reproductive consequences such as infertility and cosmetic issues often prompt patients to seek medical attention.

The Metabolic Connection: Abdominal obesity, dyslipidemia, hypertension, and hyperglycemia are among the pathological constellation of risk factors that make up Metabolic Syndrome (MetS). The most commonly used definition for its clinical diagnosis is found in the Adult Treatment Panel (ATP) III guidelines of the National Cholesterol Education Program (NCEP) [4]. Insulin resistance (IR) is the unifying denominator in the complex pathophysiology that connects PCOS and MetS. Free testosterone levels rise as a result of hyperinsulinemia's stimulation of ovarian androgen production and suppression of hepatic sex hormone-binding globulin (SHBG) synthesis. A vicious loop is created when visceral obesity and metabolic dysfunction are made worse by this hyperandrogenic milieu [5].

Study Rationale: There is no information from the North Bihar region about the relationship between the phenotype of irregular menstruation and metabolic risk, despite the known connection between PCOS and metabolic dysfunction. Does a patient with mild oligomenorrhea have a lower metabolic burden than a patient with total amenorrhea? By examining the relationship between monthly irregularities and metabolic syndrome in PCOS patients who visit Darbhanga Medical College and Hospital, this study seeks to close that gap. For the development of region-specific screening procedures that rely on clinical history in situations with limited resources, validating this link is essential.

Materials and Methods

Study Design and Setting: The Department of Obstetrics and Gynecology at Darbhanga Medical College and Hospital (DMCH), Leheriasarai, Bihar, was the site of this observational cross-sectional study. Eleven months were spent on the study. In order to account for seasonal fluctuations in patient flow, a representative sample of the local population attending the tertiary care center was recruited within this era. The institutional ethical committee examined and approved the procedure, and before being included in the trial, each subject gave written informed consent.

Study Population and Selection Criteria: A total of 125 women who visited the outpatient department and were of reproductive age—that is, between the ages of 18 and 40 were included in the study. The updated Rotterdam criteria were used to diagnose PCOS. Patients who showed at least two of the three cardinal characteristics oligo-anovulation, biochemical or clinical indicators of hyperandrogenism, and polycystic ovarian morphology on ultrasonography were included.

Strict exclusion criteria were used to guarantee the accuracy of metabolic data. Because these illnesses can resemble the clinical appearance of PCOS, women who were pregnant, nursing, or had a history of other endocrine disorders such thyroid dysfunction, hyperprolactinemia, Cushing's syndrome, or congenital adrenal hyperplasia were excluded. In order to prevent pharmacological interference with biochemical measures, patients who had taken hormonal contraceptives, glucocorticoids, or lipid-lowering medications within the three months prior to the trial were also excluded.

Clinical and Anthropometric Assessments: Detailed information on menstrual history was gathered using a systematic clinical proforma. Patients were divided into three groups according to the cycle history that was acquired. Women whose cycles lasted between 21 and 35 days made up the "Regular" group. Women with cycles longer than 35 days or less than nine periods annually were included in the "Oligomenorrhea" group. Women who had not had their period for more than three consecutive cycles or six months were included in the "Amenorrhea" group.

Measurements of height, weight, and blood pressure were included of physical examinations. Weight in kilograms divided by height in meters squared is the conventional formula for calculating Body Mass Index (BMI). A non-stretchable tape was used to measure the waist circumference (WC) at the midpoint between the iliac crest and the lower rib border. To make sure resting values were obtained, blood pressure was taken while sitting after a minimum of 10 minutes of rest.

Biochemical Analysis and Diagnostic Criteria: After at least eight hours of fasting during the night, venous blood samples were drawn from the antecubital vein. Fasting blood glucose (FBG) and a full lipid profile, comprising triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and total cholesterol, were measured in these samples.

Metabolic Syndrome (MetS) was diagnosed using the NCEP ATP III guidelines [4]. Five criteria were

used to diagnose MetS in patients: increased blood pressure (≥ 130/85 mmHg), raised fasting glucose (≥ 100 mg/dL), low HDL cholesterol (< 50 mg/dL), hypertriglyceridemia (≥ 150 mg/dL), and abdominal obesity (waist circumference> 80 cm, modified for Asian Indians).

Statistical Analysis: Microsoft Excel was used to carefully record the data, and SPSS version 22.0 was then used for analysis. While categorical data were displayed as percentages and frequencies, continuous variables were given as Mean ± Standard Deviation (SD). To compare categorical data, specifically the prevalence of metabolic syndrome among various menstruation groups, the Chi-square test was employed. When appropriate, independent t-tests or ANOVA were used for continuous variables. Statistical significance was defined as a p-value< 0.05.

Results

Demographic and Clinical Characteristics: The average age of the 125 women in the research population was 24.6 ± 4.2 years. 64% of the participants were in the 20–29 age range, making young adults the bulk of the participants.

With a mean Body Mass Index (BMI) of 27.8 ± 4.5 kg/m², the cohort was generally overweight. In terms of menstruation patterns, oligomenorrhea was reported by over half of the patients, whereas amenorrhea was recorded by over one-third. Only a tiny percentage had regular cycles, as determined by ultrasonography criteria and hyperandrogenism.

Table 1: **Baseline Demographic and Clinical Characteristics (N=125)**

Parameter	Value (Mean ± SD)
Age (years)	24.6 ± 4.2
BMI (kg/m²)	27.8 ± 4.5
Waist Circumference (cm)	88.3 ± 9.1

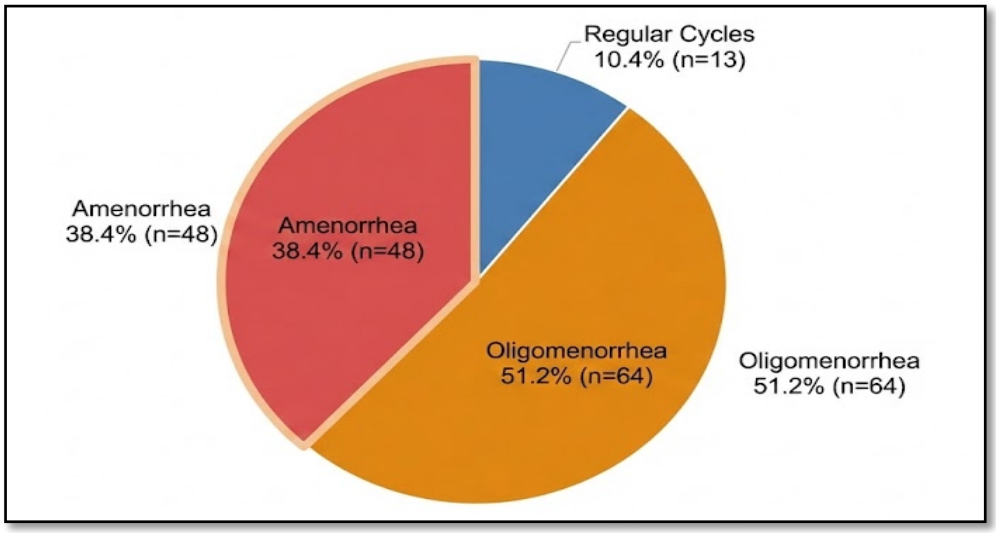

Figure 1: **Percentage distribution of study participants by menstrual cycle pattern (n=125)**

Prevalence of Metabolic Syndrome Components
48 out of 125 patients, or 38.4% of the study group, had metabolic syndrome. Central obesity was the most common risk factor when examining the syndrome's separate components, closely followed by low HDL cholesterol levels. The least prevalent factor found in this young study cohort was high blood pressure.

Table 2: **Prevalence of Individual Metabolic Syndrome Components**

Metabolic Component	Criterion (NCEP ATP III)	Frequency (n)	Percentage (%)
Abdominal Obesity	Waist Circumference > 80 cm	78	62.4%
Low HDL Cholesterol	< 50 mg/dL	71	56.8%
Hypertriglyceridemia	Triglycerides ≥ 150 mg/dL	43	34.4%
Hyperglycemia	Fasting Glucose ≥ 100 mg/dL	35	28.0%
Hypertension	BP ≥ 130/85 mmHg	21	16.8%

Correlation of Menstrual Irregularities with Metabolic Syndrome: The degree of irregular menstruation was found to be positively correlated with the existence of metabolic syndrome. The

prevalence of MetS rose gradually from patients with normal cycles to those with amenorrhea, as seen in Table 3. More over half of women with amenorrhea satisfied the diagnostic criteria for Metabolic Syndrome, making them the group with the highest burden of metabolic disease.

Table 3: **Association between Menstrual Pattern and Metabolic Syndrome**

Menstrual Pattern	Total Patients (n)	Patients with MetS (n)	Prevalence within Group (%)	p-value
Regular	13	2	15.4%	< 0.05*
Oligomenorrhea	64	21	32.8%	
Amenorrhea	48	26	54.2%	

The Chi-square test indicates a significant difference in the prevalence of metabolic syndrome across the three menstrual groups. These results were corroborated by biochemical analysis. The mean triglyceride levels were substantially higher in the amenorrhea group (148.5 ± 32.1 mg/dL) than in the oligomenorrhea group (124.3 ± 28.4 mg/dL). The association between severe anovulation and central obesity was further supported by the fact that amenorrheic women had a significantly larger waist circumference (92.4 ± 8.1 cm) than oligomenorrheic women (86.2 ± 7.5 cm).

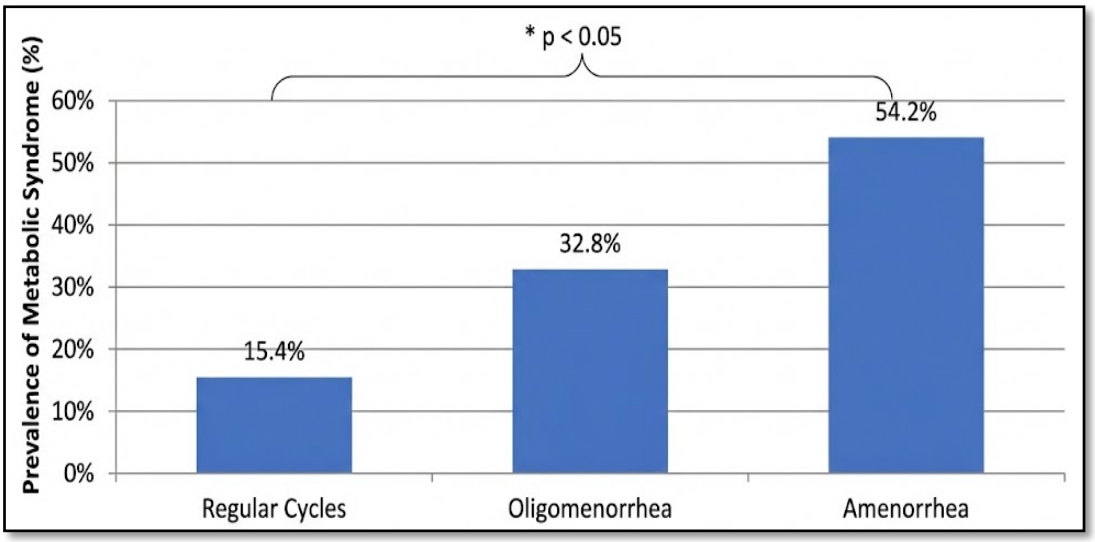

Figure 2: **Stepwise increase in Metabolic Syndrome prevalence correlated with severity of menstrual irregularity (p < 0.05)**

Discussion

Prevalence in Context: The present research that was carried was at DMCH, Leheriasarai, emphasizes the substantial metabolic load that women with PCOS in this area bear. The reported 38.4% prevalence of Metabolic Syndrome is consistent with numerous national and international research. For example, Mandrelle et al. found that women with PCOS attending an infertility clinic in South India had a similar incidence of metabolic syndrome, highlighting the notion that metabolic risk factors are common across all clinical manifestations of the disease [6]. Comparable results were also reported by Najem et al. in a population from North Africa [7]. Our result, however, is larger than other Western estimates, supporting the idea of the "Asian Indian Phenotype." According to Misra and Vikram et al., compared to Caucasian populations, women in India have a higher frequency of metabolic problems at earlier ages due to their genetic susceptibility to insulin resistance and central obesity [8].

Menstrual Irregularity as a Predictor: The strong association between the degree of irregular menstruation and metabolic syndrome is the most important discovery of our study. MetS was almost twice as common in women with amenorrhea as in those with oligomenorrhea. This validates the theory put forth by Brower et al. [9] and Ehrmann et al. [10], which contends that the degree of menstruation disturbance can be used as a clinical proxy for the severity of insulin resistance. Hyperinsulinemia, which acts on theca cells to increase androgen synthesis, is probably the mechanism. Anovulation results from the hypothalamic-pituitary-ovarian (HPO) axis being disrupted by high androgen levels. Higher insulin levels result in more severe metabolic consequences and more severe menstruation

disruption, creating a "dose-response" relationship. Additionally, oligomenorrhea was identified by Apridonidze et al. as a crucial indicator of insulin resistance, supporting its application in clinical risk assessment [11].

The Lipid Profile and Obesity: The predominance of low HDL (56.8%) and central obesity (62.4%) in our study sample is in line with the dyslipidemic profile reported by Wijeyaratne et al., who found that the most prevalent lipid abnormalities in South Asian women with PCOS were low HDL and high triglycerides [12]. This pattern raises concerns about early coronary artery disease since it is very atherogenic. The specific PCOS phenotype is crucial, according to Moran and Teede; women with ovulatory PCOS have a significantly lower metabolic risk than those with the conventional phenotype of hyperandrogenism and ovulatory failure [13]. The amenorrheic group, which is a sign of severe ovulatory dysfunction, had the worse lipid profiles, which supports our findings. Menstrual regularity and the lipid profile are frequently improved by addressing the underlying insulin resistance, according to Glueck et al. [14].

Clinical Implications: Notably, 15.4% of women with regular cycles who were diagnosed with hyperandrogenism and PCOM had metabolic syndrome. This suggests that the lack of irregularity does not completely rule out metabolic risk, even though menstrual history is a powerful predictor. Regardless of body weight, all women with PCOS should be evaluated for dyslipidemia and glucose intolerance, as emphasized by Wild et al. [15] and Carmina et al. [16], however the urgency is greater in those with severe cycle irregularities. Additionally, Legro et al. stressed in the Endocrine Society guidelines that the initial line of treatment must be lifestyle modification [17]. This was reiterated by Fauser et al. in the ESHRE/ASRM consensus, which is especially pertinent to our study population as pharmaceutical therapies could be expensive or difficult to get [18].

Limitations: When evaluating the results, it is important to take into account the many limitations of the current study. First, the results probably show some selection bias because this was a hospital-based observational study carried out at a tertiary referral facility. Compared to women in the general population who can go misdiagnosed, women seeking care at specialist facilities frequently exhibit more severe phenotypic manifestations of PCOS, such as infertility or severe hirsutism. As a result, the actual prevalence of metabolic syndrome in the larger group of PCOS-affected women in North Bihar may be overestimated by our findings.

Second, our ability to prove a temporal causal relationship between menstrual irregularities and metabolic dysfunction is necessarily limited by the cross-sectional methodology; longitudinal follow-up would be necessary to conclusively indicate that cycle irregularity precedes metabolic decline.

Third, this study used NCEP ATP III clinical criteria instead of direct biochemical indicators of insulin sensitivity, like fasting insulin levels or HOMA-IR (Homeostatic Model Assessment for Insulin Resistance), because of the financial limitations that come with a setting with minimal resources. Finally, we did not statistically correct for lifestyle variables such dietary caloric intake or physical activity levels, which are important independent predictors of metabolic health, even though exclusion criteria controlled for medication usage.

Conclusion

The severity of monthly irregularity and Metabolic Syndrome in PCOS patients are strongly positively correlated, according to this study of 125 patients at Darbhanga Medical College and Hospital. According to the research, amenorrhea should be considered a major "red signal" for underlying metabolic disorders rather than just a reproductive complaint. This young population's high rates of central obesity and dyslipidemia are concerning because they suggest a possible future burden of cardiovascular disease in the area.

These results support a risk-stratified approach to patient care from a clinical standpoint. When screening PCOS patients for metabolic syndrome, especially those who report with amenorrhea or severe oligomenorrhea, clinicians in North Bihar and comparable demographic contexts should use a low threshold. In order to restore menstrual cyclicity and lower long-term cardiometabolic risk, early detection enables the application of focused lifestyle therapies, such as dietary changes and physical activity, which continue to be the most successful first-line therapeutic techniques. To further validate these results, future research should concentrate on longitudinal studies to monitor these patients' long-term cardiovascular outcomes.

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