

ASSOCIATION OF INSULIN RESISTANCE, OBESITY, AND MENSTRUAL IRREGULARITIES IN WOMEN WITH POLYCYSTIC OVARY SYNDROME: A CLINICAL STUDY

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is a widespread endocrine and metabolic condition in women of childbearing age and is often linked with insulin resistance, obesity and menstrual problems. Such metabolic imbalances can have far-reaching effects on the reproductive health and ovulatory activity of the affected women.

Objective: To establish the relationship between insulin resistance and obesity with menstrual abnormalities among women diagnosed with polycystic ovary syndrome.

Methods: It was cross-sectional clinical research in the Department of Gynecology and obstetrics in liaison with the Department of biochemistry at a tertiary care hospital between February 2024 and April 2025. A total of 90 women between the ages of 18 and 35 years diagnosed with PCOS based on the Rotterdam criteria were used. Clinical history, anthropometric data and menstrual patterns were taken. Assessed variables included body mass index (BMI), waist circumference, fasting blood glucose, fasting insulin and Homeostatic Model Assessment of Insulin Resistance (HOMA-IR). The menstruation patterns were identified as regular cycles, oligomenorrhea, amenorrhea, polymenorrhea, and irregular cycles. The SPSS version 26 was used to analyze the data.

Results: The menstrual abnormalities could be found in 77.8 percent of the participants, and oligomenorrhea was the most frequent anomaly. Women with irregular menstrual cycles showed considerably higher values of BMI, waist circumference, fasting insulin and HOMA-IR compared to women with regular menstrual cycles ($p < 0.05$). Women with menstrual abnormalities were 77.1% insulin resistant in comparison to 35.0% of women with normal cycles. The analysis conducted using logistic regression demonstrated that the BMI and HOMA-IR were important independent predictors of menstrual irregularities.

Conclusion: Menstrual abnormalities among women with PCOS have a strong relationship with insulin resistance and obesity. Early metabolic screening and treatment could be used to enhance reproductive and menstrual outcomes in this group.

Keywords: Polycystic ovary syndrome; Insulin resistance; Obesity; Menstrual irregularities; HOMA-IR; Ovulatory dysfunction

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INTRODUCTION

Polycystic ovary syndrome (PCOS) is a rather frequent endocrine and metabolic disorder of women of reproductive age that is commonly known as one of the major causes of menstrual dysfunction, anovulatory infertility, hyperandrogenism, and metabolic imbalance¹. It is a nonhomogeneous clinical disease with different manifestations of mixes of ovulatory dysfunction, clinical

or biochemical hyperandrogenism, and atypical ovarian morphology on ultrasonography. Due to its complicated pathophysiology and extensive clinical presentation, PCOS has grown to be a topic of interest in the fields of gynecology, endocrinology, reproductive medicine, and metabolic health study. Not only does the syndrome influence the reproductive capacity and menstrual health

but it is also a leading cause of long-term cardiovascular and metabolic risk².

Menstrual abnormalities are some of the numerous clinical manifestations of PCOS and they are the most frequent and most unpleasant symptoms that have been cited by the affected women³. Such abnormalities can be oligomenorrhea, amenorrhea, polymenorrhea, longer menstrual periods, or very irregular menstrual bleeding. Menstrual dysfunction in PCOS is generally an indication of chronic anovulation and impaired follicular maturation, the two of which are directly interconnected to the hormonal and metabolic impairments that underlie the disorder. Clinical significance of these disturbances is that they can cause infertility, endometrial hyperplasia, poor quality living, and psychological stress. In most women, irregular menstruation is also the initial observation of PCOS and in most cases is the primary cause of medical visits⁴.

Insulin resistance is now being viewed as one of the focal pathophysiological changes in PCOS and it has been demonstrated to be a critical factor in both the reproductive and metabolic characteristics of the disorder⁵. Compensatory hyperinsulinemia in PCOS women is caused by insulin resistance, which further causes ovarian theca cells to hypersecrete androgens and also decreases the hepatic synthesis of sex hormone-binding globulin. This leads to accumulation of free androgens in the circulation that disrupts follicular growth, ovulation and is a cause of menstrual abnormality. Notably, the insulin resistance could be observed not only in women with obesity and PCOS, but also in a significant percentage of women that are not obese; this means that the resistance is an inherent characteristic of the syndrome in most instances. This is one of the reasons why insulin resistance is a particularly crucial aspect to consider when investigating menstrual and reproductive disorders in PCOS⁶.

Another primary clinical and metabolic characteristic that is common with PCOS and has been known to aggravate its endocrine and reproductive presentation is obesity⁷. Enhanced body fat, especially central and abdominal obesity, have a close association with impaired insulin sensitivity, persistent low-grade inflammation, and disturbed adipokine release as well as hormone imbalance. These alterations can also increase ovulatory disorders and help to exacerbate menstrual disorders. Women with PCOS and obesity tend to have more severe clinical manifestations, such as more severe menstrual irregularity, hyperandrogenism, infertility, and metabolic problems compared to the lean population. Obesity and insulin resistance could thus form a vicious cycle where metabolic and reproductive abnormalities strengthen each other⁸.

The correlation of obesity, insulin resistance and menstrual irregularity in PCOS is of high clinical relevance in that it has direct clinical implications on the early diagnosis, risk stratification and treatment⁹. Females

presenting with menstrual distress are not usually considered with the primary purpose of reproductive or gynecological concern, but with the possible metabolic factors that go into the background. Nevertheless, prompt detection of insulin resistance and obesity in PCOS women could aid in the more specific intervention programs including weight loss, dietary changes, exercise, insulin-sensitizing therapy, and reproductive management, which is personalized. These associations are even more applicable in the low- and middle-income environments where obesity and metabolic disorders are increasing at an alarming rate, and access to healthcare might be inconsistent¹⁰.

Despite the large amount of international literature published on the metabolic basis of PCOS, the lack of data on the relationship between insulin resistance and obesity and menstrual abnormalities among affected women exists, particularly among the local and regional populations¹¹. Most patients with PCOS have both metabolic and reproductive issues, but how these attributes interact is not necessarily well considered in regular clinical practice. A clearer grasp of this connection can be helpful in sustaining more comprehensive and patient-focused management methods and could additionally enhance pregnancy outcomes and post-partum healthcare¹².

Consequently, the current research was done to assess the correlation of insulin resistance and obesity with menstrual abnormalities in women with polycystic ovary syndrome¹³. The intersectional analysis of anthropometric, biochemical, and menstrual parameters will serve as the main purpose of this research to gain a better idea of the metabolic factors of menstrual dysfunction in PCOS and showcase the significance of holistic clinical evaluation in the target group of patients¹⁴.

MATERIALS AND METHODS

The research was an experimental cross-sectional clinical study carried out in the Department of Gynecology and Obstetrics in conjunction with the Department of Biochemistry at a tertiary care teaching hospital during the period of February 2024 to April 2025. The aim of the study was to determine the relationship between insulin resistance and obesity with menstrual abnormalities in women with polycystic ovary syndrome (PCOS). The data collection commenced only after receiving ethical approval of the Institutional Ethical Review Committee and all the procedures were conducted in terms of accepted ethical principles in conducting human research. All the participants were asked to give informed consent in writing before enrollment.

The study was done on 90 women diagnosed with PCOS. Non-probability consecutive sampling was used to recruit study participants who were gynecology outpatient clinic or endocrine referral case patients between the study period. The eligible women were women aged 18 to 35 years with the Rotterdam diagnostic criteria of PCOS.

Based on these criteria, PCOS was diagnosed with a minimum of two out of three of the following following features oligo-ovulation or anovulation, clinical, or biochemical evidence of hyperandrogenism, and polycystic ovary morphology on pelvic ultrasonography. Women who volunteered and had informed consent were enrolled only.

Women were not allowed to participate in case they lived with any other condition that could confound the diagnosis or influence the metabolic or menstrual parameters other than PCOS. These exclusion criteria were thyroid dysfunction problems, hyperprolactinemia problems, congenital adrenal hyperplasia, Cushing syndrome, known diabetes mellitus, pregnancy, lactation, chronic liver disease, chronic kidney disease, current use of hormonal contraceptives, insulin-sensitizing agents, corticosteroids, or anti-obesity medications in the last three months. The study also excluded women with a history of pelvic surgery, known ovarian tumors or other endocrine disorders that would have any impact on menstruation.

A comprehensive clinical and demographic history was elicited on every participant after the enrollment upon a structured data collection proforma. Data on age, marital, and how long they had had the symptoms, menstrual history, family history of PCOS or diabetes mellitus, and past treatment history was obtained. Much attention was paid to menstrual features. The classification of menstrual cycles was done based on patient-reported patterns of the cycle. Regular menstruation was determined as 21-35 days cycles. Oligomenorrhea (defined as a period of longer than 35 days between menstrual cycles) was taken as the period of no menstrual cycle during three or more consecutive months, amenorrhea (no menstrual cycle at all) as the period of no menstrual cycle during three or more consecutive months, polymenorrhea (period between menstrual cycles shorter than 21 days) was taken as the period of shortened menstrual cycles and irregular menstrual period as the period of unpredictable or variable periods between menstrual cycles. To make the analysis, participants were further divided into those who had regular cycles and those who had menstrual irregularities.

The anthropometric measure was carried out in standard techniques. The weight of the body was taken as kilograms using a calibrated digital scale and the subjects were clad in light clothing and barefoot. Stadiometer was used to measure height in meters. Body mass index (BMI) was determined by the following formula: weight (in kilograms)/squares of height (in meters) = kg/m². The participants were classified as normal weight (18.524.9kg/m²), overweight (25.029.9kg/m²), and obese (30.0 and above). Central obesity was also determined by measuring the waist circumference in centimeters at the midline between the bottom of the last palpable rib and the iliac crest top.

All the participants were sampled on venous blood after an overnight fast (8-10 hours). The blood samples

were subjected to the institutional laboratory of biochemistry through the standard operating procedures. The fasting blood glucose was determined using enzyme glucose oxidase-peroxidase assay, and the fasting serum insulin was determined in an enzyme-linked immunosorbent assay test. The Homeostatic model Assessment of Insulin Resistance (HOMA-IR) was measured to estimate insulin resistance using the following formula:

$$\text{HOMA-IR} = \frac{\text{Fasting insulin } (\mu\text{IU/mL}) \times \text{Fasting blood glucose (mg/dL)}}{405}$$

The subjects whose HOMA-IR was more than 2.5 were identified as insulin-resistant. The basis of the choice of this threshold was the fact that this parameter has been widely used in clinical and metabolic investigations of insulin sensitivity in PCOS women.

An examination was conducted on the pelvic ultrasonography results that already appeared in the patient records or were taken during clinical examination (to establish the diagnosis of the polycystic ovarian morphology where it could be relevant). Cases of hyperandrogenism were also discovered based on clinical examination record where available in the form of hirsutism, acne or androgenic alopecia. Nevertheless, the key point of the given research was the interconnection between the results of obesity and insulin resistance and menstrual anomalies instead of the comprehensive androgen profiling.

Having and experiencing menstrual irregularities was the main outcome measure of the research. Insulin resistance, body mass index, and waist circumference were the key explanatory variables. Secondary metabolic variables, including fasting glucose and fasting insulin, also were evaluated concerning menstrual pattern.

All the data collected were tabulated and analyzed through Statistical Package for the social sciences (SPSS) version 26. The quantitative variables (age, BMI, waist circumference, fasting blood glucose, fasting insulin and HOMA-IR) were given in terms of mean and standard deviation. The qualitative variables (obesity categories, insulin resistance status and menstrual pattern categories) were used as frequencies and percentages. Continuous variables in the comparison of independent samples t-test were done between women with regular cycles and menstrual irregularities. Associations between categorical variables, including menstrual disturbance and obesity status were examined by the chi-square test. In the case that was suitable, binary logistic regression analysis was carried out to determine the independent predictors of menstrual irregularity when adjusted by the corresponding covariates. A p-value of below 0.05 was taken to be statistically significant.

RESULTS

In the final analysis, 90 women with polycystic ovary syndrome were involved. The study participants had a

mean age of 26.1 + 4.6 years and most of the women were in the 21-30 years age bracket. The mean body mass index (BMI) was 30.2 ± 5.4 kg/m², which showed that majority of the participants were overweight and obese. The average waist circumference was 94.1 ± 11.2 cm, which indicates a large rate of central obesity.

The average fasting blood glucose was 97.4 pmol/dl and the average fasting insulin concentration was 17.6 pmol/dl. The mean HOMA-IR obtained was calculated to be 4.23 ± 2.01 implying that there was a high load of insulin resistance among the study population. In total, 61 (67.8) participants were insulin resistant (HOMA-IR over 2.5) and 52 (57.8) of them were overweight or obese. Table 1 shows that a significant percentage of the women had metabolic and anthropometric abnormalities meaning that there is a high degree of overlap between PCOS and metabolic dysfunction in this cohort.

Distribution of menstrual patterns:

A total of 70 (77.8%) participants had menstrual abnormalities, and only 20 (22.2%) menstrual abnormalities had regular menstrual cycles. Oligomenorrhea was the most prevalent of the various menstrual abnormalities, then amenorrhea, irregular cycles, and polymenorrhea followed. As it is shown in Table 2, the elevated occurrence of oligomenorrhea and amenorrhea is an indication of severe ovulatory impairment in women with PCOS.

Comparison of metabolic parameters according to menstrual pattern

Menstrual abnormalities in women were associated with a high degree of BMI, waist circumference, fasting insulin and HOMA-IR than women who reported regular menstrual cycles. The average BMI of the women with irregular cycles was 31.6 ± 4.9 kg/m² and that of the

women with regular cycles was 25.8 ± 3.7 kg/m² (p < 0.001). On the same note, the mean HOMA-IR was found to be 4.81 ± 2.92 in women with menstrual irregularities and 2.18 ± 2.94 in women with regular cycles (p = 0.001).

Statistically significant association (p < 0.001) existed between insulin resistance in women with an irregular menstrual cycle (n = 54) and women with a regular menstrual cycle (n = 7). The prevalence of obesity was also much higher in women who had irregular menstrual cycles. Table 3 shows that insulin resistance as well as obesity was to a great extent related to menstrual anomalies, and argues that there is a high level of metabolic contribution to reproductive malfunction in PCOS.

Table 1: Baseline clinical and metabolic characteristics of study participants (n=90)

Variable	Value
Age (years), mean ± SD	26.1 ± 4.6
BMI (kg/m ²), mean ± SD	30.2 ± 5.4
Waist circumference (cm), mean ± SD	94.1 ± 11.2
Fasting blood glucose (mg/dL), mean ± SD	97.4 ± 12.3
Fasting insulin (µIU/mL), mean ± SD	17.6 ± 7.1
HOMA-IR, mean ± SD	4.23 ± 2.01
Insulin resistance present, n (%)	61 (67.8)
Overweight, n (%)	28 (31.1)
Obese, n (%)	24 (26.7)
Normal BMI, n (%)	38 (42.2)

Table 2: Distribution of menstrual patterns among participants (n=90)

Menstrual pattern	Frequency (n)	Percentage (%)
Regular cycles	20	22.2
Oligomenorrhea	38	42.2
Amenorrhea	14	15.6
Irregular cycles	12	13.3
Polymenorrhea	6	6.7

Table 3: Comparison of metabolic parameters between regular and irregular menstrual groups

Variable	Regular cycles (n=20)	Irregular cycles (n=70)	p-value
BMI (kg/m ²), mean ± SD	25.8 ± 3.7	31.6 ± 4.9	<0.001
Waist circumference (cm), mean ± SD	85.6 ± 7.9	96.7 ± 10.5	<0.001
Fasting blood glucose (mg/dL), mean ± SD	92.1 ± 9.4	98.9 ± 12.8	0.021
Fasting insulin (µIU/mL), mean ± SD	10.8 ± 3.9	19.6 ± 6.5	<0.001
HOMA-IR, mean ± SD	2.18 ± 0.94	4.81 ± 1.92	<0.001
Insulin resistance, n (%)	7 (35.0)	54 (77.1)	<0.001
Obesity (BMI ≥30), n (%)	3 (15.0)	21 (30.0)	0.048

Table 4: Logistic regression analysis for predictors of menstrual irregularities

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
BMI (per 1 kg/m ² increase)	1.16	1.05–1.29	0.004
HOMA-IR (per unit increase)	1.69	1.24–2.30	<0.001
Waist circumference (per cm increase)	1.04	1.01–1.08	0.018
Fasting blood glucose	1.01	0.98–1.05	0.322
Age	1.02	0.91–1.15	0.601

Severity of menstrual irregularities in relation to metabolic factors

Additional subgroup analysis revealed that women who experienced amenorrhea and severe oligomenorrhea possessed the greatest mean HOMA-IR (5.12 ± 1.85) and BMI ($32.8 \pm 4.6 \text{ kg/m}^2$) in comparison with women who were experiencing milder menstrual abnormalities like polymenorrhea or fluctuating cycles. This represents a progressive association between progressive deterioration of metabolic dysfunction and progressive severity of menstrual distress.

Logistic regression analysis for predictors of menstrual irregularity

To determine independent predictors of menstrual irregularities, a binary logistic regression analysis was carried out. Age and fasting glucose levels did not make HOMA-IR and BMI insignificant predictors. Table 4 indicates that insulin resistance and obesity on their own were likely to cause menstrual problems. A one unit increase in HOMA-IR was a significant predictor of menstrual disturbance and highly predictive.

Commendably, the findings indicate that, insulin resistance and obesity are closely linked with the presence and magnitude of menstrual abnormalities in PCOS women. The women that had higher BMI, greater central obesity and had high levels of HOMA-IR levels had a high likelihood of abnormal menstrual cycles especially oligomenorrhea and amenorrhea. The findings indicate that there is a critical interaction between metabolic dysfunction and reproductive health in PCOS.

DISCUSSION

The current research indicated that there is a statistically significant relationship between insulin resistance, obesity, and menstrual abnormalities among the polycystic ovary syndrome women¹. The results suggest that women exhibiting a greater body mass index, larger waist circumference, greater levels of fasting insulin, and higher HOMA-IR score had a significant likelihood of having menstrual disturbances in comparison with women with a relatively intact metabolic profile. Such findings support the idea that PCOS is not a simple reproductive disease but a complicated endocrine-metabolic disorder where metabolic derangements are the direct as well as immediate causes of ovulatory dysfunction and menstrual variability².

Among the most striking results of the current study was the fact that menstrual irregularities were found to be very prevalent in women with PCOS³. Over three-fourths of the respondents had abnormal menstrual cycles, the most common manifestation being oligomenorrhea, then amenorrhea and irregular menses. This trend is in line with the classical reproductive phenotype of PCOS relying on chronic anovulation and disrupted follicular maturation

that results in the impairment of a normal cyclic ovarian activity. One of the first clinical symptoms of PCOS is menstrual disturbance, which is one of the primary reasons of clinical referrals, especially in young women of reproductive age⁴.

The high correlation between insulin resistance and menstrual dysfunction in the present study is both biologically reasonable and clinically significant⁵. The insulin resistance is broadly regarded as one of the pathophysiological malfunctions in PCOS. Insulin resistance leads to hyperinsulinemia that promotes the production of androgens by the ovarian theca cells and inhibits sex hormone-binding globulin in the liver, and thus, elevates the levels of free circulating androgens. These endocrine egresses disrupt the follicular development, prevent regular ovulation, and add to erratic or missing ovulation. In the current research the values of fasting insulin and HOMA-IR in women with menstrual abnormalities were significantly higher in comparison to those of women with regular menstrual periods and this fact indicates that the increasing insulin resistance directly correlates with the increasing levels of menstrual dysfunction⁶.

Of particular importance is the discovery that HOMA-IR was still one of the independent predictors of menstrual irregularity under logistic regression analysis⁷. This is an indication that insulin resistance is not simply an accompanying metabolic pathology in PCOS but might potentially be a direct mechanistic determinant of the extent of reproductive dysfunction. Women who had a high HOMA-IR score had an increased likelihood of having oligomenorrhea, amenorrhea, or disruptions in their menstrual cycle severely, which explains the necessity of timely metabolic testing in women with menstrual complaints who may be having PCOS⁸.

The other key determinant was obesity, which was discovered in the present study⁹. Women who had irregular menstrual cycles were found to have a much greater BMI and waist circumference as compared to those who had regular cycles. This observation backs the factual connection between adiposity excess and deteriorating reproductive dysfunction in PCOS. Obesity and especially central obesity has been found to worsen insulin resistance, augment systemic inflammation, modulate adipokine secretion, and impair the workings of the hypothalamic-pituitary-ovarian axis. These processes could enhance ovarian androgen surplus and ovulatory dysfunction, which aggravates menstrual disorders¹⁰.

Of particular relevance is the association between central obesity and menstrual dysfunction as witnessed in this study¹¹. Abdominal adiposity (measured as waist circumference) was more prominent in women with irregular cycles as well as it proved to be a significant predictor of the severity of menstrual disturbance independently. Central obesity is more metabolically active

than generalized obesity and is more closely linked with insulin resistance, dyslipidemia and inflammatory signaling. Consequently, the current results imply that the accumulation of abdominal fat might be of specific significance in associating both metabolic and reproductive aberration of women with PCOS¹².

It was also discovered that the mean BMI and HOMA-IR values of women with amenorrhea and more severe oligomenorrhea were the biggest, which is evidence of a graded correlation between the metabolic load and the severity of the menstrual disturbance¹³. It is a significant clinical observation since it implies that the volume of menstrual dysfunction in PCOS can indicate the level of metabolic derangement. In real clinical applications, women who have more severe abnormalities of the cycle might need more vigorous metabolic screening and treatment¹⁴.

This study has significant clinical implications¹⁵. Women who come with menstrual irregularities in most clinical settings will mostly be considered in a gynecological perspective whereas the metabolic aspect of PCOS may be underemphasized. Nonetheless, the current observations make it evident that menstrual problems in PCOS are directly correlated with obesity and insulin resistance. This implies that oligomenorrheal and amenorrheal women do not merely need to be evaluated based on the occurrence of reproductive and hormonal defects but must also undergo assessment on metabolic risk factors such as obese, insulin resistant and the possibility of developing diabetes in the future¹⁶.

These results also provide evidence of the relevance of lifestyle and early metabolic intervention in the management of PCOS¹⁷. The reduction of weight, changing the diet, physical exercise, and insulin-sensitizing measures can contribute to the enhancement of metabolic well-being, as well as the regularity of menstruation. Even modest weight losses in the body have been revealed to revive ovulatory activity and enhance the regularity of the cycles of most PCOS women. Thus, the inhibition of obesity and insulin resistance can be detected in their early stages, which can be used to control it more specifically and efficiently¹⁸.

The other significant element in this research is that the study is relevant in a regional and public health context¹⁹. The incidence of obesity, sedentary lifestyles, and metabolic syndrome is growing at an alarming rate in developing countries in the world such as Pakistan, especially among young women. Concomitantly, PCOS is either undiagnosed or not diagnosed in time in most instances. The connection between signs of metabolic dysfunction and reproductive complaints in the present study highlights the importance of higher awareness and combined practice of management in the local healthcare²⁰.

Although it has a clinical value, this study has some limitations¹. First, due to its cross-sectional nature, the study will be able to identify relationships but not a given

causal relationship between insulin resistance, obesity, and menstrual irregularities. Second, the research was performed in one tertiary care facility and a small sample size that can have an impact on the extrapolation of the results to larger groups of people. Third, the study did not provide a comprehensive hormonal profile of the endocrine, e.g., luteinizing hormone, follicle-stimulating hormone, total testosterone, or sex hormone-binding globulin, although important metabolic indicators had been measured, providing more of a mechanistic understanding of the reproductive-endocrine relationship².

However, the current study is still clinically significant as it emphasizes the great metabolic origins of menstrual alteration in PCOS women and contributes to a more multidisciplinary strategy of patient care³. The results may indicate that menstrual abnormalities in PCOS cannot be considered separately but as a part of an extended endocrine-metabolic imbalance that needs combined treatment⁴.

CONCLUSION

The current research shows that despite the fact that polycystic ovary syndrome manifests itself through insulin resistance and obesity in women, it has a strong connection with menstrual irregularities. Women having higher body mass index, central obesity, high fasting insulin level, and high HOMA-IR values had a significantly high chance of having abnormal menstrual cycling especially oligomenorrhea and amenorrhea. Obesity and insulin resistance also turned out to be important independent predictors of menstrual dysfunction.

These results underline the idea that menstrual changes in PCOS are directly connected with underlying metabolic abnormalities and thus have to be considered as a set of indicators other than individual gynecological symptoms. Anthropometric check and metabolic screening of insulin resistance and obesity should be incorporated into routine clinical examination of women having PCOS. Early detection and treatment of these abnormalities have the potential to enhance menstrual activity, reproductive performance and future metabolic performance.

Studies involving larger sample sizes and greater hormonal profiling in multiple locations and longitudinal studies are suggested to further comprehend the cause-effect relationships and enhance the evidence-based interventions in women with PCOS.

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