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OBESITY INFLUENCE ON INSULIN RESISTANT IN PREGNANT WOMEN WITH HISTORY OF POLYCYSTIC OVARY SYNDROME

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ABSTRACT

Background: Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder often linked to insulin resistance and metabolic dysfunction. Obesity, frequently observed in women with PCOS, may further intensify these metabolic disturbances, particularly during pregnancy. This study aimed to evaluate the impact of obesity on insulin resistance among pregnant women with a history of PCOS. **Methods:** A cross-sectional analytical study was carried out at Al-Imamain Al-Kadhimain Medical City between November 2024 and March 2025. Sixty pregnant women were enrolled and divided into two groups based on PCOS history. Each group was further categorized as obese or non-obese according to BMI. Fasting blood glucose, insulin, and HbA1c levels were measured during early pregnancy. Statistical analysis assessed the independent and combined effects of PCOS and obesity on insulin resistance. **Results:** Women with a history of PCOS demonstrated significantly elevated insulin resistance compared to those without PCOS. This group also exhibited higher BMI and poorer glycemic control. Obesity alone was independently associated with increased fasting glucose, insulin, and HbA1c levels. When PCOS and obesity coexisted, insulin resistance was notably exacerbated. The interaction between PCOS and obesity showed a synergistic effect, further impairing metabolic outcomes. **Conclusion:** Obesity significantly worsens insulin resistance in pregnant women with PCOS. These findings highlight the need for early screening, weight management, and metabolic monitoring in this high-risk population to reduce adverse maternal and fetal outcomes.

KEYWORDS: PCOS, Pregnancy, Obesity, Insulin Resistance, Fasting Glucose, HbA1c, Fasting Insulin.

INTRODUCTION

Obesity has emerged as a global health crisis affecting millions, with substantial repercussions on reproductive health. It is closely associated with metabolic disturbances, particularly insulin resistance (IR) and type 2 diabetes mellitus (T2DM).[1,2] During pregnancy, physiological insulin resistance is further amplified, increasing the risk of gestational diabetes mellitus (GDM), hypertensive disorders, and adverse neonatal outcomes.[3,4] These complications are significantly pronounced in women with a history of polycystic ovary syndrome (PCOS), who already exhibit baseline insulin resistance and hormonal imbalances.[5] PCOS is a multifaceted endocrine disorder that affects 6–15% of women globally, with prevalence reaching up to 20% in Middle Eastern populations, including Iraq, due to genetic, lifestyle, and environmental factors.[6–8] It is a leading cause of infertility and a precursor to metabolic disorders such as T2DM and cardiovascular disease.[9] The Rotterdam criteria, developed in 2003, remain the most widely accepted diagnostic framework for PCOS. Diagnosis requires two of the following: oligo/anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasound.[10] Based on these criteria, PCOS is categorized into four phenotypes, with phenotypes A and B—marked by hyperandrogenism and anovulation—exhibiting more severe metabolic dysfunction.[11] Insulin resistance is a hallmark of PCOS, present in 50–70% of affected women regardless of BMI. Its pathophysiology involves post-receptor defects, genetic susceptibility, and chronic inflammation.[12] Hyperinsulinemia further aggravates ovarian androgen production and impairs follicular development, contributing to anovulation and subfertility.[13] During pregnancy, this resistance intensifies, predisposing women with PCOS to GDM,

hypertensive disorders, and long-term metabolic complications.[14,15] Evaluation tools such as HOMA-IR and QUICKI are widely used to assess insulin sensitivity in clinical settings. Obesity, which affects 40–80% of women with PCOS, particularly central adiposity, exacerbates insulin resistance via the release of proinflammatory cytokines and adipokines that impair insulin signaling.[16–18] This metabolic milieu perpetuates a cycle of hyperinsulinemia, hyperandrogenism, and reproductive dysfunction. Obese women with PCOS face heightened risks of GDM, preeclampsia, cesarean delivery, and adverse neonatal outcomes such as macrosomia and neonatal hypoglycemia.[19,20] Management strategies, including lifestyle modifications and pharmacologic interventions like metformin, have demonstrated efficacy in improving metabolic parameters and pregnancy outcomes, though further evidence is needed.[21] Additionally, maternal obesity independently predicts adverse pregnancy outcomes and contributes to intergenerational transmission of metabolic disease.[22,23] Given the complexity and overlapping mechanisms of PCOS, insulin resistance, and obesity, early identification and intervention are essential to optimize maternal and fetal health outcomes during pregnancy.[24] Aim of The Study to evaluate Obesity influence on Insulin resistant in pregnant women with history of PCOS.

Method

his analytical cross-sectional study was conducted at the Obstetrics and Gynecology Department of Al-Imamain Al-Kadhimain Medical City in Baghdad, Iraq, over a five-month period from November 2024 to March 2025. The objective was to evaluate the influence of obesity on insulin resistance in pregnant women with a documented history of Polycystic Ovary Syndrome (PCOS).

A total of 60 pregnant women attending antenatal clinics were enrolled and divided equally into two groups: the PCOS group (n=30), comprising women with a confirmed history of PCOS based on the Rotterdam criteria, and the non-PCOS group (n=30), composed of age- and BMI-matched pregnant women without any previous PCOS diagnosis. Each group was further stratified into obese (BMI ≥ 25 kg/m²) and non-obese (BMI < 25 kg/m²) subgroups. Inclusion criteria included pregnant women aged 18–45 years, with singleton pregnancies confirmed by ultrasound, a gestational age of ≤ 20 weeks, and documented consent to participate. Women with multiple gestation, known endocrine disorders other than PCOS, pre-existing or early gestational diabetes, recent use of insulin-sensitizing medications or corticosteroids, or chronic systemic illnesses were excluded. Data collection involved structured interviews and review of medical records to obtain clinical and demographic information. BMI was calculated from measured height and weight. Venous blood samples were collected after an 8–12 hour fast to determine fasting plasma glucose (FPG), fasting insulin, and glycated hemoglobin (HbA1c) levels using standard automated assays in the hospital's central laboratory. Insulin resistance was evaluated using direct markers (FPG, fasting insulin, HbA1c), and further analysis using indices such as HOMA-IR and QUICKI was considered. Statistical analysis was performed using SPSS version 25. Descriptive statistics summarized the data. Independent t-tests and Chi-square tests compared continuous and categorical variables, respectively. Two-way ANOVA was used to examine the interactive effects of obesity and PCOS. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 60 pregnant women were included in the study, equally divided into two groups: 30 women with Polycystic Ovary Syndrome (PCOS) and 30 without (Non- PCOS), matched for age and preconception BMI. Comparison Between PCOS and Non-PCOS Groups (Table 1): The mean age of PCOS participants was significantly lower (29.7 ± 5.0 years) compared to the non-PCOS group (32.7 ± 5.8 years; p = 0.0082). Despite matching, the preconception BMI was significantly higher in PCOS women (38.8± 6.2 kg/m²) than non-PCOS women (30.2 ± 5.6 kg/m²; p < 0.0001). A significantly higher proportion of PCOS women were obese (96.7%) compared to the non-PCOS group (76.7%; p = 0.022).

Table 1: Comparison between PCOS pregnant women and non-PCOS pregnant women matched for age and BMI at preconception.

Group	Age (y)	BMI at preconception (kg/m²)	Obese; BMI ≥ 25 (cases)	Non-obese; BMI < 25 (cases)	FPG (mg/dL)
PCOS	29.7 ± 5.0	38.8 ± 6.2	29 (96.7%)	1 (3.3%)	110.4 ± 10.5
Non- PCOS	32.7 ± 5.8	30.2 ± 5.6	23 (76.7%)	7 (23.3%)	81.3 ± 6.9
P-value	0.0082	2.2×10^{-10}	0.022 (χ^2 test)	0.022 (χ^2 test)	4.2×10^{-15}

Metabolic parameters also showed statistically significant differences. PCOS women had higher fasting plasma glucose (FPG) levels (110.4 ± 10.5 mg/dL) than non-PCOS women (81.3 ± 6.9 mg/dL; p < 0.0001). Similarly, fasting insulin levels were markedly elevated in the PCOS group (10.68 ± 2.8 µU/mL) compared to the non-PCOS group (4.10 ± 1.04 µU/mL; p < 0.0001). Glycated hemoglobin (HbA1c) was also higher among

PCOS participants (6.156 ± 0.193%) versus non-PCOS (5.096 ± 0.189%; $p < 0.0001$), indicating impaired glucose metabolism in the PCOS group as in table 2.

Table 2: Comparison between PCOS and non-PCOS pregnant women.

Parameter	PCOS	Non-PCOS	P-value
Age (years)	29.7 ± 5.03	32.73 ± 5.77	0.0082
BMI (kg/m²)	38.8 ± 6.18	30.22 ± 5.57	2.2×10^{-10}
Fasting Glucose (mg/dL)	110.35 ± 10.48	81.32 ± 6.91	4.2×10^{-15}
Fasting Insulin (µU/mL)	10.68 ± 2.8	4.10 ± 1.04	1.78×10^{-17}
HbA1c (%)	6.156 ± 0.193	5.096 ± 0.189	<0.0001

Effect of Obesity Within PCOS Group (Table 3): Within the PCOS cohort, obesity significantly influenced metabolic outcomes. Obese PCOS women had higher fasting glucose and insulin levels, with statistically significant differences observed for both parameters ($p = 0.033$ and $p = 0.028$, respectively). The F-values for glucose and insulin were 160.41 and 145.95, respectively, indicating a strong effect of PCOS status itself, while the F-values for obesity on these parameters were lower (4.75 and 5.1), suggesting additive effects.

Table 3: Comparison between obese and non-obese PCOS women.

Category	F value (PCOS)	P value (PCOS)	F value (Obesity)	P value (Obesity)
Fasting Glucose	160.41	2.42×10^{-18}	4.75	0.033
Fasting Insulin	145.95	1.78×10^{-17}	5.1	0.028

The interaction of PCOS and obesity was further examined through two-way ANOVA. Obese women had higher BMI (39.3 vs. 24.57), higher fasting insulin (10.78 µU/mL vs. 8.05 µU/mL), and increased HbA1c (6.16% vs. 5.92%) compared to non-obese women. Significant differences were seen across all markers with *p*-values ranging from 0.0001 to 0.033, confirming the independent and combined effects of PCOS and obesity on insulin resistance markers. As in table 4.

Table 4: Two-way ANOVA table showing the influence of PCOS and obesity on insulin resistance markers.

Obesity	Age	BMI	Fasting Glucose	Fasting Insulin	HbA1c
Non-obese	39	24.57	111.36	8.05	5.92
Obese	29.38	39.3	110.34	10.78	6.16
P-value	0.0001	<0.0001	0.03346	0.02776	0.0004

DISCUSSION

This study demonstrates that pregnant women with Polycystic Ovary Syndrome (PCOS) exhibit significantly elevated markers of insulin resistance—including fasting glucose, fasting insulin, and HbA1c—when compared to pregnant women without PCOS. These results align with established evidence suggesting that PCOS is inherently associated with insulin resistance, a condition further aggravated by the insulin-resistant state of pregnancy.[21] Our findings corroborate earlier research by Dunaif et al., who proposed that women with PCOS exhibit a primary defect in insulin action, evidenced by elevated insulin levels.[22] Similarly, Legro et al. observed increased risks of gestational diabetes mellitus (GDM) and heightened fasting glucose and HbA1c levels in pregnant women with PCOS, findings that mirror those of our current study.[23] Although participants were matched for age and BMI prior to conception, PCOS women exhibited significantly higher BMI during early pregnancy. This could be attributed to increased fat accumulation due to hyperandrogenism and heightened insulin resistance, both of which are characteristic of PCOS[24] The association between obesity and PCOS is well documented, with up to 70% of PCOS patients being overweight or obese.[25] Obesity exacerbates insulin resistance through adipokine imbalance and low-grade inflammation.[26] Our two-way ANOVA analysis revealed that both PCOS and obesity had independent and significant effects on metabolic parameters. Obese participants—regardless of PCOS status—had elevated fasting insulin and HbA1c levels, highlighting obesity's role as a standalone contributor to insulin resistance. These results are consistent with those of Barber et al., who found that insulin resistance is significantly more pronounced in obese PCOS women than in lean counterparts.[27] Similarly, Zhang X et al. reported that obesity aggravates the metabolic profile of PCOS patients and increases cardiovascular risk.[28] Interestingly, non-obese women with PCOS in our study also demonstrated elevated insulin resistance markers when compared to non-PCOS controls, though to a lesser extent than their obese counterparts. This supports the hypothesis that insulin resistance is a fundamental feature of PCOS pathophysiology, independent of body weight.[29] Lastly, our findings support the conclusions of Rababa'h AM et al., who emphasized that lifestyle modifications and weight loss significantly improve insulin sensitivity and reproductive outcomes in women

with PCOS.[30] Collectively, these findings underscore the importance of early metabolic screening and targeted interventions—especially in pregnant women with PCOS—to mitigate adverse maternal and fetal outcomes.

CONCLUSION

This study confirms that pregnant women with PCOS have significantly higher insulin resistance, especially when obese. Obesity alone also worsens insulin resistance in non-PCOS women. The combination of PCOS and obesity has a synergistic effect on metabolic dysfunction. These findings highlight the dual burden of PCOS and obesity on glucose metabolism during pregnancy.

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