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Research Article

Role of Adipokines (Leptin and Adiponectin) in the Pathophysiology of Polycystic Ovary Syndrome in Pakistani Women

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ABSTRACT

Background: Polycystic Ovary Syndrome is a common endocrine disorder among women of reproductive age, frequently associated with insulin resistance and obesity. Adipokines, particularly leptin and adiponectin, play a key role in linking metabolic and reproductive abnormalities.

Objective: To evaluate serum leptin and adiponectin levels in Pakistani women with PCOS and determine their association with insulin resistance and anthropometric parameters.

Methods: This case-control study included 120 women (60 diagnosed PCOS patients and 60 age-matched healthy controls) aged 18–35 years, recruited from tertiary care hospitals in Pakistan. Serum leptin, adiponectin, fasting glucose, and insulin levels were measured. Insulin resistance was assessed using HOMA-IR. Statistical analysis was performed using independent t-test and Pearson correlation.

Results: PCOS patients exhibited significantly higher serum leptin levels compared to controls (32.8 ± 6.4 ng/mL vs 14.6 ± 4.2 ng/mL, $p < 0.001$), while adiponectin levels were significantly lower (5.2 ± 1.3 µg/mL vs 9.8 ± 2.1 µg/mL, $p < 0.001$). The leptin/adiponectin ratio was markedly elevated in the PCOS group (6.3 ± 1.8 vs 1.5 ± 0.6, $p < 0.001$). A strong positive correlation was observed between leptin and BMI ($r = 0.68$, $p < 0.001$), whereas adiponectin showed a significant inverse correlation with insulin resistance (HOMA-IR) ($r = –0.61$, $p < 0.001$). HOMA-IR was also significantly higher in PCOS patients (3.9 ± 1.2 vs 1.8 ± 0.7, $p < 0.001$).

Conclusion: Altered adipokine profile, characterized by elevated leptin and reduced adiponectin levels, plays a significant role in the pathophysiology of PCOS in Pakistani women. These findings highlight the importance of adipokines as potential biomarkers and therapeutic targets in managing PCOS-related metabolic dysfunction.

Keywords: PCOS, leptin, adiponectin, insulin resistance, Pakistan, HOMA-IR

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age, with a reported prevalence ranging from 6–15% globally and higher trends observed in South Asian populations, including Pakistan (1,2). It is characterized by hyperandrogenism, chronic anovulation, and polycystic ovarian morphology, often accompanied by significant metabolic disturbances (3).

Insulin resistance is considered a central feature in the pathophysiology of PCOS, contributing to hyperinsulinemia and excessive ovarian androgen production (4,5). In recent years, adipose tissue has been recognized as an active endocrine organ secreting adipokines that influence both metabolic and reproductive functions (6).

Among these adipokines, leptin and adiponectin play opposing roles. Leptin regulates appetite and energy homeostasis but is often elevated in obesity and PCOS, leading to leptin resistance and reproductive dysfunction (7,8). In contrast, adiponectin enhances insulin sensitivity and exhibits anti-inflammatory effects; its reduced

levels are strongly associated with insulin resistance and metabolic abnormalities (9,10).

Despite the growing global evidence, there is limited data regarding adipokine imbalance in Pakistani women with PCOS (11,12). Given the high prevalence of obesity and metabolic syndrome in this population, understanding these mechanisms is essential for early diagnosis and targeted interventions (13).

This study aims to evaluate serum leptin and adiponectin levels in Pakistani women with PCOS and determine their association with insulin resistance and anthropometric parameters (14).

MATERIALS AND METHODS

This case-control study was conducted at tertiary care hospitals in Rawalpindi and Islamabad, Pakistan, over a period of six months. A total of 120 women aged 18–35 years were included, of whom 60 patients diagnosed with polycystic ovary syndrome (PCOS) based on the Rotterdam criteria were assigned to Group A, while 60 age-matched healthy women served as controls in Group B. Women within the specified age range with a confirmed diagnosis of PCOS were included in the study, whereas those with thyroid disorders, diabetes mellitus, pregnancy, or a history of hormonal therapy within the preceding three months were excluded.

All participants underwent detailed history taking and clinical examination. Anthropometric measurements were recorded, including body mass index (BMI) and waist circumference. Fasting venous blood samples were collected for the estimation of serum leptin, serum adiponectin, fasting glucose, and fasting insulin levels. Insulin resistance was assessed using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR).

Data were analyzed using SPSS version 25. Results were expressed as mean ± standard deviation. The independent t-test was used for comparison between groups, while Pearson correlation analysis was applied to assess associations between variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Significant differences were observed in both anthropometric and biochemical parameters between PCOS patients and healthy controls, as shown in Table 1. Women with PCOS exhibited markedly higher body mass index (BMI) and waist circumference, indicating increased overall and central adiposity. Biochemically, serum leptin levels were significantly elevated in the PCOS group, reflecting increased adipose tissue mass and possible leptin resistance. In contrast, serum adiponectin levels were significantly reduced, suggesting impaired insulin sensitivity and altered metabolic regulation. The leptin/adiponectin ratio was substantially higher in PCOS patients, highlighting a shift toward a pro-inflammatory metabolic state. Furthermore, HOMA-IR values were significantly elevated in the PCOS group, confirming the presence of insulin resistance as a key feature of PCOS.

Correlation analysis revealed important relationships between adipokines and metabolic indices, as presented in Table 2. Serum leptin showed a strong positive correlation with BMI, indicating that leptin levels increase proportionally with adiposity. Additionally, leptin demonstrated a moderate positive correlation with HOMA-IR, suggesting its association with insulin resistance. Conversely, adiponectin exhibited a significant inverse correlation with HOMA-IR, indicating that lower adiponectin levels are associated with greater insulin resistance. It also showed a weak negative correlation with BMI, reflecting its decline with increasing adiposity. These findings collectively emphasize the opposing roles of leptin and adiponectin in the metabolic dysregulation observed in PCOS.

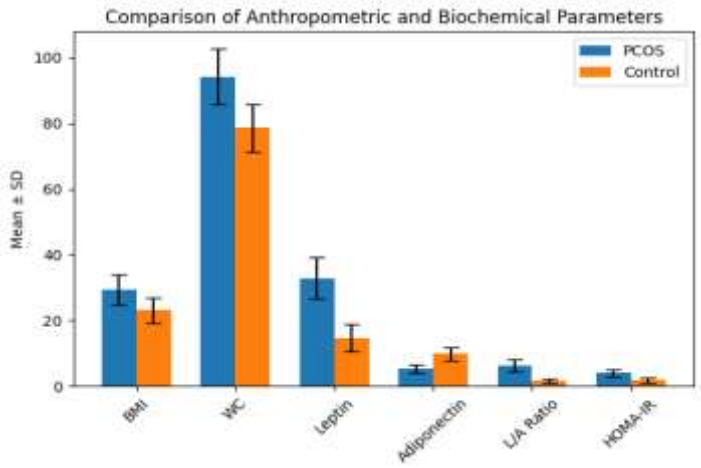
Table 1: Anthropometric and Biochemical Parameters

Parameter	PCOS Patients (n=60)	Controls (n=60)	p-value
BMI (kg/m²)	29.4 ± 4.6	23.1 ± 3.8	<0.001
Waist Circumference (cm)	94.2 ± 8.5	78.6 ± 7.2	<0.001
Serum Leptin (ng/mL)	32.8 ± 6.4	14.6 ± 4.2	<0.001
Serum Adiponectin (µg/mL)	5.2 ± 1.3	9.8 ± 2.1	<0.001
Leptin/Adiponectin Ratio	6.3 ± 1.8	1.5 ± 0.6	<0.001
HOMA-IR	3.9 ± 1.2	1.8 ± 0.7	<0.001

Table 2: Correlation of Adipokines with Metabolic Parameters

Variable	BMI (r-value)	HOMA-IR (r-value)	p-value
Leptin	+0.68	+0.54	<0.001
Adiponectin	–0.39	–0.61	<0.001*

*BMI correlation for adiponectin: p = 0.002.



DISCUSSION

This study highlights significant alterations in adipokine profiles among Pakistani women with PCOS, emphasizing their role in disease pathophysiology (15).

The elevated leptin levels observed in PCOS patients are consistent with increased adiposity and leptin resistance. Leptin resistance may impair hypothalamic signaling and disrupt gonadotropin secretion, contributing to menstrual irregularities and anovulation (16). The strong correlation between leptin and BMI further supports its association with adipose tissue mass (17).

Reduced adiponectin levels in PCOS patients indicate impaired insulin sensitivity. Adiponectin plays a protective metabolic role by enhancing glucose uptake and fatty acid oxidation (18). Its inverse relationship with HOMA-IR confirms its role in mitigating insulin resistance (19).

The significantly elevated leptin/adiponectin ratio observed in this study reflects a combined effect of increased pro-inflammatory and decreased anti-inflammatory signals, contributing to metabolic dysfunction. This ratio may serve as a more sensitive marker of metabolic risk in PCOS (20).

These findings are particularly relevant in the Pakistani population, where lifestyle factors, dietary habits, and genetic predisposition may exacerbate metabolic disturbances associated with PCOS.

CONCLUSION

Altered adipokine levels, characterized by increased leptin and decreased adiponectin, play a significant role in the pathophysiology of PCOS in Pakistani women by contributing to insulin resistance, low-grade inflammation, and reproductive dysfunction. These findings suggest that adipokines may serve as useful biomarkers for early diagnosis and potential targets for therapeutic intervention in PCOS. Routine evaluation of adipokine levels in affected patients may aid in better risk stratification, while lifestyle modification with an emphasis on weight reduction and early screening for insulin resistance should be strongly recommended. Furthermore, larger multicenter studies across diverse Pakistani populations are needed to validate these findings. However, the results should be interpreted with caution due to the relatively small sample size, single-region setting, and cross-sectional study design, which limits the ability to establish causal relationships.

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