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Original Research Paper

Some biological markers associated with risk factors in Iraqi women with polycystic ovary syndrome

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Abstract: **Objective**: This study aimed to determine the clinical, hormonal and lifestyle risk factors in women with polycystic ovary syndrome (PCOS). Methods: From January to May 2025, 85 PCOS patients (aged 18-45) who attended the Al-Ramadi Obstetrician-Gynecologist Hospital participated in this study, and 50 healthy controls were recruited. Women with PCOS were diagnosed based on Rotterdam criteria. Clinical assessments included anthropometric features, hyperandrogenism signs, menstrual history and lifestyle factors and HOMA-IR were measured. Hormonal investigations included the levels of LH : FSH ratio , Follisatin,Vaspin and Ghrelin.
Results: PCOS was significantly associated with higher BMI, HOMA-IR, physical inactivity, frequent consumption of junk food and sleep deprivation . Hirsutism, acne, and menstrual irregularities were more prevalent in the PCOS group. Hormonal results showed an increase in levels of LH : FSH ratio , Follisatin and Vaspin in PCOS patients compared to the controls, with evident decrease observed in ghrelin levels in PCOS patients compared to the control group. **Conclusion**: PCOS is strongly associated with modifiable lifestyle and metabolic risk factors. Follisatin, Vaspin, and Ghrelin disorders have been closely linked with HOMA-IR in women with PCOS. Early screening, education, and targeted interventions are critical for avoiding long-term reproductive complications.
Keywords: Adipokine , BMI , Fertility , Metabolism

1. Introduction

Polycystic ovary syndrome (PCOS) is an obesity-related disorder linked to the endocrine and metabolic systems with the cardinal features of hyperandrogenism , reproductive dysfunction, and metabolic abnormalities[1,2]. Comprehending novel biomarkers that link metabolic and hormonal pathways is essential for facilitating early diagnosis , enhancing risk stratification, and enabling targeted therapeutic approaches in patients with polycystic ovary syndrome (PCOS) [3]. As PCOS has a complex pathogenesis and development, it is widely believed that several factors contribute to its development, including genetics, lifestyle, and environmental factors [4,5] .

PCOS is an obesity-related disorder linked to the endocrine and metabolic systems. with the cardinal features of hyperandrogenism , reproductive dysfunction, and metabolic abnormalities [1,2]. The relationship between obesity and PCOS is supported by epidemiological data and meta-analyses of relevant studies [6-8].Patients with PCOS have been revealed to have a significantly higher incidence of obesity; therefore, obesity may be associated with PCOS development [9].When PCOS and obesity co-occur, their combined effects can adversely affect the clinical, biochemical, and metabolic status of an individual [10,11].PCOS patients with obesity are more susceptible to develop hyperinsulinemia, which increases their lipid profiles and glucose tolerance. Obesity enhances the

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production of androgens by activating LH , which leads to hyperandrogenism [12,13].

Follistatin is important markers of adipogenesis and is associated with an increased risk of PCOS [14]. Many researchers have reported that adipokine enhance the insulin sensitivity of adipose tissue in obesity. Ashour et al. found evidence of a relationship between PCOS and vaspin [15,16]. In recent years ,Vaspin has been demonstrated to serve a significant roles in the female reproductive system. [17,18] , and the levels of this hormone were associated with both BMI and waist circumference, and increasing levels of vaspin resulted in fat accumulation around the waist of POCS patents [19].In addition, many studies have demonstrated that obesity is the main determinant for decreased of ghrelin expression in PCOS and lower of ghrelin levels in women with PCOS , suggesting that lower levels are due to higher BMI [20,21]. Ghrelin is one of the peptides that causes subfertility in PCOS patients and the level of this peptide in PCOS patients reflects the hormonal and metabolic changes that are characteristics of the syndrome [22].

2. Methodology

Ethical approval and Informed consent statement

The study protocol was approved by University of Anbar Local Ethics in 2025. Verbal informed consent was obtained from all participants prior to enrollment, as approved by the Ethics Committee, and in accordance with the Declaration of Helsinki.

Total of 135 samples (85 patients with PCOS and 50 controls) were obtained from women who attended Al-Ramadi of obstetrician – gynecologist hospital with an age range for both group (18-45) years. All participants underwent a thorough clinical evaluation that included demographic information, anthropometric measurements (BMI), HOMA-IR, menstrual history, and a modified Ferriman-Gallwey score to assess hirsutism. Acne and other signs of hyperandrogenism were also noted. A systematic questionnaire assessed lifestyle risk factors such as dietary patterns, junk food consumption frequency, physical activity levels and sleep duration.

Laboratory investigations serum levels of Follisatin, Vaspin and Ghrelin were measured by using ELISA Kit from Abcam uses an enzyme-linked immunosorbent assay(ELISA) methodology(Shanghai Sunredbio Technology Co.,Ltd.,Shanghai, China).A Cobas e-analyzer (Roche Diagnostic GmbH, Mannheim, Germany), was utilized for this specific objective. The Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) method was done to evaluate insulin sensitivity.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) for Windows was used to analyze the data. Standard Deviation (SD), median, means, percentages, and the maximum and minimum values of the variables were used for represent categorical variables. Differences between groups were evaluated using the independent samples t-test for continuous variables .

3. Results and discussion

Distribution of study subjects according to demographic , anthropometric lifestyle factors , clinical and biological properties

Diagnosis was based on the Rotterdam criteria, and data were analyzed to compare demographic, anthropometric, clinical, and lifestyle variables between affected and unaffected individuals.The characteristics of the study population indicated that in a total of 135 participants, here we 85 women with PCOS and 50 healthy women as the control group. The mean age of women with PCOS was (31.47 ± 4.47) years and the age range was between (18-45) years.Another parameters was demonstrated in (Table1).

Table (1): Demographic and anthropometric properties for the study participants

Parameters	PCOS (n= 85)		Control (n=50)	*P-Value*
Age (Years)	31.47 ± 4.47		30.89± 4.07	NS
BMI	29.98 ± 2.76 kg / m²		19.05 ± 1.14	<0.001*
	Yes	70 (82.4%)		

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Family History of PCOS	No	15 (17.6)	No	<0.001*

NS=Non-significant, * significant at p value ≤ 0.05

Our study also showed a significant association between PCOS and lifestyle behaviors such as physical inactivity , excessive Junk food consumption and poor sleep (Table 2).

Table (2): Lifestyle factors and PCOS risk.

Factor	PCOS (n= 85)		Control (n=50)	*P-Value*
Physical Inactivity	Yes	69(81.2%)	21(42%)	< 0.001 *
	\No	16(18.8%)	29(58)	
Junk Food Consumption (>3x/week)	Yes	76(89.4%)	27 (54%)	< 0.001 *
	No	9(10.6%)	23(46%)	
Sleep < 6 hours/day	Yes	41(48.2)	15(30%)	< 0.001 *
	No	44(51.8)	35(70%)	

* significant at p value ≤ 0.05

Contrast, the clinical and biological parameters in this study were found to be significantly associated with PCOS (Table3)

Table (3):Clinical and Biological properties of PCOS patients and control group

Parameters	PCOS (n= 85)		Control (n=50)	*P-Value*
Mean Menstrual Cycle Length (days)	48.6± 7.5		29.2±4.2	< 0.001 *
Acne	Yes	74 (87.06)	19 (38%)	< 0.001 *
	No	6 (7.06)	31(62%)	
Hirsutism (Modified Ferriman Score >8)	Yes	11 (12.94)	5(10%)	< 0.001 *
	No	79 (92.94%)	45(90%)	
HOMA-IR >2.5	Yes	80(94.1%)	3(6%)	< 0.001 *
	No	5(5.9%)	47(94%)	
Elevated LH: FSH Ratio (IU/L)	10. 9 ± ±3.7	6.4 : 6.6	5.1 ± 1.4	< 0.001 *

*significant at p value ≤ 0.05

Hormonal assessment

In the present study,the results revealed that women with PCOS had higher levels of follistatin and vaspin, but lower levels of ghrelin than those the control group as shown in (Table 4) .

Table (4) : The levels of follistatin ,vaspin and ghrelin between PCOS patients and control group

Parameters	PCOS (n= 85)	Control (n=50)	*P-Value*
Follistatin ng/ml	0.28± 0.04	0.160 ± 0.03	< 0.001 *
Vaspin ng /ml	3.72± 1.29	0.350 ± 0.25	< 0.001 *
Ghrelin fmol /ml	126.1± 5.29	159.0 ±10.81	< 0.001 *

*significant at p value ≤ 0.05

The levels of various parameters, including follistatin ,vaspin and ghrelin were also correlated with IR and the results showed Follisatin and vaspin were positively correlated with IR, while ghrelin was negatively correlated with BMI in women with PCOS (Table 5) .

Table (5):The association between IR and follistatin ,vaspin and ghrelin in patients with PCOS .

Parameters	IR	
	R- value	***P-value***
Follistatin ng /ml	0. 93	< 0.001*

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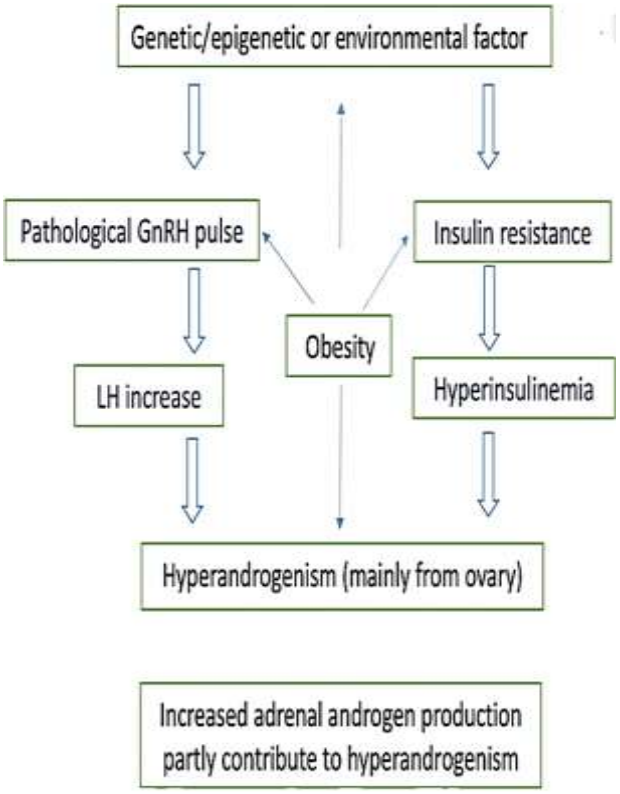
Vaspin ng /ml	0.81	< 0.001 *
Ghrelin fmol /ml	- 0.75	< 0.001 *

*significant at p value ≤ 0.05

It is thought that the interaction between environmental factors such as obesity and genetically determined hyperandrogenism, contributes to the development of PCOS and the symptoms of it which may vary throughout obesity, metabolic disorders and the ethnicity.Therefore , this study mainly consecrate to investigating the relationships between PCOS and some hormones, which may be considered as biomarkers of PCOS pathologic (figure 1).[13,23-25].



According to the diagnostic criteria and pathophysiological mechanisms underlying hyperandrogenism, PCOS patients a significantly more likely to have clinical features such as hirsutism, acne, and irregular menstruation. Additionally, most of PCOS cases in our study showed elevated LH: FSH ratios and HOMA-IR values, further supporting the metabolic basis of the syndrome [9,12] .

Our finding was indicate that PCOS and obesity were associated with increased levels of follisatin compared to control group. A similar study revealed an increase of follisatin levels in patients with PCOS than in controls [26]. High levels of follistatin are observed in PCOS patients regardless of obesity, and it is believed that an increase of follistatin levels may contribute to PCOS pathology [27] . A recent study by Peng *et al* [28] suggested that activin and follistatin locally iregulate steroidogenesis in the human ovary. An imbalance in the expression of components of the activin-inhibin-follistatin system contributes to follicular persistence and endocrine changes, which leads to the pathogenesis of POCS [29].Moreover, high levels of follistatin are expected to increase the production of ovarian androgen and reduce the levels of circulating FSH, which are features of PCOS [30] .

When correlated with BMI and obese women with PCOS, vaspin, a new adipocytokine mostly expressed in white adipose tissue, appears to contribute to the pathogenesis of metabolic disorders such as PCOS [31,32]. Several studies suggest that BMI may influence changes in circulating vaspin in patients with PCOS [33-35].Numerous findings investigated the association between PCOS and vaspin, for example, one of these finding revealed that vaspin was higher in obese women with PCOS than the controls [36]. However, another study found that obese and overweight PCOS individuals with IR had increase in vaspin levels [37] .Overt IR is a common factor in these investigations [36]. Vaspin levels in PCOS patients and controls have ssignificantly difference in the current study. Its compensatory function against metabolic problems in obese women with PCOS may be indicated by a increased vaspin level. As a result, vaspin seems to be an importent diagnostic marker for novel drug approaches in obesity-related problems [38].Another study reported that higher expression of vaspin may be an intrinsic compensatory mechanism in adipose tissue in response to impaired glucose metabolism or decreased insulin sensitivity so, rising IR and VASPIN expression [39]. The results of further studies showed that elevated vaspin levels in PCOS patients were linked to clomiphene resistance, suggesting that serum vaspin levels could be a measure for predicting the ovulation-inducing effects of clomiphene citrate treatment [40].

Ghrelin levels were significantly decrease in women with PCOS than in the healthy controls. In PCOS etiology , ghrelin has been shown to have a negative effect on HOMA IR and fertility by modifying the degree of insulin resistance and androgen levels [41] . Multiple regression analysis revealed that plasma ghrelin levels alterations were mainly related to changes in plasma androgen levels [42] .By attaching to its receptor, ghrelin inhibits the release of, LH, FSH and the progesterone and estrogen secretion [43, 44]. Ghrelin serves a variety of functions, including regulating glucose metabolism, malnutrition, body weight, and ovarian functions. Various studies have reported that ghrelin plays an important role in reproduction, including its role in suppressing LH and its association with obesity and IR [45,46].

Finally,in this study several interesting correlations were identified between follistatin ,vaspin , and ghrelin levels and BMI and IR in PCOS patients and controls. The association between these hormones were significant in the PCOS in compared with healthy control.These results confirm the result of previous studies, which have shown a significant correlation between these hormones with IR in the PCOS pathogenesis .

Conclusion

This study demonstrated that PCOS is highly prevalent in Iraqi women and clearly correlates with poor diets, sedentary behavior, and metabolic markers. Furthermore, Follistatin, vaspin and ghrelin may be useful marker for PCOS incidence and may be increased risk factors for POCS. Early lifestyle interventions, awareness campaigns, and routine primary care screening can reduce the burden of PCOS and its long-term health effects.

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Author's Contributions

Conceptualization , H.M.Saleem ; experimental work and responsible for project admin ,H.R.A.Al-Hetty;writing-original draft preparation; and R. K. Ibrahim writing-review and editing.

Conflicts of interest

No conflicts of interest

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