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ORIGINAL ARTICLE

THE PREVALENCE AND SIGNIFICANCE OF HYPERANDROGENISM IN WOMEN WITH POLYCYSTIC OVARY SYNDROME

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ABSTRACT

Background: Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder in women of reproductive age, and is characterized by hyperandrogenism, oligo/anovulation, and polycystic ovaries. The present study aimed to determine the effects of body mass index and age on serum testosterone levels in women with PCOS.

Materials & Methods: This comparative observational study was conducted at Alshaheed Fayroz Hospital, Wasit, Iraq, between February 2022 and April 2022. In total, 30 infertile women diagnosed with PCOS and a control group consisting of 10 healthy fertile women were selected using convenience sampling. Blood samples were collected to measure testosterone levels using enzyme-linked fluorescence assay (ELFA). BMI was calculated and the effects of BMI and age on testosterone levels were analyzed.

Results: Women with PCOS exhibited significantly higher testosterone levels (39.52 ±1.89 ng/dl) compared to controls (16.51 ±1.18 ng/dl). Elevated testosterone levels were observed in obese and overweight PCOS patients (42.49 ±4.14 and 40.87 ±1.76 ng/dl, respectively) compared to normal and underweight controls. Additionally, PCOS patients aged over 30 years showed higher testosterone levels (43.74 ±2.41 ng/dl) than those under 30 years (36.72 ±2.54 ng/dl).

Conclusion: This study underscores the significant role of BMI and age in influencing testosterone levels in women with PCOS, highlighting the need for targeted interventions addressing weight management and hormonal regulation.

KEY WORDS: Polycystic ovary syndrome; Hyperandrogenism; Body Mass Index.

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INTRODUCTION

One of the most common endocrine disorders is polycystic ovarian syndrome (PCOS), which was initially identified by Stein and Leventhal in 1935.[1] There is a direct relationship between PCOS and high production of ovarian androgens (hyperandrogenemia), insulin resistance and hyperinsulinemia are seen in approximately 75-90% of afflicted women.[2] Some of the long-term effects are: development of diabetes mellitus, dyslipidimia or high levels of lipids in the blood and cardiovascular diseases.[3]

Disordered PCOS still encompasses a complete patho-physiology unclear due to heterogeneity of the disorder while we could be assured that there are most probably, multiple mechanisms.[4]

Elevated blood levels of androgens, testosterone, androstenedione, together with dehydroepiandrosterone sulfate, are the most notable biochemical change.[5] The most prevalent clinical findings include alopecia, acne, greasy skin, seborrhea, and central obesity or apple shape.[6,7] Some women with PCOS may seek medical attention due to worries about long-term health risks although depending on the patient's medical history and physical examination, an earlier assessment may be warranted.[8] The age of the female and ovarian aging, which is correlated with an increase in chronological age, also influence when infertility is first evaluated.[9] There is a risk of type 2 diabetes or impaired glucose tolerance in obese women with PCOS, given the metabolic con-

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cerns associated with this disease.[10]

Insulin resistance, obesity, hypertension, dyslipidemia, and hyperhomocysteinemia are the cardiovascular risk factors associated with PCOS. Obesity predisposes to a considerable risk increase in cardiovascular diseases either mediated directly or through changes in the elements of the metabolic syndrome.[11] In women with PCOS the risk increase of CHD is 50% as compare to age and BMI matched women without PCOS.[12]

Abnormalities in insulin and insulin growth factor-1 (IGF-1) may be caused by the pathogenesis of PCOS because it stimulates androgen production.[13] Metformin treatment in women with PCOS is effective in the management of hormonal imbalances, which in turn reduces the manifestation of PCOS. pathogenesis. This is because metformin is very useful in lowering the IGF-1 level while at the same time trying to get the insulin level back to normal.[14] The objective of the study was to determine the effect of body mass index and age on serum testosterone levels in women with PCOS.

MATERIALS AND METHODS

Study Design and Setting: This comparative observational study was conducted at Alshaheed Fayroz Hospital, Wasit, Iraq, between February 2022 and April 2022. This study aimed to analyze the hormonal and metabolic profiles of women diagnosed with Polycystic Ovary Syndrome (PCOS).

Participants: This study included 30 infertile women diagnosed with PCOS and a control group of 10 healthy fertile women. Participants were recruited using convenience sampling methods. The PCOS group was selected based on clinical diagnosis criteria, whereas the control group comprised women with regular menstrual cycles. To confirm PCOS, ultrasound and blood samples were obtained from all participants during the follicular phase (3, 4, or 5 days).

The inclusion Criteria included women diagnosed with PCOS based on the Rotterdam criteria (oligo/anovulation, hyperandrogenism, and polycystic ovaries),[15] healthy women with regular menstrual cycles and no history of endocrine disorders, and participants who provided written informed consent. Exclusion criteria included a history of endocrine or metabolic disorders other than PCOS or current use of hormonal medications.

Data Collection: Blood samples were collected from each participant for analysis of testosterone levels. Five ml of venous blood was collected from each PCOS patient and healthy control woman. The blood was clotted at 37 °C for 30 min before centrifugation. After centrifuging the tubes at 5000 rpm for 5 min, serum was collected and frozen until use. The enzyme-linked fluorescence assay (ELFA) technique was used for hormone measurement using an Addendum Mini VIDAS equipment (VIDAS)12 model,1992, BioMerieux Company, France).

Body Mass Index (BMI) was calculated as the weight in kilograms divided by height in square meters (kg/m^2). BMI was divided into underweight (< 18.5 kg/m^2), healthy weight (18.5 to 24.9 kg/m^2), overweight but not obese (25 to 29.9 kg/m^2) and obesity (> 30 kg/m^2) based on the classification of the WHO.[16]

Ethical Considerations: The study was approved by the local ethics committee of Alshaheed Fayroz Hospital. Written informed consent was obtained from all participants prior to inclusion in the study.

Statistical Analysis: Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 22.0. The T-test and Analysis of Variance (ANOVA) with Least Significant Difference (LSD) tests were employed to compare the means. Statistical significance was set at $P \leq 0.05$.

RESULTS

The levels of testosterone were highly significant ($P \leq 0.010$) in patients with PCOS (39.52 ± 1.89 ng/dl) compared to the healthy control group that recorded (16.51 ± 1.18 ng/dl) (Table 1).

The effects of BMI on testosterone levels revealed that there was a significant increase ($0P \leq 0.050$) in patients with PCOS, depending on their BMI: 42.49 ±4.14; 40.87 ±1.76 ng/dl in obesity and overweight, respectively, relative to the healthy control group (32.19 ±6.06; 29.33 ±0.00 ng/dl) in the normal

Table 1: Comparison between patients and control groups in Testosterone

Group	No	Mean ±SE of Testosterone (ng/dl)
Patients with PCOS	30	39.52 ± 1.89
Control	10	16.51 ± 1.18
T-test	---	6.824 **
P-value	---	0.0001
** ($P \leq 0.01$).		

weight and underweight groups, respectively (Table 2).

Table 2: Effect of BMI in Testosterone level of patients group

BMI	No (%)	Mean ±SE of Testosterone (ng/dl)
Over weight	15 (50.00%)	40.87 ± 1.76 a
Obesity	9 (30.00%)	42.49 ± 4.14 a
Under weight	1 (3.33%)	29.33 ± 0.00 b
Normal	5 (16.67%)	32.19 ± 6.06 b
LSD value	---	7.043 *
P-value	0.0001 **	0.0447
Means having with the different letters in same column differed significantly. * (P≤0.05), ** (P≤0.01).		

* (P<0.05), SE: LSD: Least Significant Differences, BMI: Body Mass Index, and standard error

This study also involves the effect of the age in testosterone levels, the results were obtained showed increase significantly (P≤0.05) in patients with PCOS whom ages more than 30 years (43.74 ± 2.41 ng/dl) compared to the age group less than 30 years that recorded (36.72 ± 2.54 ng/dl) (Table 3).

Table 3: Effect of Age in Testosterone level of patients group

Age groups	No	Mean ± SE of Testosterone (ng/dl)
<30 yr.	18	36.72 ± 2.54
≥30 yr.	12	43.74 ± 2.41
T-test	---	6.712 *
P-value	---	0.0471
* (P≤0.05).		

DISCUSSION

According to a study by Carmina et al.,[17] there was a positive association between higher blood levels of testosterone, androstenedione, and 17-hydroxyprogestrone, and LH hypersecretion. Additional factors contributing to hyperandrogenism include elevated testosterone precursor synthesis resulting from abnormal theca cell androgen production, as well as heightened serine phosphorylation of the insulin receptor, which triggers the activation of P450c17 α enzymes in the adrenal and ovarian glands, consequently leading to increased androgen production.[18] Hyperinsulinemia is characterized by elevated free testosterone, but the total testosterone concentration may be in the upper range of normal. Insulin further reduces the production and release of Sex hormone binding protein (SHBG) by the liver, resulting in elevated levels of free testosterone.[19] Hyperinsulinemia and an increase in LH cause ovarian theca cells to produce more testosterone.[20]

The current results corroborated those of Benson et al.,[21] who provided a description of women with polycystic ovary syndrome (PCOS) who were fat or overweight and had high levels of testosterone. According to Wang et al.,[22] women with PCOS had a significant incidence of overweight and obesity. Obesity is linked to insulin resistance and a reduction in SHBG, which raised the level of testosterone in the blood.[23]

The findings of Liang et al.,[24] which showed that younger PCOS women (30 years old) had noticeably greater testosterone levels than older women (30–40 years old), were confirmed by this investigation. In this study, it was shown that women with PCOS had higher testosterone levels than the control group, particularly older women. Furthermore, it is known that androgen levels in females with PCOS are elevated in the early adult years but decrease as menopause approaches. According to a study by Pinola et al.,[25] women with PCOS aged > 30 years and > 50 years had substantially higher serum DHEAS levels.

Therefore, this research assumes that the significant decline in SHBG may be related to the rise and inter-individual variation in androgen indices. This, as has already been shown, is connected to larger body mass, glucose intolerance, and insulin resistance in some of the participants.[26]

CONCLUSION

In conclusion, the study highlights that hyperandrogenism, characterized by elevated testosterone levels, is significantly more prevalent in women with PCOS compared to healthy controls. The data reveal that not only is PCOS associated with higher levels of testosterone, but that these levels are further influenced by body weight and age. Specifically, overweight and obese women with PCOS showed higher testosterone levels, suggesting that BMI is a critical factor in the hormonal expression of PCOS. Additionally, older women with PCOS tended to have higher testosterone levels than their younger counterparts. These findings suggest that management strategies for PCOS should consider both the metabolic and reproductive aspects of the syndrome, with particular attention to weight management and hormonal regulation across different age groups.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	RHE
Acquisition, Analysis or Interpretation of Data:	RHE
Manuscript Writing & Approval:	RHE

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.