

Clinical assessment of female sexual hormones and some antioxidant vitamins in Iraqi women with polycystic ovary syndrome according to body mass index and blood group variables

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ABSTRACT

Background. Polycystic ovary syndrome (PCOS) is defined as an endocrine disorder affecting women which causes infertility in their reproductive age presenting a variety of symptoms including acne, irregular menstruation, hirsutism obesity, hypertension and infertility.

Aim of study. The present study was established for the assessment of Polycystic ovary syndrome (PCOS) patients sexual hormones and some vitamins.

Materials and methods. Blood serum was clinically obtained from 180 Iraqi women (80 healthy women and 100 women diagnosed with PCOS). The subjects were selected depending on their blood groups (only positive) with approximately the same number of women in each group. Then they were separated into three groups according to their body mass index, ensuring that each group had a similar number of subjects to eliminate any randomness and errors in the results. Results and discussion. Luteinizing hormone (LH) and prolactin (PRL) were registered at a significantly high increase ($p < 0.0001$), whereas follicle-stimulating hormone (FSH) showed a modest significant decrease ($p < 0.001$) within females with PCOS when compared against the control group, while vitamins E, A, and C recorded a high significant decrease ($p < 0.0001$) among PCOS women in contrast with the healthy group across all positive blood groups and body mass indexes (BMIs) tested.

Conclusion. Effect of the blood group and BMI on the values of the female sexual hormones (LH, FSH and PRL) and the vitamins (A, E and C). It was noticed that there was a high significant variation between the levels of LH and PRL in females infected with PCOS.

Keywords: polycystic ovary syndrome, prolactin, vitamin E, vitamin C, Luteinizing hormone, blood group factor, body mass index

INTRODUCTION

PCOS is a very complex medical condition which occurs in most females (married and single). This disease leads to biochemical and clinical disorders in the biological action of the female reproductive system and it may lead to many health disturbances such as hypertension, inability to become pregnant, diabetes and

uterine cancer. PCOS is mostly correlated clinically with the oxidant-antioxidant system. Therefore, this syndrome causes changes in the biochemical system present in the woman's reproductive system. So, a multi-risk status will occur leading to alterations in the levels of antioxidant enzymes, antioxidant vitamins, trace elements (copper, zinc, selenium), lipid profile, uric acid, malondialdehyde, creatine and creatinine [1-3]. Se-

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lenium, copper and zinc are very important macronutrients that the body needs as they are dependable in cell activity and oxidative stress [4].

Different metabolic clinical mechanisms were suggested to explain the biochemical abnormal cases of PCOS such as alteration of the biochemical balance, hormones, insulin resistance (IR), pathogenesis status and genetic heritage. Various types of research were established regarding polycystic ovary syndrome and its pathological reasons and most of the studies confirmed on pathophysiology concerning the disease. The investigation of the increase in biochemical oxidative stress of PCOS found that the stress may cause damage to the genes and deoxyribonucleic acid in the living cell, especially in the mitochondria, which will lead to a decrease in fertility [5,6].

Different factors have roles in the change of biochemical and clinical variables like age, pregnancy, body mass index, blood group, marital status, family history and smoking. Various clinical markers were estimated in PCOS such as enzymatic antioxidants (superoxide dismutase, glutamate–oxaloacetate transaminase, glutamate pyruvate transaminase, catalase and glutathione peroxidase), female sexual hormones (LH, FSH and PRL), trace elements (copper, selenium and zinc), vitamins (vitamin D, C and A), C-reactive protein and fasting insulin [7-9]. The female sexual hormones represented by FSH, LH, and PRL exist in the reproductive system of women. It is necessary to chemically balance these hormones because the imbalance process leads to alteration in sexual desire and also many health complications such as bone loss, infertility and hair loss. When PCOS happens in the female reproductive system, the levels of sexual hormones belonging to women will change depending on age, marital status, pregnancy, smoking and the presence of any other diseases [10,11].

Vitamins A, C and E are considered biochemical antioxidants that have an important role as a defense system in the reproductive system of women with PCOS. The supplementation of these vitamins has been investigated due to their antioxidant qualities and their positive impact on PCOS. Randomized research data suggests that intake of vitamins C and E decreased serum androgens and increased the thickness of the endometrial lining in PCOS patients. This combination of vitamins was also noticed to diminish oxidative stress markers; however, the evidence is still in its early stages [12]. Assorted studies were performed regarding the clinical function of antioxidant vitamins in various women infected by PCOS and their correlations with other biochemical markers [13,14].

So the current study emphasizes the clinical roles of female sexual hormones and antioxidant vitamins within the blood sera of Iraqi women diagnosed with PCOS

depending on body mass index and blood group factors.

MATERIALS AND METHODS

Participant PCOS women

One hundred female patients and eighty females without any health issues participated in this research. They were divided according to their body mass index, (normal, overweight and obese) and blood groups, (A+, B+, AB+ and O+) while ensuring that the women with PCOS were not infected by any other diseases and didn't smoke. All the participants were between the ages (14-45 years).

Location and Blood Sampling

The samples were obtained from various PCOS women in Basrah Teaching Hospital of Gynecology and children in Basrah/ Iraq. Samples were drawn from 8:00 a.m. to 11:00 pm by a trained nurse. A volume of 5 ml of venous blood was gathered from the PCOS and control group then the samples were put in vacutainer tubes and centrifuged with a speed equal to 5000 rpm for five minutes. The total sera belonging to PCOS women was kept at 20 °C for the assessment of the biochemical variables, and then the remaining blood was placed in special tubes to separate the blood plasma. Following that, the red blood cells were rinsed using sodium chloride solution (9 %w/v) afterwards, the mixture was lysed using demineralized water at a (1:1 v/v) ratio [15].

Assessment of Biochemical Variables

The levels of FSH, PRL and LH were estimated in blood sera by an enzyme-linked Immunosorbent assay (ELISA) kit depending on the activity of enzymes present in this characteristic kit [16]. Also, antioxidant vitamins A, C and E levels were measured in blood serum by using the ELISA technique for both PCOS females (having various body mass index and blood groups) and healthy women [17].

Ethical approval

In this study the ethical approval with the number (592) on (26/4/2022) was acquired from the Basrah Health Department – Training and Human Development – Center of Knowledge Management / Research Division.

Statistical analysis

All data resulting from the current study was expressed as mean \pm standard deviation for both groups (PCOS patients and healthy females) depending on the variables of body mass index and the blood groups. The

Statistical program represented by SPSS, version 25, was carried out to analyze the total result of PCOS women and the analysis was established by using various univariate programs. Also, the value of the regression factor (r) was used to identify all patients and healthy women. The p-value was calculated statistically and was evaluated to be less than 0.05 for the lowest significance.

RESULTS

Hormones LH, FSH and PRL were estimated in Table 1 for PCOS and healthy women according to the blood group factor variable.

Assorted values of the levels were recorded to be equal to 17.960 ± 0.412 , 17.914 ± 0.452 , 18.037 ± 0.304 and 17.941 ± 0.489 ng/mL for LH in the serum of the women with PCOS for blood groups A+, B+, AB+ and O+ respectively. Whereas FSH showed the levels represented by 5.841 ± 0.364 , 5.803 ± 0.378 , 5.784 ± 0.283 and 5.858 ± 0.408 ng/mL for the same blood groups in PCOS patients. PRL recorded various levels equal to 17.515 ± 2.267 , 17.587 ± 2.147 , 17.650 ± 2.035 and 17.242 ± 2.454 ng/mL in PCOS females with blood groups A+, B+, O+ and AB+. The maximum levels belonging to LH, FSH and PRL were noticed in the blood groups AB+, O+ and AB+ respectively while the minimum levels of the same female sexual hormones were found in the blood groups B+, AB+ and B+ respectively.

Body mass index is one of the variables which has a biochemical effect on polycystic ovary syndrome in various females. The levels of women's sexual hormones

were estimated in Table 2 according to body mass index for PCOS women and healthy females.

The values of the body mass index are: normal BMI= $18-25 \text{ kg/m}^2$, overweight BMI= $25-30 \text{ kg/m}^2$, obese BMI= $30+ \text{ kg/m}^2$ LH shows three levels equal to 17.628 ± 0.396 , 17.863 ± 0.238 and 18.358 ± 0.199 ng/ml for the PCOS women (normal, overweight, obese) respectively, whereas FSH recorded levels were 6.266 ± 0.152 , 5.814 ± 0.123 and 5.438 ± 0.076 ng/ml for the same status of body mass index. The three levels belonging to PRL hormone were estimated to be equal to 14.719 ± 1.343 , 17.863 ± 0.238 and 19.598 ± 0.702 ng/ml for the same variable (normal, overweight, obese). It was noticed that as the weight of the patient increased, the LH and PRL levels increased, however, FSH levels decreased.

Antioxidant vitamins A, C and E have an important clinical role associated with the roles of female sexual hormones. The levels of these vitamins were assessed in the blood serum of PCOS women depending on blood group variables as illustrated in Table 3.

Vitamins A, C and E recorded various levels equal to 1168.934 ± 292.224 pg/ml, 2.666 ± 4.226 ng/ml and 7.885 ± 1.606 pg/ml in blood sera of PCOS women having blood A+ group, whereas the same vitamins showed levels equal to 1212.601 ± 410.663 pg/ml, 1.928 ± 3.535 ng/ml and 9.095 ± 2.138 pg/ml in PCOS females with the B+ blood Group. Also, various levels represented by 939.8380 ± 208.854 pg/ml, 2.306 ± 3.898 ng/ml and 7.310 ± 0.585 pg/ml were recorded for the antioxidant vitamins for blood group AB+ for the same patients. The same vitamins showed assorted levels equal to 1059.518 ± 166.984 pg/ml, 3.374 ± 4.543 ng/ml and

TABLE 1. Levels of female sexual hormones in blood serum of PCOS and healthy women depending on blood group variable

PRL (ng/mL)	FSH (ng/mL)	LH (ng/mL)	Women Groups	Blood group
9.355 ± 0.732	6.844 ± 0.285	8.275 ± 0.203	Control (No.=21)	A+
$17.515 \pm 2.267^{***}$	$5.841 \pm 0.364^{**}$	$17.960 \pm 0.412^{***}$	PCOS (No.=25)	
8.727 ± 0.750	6.959 ± 0.390	8.152 ± 0.232	Control (no.=19)	B+
$17.587 \pm 2.147^{***}$	$5.803 \pm 0.378^{**}$	$17.914 \pm 0.452^{***}$	PCOS (no.=24)	
9.077 ± 0.903	6.606 ± 0.466	8.212 ± 0.369	Control (no.=19)	AB+
$17.650 \pm 2.035^{***}$	$5.784 \pm 0.283^{**}$	$18.037 \pm 0.304^{***}$	PCOS (no.=25)	
8.985 ± 0.889	6.651 ± 0.370	8.225 ± 0.272	Control (no.=21)	O+
$17.242 \pm 2.454^{***}$	$5.858 \pm 0.408^{**}$	$17.941 \pm 0.489^{***}$	PCOS (no.=26)	

The levels were expressed as mean \pm SD, ***p <0.0001; ** p <0.001; * p <0.05, N.S: Non-significant

TABLE 2. The levels of female sexual hormones and blood serum of PCOS women according to body mass index factor

PRL (ng/mL)	FSH (ng/mL)	LH (ng/mL)	Women Groups	BMI
8.581 ± 0.599	7.022 ± 0.418	8.021 ± 0.210	Control (no.=28)	Normal
$14.719 \pm 1.343^{***}$	$6.266 \pm 0.152^{**}$	$17.628 \pm 0.396^{***}$	PCOS (no.=31)	
9.103 ± 0.677	6.662 ± 0.305	8.223 ± 0.195	Control (no.=27)	Overweight
$17.863 \pm 0.238^{***}$	$5.814 \pm 0.123^{**}$	$17.863 \pm 0.238^{***}$	PCOS (no.=34)	
9.495 ± 0.970	6.586 ± 0.325	8.432 ± 0.249	Control (no.=25)	Obese
$19.598 \pm 0.702^{***}$	$5.438 \pm 0.076^{**}$	$18.358 \pm 0.199^{***}$	PCOS (no.=35)	

The levels were expressed as mean \pm SD, ***P <0.0001; **P <0.001; *P <0.05, N.S: Non-significant

TABLE 3. The levels of antioxidant vitamins in the blood serum of PCOS women according to blood group variable

Vitamin E (pg/ml)	Vitamin C (ng/ml)	Vitamin A (pg/ml)	Women Groups	Blood group
23.019±3.967	27.754±12.428	1959.668±278.113	Control (no.=21)	A+
7.885±1.606***	2.666±4.226***	1168.934±292.224***	PCOS (no.=25)	
23.582±4.512	24.184±8.061	1857.260±267.889	Control (no.=19)	B+
9.095±2.138***	1.928±3.535***	1212.601±410.663***	PCOS (no.=24)	
23.942±2.899	23.953±8.164	1929.459±293.230	Control (no.=19)	AB+
7.310±0.585***	2.306±3.898***	939.838±208.854***	PCOS (no.=25)	
23.083±3.839	24.478±8.310	1910.430±256.976	Control (no.=21)	O+
7.441±1.523***	3.374±4.543***	1059.518±166.984***	PCOS (no.=26)	

The levels were expressed as mean ± SD, ***p < 0.0001; ** p < 0.001; * p < 0.05, N.S: Non-significant

TABLE 4. The levels of antioxidant vitamins in the blood serum of PCOS women according to body mass index variable

Vitamin E (pg/ml)	Vitamin C (ng/ml)	Vitamin A (pg/ml)	Women Groups	BMI
22.976±4.308	23.550±8.975	1858.159±302.274	Control (no.=28)	Normal
8.440±1.911***	3.014±4.118***	1150.679±375.118***	PCOS (no.=31)	
22.409±3.546	25.421±10.732	1911.445±278.074	Control (no.=27)	Overweight
7.803±1.441***	2.474±4.153***	1035.708±217.646***	PCOS (no.=34)	
24.909±3.042	26.629±8.512	1983.290±217.176	Control (no.=25)	Obese
7.562±1.630***	2.306±3.980***	1099.544±285.661***	PCOS (no.=35)	

The levels were expressed as mean ± SD, *** p < 0.0001; ** p < 0.001; * p < 0.05, N.S: Non-significant

7.441±1.523 pg/ml for PCOS women who have O+ blood group. The greatest values of vitamins A, C and E levels were noticed in blood groups B+, O+ and B+ but the lowest levels of the same vitamins were recorded in blood groups AB+, B+ and AB+.

Because BMI is a necessary factor, therefore, the values of the vitamins A, E and C were estimated depending on this clinical factor as indicated in Table 4 for both PCOS women having (normal, overweight and obese) bodies.

The values of the body mass index are: normal BMI=18-25 kg/m², overweight BMI=25-30 kg/m², obese BMI=30+ kg/m². The impact of BMI was clear in the females infected by PCOS where vitamins A, C and E showed various levels equal to 1150.679±375.118 pg/ml, 3.014±4.118 ng/ml and 8.440±1.911 pg/ml respectively in blood sera belonging to normal PCOS women, whereas the same antioxidant vitamins recorded level values 1035.708±217.646 pg/ml, 2.474±4.153 ng/ml and 7.803±1.441 pg/ml respectively for overweight PCOS women. Also, the levels of the same vitamins were noticed to be 1099.544±285.661 pg/ml, 2.306±3.980 ng/ml and 7.562±1.630 pg/ml for obese women. The maximum levels of vitamins A, C and E all belonged to the Normal body type, while the minimum level values for the same vitamins were estimated in PCOS women having overweight and obese bodies.

DISCUSSION

Hormonal balance has a crucial function in a female’s life. A lot of diseases are induced by hormone

imbalances, including early menopause, primary ovarian insufficiency, ovarian cancer, and polycystic ovary syndrome (PCOS) [18]. Because of the significance of the female sexual hormones, which are responsible for pregnancy and reproduction, the research was conducted to assess the values of LH, FSH and PRL and antioxidants vitamins (A, C and E) in the blood serum of PCOS women. Whilst many PCOS women have FSH and LH values between 5-20 mIU/ml, numerous cases showed a ratio of 1:3 between FSH and LH. This abnormality found in the LH to FSH ratio is enough to cause anovulation [19].

In this study, the impacts of blood group and BMI were investigated on the levels belonging to female sexual hormones and vitamins in assorted PCOS women. Various studies confirmed the biochemical function of the clinical parameters in following the severity of PCOS in different women of assorted ages, blood groups, body mass indexes and marital status [20,21]. When comparing the levels of the three hormones tested in the patients to the healthy group, it is noticed that LH levels significantly increased (**p < 0.0001) in the blood sera of PCOS women following the blood group variable (O+, AB+, B+ and A+) while FSH levels pointed to a slight significant decrease (**p < 0.01) in the same PCOS women according to the same blood groups, whereas a high significant increase (**p < 0.0001) was noticed for the level of prolactin in blood serum in PCOS women having the same blood groups. Although the results gathered according to the blood group variable showed consistent trends of increase and decrease of the sexual hormones in PCOS women, there were dif-

ferences between the levels in each of the four blood groups tested. So, the blood group type is considered an important clinical marker to follow the increase or decrease of female sexual hormone levels [22,23]. The body mass index is a necessary variable to follow the levels of female sexual hormones in women affected by PCOS compared with the control group. So, the alteration in the class of body mass index leads to an alteration in the levels of female sexual hormones [24].

Obesity disrupts the functions of the reproductive system and leads to infertility. It is a very notable discovery in the study of PCOS relating to IR, indicated by the accumulation of visceral and abdominal subcutaneous adipose tissue. It has been found that 30% to 60% of all women affected by PCOS have a degree of obesity [25]. LH and PRL pointed to a highly significant increase ($***p < 0.0001$) while FSH levels exhibited a slight significant decrease ($**p < 0.001$) in the blood serum of PCOS women in all the weight classes tested. However, the research displayed that the levels of PRL and LH were positively proportional to the BMI whereas FSH decreased with the increase of the BMI. The effect of the blood group as an important factor is considered a clinical indicator for the investigation of the levels of antioxidant vitamins in females with PCOS having diverse blood groups for both single and married females [26].

Vitamins A, C and E displayed a significant high decrease ($***p < 0.0001$) in the blood serum of PCOS women in all the blood groups tested. It is noticed that the levels of vitamin C in PCOS women when assessed against the healthy group, have the highest significant decrease in contrast with vitamins A and E. But, the alteration in the levels of antioxidant vitamins is limited by the change in the class of the blood group belonging to women with PCOS [27].

Also, vitamins A, C and E recorded a significantly high decrease ($***p < 0.0001$) belonging to their values in the blood sera of polycystic ovary syndrome women

who have various degrees of obesity, while the same vitamin revealed a less significant decrease ($***p < 0.0001$) in PCOS women without obesity. So, the levels of a blood serum of PCOS women vary according to body mass index [28].

CONCLUSION

The research conducted, pointed to the modest effect of the blood group and BMI on the values of the female sexual hormones (LH, FSH and PRL) and the vitamins A, E and C. It was noticed that there was a high significant variation between the levels of LH and PRL in females infected with PCOS and the healthy group while a modest significant difference was determined in the values of FSH between the two groups mentioned above. In addition, a highly significant variation was noted in the values of the vitamins A, E and C when comparing the women diagnosed with PCOS and healthy women. Also, the increase in the patient's weight meant an increase in the severity of PCOS due to a decrease in the levels of FSH hormone and vitamins A, E and C and an increase in LH and PRL.

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Author's contributions:

Conceptualization: A.A.S. and A.D.M.A.; methodology: A.A.S.; software: A.D.M.A.; validation: A.A.S.; formal analysis: A.A.S.; investigation, A.D.M.A.; resources: A.D.M.A.; data curation: A.A.S.; writing—original draft preparation: A.D.M.A.; writing—review and editing: A.D.M.A.; visualization: A.A.S.; supervision: A.A.S.; project administration: A.A.S.; funding acquisition: A.D.M.A.

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