



RESEARCH ARTICLE

REPRODUCTIVE HORMONE LEVELS AND METABOLIC SYNDROME IN WOMEN WITH POLYCYSTIC OVARY SYNDROME IN SANA'A, YEMEN

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Abstract

Background and Objectives: Polycystic ovary syndromes (PCOs) are the most complex endocrine disorders of the female reproductive system with metabolic and psychiatric manifestations. It affects 5-10% of women of childbearing age. There are paucity of information on PCOs. Therefore the present study aimed at the effect of reproductive hormones, metabolic syndromes, smoking and khat chewing on the PCOs among women in Sana'a.

Subjects and Methods: The study included 45 Yemeni women of the age group 18-45 years with PCOs classified into two groups regarding age: Group I 18-29 years old, Group II 30-45 years old and underwent clinical assessment (waist, BMI and sex hormones, blood pressure, glucose, lipids, and insulin), and transvaginal ultrasound. Clinical data, history of other diseases and data of chewing and smoking also collected. Also the study included 45 healthy control women matched in age with the cases. **Results:** The prevalence of MS among PCOs patients was 35% and the most prevalent MS risk factors among PCOs patients were waist circumference (WC) 64.4%, and HDL-C 64.4% respectively, while prevalence of triglycerides (TG), hypertension and fasting blood sugar (FBS) were 28.9%, 20% and 13.3%, respectively. PCOs patients had significant increase in serum levels of luteinizing hormone (LH) ($p < 0.001$), Insulin ($p < 0.001$), HOMA-IR ($p < 0.001$), T testosterone (TT) ($p < 0.001$), DHEA-S ($p < 0.001$) and FBS ($p < 0.016$). Lean PCOs patients had a significant increase in TT than overweight/obese PCOs ($p < 0.045$) and dehydroepiandrosterone sulfate (DHEA-S) was found to be significantly higher in PCOs women with MS ($p < 0.011$). Insulin resistance was significantly higher in PCOs women with hypertension as compared to PCOs women without hypertension ($p < 0.023$).

Conclusions: There is a relationship between PCOs and reproductive hormone disorder. Patients had significant increases in serum levels of LH, LH/Follicle Stimulating Hormone (FSH), Insulin, TT, and DHEA-S. Also, a relationship was found between the syndrome and infertility, hirsutism, irregular menstruation, polycystic ovaries and multiple sclerosis.

Keywords: Hormones, insulin, metabolic risk factors, polycystic ovary syndrome.

INTRODUCTION

Polycystic ovary syndrome (PCOs) begins during adolescence and gradually transitions to adulthood and its effects persist even post-menopause. Clinical features of PCOs can be categorized in three different groups such as reproductive, metabolic, and psychological; which the most common multifaceted

and heterogeneous endocrinopathy disorder among adult women¹. It estimated to affect 6-8% of females in reproductive age². Chronic anovulation, infertility, clinical evidence of Hyperandrogenism (hirsutism, balding of the male pattern and, acne) and enlarged polycystic ovaries have been characterized by PCOs³. PCOs also related to resistance to the action of insulin leading to biochemical disturbance to the metabolism

of carbohydrates, sex steroids and lipids⁴, in addition to an increase in inflammation markers. In 2003, Rotterdam consensus has been reached on the diagnosis of PCOs in women with at least two of the following characteristics: clinical or biochemical hyperandrogenemia, amenorrhea or oligomenorrhea and ultrasound involvement of ovarian cyst. Even increased cardiovascular disease (CVD) risk factors are identified for women with PCOs⁵, besides increased MS prevalence. PCOs patients are advised to be tested for MS and CVD risk factors⁶. More precisely, PCOs women may have altered tolerance to glucose and dyslipidemia⁷. Moreover, thyroid disorders are now recognized to be more prevalent in patients with PCOs than in a regular population⁸. However, accurate data on the prevalence and incidence is limited and variable, mainly due to the different sets of the diagnostic criteria used to define the disorder as well as the exact number of women affected is unknown⁹. PCOs is also often undiagnosed¹⁰. Not surprisingly, the prevalence of PCOs appear to be higher from 35-90% in women with menstrual abnormalities also is increased in the presence certain diseases. The prevalence of PCOs in women with epilepsy, for example, exceeds that in women without epilepsy¹¹. This research aimed to determine the independent correlation of metabolic and clinical outcomes in a well-characterized population of patients with and without PCOs. We have provided data on 45 women with PCOs and 45 women without PCOs, hormonal and metabolic findings were compared in patients divided into two classes' case and control. In Yemen, there are no published data regarding the prevalence or incidence of PCOs among women. Because there is a great need for research into many issues related to the complexity of PCOs processes among Sana'a women and the late negative impact on their health, the aim of the current study is to determine the independent association of metabolic and clinical outcomes in a group of women with PCOs.

SUBJECTS AND METHODS

Specimen Collection and Processing

A total of 45 diagnosed PCOs women's between 18- 43 years age groups were selected from the department of obstetrics and gynaecology at AL-Kuwait University Hospital, Al-Sabeen Hospital, central health lab and modern international lab in Sana'a. 45 women without PCOs were selected as control. The PCOs subject was selected if they had 2 out of 3 criteria met (oligoovulation and anovulation) excess androgen activity, polycystic ovaries by gynecologic ultrasound, with excluding other endocrine disorders; that may cause similar symptoms like hyperprolactinemia, hypothyroidism, cushing syndrome and congenital adrenal hyperplasia.

Assay

5ml of Venous blood sample was collected after 12 h overnight fasting assayed at 8:00-10:00 AM, during the 3rd-5th day of the menstrual cycle (the only early follicular phase). Nine hormones α -OH progesterone, Dehydroepiandrosterone included sulfate (DHEA-S), thyroid-stimulating hormone, prolactin (PRL), follicle

stimulating hormone (FSH), luteinize hormone (LH), insulin and total testosterone (TT) were measured by ELISA technique using commercial kits (Human Germany, DRG International USA, Roche, Germany, Abbott USAs). Glucose, Cholesterol, Triglycerides, HDL-cholesterol (HDL-C) and LDL-cholesterol (LDL-C) were measured by enzymatic colorimetric reaction using commercial kits (Human Germany).

Data collection

The primary data collection technique, i.e., the (self-administered) questionnaire was used to collect the data for cases and controls. Which consists of three parts;

1. The demographic characteristics of the participants;
2. The epidemiological characteristics of the participants and;
3. Medicinal properties of the participants.

The demographic section includes the marital status and age of the participants, while the epidemiological section includes obesity, smoking, khat chewing, family history of diabetes, obesity, hirsutism, and medical characteristics include menstruation and regular menstruation, fertility.

Data Analysis

Data analysis was performed using the SPSS software (16.0, SPSS Inc, Chicago, IL), and the significant difference was indicated if (p -value < 0.05). Continuous variables were checked for normality using the one-sample Kolmogorov-Smirnoff test; they are expressed as mean \pm standard deviation (SD). The categorical variables are expressed as percentages. Distributions between groups are compared using the T-test with Bonferroni correction for pairwise comparison. Insulin sensitivity, expressed as the IS, was calculated using mathematical modeling (MIN MOD version 3.0) HOMA-IR and HOMA-% β were calculated using the 1996 HOMA2 computer model.

RESULTS

The sample size of this study was 90 women belong to 18-43 years of age group. 45 of them were healthy controls women and 45 PCOs patients; who have been diagnosed based on the 2003 Rotterdam criteria. Hirsutism was found in 43 (95.6%), 41 (91%), had menstrual irregularity. Percentage of oligomenorrhea, amenorrhea and normal menstrual was 25 (55.5%), 16 (35.5%) and 4 (9%) respectively, Among the 17 infertile patients; 11 (24.4%) had primary infertility and 6 (13.3%) had secondary infertility. PCO on ultrasound was recorded 42 (93.3%) and 3 (6.7%); had no PCO. 18 (40%) had acne while 3 (6.7%) had alopecia, 18 (40%) of PCOs patients had acne, while 3 (6.7%) had alopecia (Table 1). Menses frequency was significantly higher among PCOs patients than that of healthy controls women ($p < 0.001$). Systolic and diastolic blood pressure was also significantly higher among PCOs women as compared to the healthy control group ($p < 0.008$ and $p < 0.047$) respectively. There were no significant differences in menarche, height, weight, BMI and WHR between PCOs patients and healthy controls (Table 2).

Table 1: Description of the most important clinical finding of PCOs patients.

Clinical finding (Variable)	PCOs		
	Yes N (%)	No N (%)	
Hirsutism	43(95.6%)	2(4.4%)	
Acne	18(40%)	27(60%)	
Alopecia	3(6.7%)	42(93.3%)	
Infertility		17(37.7%)	-
	Primary	11(24.4%)	-
	Secondary	6(13.3%)	-
Menstrual irregularity	41(91%)	4(9%)	
	Regular	4(9%)	-
	Oligomenorrhea	25(55.5%)	-
	Amenorrhea	16(35.5%)	-
PCO	42(93.3%)	3(6.7%)	

Mean±SD, n=45, N: number; SD: standard deviation; * *p*-value < 0.05 considered significant; ** *p*-value < 0.001 considered highly significant.

The family history of PCOs was significantly increased among PCOs patients compared to that of healthy controls ($p < 0.001$, $p < 0.004$) respectively. Table 3 depicted the family history of PCOs; were significantly increased among PCOs patients compared to that of healthy controls ($p < 0.001$, $p < 0.004$), respectively. However, smoking was more common among healthy

controls than patients ($p < 0.002$). Also, Khat chewing, obesity, family history of obesity and diabetes between two controls and PCOs patients were not significantly different. Table 4 shows the differences between biochemical markers between PCOs patients and healthy control women.

Table 2: Demographic characteristics of both healthy control and polycystic ovary syndrome patients.

Variables	Non-PCOs	PCOs	<i>p</i> -value
Menarche(years)	12.49±2.67	12.73±1.59	0.83
Married	20(44.4%)	17(37.7%)	0.280
Single	25(55.65)	28(62.2%)	
BMI (Kg\m ²)	25.37±4.57	26.85±7.81	0.26
WHR(cm)	0.81±0.08	0.82±0.09	0.27
WC(cm)	79.93±11.68	84.0±17.83	0.204
Days between menstrual cycle (day)	25.18±3.05	86.24±56.59	<0.001**
Systolic blood pressure (mmHg)	114.89±13.71	124.3±18.69	0.008**
Diastolic blood pressure (mmHg)	79.56±9.58	83.78±9.89	0.043*

Mean±SD, n=45, N: number; SD: standard deviation; * *p*-value < 0.05 considered significant; ** *p*-value < 0.001 considered highly significant.

Table 3: Distribution of risk factors for PCOs in both healthy controls and polycystic ovary syndrome patients.

Risk factors	Non-PCOs	PCOs	Odd ratio (95%CL)	<i>p</i> -value
Smoking	16 (35.6%)	4 (8.9%)	0.177(0.054-0.0584)	0.002**
Chewing Khat	17(37.8%)	10 (22.2%)	0.471(0.186-1.188)	0.107
Obesity	27 (60%)	29 (64.4%)	1.325(0.566-3.099)	0.517
Family history of DM	30 (66.7%)	24 (53.3%)	0.571(0.244-1.341)	0.197
Family history of obesity	32(71.1%)	31 (68.9%)	0.900 (0.365-2.271)	0.818
Family history of PCOs	0 (0%)	9(20.0%)	0.444(0.345-0.567)	0.004**

Mean±SD, n=45, N: number; SD: standard deviation; * *p*-value < 0.05 considered significant; ** *p*-value < 0.001 considered highly significant.

The hormonal disturbance of LH, LH/FSH ratio, T. Testosterone and DEHA-S were statically significant to PCOs patients compared to healthy controls ($p < 0.001$, $p < 0.001$, $p < 0.001$) respectively. Moreover, FBS, Insulin and HOMA-IR were moderate significant to PCOs patients ($p < 0.020$, $p < 0.001$, $p < 0.001$) respectively whereas, there were no significant increase was found in lipid profile among PCOs patients as compared to healthy controls. The difference in FSH level was observed between PCOs patients and controls. Comparison side, at the Prevalence of different characteristics of metabolic syndrome between PCOs patients and healthy control women, was 16(35.6% vs.0 (0%)). The rate of WC indicated the rate of central obesity was 29(64.4% vs. 24(53.3%)), FBS≥100mg/dl was [6(13.3% vs. 2(4.4%)), Triglycerides≥150mg/d (13(28.9% vs. 7(15.6%)), HDL-C<50

mg/dl was 29.9(64.4% vs. 14(31.1%)) and blood pressure≥130/85 mmHg in PCOs women was (9(20%) vs. 1(2.2%) respectively. The risk of metabolic syndrome was higher significant among PCOs patients than controls ($f < 0.002$) and no significant differences in the characteristics of metabolic syndrome except blood pressure ($p < 0.284$, $p < 0.138$, $p < 0.655$, vs. $p < 0.007$). Comparison of the prevalence of different characteristics of metabolic syndrome between PCOs patients and healthy control women was 16(35.6% vs.0 (0%)). The rate of WC indicated the rate of central obesity was 29(64.4% vs. 24(53.3%)), FBS≥100mg/dl was (6(13.3% vs. 2(4.4%)), Triglycerides≥150 mg/d 13(28.9% vs. 7(15.6%)), HDL-C<50 mg/dl was 29.9(64.4% vs. 14(31.1%)) and blood pressure ≥130/85 mmHg in PCOs women was 9(20%) vs. 1(2.2%), respectively.

Table 4: Description and *p*-value of the biochemical parameters for both healthy controls and polycystic ovary syndrome patients.

Parameters	Normal Range	Non-PCOs	PCOs	<i>p</i> -Value
LH (mIU/L)	(1-18)	4.10±1.41	12.4±6.32	<0.001**
FSH(mIU/L)	(3.0- 7.9)	6.18±1.30	6.00±2.25	0.658
LH/FSH ratio	(1:1)	0.669±0.18	2.23±1.16	<0.001**
T.T (ng/ml)	(0.06-0.82)	0.212±0.107	0.657±0.614	<0.001**
DHEA-S (ng/ml)	(0.06-0.82)	1.61±0.99	3.28±2.36	<0.001**
Insulin (µ/ml)	(3-17)	7.98±3.41	13.24±9.46	<0.001**
F.B.S (mg/dl)	(70-115)	80.78±8.95	89.89±23.23	0.02*
HOMA-IR	-	1.61±0.76	3.13±2. 86	0.001**
HOMA-%β	-	139.95±53.02	146±13	0.590
HOMA-S	-	95.99±50.40	71.75±48.05	0.022
Cholesterol (mg/dl)	< 200	190.67±36.94	204.98±36.04	0.06
Triglyceride (mg/dl)	< 150	114.73±47.82	130.78±57.75	0.155
HDL-C(mg/dl)	>40	44.91±9.15	46.33±14.71	0.583
LDL-C (mg/dl)	<130	122.84±30.40	131.53±36.69	0.225

Mean±SD, n=45, N: number; SD: standard deviation; * *p*-value < 0.05 considered significant; ** *p*-value < 0.001 considered highly significant.

Figure 1 also showed the comparison prevalence characteristics of metabolic syndrome between PCOs patients and control (healthy) women's.

Clinical, metabolic characteristics and hormones

The clinical and biochemical characteristics of the 45 patients divided according to age. The obesity markers (BMI, WC) associated more with age ($p < 0.008$, $p < 0.039$) also diastolic blood pressure and HOMA-IR

($p < 0.037$, $p < 0.004$). At the same time, hormonal disturbance of LH, LH/FSH ratio, T. Testosterone were lower significant with age ($p < 0.048$, $p < 0.007$, $p < 0.004$) respectively. Also, no significant difference in systolic blood pressure, FSH, DHEA-S, Insulin, F.B.S, HOMA% β cell, HOMA-S, Cholesterol, Triglyceride, HDL.C, LDL.C with ageing among PCOs patient (Table 6).

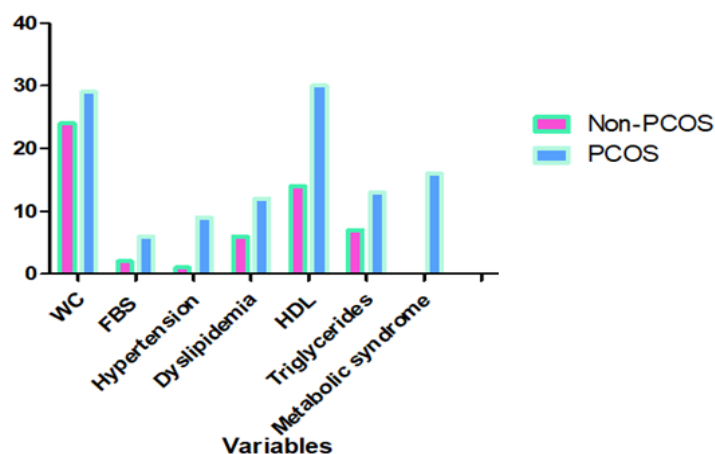


Figure 1: Comparison prevalence characteristics of metabolic syndrome between PCOs patients and control (healthy) women's.

Table 5: comparison the prevalence of different characteristics of metabolic syndrome between PCOs patients and healthy control women.

Variables	Non-PCOs	PCOs	<i>p</i> - Value
WC ≥ 80(cm)	24(53.3%)	29(64.4%)	0.284
FBS ≥ 100(mg/dl)	2(4.4%)	6(13.3%)	0.138
Hypertension: SBP/DBP ≥ 130/85(mmHg)	1(2.2%)	9(20%)	0.007*
Dyslipidemia	6(13.3%)	12(26.7%)	0.114
Triglycerides ≥ 150 (mg/dl)	7(15.6%)	13(28.9%)	0.128
HDL < 50(mg/dl)	14(31.1%)	30(64.4%)	0.655
Metabolic syndrome	0(0%)	16(35.6%)	0.002°

Mean±SD, n=45, N: number; SD: standard deviation; * *p*-value < 0.05 considered significant; ** *p*-value < 0.001 considered highly significant.

Table 7 indicates no significance difference in anthropometrics, hormonal profiles and metabolic parameters in two ages groups except insulin and HOMA-IR were more significant in 30-43 year group than smaller groups (18-29 year) ($p < 0.027$, $p < 0.01$) indicated that insulin and HOMA-IR were worse with age.

Rotterdam criteria and the metabolic syndrome criteria: Figure 2 indicates the frequency of the Rotterdam criterion in the two groups of patients, separated by age. The incidence of the individual criteria of the metabolic syndrome show older age group was associated with others manifestations.

Table 6: The association between ages, the clinical and biochemical variables in PCOs patients.

Variables	18-29 year (N=35)	30-43 year (N=10)	p--Value
BMI(Kg/m ²)	25.24±6.56	32.46±9.52	0.008**
Waist(cm)	81.09±17.03	94.20±17.20	0.039*
Systolic blood pressure (mmHg)	122.29±19.60	131.50±13.55	0.172
Diastolic blood pressure (mmHg)	82.14±10.24	89.50±5.99	0.037*
LH (mIU/L)	13.37±6.46	8.91±4.56	0.048*
FSH(mIU/L)	5.85±2.45	6.53±1.32	0.407
LH\FSH ratio	2.47±1.17	1.37±0.64	0.007**
T.T (ng/ml)	0.73±0.67	0.41±0.22	0.004**
DHEA-S (ng/ml)	3.33±2.55	3.08±1.57	0.124
Insulin (u/ml)	11.14±5.15	20.59±16.11	0.160
F.B.S (mg/dl)	87.03±17.44	99.90±36.69	0.768
HOMA- % β	142.083±62.82	181.29±76.76	0.105
HOMA-S	77.74±51.48	50.79±25.34	0.119
HOMA-IR	2.48±1.70	5.38±4.67	0.004**
Cholesterol (mg/dl)	201.09±38.37	206.10±27.65	0.704
Triglyceride(mg/dl)	123.91±58.08	132.30±58.98	0.648
HDL.C (mg/dl)	42.34±13.91	47.80±17.57	0.395
LDL.C(mg/dl)	133.66±38.45	130.50±30.80	0.831

Mean±SD, N: number; SD: standard deviation; * p-value < 0.05 considered significant; ** p-value <0.001 considered highly significant

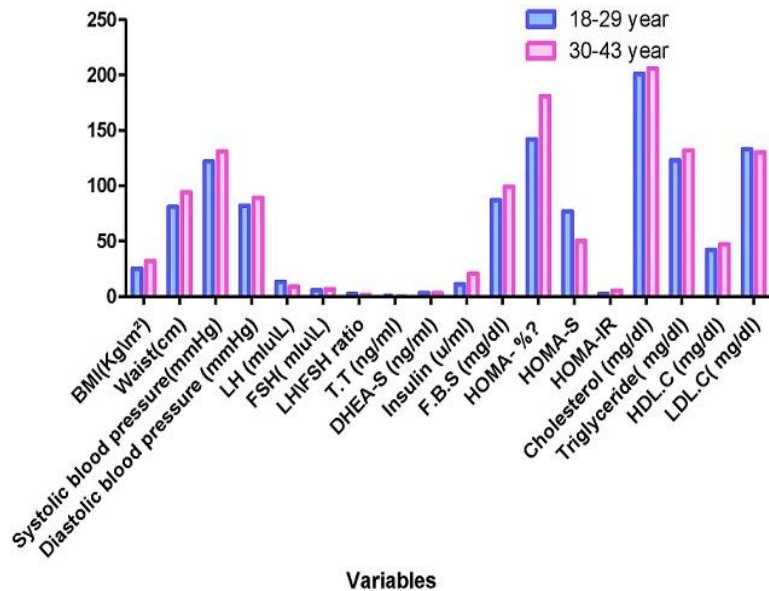


Figure 2: Association between age and variables (clinical and biochemical) in PCOs patients.

DISCUSSION

This study aims to investigate the percentage of infertility among PCOs women in Sana'a Yemen. Study association of PCOs with reproductive hormones and metabolic factors and investigate the association of investigated parameters with smoking and khat chewing. The case study included 45 PCOs women, among which only 17(33.3%) were married and 45 healthy control women, among which 20(44.4%) were married. The case and control groups were similar in their demographic profile, and age ranged 18-43 years. Mean age of menarche was not different between case and control in (12.73±1.59, 12.73±2.67) respectively. The mean age of menarche is typically between 12 and 13 years. The reported mean age of menarche was similar to previous studies^{12,13}. Among the 45 PCOs patients, only 17(37.8%) were married. All of the married PCOs women were infertile with primary

infertility (the individual who have never established a pregnancy) representing 11(24.4%), and secondary infertility (the individual who has conceived previously (including miscarriages) but is currently unable to establish a subsequent pregnancy established a pregnancy) (10) representing 6 (13.3%). In one of the largest published series of 1,871 women with PCOs, whereas 14% were presented with secondary infertility¹⁴. This finding was different from a Greek study presenting primary and secondary infertility by 49%, and 26% respectively¹⁵. Primary infertility is more common among PCOs patients. Irregular menses was found in 41(91.1%) of the total women included in this study, among which 25 (55.6%) had either oligomenorrhea or 16 (35.6%) amenorrhea, while 4 (8.9%) of them still had regular menses. Hirsutism, in general, was the second most common complaint after infertility that the attendants claimed to suffer.

Table 7: The association between age, clinical and biochemical variables in the healthy controls group.

Variables	18-29 year (N=19)	30-43 year (N=26)	p-Value
BMI (Kg\m ²)	24.50±5.16	26.46±4.08	0.278
Waist (cm)	77.26±12.82	81.88±10.59	0.193
WHR	0.807±0.87	81.88±10.59	0.747
Systolic blood pressure (mmHg)	113±10.28	115±15.88	0.545
Diastolic blood pressure (mmHg)	79.21±8.38	79.81±10.53	0.893
LH (mlμ\L) (1-18) mlμ\L	3.70±1.53	4.40±1.28	0.101
FSH(mlμ\L) (3.0- 7.9) mlμ\L	5.85±2.45	6.53±1.32	0.341
LH/FSH ratio (1:1)	5.96±1.55	6.33±1.08	0.247
T. Testosterone (ng/ml) (0.06-0.82) ng/ml	0.73±0.67	0.41±0.22	0.094
DHEA-S (ng/ml) (0.06-0.82) ng/ml	3.33±2.55	3.08±1.57	0.829
Insulin (μ/ml) (3-17) μ/ml	6.67±3.46	8.93±3.10	0.027*
F.B.S (mg/dl) (70-115) mg/dl	78.01±8.57	82.81±8.83	0.075
HOMA-% β cell (%)	138.80±63.60	140.17±54.89	0.915
HOMA-S	96.71±52.97	98.71±64.51	0.912
HOMA-IR	1.27±0.63	1.86±0.77	0.01*
Cholesterol (mg/dl) Up to 200mg/dl	186.32±34.8	193.85±38.78	0.506
Triglyceride(mg/dl) Up to 200mg/dl	104.21± 36.20	122.42±54.17	0.211
HDL.C (mg/dl) (40-60) mg/dl	44.21±8.95	45.42±9.43	0.666
LDL.C (mg/dl) (100-160)mg/dl	121.47±28.16	123.85±32.45	0.799

Mean±SD, N: number; SD: standard deviation; *p-value < 0.05 considered significant;** p-value <0.001 considered highly significant.

Current study found hirsutism in 95.6 % of the studied PCOs women in Sana'a. Prevalence of hirsutism in PCOs generally ranges from 40% to 90% among European and American women. It is common in dark skinned people, and rare in Japanese and Asian females¹⁶. Another explanation for this discrepancy is the genetically determined differences in skin 5α-reductase activator maybe because of diet and environment¹⁶. Therefore, acne is common in PCOs; in current study, 40% from the PCOs patients had acne. Also, Alopecia prevalence in current study was 6.7% which is rare manifestation among PCOs patients. Recent results were compatible with previous reports which found the prevalence of alopecia to be 6% - 10%¹⁸. PCOs and non-PCOs at ultrasound scan was (93.3% and 6.7%) respectively, which meets the Rotterdam criteria of PCOs cases 93%¹⁹. Family history of PCOs among mothers of patients was markedly significant as compared to controls ($p < 0.0001$). The results of present study are in line with previous investigation reported by Mukherjee *et al.*,²⁰. On the other hand, there was no significance in a family history of DM and obesity, which were different from studies established in Greeks, United Arab Emirates, and Libya (71%, 75.5%, 82%) respectively^{21,22}. Furthermore, in current study, smoking did not affect androgens (TT and DHEA-S) ($p < 0.45$, $p < 0.72$) among PCOs women. This may be due to recall bias, small sample size, or because women in Sana'a are usually not chronic smokers. Triglyceride, LDL-C was significantly higher while HDL-C was significantly lower among smoker patients as compared to non-smokers. Moreover, there was no association between chewing khat and different hormonal and metabolic parameters measured in the PCOs group. No previous researches were established to estimate the effect of khat on PCOs. Therefore, further studies are needed to confirm or exclude current findings. In general, smoking and khat have not changed in the reproductive hormones and metabolic

parameters²³. In this study, the presence of PCOs was not associated with any differences in FSH level. There is an association with LH levels and LH/FSH ratios were remarkably higher among the PCOs patients as compared to the healthy controls ($p < 0.001$, < 0.001). The similar results were reported by previous findings in Makah, Jeddah, Iraq, Thai and Libya^{24,25}. Total testosterone levels were significantly higher in used PCOs patients ($p < 0.001$), also DHEA-S levels increased significantly among PCOs women ($p < 0.001$). In recent study revealed an increase in all MS risk factors as compared to control among which insulin resistance and hypertension were statistically significant. As per NHLBI/AHA criteria, the MS characteristics such as WC 29.9(64.4%), HDL-C 29.9(64.4%), HTN 9 (20%), TG13 (28.9%), FBS 6(13.3%) respectively were recorded in PCOs patients. In recent study, the patient phenotype differed greatly from one another age groups. Age was positively associated with obesity markers (BMI and waist circumference) in women with PCOs. The investigating of PCOs in women of different ages is important because it is now understood the increase metabolic and cardiovascular risk and undoubtedly depend on age²⁶. As a result, these age-related changes may affect the observed incidence of PCOs. This study found that Women aged 30-43 years possessed higher BMI and waist than younger women (aged 18-29 years). This study was in agreement with Gu'lekli's suggestion that PCOs women are susceptible to gain weight as they get older²⁷. PCOs is careful to be a polygenic trait, and clinical features of this disorder may change with age, beginning in adolescence until menopause²⁸. During the transvaginal US PCOs is a standard variant, and the incidence of PCOs in young, healthy women younger than 21 years was as high as 80% in a Danish study²⁹. Duijkers found that the prevalence of PCOs was 84% in young women aged 18-22 years compared to 33% in the age group of 33-37 years suggesting that the prevalence of PCOs is

lower in older women³⁰. Current evidence supports the need to adapt the PCOs criterion in the Rotterdam definition of PCOs to patients' age, as indicated by Duijkers and Kristenssens. Recent study included only patients with Rotterdam PCOs parameters, and the latest guideline indicates that before PCOs can be diagnosed, all 3 Rotterdam parameters must be present in adolescents. Older patients may be more commonly diagnosed with idiopathic hirsutism diseases due to enhanced ovulation rate³¹.

CONCLUSIONS

The PCOs is hormonal disturbance disease, and there is a strongly associated between PCOs and each of these hormones: T.T, DHEA-S, LH, LH/FSH ratio, insulin and HOMA-IR. The hormonal disturbance was clinically presented among PCOs patients in Sana'a as follows: Hirsutism was the most common symptom, and alopecia was the least common, high parentage of PCOs patients suffer from the irregular menstrual period, all married PCOs women were infertile, high prevalence of polycystic ovary (pearl necklace appearance with (many cysts up on ultrasound examination) among PCOs patients, The most significant predictor of metabolic syndrome in PCOs patients was increased waist circumference and reduced HDL-C, Insulin resistance (HOMA-IR) was a strong association with PCOs; Obesity was not a risk factor for PCOs. Contrary to previous studies, there was a strong association between the family history of PCOs and presentation of the PCO Syndrome among patients. Chewing khat insignificantly reduced testosterone, DHEA-S, insulin, HOMA-IR, HOMA-β, LH, while increases FSH. No significant association was found between PCOs neither with smoking nor with khat chewing. Therefore, further study should be needed in future to evaluate the effects of smoking and khat on PCOs No previous researches were established to estimate the effect of khat on PCOs.

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AUTHOR'S CONTRIBUTIONS

Sina L: writing original draft, methodology. **Reem A:** investigation, conceptualization, literature survey. **Al-Shehari WA:** interpretation of data. **Edrees WH:** data curation, conceptualization. **Jumaan RM:** interpretation of data. **Al-Tamimi SAA:** editing, methodology. All authors revised the article and approved the final version.

DATA AVAILABILITY

The data and material are available from the corresponding author on reasonable request.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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