

Nutritional Status of Patients with Polycystic Ovary Syndrome (PCOS) in Irbid Governorate, Jordan: A Case-Control Study

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Abstract

Polycystic Ovary Syndrome (PCOS) is a crucial infertility problem among women in the world; especially Arab women. The main objective of this case-control study was to perform anthropometric, biochemical, clinical and nutritional assessment among PCOS patients. The study population composed of 60 Jordanian women aged 19–39 years, and classified into two groups: 30 were cases (PCOS patients) and 30 were control group (Healthy women). Results of the study indicated that the Body Mass Index (BMI) were significantly higher among PCOS patients than healthy women. Furthermore, significant differences were shown in the mean values of Luteinizing Hormone (LH) and (LH): Follicle-Stimulating Hormone (FSH) (LH:FSH) ratio which were higher among PCOS patients with a $p=0.01$ and $p=0.03$, respectively. Also, significant differences between PCOS patients and healthy women were shown for three clinical manifestations of PCOS including infertility, sleep apnea, and eating disorders. Moreover, the findings of the validated food frequency questionnaire (FFQ) revealed no significant differences between two study groups in the consumption of macronutrients and total energy intake. It is obviously concluded from the study that PCOS is remarkably responsible for substantial variations in anthropometric and biochemical measurements, hormonal levels, and clinical features among PCOS patients.

Key words: BMI, hirsutism, infertility, luteinizing hormone, macronutrients

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الحالة التغذوية لمرضى متلازمة تكيس المبايض في محافظة إربد، الأردن:
دراسة الحالات والشواهد

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ملخص

تعتبر متلازمة تكيس المبايض مشكلة عقم هامة بين النساء في العالم وخاصة النساء العربيات. كان الهدف الرئيسي من هذه الدراسة (الحالات والشواهد) هو إجراء تقييم جسماني وبيوكيميائي وسريري وتغذوي لدى مرضى متلازمة تكيس المبايض. تكون مجتمع الدراسة من 60 امرأة اردنية تتراوح اعمارهن ما بين 19 و 39 سنة وتم تقسيمهن الى مجموعتين : 30 منهم حالات مرضية (مرضى متلازمة تكيس مبايض) و 30 اخرين كانوا شواهد (نساء أصحاء). اظهرت النتائج أن مؤشر كتلة الجسم كان أعلى بشكل ملحوظ بين مرضى تكيس المبايض مقارنة بالنساء الأصحاء. اضافة لذلك، فأن فروق ذات دلالة معنوية لوحظت في قيم متوسطات الهرمون الملوتن وقيم نسبة الهرمون الملوتن الى الهرمون المنبه للجريب والتي كانت أعلى بين مرضى تكيس المبايض بدلالات معنوية $p=0.01$ و $p=0.03$ ، على التوالي. كذلك، لوحظ وجود فروق ذات دلالة معنوية بين مرضى تكيس المبايض والنساء الأصحاء في ثلاثة مظاهر سريرية لمتلازمة تكيس المبايض وهي العقم، وتوقف التنفس أثناء النوم، واضطرابات الأكل. بالإضافة لذلك، فان نتائج استبيان تردد الغذاء المُصادق عليه اظهرت عدم وجود فروق ذات دلالة معنوية بين مجموعتي الدراسة في استهلاك المغذيات الكبرى وإجمالي استهلاك الطاقة. نستنتج بوضوح ان متلازمة تكيس المبايض مسؤولة بشكل ملحوظ عن حدوث اختلافات كبيرة في القياسات الجسمانية والبيوكيميائية ومستويات الهرمونات والمظاهر السريرية لدى مرضى متلازمة تكيس المبايض.

الكلمات المفتاحية: مؤشر كتلة الجسم، الشعرانية، العقم، الهرمون الملوتن، المغذيات الكبرى.

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Introduction:

Polycystic Ovary Syndrome (PCOS) is one of the most widely recognized women endocrine regenerative disorder and metabolic disproportionate disorder (Arentz et al., 2017). PCOS with its possible genetic cause, may influenced also by environmental causes, like nutrition and physical activity (Norman et al., 2007; Escobar-Morreale, 2018). PCOS has been linked to a higher risk of cardiac and metabolic disease (Nestler, 2000; McLuskie & Newth, 2017). High prevalence of overweight/obesity (Lim et al., 2012) and insulin resistance (Lin et al., 2013) have been reported in women with PCOS.

Clinical signs of PCOS include irregular menstruation (Bouzas et al., 2014), hyperandrogenism and elevated levels of both serum Luteinizing Hormone (LH) and Follicle-Stimulating Hormone (FSH) (Fauser et al., 2012). The beginning of clinical signs of PCOS is during adolescence, which is affected by high levels of androgens throughout intrauterine life (Franks et al., 2006). There has been limited research in the Jordanian community on PCOS, weight management, and dietary lifestyle changes. Therefore, this case-control study aimed to find out the effect of PCOS on anthropometric, biochemical, and dietary variables.

Materials and Methods:

Study population

A case-control study has been conducted on 60 Jordanian women within reproductive age (ages 19–39 years). The participants included were as follow; 30 patients with PCOS (cases group) and 30 healthy women (control group). The study sample was randomly selected from Obstetrics and Gynecology clinics in the Princess Badi'a Hospital in Northern Jordan in Irbid from February to May, 2021. Ultrasound imaging was used by specialist gynecologists using Rotterdam criteria to diagnose all of the patients with PCOS (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004).

Ethical Considerations

Ethical approval (IRB: MU/AGR/2021/560) was given by Ethics Committee of the Faculty of Agriculture/ Mutah University in January 2021. Official permission have been also obtained from the directors of Princess Badi'a Hospital. In addition, written informed consent has been obtained from each participant before being part of the study.

Study Instruments

Data was collected from patients in clinics by a face-to-face interview with each patient to collect data regarding sociodemographic characteristics and clinical symptoms. Economic status was classified according to (Alkhalidy et al., 2021). In addition, anthropometric measurements have been taken for all participants. Weight was measured and recorded in kilogram using advanced Tanita scale (MC-780U, Japan) while the height was measured and recorded in meter from the top of head to the sole of feet tape. Body Mass Index (BMI) was calculated as the weight (kg) divided by the square of the height (m). BMI values $< 18.5 \text{ kg/m}^2$ is underweight, between $18.5\text{-}24.9 \text{ kg/m}^2$ is normal, between $25\text{-}29.9 \text{ kg/m}^2$ is overweight and $\geq 30 \text{ kg/m}^2$ is obese (WHO, 1995). Biochemical characteristics of participants were taken from patients medical records. Clinical assessment and physical examinations were conducted by specialist from Obstetrics and Gynecology clinics in the Princess Badi'a Hospital. Finally, a validated semi-quantitative food frequency questionnaire (FFQ) for 147 food items was used during the interviews (Mirmiran et al., 2010). For each food item reported, the amount was translated into energy and grams of nutrients using ESHA Food Processor Nutrition Analysis Software (ESHA) (Ghaffarpour et al., 1999).

Statistical Analysis

Statistical analyzes was done by SPSS (version 26) and the value of $p < 0.05$ was considered statistically significant. For data with a normal distribution, Student's t-test used to compare continues variables between control and PCOS groups. Regarding categorical data, Chi square test was performed.

Results:

General Socio-demographic characteristics for PCOS group and control group were as shown in (Table 1). The mean age for PCOS group was 29.53 ± 4.988 with no significant difference comparing to control group, which has a mean age of 29.97 ± 6.338 . Regarding all other socio-demographic characteristics (including social status, educational qualification, economic status, and work status), there was a significant difference between both groups.

Table (1) Socio-demographic characteristics among PCOS and control group

Variables	Category	PCOS n (%)	Control n (%)	P value*
Age [#]		29.53 ± 4.988	29.97 ± 6.338	0.763
Social Status	Single	2 (6.7%)	4 (10%)	0.01*
	Married	27 (90%)	23 (76.7%)	
	Divorced	1 (3.3%)	3 (10%)	
Educational Qualification	Undergraduate level	14 (46.7%)	9 (30%)	0.03*
	Secondary	4 (13.3%)	9 (30%)	
	Diploma	10 (33.3%)	7 (33.3%)	
	Postgraduate studies	2 (6.7%)	2 (6.7%)	
Economic Status	High (≥ 800 JD)	2 (6.7%)	4 (13.3%)	0.04*
	Medium (350-799 JD)	15 (50%)	16 (53.3%)	
	Weak (< 350JD)	13 (33.3%)	10 (33.3%)	
Work Status	Student	1 (3.3%)	6 (20%)	0.02*
	Housewife	15 (50%)	13 (43.3%)	
	An employee in the public sector	5 (16.7%)	5 (16.7%)	
	An employee in the private sector	9 (30%)	6 (20%)	

The values are expressed as frequency (n) and percentages (%)

: Mean ±SD

Chi-square conducted, *P <0.05

Table (2) depicts the comparison regarding BMI among all study participants. It was found that BMI was significantly higher among those with PCOS. It was found that BMI had a ranges between 27.7-39.4 kg/m², 18.9 to 29.8 kg/m² among PCOS and control group, respectively.

Table (2) Body Mass Index (BMI) among PCOS and control group

Variable	Category	PCOS n (%)	Control n (%)	P value*
BMI (kg/cm ²)	Normal	-	15 (53.3%)	0.02*
	Over weight	7 (23.3%)	14 (43.4%)	
	Obese	23 (76.7%)	1 (3.3%)	

The values are expressed as frequency (n) and percentages (%).

Chi-square conducted, *P <0.05

Furthermore, (Table 3) illustrates biochemical measurements for both groups of the study. Generally, both vitamin D and ferritin were insignificantly lower among PCOS group than control group, while other variable were the opposite. A significant differences were shown in LH ($p=0.01$) and the ratio of LH:FSH ($p=0.03$) with higher value among PCOS group comparing to control group.

Table (3) Biochemical characteristics among PCOS and control group

Variable	PCOS (n=30)	Control (n=30)	P value*
	M ± SD	M ± SD	
Vitamin D	20.922 ± 7.630	34.33 ± 17.036	0.24
Ferritin	69.840 ± 44.324	77.13 ± 63.282	0.23
Thyroid-Stimulating Hormone (TSH)	5.006 ± 1.057	2.526 ± 1.160	0.11
Follicle-Stimulating Hormone (FSH)	12.107 ± 3.027	8.527 ± 2.5	0.43
Luteinizing Hormone (LH)	21.677 ± 3.256	13.41 ± 5.150	0.01*
LH:FSH	1.998 ± 1.110	1.726 ± 0.833	0.03*
Prolactin	20.773 ± 8.130	14.985 ± 6.170	0.21
Triglyceride (TG)	1.826 ± 0.730	1.047 ± 0.557	0.17
Total Cholesterol (TC)	5.100 ± 1.130	3.394 ± 1.788	0.17

The values are expressed as means (M) and Standard Deviations (SD), t-tests were conducted. * $P<0.05$

In addition, the clinical characteristics of PCOS patients and health women were as shown in (Table 4). In general, all characteristics in PCOS women were higher than control group. More specifically, infertility, sleep apnea, and eating disorders were among clinical variables that significantly higher among patients with PCOS comparing to control group with ($p=0.00$) for all of these variables.

Table (4) Clinical characteristics among PCOS and control group

Variables	PCOS n (%)	Control n (%)	P value*
Hirsutism			
▪ Yes	26 (86.6%)	4 (13.3%)	0.40
▪ No	4 (13.3%)	26 (86.7%)	
Interruption and Delayed Menstruation			
▪ Yes	29 (96.7%)	2 (6.7%)	0.79
▪ No	1 (3.3%)	28 (93.3%)	
Acne			
▪ Yes	19 (63.3%)	14 (46.7%)	0.16
▪ No	11 (36.7%)	16 (53.3%)	
Infertility			
▪ Yes	25 (83.3%)	-	0.00*
▪ No	5 (16.7%)	30 (100%)	
HormonalN Imbalance			
▪ Yes	23 (76.7%)	1 (3.3%)	0.58
▪ No	7 (23.3%)	29 (96.7%)	
Sleep apnea			
▪ Yes	13 (43.3%)	-	0.00*
▪ No	17 (56.7%)	30 (100%)	
Mood Swings			
▪ Yes	20 (66.7%)	10 (33.3%)	0.27
▪ No	10 (33.3%)	20 (66.7%)	
Eating Disorders			
▪ Yes	29 (96.7%)	-	0.00*
▪ No	1 (3.3%)	-	
Excessive Sweating			

Variables	PCOS n (%)	Control n (%)	P value*
▪ Yes	18 (60%)	6 (20%)	0.71
▪ No	12 (40%)	24 (80%)	
Pelvic Pain			
▪ Yes	18 (60%)	3 (10%)	0.80
▪ No	12 (40%)	27 (90%)	

The values are expressed as frequency (n) and percentages (%).

Chi-square conducted, *P < 0.05

Finally, (Table 5) indicates the dietary assessment for PCOS and control groups. There were no significant differences in energy or macronutrient intake. In addition, it was found that dietary intake of carbohydrate and fat were higher among PCOS group than the control group, although these changes were not statistically significant ($p > 0.05$).

Table (5) Dietary assessments among PCOS and control group

Variables	PCOS (n=30)	Control (n=30)	P value*
	Mean ± SD	Mean ± SD	
Energy (Kcal)	2434.17±165.045	2104.03 ± 372.309	0.987
Carbohydrates (g/d)	327.03 ± 18.311	287.70 ± 15.881	0.944
Protein (g/d)	48.90 ± 5.033	49.77 ± 4.415	0.185
Fat (g/d)	25.10 ± 4.619	19.93 ± 5.539	0.073
Fiber (g/d)	25.13 ± 4.142	26.50 ± 5.036	0.323

The values are expressed as means (M) and Standard Deviations (SD),
 t-tests were conducted. *P < 0.05

Discussion:

Many clinical examinations suggest that PCOS may be a genetically unstable complex polymorphism with strong genetic and environmental influences, such as diet and lifestyle (Ajmal et al., 2019). Results of our study indicated that BMI values were higher among PCOS comparing to healthy women. Regarding anthropometric measurements, the relation between PCOS and BMI is supported by previous studies, which reported that about 38%- 88% of women with PCOS were either overweight or obese (Legro, 2000; Barber & Franks, 2021). Moreover, epidemiological data from a study conducted by (Ollila et al., 2016) revealed relations between BMI and features of PCOS.

Concerning relations between biochemical variables among PCOS and control, our study has shown that both vitamin D and ferritin were lower in PCOS comparing to control group. Meanwhile, other biochemical variable were higher among PCOS patients. Regarding vitamin D, in a study conducted by (Holick et al., 2011), it was found that 27 PCOS women from 30 had vitamin D deficiency. Moreover, (Al-Bayyari et al., 2021) documented that using a dose of 50,000 IU per week of vitamin D₃ decreased the scores of hirsutism and levels of androgen among overweight women with PCOS. On behalf of ferritin, our results was in contrast to results of study conducted by (Escobar-Morreale, 2012) which reported that ferritin rises in PCOS patients due to low hepcidin that increases iron absorption.

Regarding other biochemical variable which include TSH, FSH, LH, LH:FSH, prolactin, TG, and TC were higher among PCOS patients in our study. Only LH and LH:FSH have shown significant increase among PCOS group comparing to control group. Our results were not agreed with (Abdelsalam & Ibrahim, 2015) who found that Thyroid-Stimulating Hormone (TSH) serum levels increased significantly in PCOS women and it contributed to overweight and obese comparing with control group. On the other hand, our results were agreed with (Al-Jefout et al., 2017) and (Eagleson et al., 2000) who found that Luteinizing Hormone (LH) values higher between Polycystic Ovary PCOS women than in control group. Eagleson et al. (2000) explained that PCOS females had a defect in the GnRH neural network and an increased pulse amplitude of pituitary activity and this is the main reason beyond high levels of LH among PCOS females. Concerning prolactin hormone, our results were agreed with (Abdelsalam & Ibrahim, 2015) who found and explained that PCOS was associated with hypothyroidism, and later may cause hyperprolactinemia in the same

patient. Regarding biochemical variables related to TG and TC, (Wild et al., 2011) reported that the most prevalent metabolic abnormality observed in PCOS patients was dyslipidemia, which is manifested by excessive triglycerides and low high density lipoprotein (HDL). Also, (Sirmans & Pate, 2013) documented that dyslipidemia was one of the clinical features of PCOS. Patel's (2018) study found that the degree of LDL cholesterol increased, while HDL cholesterol decreased. Also, (Usta et al., 2018) found that HDL counts levels in PCOS group was less than Control group. Our results were in accordance with (Wyskida et al., 2020) who expressed that cholesterol levels shown an increase in PCOS women.

The relations between PCOS and major clinical features were a cornerstone in our study. Our study results have shown that the percentage of participants with hirsutism and acne were higher in PCOS women comparing to control group. Our results were agreed with (Rager & Omar, 2006) who indicated that PCOS women have presence of hirsutism and/ or acne and explained that due to clinical hyperandrogenism (HA). Also, other clinical features including interruption and delayed menstruation, hormonal imbalance, mood swings, excessive sweating, and pelvic pain have shown to be more common in women with PCOS than in individuals without the condition. Three features including infertility, sleep apnea, and eating disorders have shown significant rise among PCOS group comparing to control group. Lentscher et al. (2021) documented that women with PCOS are at high risk of infertility due to anovulation. In addition, (Hanson et al., 2017) reported that PCOS patients are often characterized with ovulation disorders. Regarding variable of sleep apnea, (Kahal et al., 2017) indicated that sleep apnea appears to be associated with PCOS in obese women. Moreover, (Tasali et al., 2008) found that sleep disturbances is an important feature in PCOS and sleep apnea is highly common than expected in PCOS patients. The third variable related significantly to PCOS was eating disorders. Our results was in accordance with previous studies carried by (Pirodda et al., 2019) and (Cetik et al., 2022).

According to our results regarding the relation between dietary assessment and PCOS, the dietary intake of total energy, carbohydrates, fat were higher among PCOS group although there were no significant differences. These aforementioned results were agreed with (Barrea et al., 2019) whom suggested that PCOS women consumed more carbohydrates and total fat than control group. Meanwhile, (Mohit et al., 2020) reported that the total energy, energy consumption from carbohydrates, fat, and

protein content in the two groups were not substantially different. Furthermore, our results revealed that PCOS women consumed more saturated fat. These results were agreed with previous studies conducted by (Salmerón et al., 2001) and (Lovejoy et al., 2001).

Conclusions:

The findings of this study indicate that overweight and obesity are highly considered issues among women with PCOS patients and the physicians who treat those patients should be careful during clinical management. Moreover, PCOS is highly associated with disturbances in many laboratory and physical examinations. Furthermore, a comprehensive assessment of dietary disorders and dietary patterns in women with PCOS is highly recommended. As a result of, physicians should consider all parameters including anthropometric, biochemical, clinical and dietary measures when diagnosing and providing medical care for cases of PCOS.

Strengths and limitations of the study:

Unsurprisingly, the cause of PCOS is still debated but among the strengths of the study is the representative sample size of childbearing women with PCOS. The study is highly important for large proportion of women especially for pregnant adolescents. The study revealed the relations between PCOS and body mass index, hormonal, and many clinical signs and symptoms of the syndrome. Among limitations of the study was the inability to determine the dietary patterns among PCOS patients, which may help in understanding of proper nutritional management of PCOS. Moreover, extra studies are needed to explore the nutritional status for more of the micronutrients (including vitamins and minerals) among PCOS patients. On the other hand, extra explanations are needed to clarify the environment-gene interactions and the factors that exacerbates reproductive and metabolic problems among PCOS patients.

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