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Research Article

Polycystic Ovary Syndrome and Urinary Tract Stones: A Body Mass Index-Adjusted Analysis in Iraqi Women

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Abstract

Background: Polycystic ovary syndrome (PCOS) has an unknown and complex etiology. It affects 5–10% of women in the reproductive age. Patients are known to have increased ovarian androgen production that is associated with decreased menses, hirsutism, and acne. Urinary tract stones (UTS) are a multifactorial disorder, with age and sex being known risk factors. Many PCOS patients are obese, and links between nephrolithiasis and obesity have been shown previously. ***Objectives***: To identify the relation between PCOS and UTS considering the patients' body mass index (BMI). ***Methods***: This is a cross-sectional study that enrolled 407 women aged 18-40 who attended the gynecology and obstetrics clinic at Al-Elwiya Maternity Teaching Hospital. The patients were assigned to the PCOS group or the control group. The data collected includes age, weight, height, body mass index (BMI), and the results of abdominal ultrasonography to detect UTS. ***Results***: One hundred ninety women were in the PCOS group and 217 in the control group. The PCOS group had a higher BMI than the control group. Patients with UTS had a higher BMI than those without UTS. PCOS combined with a higher BMI showed an increased risk of having UTS. However, analysis of each of the variables taking the other into account showed no significant association. ***Conclusions***: PCOS and BMI both raise the chances of having UTS; however, each one showed no significant association when adjusting for the other.

Keywords: Body Mass Index, Obesity, Overweight, Polycystic Ovary Syndrome, Urinary stone, Underweight.

متلازمة تكيس المبايض وحصوات المسالك البولية: تحليل معدل حسب مؤشر كتلة الجسم لدى النساء العراقيات

الخلاصة

الخلفية: متلازمة تكيس المبايض (PCOS) لها سبب غير معروف ومعقد. وهي تؤثر على 5-10٪ من النساء في سن الإنجاب. ومن المعروف أن المرضى يعانون من زيادة إنتاج الأندروجين في المبيض المرتبط بانخفاض الدورة الشهرية وكثرة الشعر وحب الشباب. حصوات المسالك البولية هي اضطراب متعدد العوامل، حيث يعتبر العمر والجنس من عوامل الخطر المعروفة. يعاني العديد من مرضى متلازمة تكيس المبايض من السمنة، وقد تم إثبات وجود روابط بين حصوات الكلى والسمنة مسبقًا.**الأهداف:** تحديد العلاقة بين متلازمة تكيس المبايض وحصوات المسالك البولية مع مراعاة مؤشر كتلة الجسم (BMI) لدى المرضى.**الطرائق:** هذه دراسة مقطعية شملت 407 امرأة تتراوح أعمارهن بين 18 و40 عامًا، حضرن عيادة أمراض النساء والتوليد في مستشفى العلوية التعليمي للولادة. تم توزيع المريضات على مجموعة متلازمة تكيس المبايض أو مجموعة التحكم. تتضمن البيانات التي تم جمعها العمر والوزن والطول ومؤشر كتلة الجسم ونتائج الموجات فوق الصوتية للبطن للكشف عن حصوات المسالك البولية. **النتائج:** كان هناك مائة وتسعون امرأة في مجموعة متلازمة تكيس المبايض و217 في مجموعة التحكم. كان مؤشر كتلة الجسم لدى مجموعة متلازمة تكيس المبايض أعلى من مجموعة التحكم. كان مؤشر كتلة الجسم لدى المرضى المصابين بمتلازمة تكيس المبايض أعلى من أولئك الذين لا يعانون من حصوات المسالك البولية .أظهرت متلازمة تكيس المبايض مع مؤشر كتلة الجسم الأعلى زيادة خطر الإصابة بـ حصوات المسالك البولية. ومع ذلك، أظهر تحليل كل من المتغيرات مع الأخذ في الاعتبار الآخر عدم وجود ارتباط كبير. **الأستنتاج:** تزيد متلازمة تكيس المبايض ومؤشر كتلة الجسم من فرص الإصابة بـ حصوات المسالك البولية، ومع ذلك، لم يظهر أي منهما ارتباطًا كبيرًا عند التحكم في الآخر.

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INTRODUCTION

Stein and Leventhal described polycystic ovary syndrome (PCOS) for the first time in 1935, observed in seven case reports of women having similar clinical features [1,2]. PCOS is a multifactorial entity with an exact etiology yet to be defined [1,3]. Affected women may present with several reproductive, endocrine, metabolic, and psychosocial symptoms [4]. PCOS ranks among prevalent endocrine abnormalities among women [5]. It affects around 5–10% of women of fertility age and 75–80% of anovulatory women [6,7]. Multiple genes that participate in multiple stages of estrogen production and androgen regulation were recognized to play a role in the pathophysiology of PCOS [8]. PCOS is marked by increased production of ovarian androgens that manifests clinically through abnormalities such as menstrual irregularities,

hirsutism, and acne. Furthermore, this syndrome is linked to long-term health hazards, including dyslipidemia, insulin resistance, and ischemic heart disease [9]. No study directly addressed the connection between PCOS and urinary tract stones (UTS); nevertheless, such a relationship has been suggested [10]. UTS has a multifactorial predisposing factor, with age and sex being known risk factors [1]. UTS disease is a widespread global health issue and a prevalent problem in the study locality [11]. Over 80% of UTS are calcium-containing stones (calcium oxalate and calcium phosphate), with the remaining stones largely being uric acid, cystine, or triple phosphate stones [12]. Many PCOS patients are obese, and the connection between UTS and obesity, insulin resistance, and metabolic syndrome was documented [10,13]. Evidence from older research involving patients with urinary tract stones suggests a connection between obesity and an increased urinary concentration of uric acid, oxalate, and calcium, which raises the likelihood of UTS formation [14]. More than one prominent hypothesis explaining the development of PCOS suggests that the clinical picture of PCOS develops in genetically susceptible individuals when exposed to a specific environmental contributor. Obesity and insulin resistance are believed to be among the most significant environmental triggers for this syndrome [15]. The Rotterdam Criteria (2004) stated that at least two of the following: 1) Decreased or absent ovulation marked by irregular or absent menses; 2) Clinical or laboratory evaluations suggesting increased levels of circulating androgens; and 3) The ovarian size should be more than 10 ml or have a minimum of 12 follicles measuring between 2 and 9 millimeters [16]. For accurate assessment of the ovaries, transvaginal ultrasonography offered an excellent modality [8]. Ultrasonography of the abdomen and pelvis is generally accepted as the first-line modality for the diagnosis of urinary tract stones, as the gold-standard alternative (computerized tomography) comes at the high cost of radiation exposure [18]. Combined contraceptive pills are used as the primary treatment modality for PCOS patients who are seeking contraception for both avoiding pregnancy and reducing circulating androgen levels and the additional benefit of cycle regulation. Their effect on androgen is suggested as the reason for the reduction in UTS formation in patients using this type of treatment [1]. To the authors' best knowledge, this is the first study that aimed to identify the impact of PCOS as a risk factor on the presence of urinary tract stones in a clinical setting.

METHODS

Study design and setting

A cross-sectional observational study was conducted from July,1,2024 to November,15,2024. We enrolled a convenience sample of 407 women aged 18-40 years attending the gynecology and obstetrics clinic at Al-Elwiya Maternity Teaching Hospital.

Patient selection

The sample size was suggested by Cohen's h formula assuming a prevalence of 7% and 14% in control and the PCOS groups consecutively aiming at a statistical power of 80% and a significance level of 80% [18]. The calculation suggested a sample size of at least 155 participants in each group. The sample size collected was slightly large considering the possibility of the exclusion of some participants. We excluded women with previous bariatric surgery, Fowler syndrome, gluten sensitivity, malabsorption syndrome, and cystinuria.

Data collection and outcome measurement

Data were collected on age, weight, and height. A focused history and clinical examination were conducted for all patients. For some patients, one or more blood tests were obtained, including but not limited to serum levels of testosterone, dehydroepiandrosterone sulfate (DHEA-S), androstenedione, luteinizing hormone (LH), follicle-stimulating hormone (FSH), and sex hormone-binding globulin. Abdominal and pelvic ultrasound were done for all patients as part of the diagnosis of PCOS and as screening for urinary tract stones. Transvaginal ultrasonography was done for some patients based on the individual condition as requested by the treating gynecologist. PCOS diagnosis was based on the Rotterdam criteria [16]. The results of blood tests and the findings of pelvic ultrasound were not included in the data prepared for statistical analysis since they were collected conditionally as part of the diagnosis of PCOS and hence were not available for all participants. The study participants were divided into the PCOS group (190 women) and the control group (217) and were compared for the presence of urinary tract stones, taking into account the BMI of the subjects. In addition, PCOS was tested alone for association with urinary tract stones and with BMI without taking each other into account. On the other hand, BMI was tested with and without taking PCOS into account as a risk factor for the presence of urinary tract stones.

Ethical considerations

The Scientific and Ethical Committee of Alkindy College of Medicine provides final approval for the study in its 2nd meeting on October 17th,2024 in compliance with the Declaration of Helsinki (2013) and its later amendments. A written consent was obtained from all the participants. The study protocol was registered at www.clinclatrial.gov (NCT06729359).

Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 25 was used to analyze data. Descriptive statistics were used to express the results. Kolmogorov-Smirnov Test and Q-Q plot were used to check the normality of distribution. Mann-Whitney U Test was used to compare continuous variables. The Chi-square test was used to compare categorical variables. An omnibus of model coefficients was used

to define the overall statistical significance of risk factors. The odds ratio was used to describe the effect of each risk factor, and logistic regression (Wald Test) was used to measure the statistical significance of each risk factor while controlling for the other.

RESULTS

A total of 413 participants were recruited for the study. Six participants were excluded from the analysis: 2 patients had a history of previous bariatric surgery, 1 patient had Fowler syndrome, 1 had gluten sensitivity, 1 had malabsorption syndrome, and 1 had cystinuria. The analysis of data included 190 patients with PCOS and 217 female participants in the control group. The analysis showed no significant difference between the ages of both groups. On the other hand, the average body mass index (BMI) of patients with PCOS was significantly higher than that of the control group, as shown in Table 1.

Table 1: the age and body mass index of PCOS patients and the control group

Parameter	PCOS	n	Median (IR)	*p*-value*
Age (years)	No	217	30(10)	0.273
	Yes	190	28(12)	
BMI (kg/m^2)	No	217	27.69(4.36)	0.009
	Yes	190	28.32(4.91)	

PCOS: Polycystic Ovary Syndrome; IR: Interquartile Range; BMI: Body mass index. * Mann-Whitney U test.

A higher body mass index was significantly associated with the presence of urinary tract stones when analyzed separately (Table 2).

Table 1: the age and body mass index of PCOS patients and the control group

Parameter	PCOS	n	Median (IR)	*p*-value*
Age (years)	No	217	30(10)	0.273
	Yes	190	28(12)	
BMI (kg/m^2)	No	217	27.69(4.36)	0.009
	Yes	190	28.32(4.91)	

PCOS: Polycystic Ovary Syndrome; IR: Interquartile Range; BMI: Body mass index. * Mann-Whitney U test.

In the same way, patients with PCOS had a statistically significant risk of having urinary tract stones when analyzed without taking BMI into account (Table 3).

Table 3: the association between urinary tract stone formation and Polycystic ovary syndrome without taking BMI into account

		Stones		Total	*p*-value*
		No	Yes		
PCOS	No	205	12	217	0.42
	Yes	169	21	190	
Total		374	33	407	

* Chi square test.

PCOS combined with a higher BMI was associated with a higher occurrence of UTS with a *p*-value of 0.022 as shown in the Omnibus test. However, analysis of each of them taking the other into account showed no statistical significance (Table 4). Also, analysis showed that the presence of PCOS increases the risk of having UTS by 1.868. And one point in increment in BMI increases the risk of having UTS by 1.062.

Table 4: the association between UTS and Polycystic ovary syndrome and BMI as risk factors taking each other into account

	Association with the presence of urinary tract stones	
	p-value*	Odd ratio
PCOS	0.105	1.868
BMI	0.050	1.062

* Wald test.

DISCUSSION

This study revealed no significant difference in the age between both study groups. This finding is similar to that by Fedrigon *et al*. and Zhu *et al*., but it is different from that found by Rostami Dovom *et al*. [19,20,10]. Regarding the average BMI, it was significantly higher among patients with PCOS compared to those in the control group, which is a finding similar to that by Jalilian *et al*. [21] and Fang *et al*. [22], but it is different from that performed by Fedrigon *et al*. [19], Rostami Dovom *et al*. [10], and Zhu *et al*. [20]; this difference in the findings might be attributed to the difference in the design of studies by Fedrigon *et al*. [19] and Rostami Dovom *et al*. [10], which are case-control studies [19,10]. Obesity worsens PCOS, mainly by exacerbating insulin resistance. The connection between PCOS and obesity is attributed to dysfunction of the hypothalamic-pituitary–ovarian axis. Hyperinsulinemia, the well-known association of obesity, increases insulin resistance and induces dyslipidemia in patients with PCOS. In addition, the increase in luteinizing hormone promoted by obesity raises androgen levels, contributing to hyperandrogenism [3]. Modifications of the lifestyle, including regular exercise, weight reduction, and improved body contour, were linked to a reduction in insulin resistance and hyperandrogenism [10]. This study revealed that a higher body mass index was associated with the presence of UTS when analyzed without taking PCOS into consideration. This finding is similar to that reported by Feng *et al*. and Güler [23,24]. The association between UTS and the combination of obesity, insulin resistance, and metabolic syndrome is documented. The lowering effect of insulin resistance on urinary pH is proposed as a cause for the increased formation of UTS. In the same way, obese patients tend to have lower urinary pH and higher urinary levels of calcium, oxalate, and uric acid, further increasing the risk of UTS formation [13]. The patients with PCOS had a statistically significant risk of having UTS when analyzed without taking BMI into account. This finding was in tune with that reported by Rostami Dovom *et al*. and Fedrigon *et al*. [10,19]. Research showed that the castration of male rats reduces UTS formation, suggesting that high testosterone levels may be a risk factor for UTS. This fact is probably explained by the hypothesized effect of testosterone in enhancing the action of glycolic acid oxidase, which plays a key role in the metabolic pathway responsible for oxalate production. Also, the activity of this enzyme is reduced by estrogen in animal models [1]. PCOS combined with a higher BMI was associated with a higher occurrence of UTS in the omnibus test. However, analysis of each of them taking the other into account showed no statistical

significance. This could be attributed to the fact that our study sample was a non-random sample.

Conclusion

PCOS and BMI increased the odds of having urinary tract stones, however, each one showed no significant association when controlling the other.

Recommendations

Conducting more future studies on PCOS and urinary tract stones with random sampling and larger sample sizes and in multiple centers.

Conflict of interests

No conflict of interest was declared by the authors.

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

REFERENCES

1. Kaygusuz I, Karatas OF, Kafali H, Cimentepe E, Unal D. Is polycystic ovarian syndrome a risk factor for urolithiasis? *Urolithiasis*. 2013;41(4):361-362. doi: 10.1007/s00240-013-0564-9.
2. Adashi EY, Cibula D, Peterson M, Azziz R. The polycystic ovary syndrome: the first 150 years of study. *F S Rep*. 2022;4(1):2-18. doi: 10.1016/j.xfre.2022.12.002.
3. Singh S, Pal N, Shubham S, Sarma DK, Verma V, Marotta F, et al. Polycystic ovary syndrome: Etiology, current management, and future therapeutics. *J Clin Med*. 2023;12(4):1454. doi: 10.3390/jcm12041454.
4. Aziz ZN-E, Saleh BO, Thaker AZ. Free testosterone, dihydrotestosterone, and adiponectin in the evaluation of vitamin D supplementation for polycystic ovarian syndrome: A metformin comparative study. *Al-Kindy Coll Med J*. 2024;20(3):239-244.
5. Abdull TN. Step-up protocol gonadotrophin versus laparoscopic ovarian drilling in clomiphene citrate resistant PCOS infertile women in two Iraqi hospitals. *Al-Kindy Coll Med J*. 2019;15(1):103-109.
6. Bellver J, Rodríguez-Tabernero L, Robles A, Muñoz E, Martínez F, Landeras J, et al. Polycystic ovary syndrome throughout a woman's life. *J Assist Reprod Genet*. 2018;35(1):25-39. doi: 10.1007/s10815-017-1047-7.
7. Legro RS, Strauss JF. Molecular progress in infertility: polycystic ovary syndrome. *Fertil Steril*. 2002;78(3):569–576. doi: 10.1016/s0015-0282(02)03275-2.
8. Rasquin LI, Anastasopoulou C, Mayrin JV. Polycystic ovarian disease. 2022 Nov 15. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024. PMID: 29083730.
9. Azziz R. Polycystic ovary syndrome. *Obstet Gynecol*. 2018;132(2):321-336. doi: 10.1097/AOG.0000000000002698.
10. Rostami Dovom M, Rahmati M, Amanollahi Soudmand S, Ziaeefar P, Azizi F, Ramezani Tehrani F. The hidden link between polycystic ovary syndrome and kidney stones: Finding from the Tehran Lipid and Glucose Study (TLGS). *Diagnostics (Basel)*. 2023;13(17):2814. doi: 10.3390/diagnostics13172814.
11. Tahir NL, Hassan QA, Kamber HM. The prevalence of a clinically silent nephrolithiasis in Baghdad population: An initial ultrasound screening study from Iraq. *Acta Medica Iranica*. 2019:51-56. doi: 10.18502/acta.v57i1.1753.
12. Almannie RM, Al-Nasser KA, Al-Barraq KM, Alsheheli MM, Al-Hazmi HH, Binsaleh SA, et al. The effect of the body mass index on the types of urinary tract stones. *Urol Ann*. 2020;12(1):42-48. doi: 10.4103/UA.UA_161_18.
13. Mosli HA, Mosli HH. Increased body mass index is associated with larger renal calculi. *Urology*. 2012;80:974-977. doi: 10.1016/j.urology.2012.07.027.
14. Del Valle EE, Negri AL, Spivacow FR, Rosende G, Forrester M, Pinduli I. Metabolic diagnosis in stone formers in relation to body mass index. *Urol Res*. 2012;40(1):47-52. doi: 10.1007/s00240-011-0392-8.
15. Puttabyatappa M, Padmanabhan V. Ovarian and extra-ovarian mediators in the development of polycystic ovary syndrome. *J Mol Endocrinol*. 2018;61(4):R161-R184. doi: 10.1530/JME-18-0079.
16. Rotterdam ESHRE/ASRM-Sponsored PCOS consensus workshop group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). *Hum Reprod*. 2004;19(1):41-47. doi: 10.1093/humrep/deh098.
17. Skolarikos A, Jung H, Neisius A, Petřík A, Somani B, Tailly T, et al. EAU Guidelines on Urolithiasis 2024. European Association of Urology 2024. Available from: https://uroweb.org/guidelines/urolithiasis
18. Cohen J. Statistical power analysis for the behavioral sciences. Routledge; 2013. doi: 10.4324/9780203771587.
19. Fedrigon D, Alazem K, Sivalingam S, Monga M, Calle J. Nephrolithiasis and polycystic ovary syndrome: A case-control study evaluating testosterone and urinary stone metabolic panels. *Adv Urol*. 2019;2019:3679493. doi: 10.1155/2019/3679493.
20. Zhu X, Kaygusuz I, Eser A, Yildirim ME, Çimentepe E, Yüce E, et al. Is polycystic ovarian syndrome a risk factor for urinary stone disease? *Clin Oncol*. 2018;3:1443.
21. Jalilian N, Haghnazari L, Rasolinia S. Leptin and body mass index in polycystic ovary syndrome. *Indian J Endocrinol Metab*. 2016;20(3):324-328. doi: 10.4103/2230-8210.180005.
22. Fang Y, Liu L, Yang Y, Zhang B, Xie S. Causal association between BMI and polycystic ovarian syndrome: Bidirectional 2-sample mendelian randomization study. *J Clin Endocrinol Metab*. 2024;110(1):41-47. doi: 10.1210/clinem/dgae446.
23. Feng X, Wu W, Zhao F, Xu F, Han D, Guo X, et al. Relationship between body mass index and kidney stones based on dose-response analyses using restricted cubic splines applied to NHANES 2011-2016 data. *J Ren Nutr*. 2021;31(3):263-269. doi: 10.1053/j.jrn.2020.05.003.
24. Güler Y. Effects of body mass index on urinary lithogenic factors in urinary system stone patients. *Folia Med (Plovdiv)*. 2024;66(1):80-87. doi: 10.3897/folmed.66.e114369.