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Research Paper

Association between Serum Level of Uric Acid and Polycystic Ovarian Syndrome in Females with and without Insulin Resistance -Baghdad Medical City / 2024

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ABSTRACT:

BACKGROUND:

Polycystic ovarian syndrome (PCOS) is a hormonal disorder of females, the elevated of serum uric acid is linked to metabolic disease as PCOS

OBJECTIVE:

To estimate the prevalence of hyperuricemia in females of PCOS with or without insulin resistance and compare serum level of uric acid in patients of PCOS whether the insulin resistance is present or not.

PATINETS AND METHODS:

Cross-sectional; comparative stud; non-probability convenience sampling was conducted at Out-patient's department of Gynecology of Baghdad Medical City, from March 15th till September 15th 2024. The study tools used measuring serum level of uric acid and HOMA-IR (homeostatic model assessment-insulin resistant) which is the gold standard in assessment of insulin resistance. Also used questionnaire that cover socio-demographic of study participants and used Rotterdam criteria for diagnosis of polycystic ovarian syndrome (PCOS). **Inclusion criteria** all females, that are 20-40 years old diagnosed with PCOS, are included . **Exclusion criteria** include females of PCOS with and without insulin resistance and had diabetes mellitus; hypertension; Cushing's syndrome; coronary heart disease; liver cirrhosis; renal diseases women who are pregnant, lactated, smoker, taken vitamin supplementation and medications such as (diuretic, hormonal, hypoglycemic).

RESULTS:

The study showed that serum level of uric acid was highest among PCOS with insulin resistance 78.1% with P. value 0.008 and there was statistical significant association.

CONCLUSION:

More than two third of PCOS with insulin resistance had increase in serum level of uric acid and approximately less than one third of PCOS without insulin resistance had increase serum level of uric and there was statistical significant association.

KEYWORDS: polycystic ovarian syndrome, insulin resistance, uric acid .

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INTRODUCTION:

Polycystic Ovarian Syndrome is a hormonal disorder of females, the anovulation; infertility; hyperandrogenism and metabolic dysfunctions which are the characteristics of the disease [(1)]. Main cause of this disease is insulin resistance that cause hyperinsulinemia; altered response of gonadotropins; irregular metabolism of ovarian androgen [(2,3,4,5)].

There are some unique features of PCOS in adolescents as decline in insulin sensitivity during puberty that may developed of insulin resistance (IR) and hyperinsulinemia [(6)]. The clinical features of insulin resistance (IR) and hyperandrogenism usually begin during adolescent in females with PCOS and these may be increased with the presence of obesity. [(7)]

There are several criteria used in diagnosis of PCOS; The most common is the National Institute of Health (NIH) and Rotterdam criteria [(8)]. These criteria were expanded in 2003 with the introduction of the Rotterdam criteria; considered gold standard which require the two out of the following features of PCOS in absence of

congenital adrenal hyperplasia; androgen-secreting neoplasms; hyperprolactinemia, [9] :

1. Oligo – and /or anovulation.
2. Signs of hyperandrogenism, whether clinical or biochemical (serum testosterone and dehydroepiandrosterone sulfate (DHEAS)).
3. Polycystic ovaries on ultrasonography (the presence of eight or more subcapsular follicular cysts measuring less than 10 mm and an increase in ovarian stroma. [9]

PCOS is estimated to occur about 6–7% of global population [10]. The World Health Organization (WHO) estimates that PCOS affects 8–13% of women of reproductive age [11]. It is suggested that this increased prevalence is likely due to changes in lifestyle, diet, and stress [12,13].

An organic acid called uric acid (UA) is end product of purine nucleotides metabolism, elevated serum uric acid (SUA) levels may have a pro-oxidative and pro-inflammatory effect that lead to metabolic syndrome including; polycystic ovarian syndrome, diabetic patients, obese people and adiposity [14,15]. The pro-oxidant effect of uric acid has been observed to be of notable involve itself in the pathogenesis of the metabolic syndrome. Existing literature has reported a positive correlation between polycystic ovarian syndrome (PCOS) in women and elevated levels of oxidative stress [16,17]. Furthermore, investigations revealed an association between total testosterone levels and serum uric acid levels among women with polycystic ovarian syndrome (PCOS), thus showed the association between hyperandrogenism and hyperuricemia [18].

PATIENTS AND METHODS:

Cross-sectional comparative study, non-probability convenience sampling conducted at Out-patient's department of Gynecology in Baghdad Medical City, from March 15th till September 15th 2024.

The target population of this study was patients of PCOS with or without insulin resistance. This study was take two groups 200 patients of PCOS participated depend on their impaired insulin response:

Group (A): In this group females were obtained due to their PCOS and insulin resistance.

Group (B): In this group females were obtained due to their PCOS and without insulin resistance.

Inclusion Criteria:

all females that are 20-40 years old diagnosed with PCOS using Rotterdam criteria (Oligo- and/or anovulation, Signs of hyperandrogenism, polycystic ovaries on ultrasonography [9]).

Exclusion Criteria:females of PCOS with or without insulin resistance and had diabetes mellitus; hypertension; Cushing's syndrome; coronary heart disease; liver cirrhosis; renal diseases women who are pregnant, lactated, smoker, taken vitamin supplementation and medications such as (diuretic, hormonal, hypoglycemic).

The questionnaire encompassed two parts:

Part one: Cover socio-demographic of study participants by researcher-reported which included: Age, height, weight, Body Mass Index (BMI) is a medical screening tool that measures the ratio of height to weight to estimate the amount of body fat that classified as (underweight <18.8, normal weight 18.5-24.9, overweight 25-29.9, obesity ≥30) [19], marital state (single, married, divorced, widow), number of children, history of infertility.

Part two: Females of polycystic ovarian syndrome diagnosed with Rotterdam criteria [9]:

1. Oligo- and/or anovulation.
2. Signs of hyperandrogenism; whether clinical or biochemical [serum testosterone and dehydroepiandrosterone sulfate (DHEAS)].
3. Polycystic ovaries on ultrasonography (the presence of eight or more subcapsular follicular cysts measuring less than 10 mm and an increase in ovarian stroma). [9]

Serum uric acid measurement by a health care professional will take a blood sample from a vein in arm, using a small needle (cut point defined for hyperuricemia >360 µmol/L [6.0 mg/dL]) in women [20].

Determine insulin resistance; by measures plasma insulin and glucose level that drawn after an overnight fast to calculate HOMA-IR (homeostatic model assessment-insulin resistant) which is the gold standard in assessment of insulin resistance: HOMA1-IR= [Fasting Insulin (µU/ml) × fasting glucose(mg/dl)] ÷ 405

(HOMA1-IR level = 0.7- 2 normal reference range; and level >2 insulin resistance) [21].

RESULTS:

Figure 1: Distribution of study groups PCOS with insulin resistance was 65% (130 out of 200 sample size) and PCOS without insulin resistance was 35% (70 out of 200 sample size).

Table 1: Shows that Polycystic Ovarian Syndrome with insulin resistance was 61% highest among aged 20-30 years and there was significant association between Group A and age. Mean age of females was 29.15 years ±4.75 years, the mean age with Group A was 29.95 ± 4.57 years and mean age in Group B was 27.66 ± 4.75 years.

Regarding BMI level, Polycystic Ovarian Syndrome with insulin resistance was highest among participants who were obese 71.5% and there was significant association found between BMI level and Group A. Moreover, Polycystic Ovarian Syndrome with insulin resistance was highest among patients who had positive family history 71.2% and there was statistical significant association between Group A and positive family history. Also, Polycystic Ovarian Syndrome with insulin resistance was found higher 67.1% among married and there was no significant association between Group A and marital state. Polycystic ovarian syndrome with insulin resistance was found in 90% of patient who had no children and there was significant association between Group A and number of children. Finally, the Polycystic Ovarian Syndrome with insulin resistance was highest among patients who had history of infertility 73.8% and there was statistical significant association between Group A and history of infertility.

Table 2: shows that serum level of uric acid was highest among PCOS with insulin resistance 78.1% and there was significant association between serum level of uric acid and PCOS with insulin resistance.

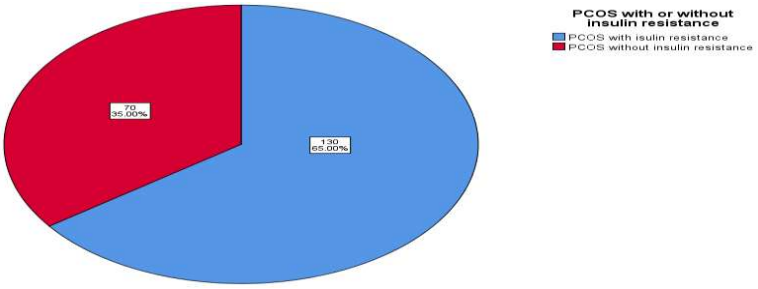

Figure 1: Distribution of the studied Groups

Table 1: Distribution of the studied Groups with Socio-demographic and health characteristics..

Variables	Group PCOS with insulin resistance (n=130)		Group without insulin resistance (n=70)		Total (n=200)		P-value
	No.	%	No.	%	No.	%	
Age(years) 20-30 31-40	69 61	56.5 78.2	53 17	43.4 21.7	122 78	61 39	0.002
BMI (kg/m²) normal weight (18.5-24.9) overweight (25-29.9) obesity (>30)	21 31 78	70 50.8 71.5	9 30 31	30 49.2 28.4	30 61 109	15 30.5 54.5	0.02
Family history Positive negative	104 26	71.2 48.1	42 28	28.7 51.8	146 54	73 27	0.002
Marital state single married divorced widow	15 94 16 5	65.2 67.1 55.1 62.5	8 46 13 3	34.7 32.8 44.8 37.5	23 140 29 8	11.5 70 14.5 4	0.674
Number of children* none 1-3 >3	36 60 19	90 60 51.3	4 40 18	10 40 48.6	40 100 37	22.5 56.4 20.9	0.01
History of infertility Yes No	82 33	73.8 50	29 33	26.1 50	111 66	62.7 37.2	0.01

*(Group PCOS with insulin resistance n=115, Group PCOS without insulin resistance n=62, Total n=177)

Table 2: Distribution of the studied groups with serum level of uric acid.

Serum level of uric acid	Group PCOS with insulin resistance (n=130)		Group PCOS without insulin resistance (n=70)		Total (n=200)		P-value
	No.	%	No.	%	No.	%	
increase	50	78.1	14	21.8	64	32	0.008
normal	80	58.8	56	41.1	136	68	

Mean of serum level of uric acid is 5.67 ± SD 1.12

DISCUSSION:

The current study had shown that more than half 61% of polycystic ovarian syndrome aged 20-30 years, The mean age of cases was 29.15 years ±4.75 years, there was significant association between polycystic ovarian syndrome and age and this was agreed with a study in Pakistan[22].

The prevalence of polycystic ovarian syndrome in this study was higher among obese participants which was similar to the results obtained by a study conducted in Iraq shown that body weight above normal BMI has positive relation with polycystic ovarian syndrome [23] .

A positive Family history of polycystic ovarian syndrome and the occurrence of this disease was found higher among participants and this was correlated with the study done in Oman and United Arab Emirates [24].

The study was shown that the polycystic ovarian syndrome was found more among married than divorced, widow and less among single which was agreed with study done in Tehran, Iran that the marital state did not differ significantly by group with polycystic ovarian syndrome (PCOS) [25].

The number of children differ between polycystic ovarian syndrome with or without reduced insulin response and this is agreed with Western Australia that some women with polycystic ovarian syndrome are at a greater risk of obstetric problems may arise in pregnancy [26].

Infertility was found higher among PCOS and there was a significant association between prevalence of infertility and PCOs this concordance with a study done in Yemen that has shown Polycystic ovary syndrome (PCOS) is a significant cause of infertility due to ovulation dysfunction in women of childbearing age [27].

This study showed increase serum level of uric acid among patients of polycystic ovarian syndrome with insulin resistance and there is significant association which was agreed with study done in China showed that Polycystic ovarian syndrome is associated with a significant elevation of serum uric acid level and insulin resistance (IR) may be the mediators in the pathogenesis of hyperuricemia in women with Polycystic ovarian syndrome[28], also concordance with study done by Sun R. and Shen J. that found the Serum uric acid is one of the characteristic factors of metabolic syndrome, the occurrence and development of hyperuricemia is closely associated with insulin resistance and hyperinsulinemia in patients with polycystic ovarian syndrome[29].

The serum uric acid may play a crucial role in polycystic ovarian syndrome and its related metabolic disorders, as they share common risk factors, elucidating the relationship between hyperuricemia and polycystic ovarian syndrome may offer valuable insights into pathogenesis mechanisms of polycystic ovarian syndrome [30].

The study In India showed the incidence of hyperuricemia in polycystic ovarian syndrome (PCOS), The HOMA-IR was positively correlated with both hyper and non-hyper uricemic groups [31], this was agreed with the current study.

CONCLUSION:

The study showed that more than two third of Group A had increase in serum level of uric acid and approximately less than third of Group B had increase serum level of uric acid and there was significant association found between polycystic ovarian syndrome with insulin resistance and serum level of uric acid. Dietary recommendations and lifestyle changes with exercise and weight reduction can help PCOS that reduce risk of hyperuricemia.

REFRENCES:

1. Ning N, Balen A, Brezina PR, Leong M, Shoham Z, Wallach EE, et al. How to recognize PCOS.Reproductive Biomedicine Online.; 2013;(5):500-5.
2. Guler I, Himmetoglu O, Turp A, Erdem A, Erdem M, Onan MA, et al. Zinc and homocysteine levels in polycystic ovarian syndrome patients with insulin resistance. Biological Trace Element Research. 2014;158(3) :297-304.
3. Musmar S, Afaneh A, Mo'alla H. Epidemiology of polycystic ovary syndrome: a cross sectional study of university students

at An-Najah national University-Palestine. Reproductive Biology and Endocrinology. 2013;11(1):1-6.

4. Devi SL and Jaweed SA. Homocysteine, c-reactive protein and traditional cardiovascular risk markers in polycystic ovary syndrome. International Journal of Current Research and Review. 2013 ;5(6): 59-68.
5. Diamanti-Kandarakis E and Dunaif A. Insulin resistance and the polycystic ovary syndrome implications. Endocrine Reviews. 2012;33(6) :981-1030.
6. Maria Trent , Catherine M Gordon . "Diagnosis and Management of Polycystic Ovary Syndrome in Adolescents. Pediatrics " may 2020; 145- 210–218.
7. Stepto, N.K.; Cassar, S.; Joham, A.E.; Hutchison, S.K.; Harrison, C.L.; Goldstein, R.F.; Teede, H.J. Women with polycystic ovary syndrome have intrinsic insulin resistance on euglycaemic-hyperinsulaemic clamp. Hum. Reprod. 2013;28:777–84.
8. Chang, S.; Dunaif, A. Diagnosis of Polycystic Ovary Syndrome: Which Criteria to Use and When? Endocrinol. Metab. Clin. North Am. 2021;50:11-23.
9. The Rotterdam EA-SPCWG. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. Fertil. Steril. 2004;81:19-25.
10. Vrbikova, J.; Hainer, V. Obesity and polycystic ovary syndrome. Obesity Facts 2009;2:26–35.
11. Begum GS, Almashaikhi NAT, Albalushi MY, Alsalehi HM, Alazawi RS, Goud BKM, et al. Prevalence of Polycystic Ovary Syndrome (PCOS) and Its Associated Risk Factors among Medical Students in Two Countries. Int J Environ Res Public Health. 2024;21(9):1165.
12. Padubidri, V.G.; Daftuary, S. Howkins and Bourne Shaw's Textbook of Gynaecology, 15th ed.; Elsevier Publication: New Delhi, India, 2011:369.
13. Wijeyaratne, C.N.; de A Seneviratne, R.; Dahanayake, S.; Kumarapeli, V.; Palipane, E.; Kuruppu, N.; Yapa, C.; de A Seneviratne, R.; Balen, A.H. Phenotype and metabolic profile of South Asian women with polycystic ovarian syndrome (PCGS): Results of a large database from specialist Endocrine Clinic. Hum. Reprod. 2011;26:202–13.
14. So A, Thorens B. Uric Acid Transport and Disease. J Clin Invest 2010;120(6):1791–99.
15. Lyngdoh T, Vuistiner P, Marques-Vidal P, Rousson V, Waeber G, Vollenweider P, et al. Serum Uric Acid and Adiposity: Deciphering Causality Using a Bidirectional Mendelian Randomization Approach. PloS One 2012;7(6):e39321.
16. Macut D, Simic T, Lissounov A, Pljesa-Ercegovac M., Bozic I, Djukic T. Insulin resistance in non-obese women with polycystic ovary syndrome: relation to byproducts of oxidative stress. Exp Clin Endocrinol Diabetes. 2011;119(7):451–14.
17. Durmus U, Duran C, Ecirli S. Visceral adiposity index levels in overweight and/or obese, and non-obese patients with polycystic ovary syndrome and its relationship with metabolic and inflammatory parameters. J Endocrinol Invest. 2017;40(5):487–97.
18. Liangshan Mu , Jiexue Pan , Lili Yang , Qianqian Chen , Ya Chen , Yili Teng . Association between the prevalence of hyperuricemia and reproductive hormones in polycystic ovary syndrome. Reproductive Biology Endocrinolology . 2018;16(1):104.
19. Hales CM, Fryar CD, Carroll MD, Freedman DS, Ogden CL. Trends in Obesity and Severe Obesity Prevalence in US Youth and Adults by Sex and Age, 2007-2008 to 2015-2016. JAMA. 2018 ;319(16):1723-25.
20. Maiuolo, J., Oppedisano, F., Gratteri, S., Muscoli, C. & Mollace, V. Regulation of uric acid metabolism and excretion. Int. J. Cardiol. 2016;213: 8–14.
21. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. 2017;130:2473–88.
22. Mu L, Pan J, Yang L, Chen Q, Chen Y, Teng Y, Wang P, Tang R, Huang X, Chen X, Yang H. "Association between the prevalence of hyperuricemia and reproductive hormones in polycystic ovary syndrome". Reprod Biol Endocrinol. 2018;16(1):104.
23. Kasim S. F. and Saadoon S. J. , "The Correlation of BMI and Age to Some Hormonal Indices in Iraqi Women with the Polycystic Ovarian Syndrome," 2022; 829-33.
24. Begum, G.S.; Almashaikhi, N.A.T.; Albalushi, M.Y.; Alsalehi, H.M.; Alazawi, R.S.; Goud, B.K.M.; Dube, R. Prevalence of Polycystic Ovary Syndrome (PCOS) and Its Associated Risk Factors among Medical Students in Two Countries. Int. J. Environ. Res. Public Health 2024; 21:1165.
25. Behnaz Navid , Maryam Mohammadi a , Roxana Sasannejad b , Mahnaz Aliakbari Dehkordi b , Saman Maroufizadeh a , Maryam Hafezi c , Reza Omani-Samani a., "Marital

satisfaction and social support in infertile women with and without polycystic ovary syndrome," Middle East Fertility Society Journal" 2018; 23(4): 450–55.

26. Hart R., "Generational Health Impact of PCOS on Women and their Children.," Med. Sci. (Basel, Switzerland), Mar. 2019; 7(3): 2076-3271.

27. Abdulrahman R. Mahmood, Mohamad R. Abdullah, Husam S. Khalaf, Waled Abdo Ahmed. Reproductive Dysfunction in Women with PCOS: A Review Article. Ibn AL-Haitham J Pure Appl Sci. 2024;37(2):231–341.

28. Gong Z., Sun Y., Zhang L., Zhu X., and Shi Y., "The positive association between hyperuricemia and polycystic ovary syndrome and analysis of related factors.," Front. Endocrinol. (Lausanne) 2024;15:1356859.

29. Sun R. and Shen J., "Relationship between polycystic ovary syndrome and hyperuricemia," Open J Nat Sci 2017; 113.

30. Gong Z., Zhang L., and Shi Y., "The potential role of uric acid in women with polycystic ovary syndrome," Gynecol. Endocrinol.,2024;40(1):2323725.

31. Ranakishor Pelluri, Kongara Srikanth, Harika Paritala, Vamsi Ravi, Sri Pandu Mukharj, Unnam Venkateswarlu ,. "The role of high serum uric acid levels in androgenic and non androgenic polycystic ovarian syndrome patients," Clin. Epidemiol. Glob. Heal., October 2021;12: 100910.