National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Association of clinical features of polycystic ovarian syndrome with body mass index and gonadotropin hormones

Srikrishna Sasi Ratnakaram, Elizabeth Rani Reddy

Department of Physiology, Government Medical College, Anantapur, Andhra Pradesh, India

Correspondence to: Elizabeth Rani Reddy, E-mail: drelizabeth.reddypogu@gmail.com

Received: January 17, 2020; **Accepted:** February 15, 2020

ABSTRACT

Background: Diagnosing polycystic ovarian syndrome (PCOS) is utmost important to treat accurately and also to assess further complications, as PCOS has higher rates of endometrial cancer, cardiovascular disease, dyslipidemia, and type 2 diabetes mellitus. **Aims and Objectives:** The objectives of this study were to know the clinical features of PCOS and to know the association of PCOS with gonadotropin hormones and body mass index (BMI). **Materials and Methods:** A prospective study conducted on PCOS patients from January 2018 to April 2019. PCOS was diagnosed by clinical, laboratory, and radiological investigations. PCOS patients were advised to undergo gonadotropin hormones analysis. **Results:** About 50% of patients with oligomenorrhea, acne, hirsutism, and polycystic ovaries had luteinizing hormone/follicular-stimulating hormone (LH/FSH) ratio >2/1. Around 60% of patients with polycystic ovaries had BMI <25. Around 20% of patients with hirsutism, acne, and oligomenorrhea had BMI >25. Polycystic ovaries have shown signification in relation to LH/FSH >2/1 (95% confidence interval [CI] 2.05–31.09; $P = 0.002$), FSH ≥7 (95% CI 0.02–0.40; $P = 0.001$), and LH ≥10 (95% CI 0.05–0.75; $P = 0.001$). **Conclusion:** PCOS diagnosis is a multidisciplinary approach should be evaluated by clinical features, hormonal evaluation, and radiological investigations. Diagnosing polycystic ovaries by ultrasonography and hyperandrogenism are a hallmark for PCOS.

KEY WORDS: Clinical Features; Gonadotropin Hormones; Polycystic Ovarian Syndrome

INTRODUCTION

Polycystic ovarian syndrome (PCOS) is a common endocrine gynecological disorder, often present during reproductive life. It has multiple origins, but the exact cause behind it is still unknown. It is a heterogeneous condition may present with abnormal uterine bleeding, hirsutism, acne, infertility, small cysts in one or both ovaries, etc. The pathophysiology includes elevated androgen levels, chronic anovulation, and insulin resistance.[1] The primary defect is in the hypothalamic-pituitary axis, insulin secretion and action, and ovarian function.

Hyperandrogenism can cause inhibition of follicular development, microcysts in the ovaries, anovulation, and menstrual changes. It is a clinical hallmark of PCOS. Insulin resistance is associated with hyperinsulinemia which causes increase in gonadotropin-releasing hormone (GnRH), reverses luteinizing hormone/follicular-stimulating hormone (LH/FSH) ratio, increases in androgen levels, and decreases production of sex hormone-binding globulin (SHBG).[2]

The prevalence of PCOS is 5–10% among reproductive age group females.[3] The National Institute of Health Office of Disease Prevention estimates that approximately 5 million women of childbearing age affected by PCOS faces 4 billion $ approximately per year for diagnosing and treating PCOS.[4]

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2020.10.02035202015022020	

Worldwide, accepted criteria for diagnosing PCOS are Rotterdam criteria which include hyperandrogenism, oligo-ovulation or anovulation, and polycystic ovaries. As such, there is no single test to clinch the diagnosis of PCOS. Along with pelvic ultrasound, complete history, and examination, gonadotropin hormone levels help in exact diagnosis. Diagnosing PCOS is utmost important to treat accurately and also to assess further complications, as PCOS has higher rates of endometrial cancer, cardiovascular disease, dyslipidemia, and type 2 diabetes mellitus.[5] Final diagnosis is based on clinical features, physical findings, and few laboratory investigations.

We have shown interest to do this study to increase awareness among clinicians about body mass index (BMI) relation to PCOS clinical features and gonadotropin hormones in PCOS. The objectives of this study were to know the clinical features of PCOS and to know the association of PCOS with gonadotropin hormones and BMI.

MATERIALS AND METHODS

A prospective study conducted on PCOS patients by the Department of Physiology, Government Medical College, Anantapur, from January 2018 to April 2019. A total of 160 patients attending the gynecology outpatient department and diagnosed with PCOS were included in this study after taking consent. After taking approval from the ethical committee of our institute, this study has been geared up.

Inclusion Criteria

The following criteria were included in the study:
- Patients who gave their consent to include in the study.
- Patients in the age group of 18–40 years.

Exclusion Criteria

Patients with other etiologies, including thyroid disorders, Cushing's syndrome, hyperprolactinemia, adrenal and pituitary disorders, acromegaly, diabetes, and cardiovascular disease, were excluded from the study.

Patients detailed clinical history and systemic examination done to evaluate the exact cause. PCOS was diagnosed by clinical, laboratory, and radiological investigations. PCOS patients were advised to undergo gonadotropin hormones analysis and BMI was calculated as weight (kg)/height squared (m^2). Hirsutism score was assessed by Ferriman–Gallwey scoring system. Polycystic ovaries were evaluated by ultrasonography.

Statistical Analysis

All the variables were plotted in spread Excel sheet and evaluated. Data were analyzed by GraphPad software. Descriptive qualitative variables were expressed as number, percentages. Mean and standard deviation calculated in spread Excel sheet. Odds ratio at 95% confidence interval (CI) and *P* value were assessed using GraphPad software. $P < 0.05$ was considered statistically significant.

RESULTS

In the present study, a total of 160 patients diagnosed with PCOS were assessed. The mean age of the patient was 26.19 ± 5.03, BMI was 24.42 ± 5.61, waist–hip ratio (WHR) was 0.83 ± 0.042, FSH was 6.9 ± 2.18, LH was 9.11 ± 4.54, and LH/FSH was 1.61 ± 1.42.

Among PCOS women, 92.5% had polycystic ovaries, 90.6% study population had oligomenorrhea, 61.2% had hirsutism, and 40% had acne [Table 1].

For statistical analysis, LH/FSH ratio, FSH, LH, and BMI parameters were categorized into two groups as high and low. Patients with clinical presentations in relation with high parameters were assessed and plotted in Table 2. About 50% of patients with oligomenorrhea, acne, hirsutism, and polycystic ovaries had LH/FSH ratio >2/1. Around 60% of patients with polycystic ovaries had BMI <25. Around 20% of patients with hirsutism, acne, and oligomenorrhea had BMI >25.

OR is calculated for clinical features in relation to hormones and BMI and $P < 0.05$ is considered to be statistically significant. Polycystic ovaries have shown signification in relation to LH/FSH >2/1 (95% CI 2.05–31.09; $P = 0.002$), FSH ≥7 (95% CI 0.02–0.40; $P = 0.001$), and LH ≥10 (95% CI 0.05–0.75; $P = 0.001$) [Table 3].

DISCUSSION

Polycystic ovaries are due to numerous small collections of fluid in follicles and these obstruct to release eggs. As a

Table 1: Findings of various parameters

Parameter	Mean±SD	
Age	26.19±5.03	
BMI	24.42±5.61	
WHR	0.83±0.042	
FSH	6.9±2.18	
LH	9.11±4.54	
LH/FSH	1.61±1.42	
Parameter	**Number of patients**	**Percentage**
Polycystic ovaries	148	92.5
Oligomenorrhea	145	90.6
Hirsutism	98	61.2
Acne	64	40

BMI: Body mass index, FSH: Follicular-stimulating hormone, LH: Luteinizing hormone, SD: Standard deviation, WHR: Waist–hip ratio

Table 2: Clinical features in relation to hormones and BMI

Clinical features	LH/FSH >2/1 (%)	FSH ≥7 (%)	LH ≥10 (%)	BMI >25 (%)
Oligomenorrhea	77 (53.1)	26 (17.9)	37 (25.5)	22 (15.1)
Acne	35 (54.6)	11 (17.1)	30 (46.5)	12 (18.7)
Hirsutism	58 (59.1)	40 (40.8)	35 (35.7)	22 (22.4)
Polycystic ovaries	104 (70.2)	35 (23.6)	55 (37.1)	58 (39.1)

BMI: Body mass index, FSH: Follicular-stimulating hormone, LH: Luteinizing hormone

Table 3: Clinical features correlation with BMI and gonadotropin hormones

Clinical features	LH/FSH >2/1			FSH ≥7			LH ≥10			BMI >25		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Oligomenorrhea	0.66	0.18–1.73	0.32	0.43	0.13–1.38	0.15	1.37	0.36–5.12	0.63	0.71	0.18–2.7	0.625
Acne	1.42	0.75–2.69	0.27	0.71	0.18–2.7	0.62	1.76	0.92–3.37	0.086	1.76	0.92–3.37	0.086
Hirsutism	1.19	0.62–2.26	0.58	1.09	0.56–2.09	0.79	0.72	0.37–1.37	0.32	0.37	0.18–0.74	0.005
Polycystic ovaries	8.0	2.05–31.0	0.002*	0.10	0.02–0.40	0.001*	0.19	0.05–0.75	0.01*	0.77	0.22–2.65	0.682

*Statistically significant. CI: Confidence interval, BMI: Body mass index, FSH: Follicular-stimulating hormone, LH: Luteinizing hormone, OR: Odds ratio

result, the ovaries may fail to function regularly. Signs of PCOS include elevated LH and GnRH levels, whereas FSH levels are muted or unchanged. Hyperandrogenism symptoms include acne, hirsutism, seborrhea, androgenic alopecia, and virilization.

In the present study, a total of 160 patients diagnosed with PCOS were assessed. The mean age of the patient was 26.19 ± 5.03, BMI was 24.42 ± 5.61, WHR was 0.83 ± 0.042, FSH was 6.9 ± 2.18, LH was 9.11 ± 4.54, and LH/FSH was 1.61 ± 1.42. Among PCOS women, 92.5% had polycystic ovaries, 90.6% of the study population had oligomenorrhea, 61.2% had hirsutism, and 40% had acne. About 50% of patients with oligomenorrhea, acne, hirsutism, and polycystic ovaries had LH/FSH ratio >2/1. Around 60% of patients with polycystic ovaries had BMI <25. Around 20% of patients with hirsutism, acne, and oligomenorrhea had BMI > 25. Polycystic ovaries have shown signification in relation to LH/FSH >2/1 (95% CI 2.05–31.09; $P = 0.002$), FSH ≥7 (95% CI 0.02–0.40; $P = 0.001$), and LH ≥10 (95% CI 0.05–0.75; $P = 0.001$).

Hashemi *et al*.[6] documented that the mean age of the PCOS patient was 29.4 ± 4.9, LH level was 8.3 ± 7.1, and FSH level was 7.1 ± 3.7. Khan *et al*.[7] observed that the mean age of the patient was 28.7 ± 5.2, BMI was 28.4 ± 4.1, LH level 10.8 ± 2.8, FSH level 3.9 ± 1.2, and LH/FSH ratio 2.8 ± 235; 57.1% of patients had oligomenorrhea, 31.4% had amenorrhea, 5.7% had polymenorrhea, and 66.6% had hirsutism. Sirmans and Pate[8] found that 70% of PCOS women had hirsutism. Yuan *et al*.[9] also observed similar findings of the mean age of patient as 27.9 ± 2.13, BMI 24.04 ± 3.4, and LH/FSH 1.5 ± 0.8. A study from Riyadh found higher BMI in PCOS women as 31.9 ± 6.4, the mean age of patient was 35.9 ± 5.0 and noted 77.4% of oligomenorrhea.[10] Esmaeilzadeh *et al*.[11] noted 92% of oligomenorrhea, 31.4% acne, 78.9% hirsutism, and 89.1% polycystic ovaries. Wijeyaratne *et al.*[12] stated that 82.5% of PCOS women had polycystic ovaries in ultrasonographic findings. Takahashi *et al*.[13] also noted that 94% of PCOS women had polycystic ovaries.

Few studies observed increase in LH/FSH ratio among PCOS women.[14] Ann *et al*.[15] reported that 75% of PCOS patients had elevated LH and 94% had elevated LH-to-FSH ratio. Joanne *et al*.[16] documented that amplitude and frequency of LH secretion increased in PCOS when compared to normal women and also noted with the increase in LH secretion, there is a relative suppression of FSH. Banaszewska *et al*.[14] mentioned that there is a significant increase in LH/FSH ratio in relation to BMI, serum insulin parameters. Kumar *et al*.[17] did a PCOS study on Indian women noted that an increased LH/FSH ratio (>1.5) was seen in women with PCOS compared with control women. Kim *et al*. found a higher hyperandrogenism in women with high BMI.[18] Yuan,[9] Kim *et al*.,[18] and Malkud[19] noted that approximately 80% of women with severe acne had elevated levels of blood androgen.

In similar to this study, Esmaeilzadeh *et al*. [11] have done a study on clinical features association with BMI and gonadotropin hormones, stated that there is no statistical significance of LH, FSH, and LH/FSH ratio in relation to oligomenorrhea, BMI, and hirsutism; whereas, correlation of polycystic ovaries and LH/FSH ratio showed statistical significance ($P \leq 0.05$). Pavičić Baldani *et al*.[20] conducted a research work on hyperandrogenism features in PCOS women, observed that there is no significant association between acne, hirsutism, and gonadotropin hormones. Diagnosing polycystic ovaries among PCOS women is a most sensitive investigation.[21]

Kumar *et al*.[17] showed negative correlation between BMI and LH levels in PCOS patients. Yau *et al*.[22] noted that 80–85% of women with hyperandrogenism clinically have PCOS. Da Silva Feuser *et al*.[23] stated that in PCOS patients, BMI has

negative association with baseline of LH levels. Sachdeva *et al*.[24] mentioned that there are no significant differences in the LH, follicle-stimulating hormone (FSH), LH-FSH ratio, and 17-hydroxyprogesterone levels between obese and non-obese PCOS women.

Mahmoud[25] conducted a study on 180 patients of obese and non-obese polycystic ovary syndrome, stated that women with higher BMI have higher age of menarche, abortion, menstrual disturbance, hyperandrogenism, and acanthosis nigricans with a statistically significant difference. Mean levels of studied metabolic and sex hormones were also shown significantly higher in obese PCOS women.

Kumar *et al*.[17] conducted a study on hormones of PCOS women and normal women, they have found a significant correlation of parameters such as fasting insulin, insulin resistance, fasting glucose, thyroid hormones, prolactin, LH, and FSH. They also stated that previously LH/FSH ratio is a hallmark of study, but it is no longer a characteristic parameter, because there is LH surge in PCOS patients, which cause inconsistency in LH/FSH ratio. Fakhoury *et al*.[10] did a study at Riyadh among PCOS women and normal women, observed that LH/FSH and total testosterone were significantly increased in PCOS cases, whereas FSH, SHBG, and progesterone were significantly decreased in PCOS patients.

Yuan *et al*.[9] did a comparative prospective study on PCOS women hyperandrogenism signs and without hyperandrogenism signs, noted a significant difference between total testosterone (<0.0001), free androgen index ($P = 0.000$), SHBG ($P = 0.018$), and BMI ($P = 0.017$).

Hashemi *et al*. [6] did a comparative level study of hormones in infertile women with PCOS and normal women, found that LH surge is significant in infertile group ($P = 0.004$), and also noticed that progesterone hormone showed a significant difference between the two groups ($P = 0.007$).

PCOS is associated with endometrial, ovarian, and breast cancers, this may be due to multiple ovulation, long time exposure to estrogen, hyperinsulinemia, hyperandrogenism, and obesity.[26] It can be responsible for metabolic syndrome, cardiovascular diseases, hypertension, and hyperlipidemia.[27] Women with PCOS pose higher risk of acquiring preeclampsia or pregnancy-induced hypertension, gestational diabetes mellitus, and preterm deliveries.[28]

In this study, we have assessed gonadotropin hormones to all patients and their correlation with PCOS clinical features, which is helpful to clinicians for managing patients. Statistical significance was assessed. Limitations in this study are unable to do follow-up of patients after management as this study done in a government hospital, majority of the patients hailing from rural areas.

CONCLUSION

We conclude that most of the patients presented with oligomenorrhea and polycystic ovaries. Polycystic ovaries characteristic is significantly correlated with LH/FSH ratio, LH, and FSH levels. PCOS diagnosis is a multidisciplinary approach, which should be evaluated by clinical features, hormonal evaluation, and radiological investigations. Diagnosing polycystic ovaries by ultrasonography and hyperandrogenism are a hallmark for PCOS.

REFERENCES

1. Umland EM, Weinstein LC, Buchanan EM. Menstruation-related disorders. In: DiPiro JT, Talbert RL, Yee GC, editors. Pharmacotherapy: A Pathophysiologic Approach. 8th ed. New York: McGraw-Hill; 2011. p. 1393.
2. Mihailidis J, Dermesropian R, Taxel P, Luthra P, Grant-Kels JM. Endocrine evaluation of hirsutism. Int J Womens Dermatol 2015;1:90-4.
3. Hu L, Shen H, Wu QF, Tian L, Hu MH. Treatment of polycystic ovarian syndrome with insulin resistance by insulin-sensitizer. Clin Exp Obstet Gynecol 2014;41:288-92.
4. ACOG Committee on Practice Bulletins-Gynecology. ACOG practice bulletin No. 108: Polycystic ovary syndrome. Obstet Gynecol 2009;114:936-49.
5. McFarland C. Treating polycystic ovary syndrome and infertility. MCN Am J Matern Child Nurs 2012;37:116-21.
6. Hashemi AH, Mozdarani H, Naghavi A. Comparison of the levels of LH and FSH TSH prolactin progesterone and estradiol hormones between Iranian infertile women with polycystic ovary syndrome and healthy women. Int J Med Res Health Sci 2016;5:370-5.
7. Khan A, Karim N, Ainuddin JA, Fahim MF. Polycystic ovarian syndrome: Correlation between clinical hyperandrogenism, anthropometric, metabolic and endocrine parameters. Pak J Med Sci 2019;35:1227-32.
8. Sirmans SM, Pate KA. Epidemiology, diagnosis, and management of polycystic ovary syndrome. Clin Epidemiol 2013;6:1-3.
9. Yuan C, Liu X, Mao Y, Diao F, Cui Y, Liu J. Polycystic ovary syndrome patients with high BMI tend to have functional disorders of androgen excess: A prospective study. J Biomed Res 2016;30:197-202.
10. Fakhoury H, Tamim H, Ferwana M, Siddiqui IA, Adham M, Tamimi W. Age and BMI adjusted comparison of reproductive hormones in PCOS. J Family Med Prim Care 2012;1:132-6.
11. Esmaeilzadeh S, Andarieh MG, Ghadimi R, Delavar MA. Body mass index and gonadotropin hormones (LH and FSH) associate with clinical symptoms among women with polycystic ovary syndrome. Glob J Health Sci 2014;7:101-6.
12. Wijeyaratne CN, Jayasinghe A, de Silva DG, Parkes AB, Lazarus JH, Premawardhana LD. Iodine prophylaxis, goitre and thyroid autoimmunity in Sri Lanka. Ceylon Med J 2005;50:20-3.
13. Takahashi K, Okada M, Ozaki T, Uchida A, Yamasaki H, Kitao M. Transvaginal ultrasonographic morphology in polycystic ovarian syndrome. Gynecol Obstet Invest 1995;39:201-6.

14. Banaszewska B, Spaczyński RZ, Pelesz M, Pawelczyk L. Incidence of elevated LH/FSH ratio in polycystic ovary syndrome women with normo-and hyperinsulinemia. Rocz Akad Med Bialymst 2003;48:131-4.
15. Ann ET, Brain M, Kathryn AM, Ellen JA, Judith MA, David S, *et al*. Determinants of abnormal gondotropin secretion in clinically defined women with polycystic ovary syndrome. J Clin Endocronol Metab 1997;82:102-8.
16. Joanne W, Nanette FS, Janet EH, Filicori M, William FC. Hyper function of the hypothalamic-pituitary axis in women with polycystic ovarian disease: Indirect evidence for partial gonadotroph desensitization. J Clin Endocronol Metab 1987;66:212-8.
17. Kumar AN, Naidu JN, Satyanarayana U, Ramalingam K, Anitha M. Metabolic and endocrine characteristics of Indian women with polycystic ovary syndrome. Int J Fertil Steril 2016;10:22-8.
18. Kim MJ, Lim NK, Choi YM, Kim JJ, Hwang KR, Chae SJ, *et al*. Prevalence of metabolic syndrome is higher among non-obese PCOS women with hyperandrogenism and menstrual irregularity in Korea. PLoS One 2014;9:e99252.
19. Malkud S. A hospital-based study to determine causes of diffuse hair loss in women. J Clin Diagn Res 2015;9:WC01-4.
20. Pavičić Baldani D, Škrgatić L, Bukvić Mokos Z, Trgovčić I. Hyperandrogenemia association with acne and hirsutism severity in Croatian women with polycystic ovary syndrome. Acta Dermatovenerol Croat 2013;21:105-12.
21. Adams J, Franks S, Polson DW, Mason HD, Abdulwahid N, Tucker M, *et al*. Multifollicular ovaries: Clinical and endocrine features and response to pulsatile gonadotropin releasing hormone. Lancet 1985;2:1375-9.
22. Yau TT, Ng NY, Cheung LP, Ma RC. Polycystic ovary syndrome: A common reproductive syndrome with long-term metabolic consequences. Hong Kong Med J 2017;23:622-34.
23. Da Silva Feuser CS, Barbosa JS, da Silva DE, de Medeiros DS. Current insights into gonadotropic pituitary function in the polycystic ovary syndrome. Asia Pac J Reprod 2014;3:64-70.
24. Sachdeva G, Gainder S, Suri V, Sachdeva N, Chopra S. Obese and non-obese polycystic ovarian syndrome: Comparison of clinical, metabolic, hormonal parameters, and their differential response to clomiphene. Indian J Endocrinol Metab 2019;23:257-62.
25. Mahmoud MI, Habeeb F, Kasim K. Reproductive and biochemical changes in obese and non obese polycystic ovary syndrome women. Alex J Med 2015;51:5-9.
26. Chittenden BG, Fullerton G, Maheshwari A, Bhattacharya S. Polycystic ovary syndrome and the risk of gynaecological cancer: A systematic review. Reprod Biomed Online 2009;19:398-405.
27. Elting MW, Korsen TJ, Bezemer PD, Schoemaker J. Prevalence of diabetes mellitus, hypertension and cardiac complaints in a follow-up study of a Dutch PCOS population. Hum Reprod 2001;16:556-60.
28. Løvvik TS, Wikström AK, Neovius M, Stephansson O, Roos N, Vanky E. Pregnancy and perinatal outcomes in women with polycystic ovary syndrome and twin births: A population-based cohort study. BJOG 2015;122:1295-302.

How to cite this article: Ratnakaram SS, Reddy ER. Association of clinical features of polycystic ovarian syndrome with body mass index and gonadotropin hormones. Natl J Physiol Pharm Pharmacol 2020;10(04):285-289.

Source of Support: Nil, **Conflicts of Interest:** None declared.