Journal of Pakistan Association of Dermatologists. 2024;**34(4)**:869-877.

Original Article

Investigation of the frequency of polycystic ovary syndrome and its related factors in patients with severe acne

Salman Daneshi[1], Motahareh Hosseini[2], Asma Amiri Domari[3], Rasoul Raesi[4,5], Mohadeseh Malekpour Afshar[6], Vahid Pooladvand[7], Reza Faryabi[*1]

[1] School of Public Health, Jiroft University of Medical Sciences, Jiroft, Kerman, Iran.
[2] Department of Dermatology, School of Medicine, Imam Khomeini Hospital, Jiroft University of Medical Sciences, Jiroft, Kerman, Iran.
[3] Anesthesiology Department of Surgery, School of Medicine Imam Khomeini Hospital, Jiroft University of Medical Sciences, Jiroft, Kerman, Iran.
[4] Department of Nursing, Torbat Jam Faculty of Medical Sciences, Torbat Jam, Iran.
[5] Department of Health Services Management, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran.
[6] School of Medicine, Imam Khomeini Hospital, Jiroft University of Medical Sciences, Jiroft, Kerman, Iran.
[7] Department of Clinical Biochemistry, School of Medicine, Jiroft University of Medical Sciences, Jiroft, Iran.

Abstract

Objective The objective of the study was conducted with the aim of determining the frequency of polycystic ovaries and their related factors in patients with severe acne.

Methods This study was a cross-sectional study with a descriptive and analytical approach that was conducted using available sampling on 100 women with severe acne who referred to the skin clinic of Imam Khomeini Hospital in Jiroft in 2021. The data collection tool included a researcher-made checklist including history, and clinical examination, and based on that, patients with any specific symptom were referred for hormonal diagnostic tests such as free testosterone and total serum measurement. The data were analyzed with SPSS-18.

Results The prevalence of PCOS with severe acne was 29% in patients in the south of Kerman province. There was a significant relationship between PCOS and severe acne in people with menstrual disorders ($P<0.05$), severe acne in people with and without exercise ($P<0.05$), BMI ($P<0.05$), and people with and without thyroid disorders ($P<0.05$).

Conclusion A statistically significant relationship was found between the severity of acne and polycystic ovaries. Considering the effects of acne on women's hormonal screening, and ultrasound are recommended in girls with severe acne.

Key words
Ovary; Polycystic; Acne; Women.

Introduction

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder (endocrinopathy) in women and the most common reason of infertility caused to lack of ovulation.[1] The name of this syndrome is due to the attendance of large ovaries comprising small cysts in most affected women, and these cysts are located in the outer layer of each ovary.[2]

Women suffering from this disease have common symptoms such as menstrual disorders (especially occasional bleeding (oligomenorrhea), symptoms of hyper-androgenism such as hairiness (hirsutism) and acne, hair loss, and infertility.

Patients are exposed to serious complications such as the increased risk of endometrial and breast cancer, dyslipidemia, Hypertension, cardiovascular diseases, and diabetes. The prevalence of obesity and dyslipidemia in PCOS patients is higher than in healthy women. 40% of affected women are obese and 75% are infertile.[3]

This disease is seen in approximately 6-10% of all women who are in reproductive age. The cause of this disease is not known, but researchers believe that hereditary factors and diabetes, and rarely the use of thyroid drugs such as methimazole play a role in its appearance.[4]

Irregular periods, excessive hair growth, skin rashes (acne), and obesity are observed in women PCOS. This complication can be identified in adolescence with erratic menstrual periods or it can be diagnosed later due to weight gain or fertility problems.[5]

The exact cause of PCOS is still unknown. Affected women may have difficulty conceiving due to problems with ovulation. Early diagnosis and treatment can help prevent long-term complications such as type 2 diabetes, heart disease, and stroke.[6]

Ultrasound evidence of polycystic ovary (increased ovarian volume to more than 9 ml, the presence of 2-8 mm cysts in the number of 10 or more in each ovary, and increased uterine stroma density (endometrial hyperplasia).[1] Metabolic disorders such as increased serum levels of LH, testosterone, insulin, prolactin, and insulin resistance are common in this disease.[2]

Treatment is with clomiphene, oral contraceptive pills, gonadotropins, GnRH agonists, simultaneous use of calcium and vitamin D, and a weight loss diet. In resistant cases, laparoscopy is performed.[3] Insulin resistance is a main factor in the pathogenesis of PCOS, therefore insulin-lowering drugs such as metformin are widely used in the treatment of this syndrome.[4]

PCOS symptoms often begin soon after the first menstrual period. In some cases, it occurs in the following years of fertility, due to a gradual increase in weight. Its symptoms vary from person to person. Irregular menstruation is one of the most common characteristics of this disease. Abnormal menstruation means an interval of more than 35 days between two periods, less than 8 periods in a year, absence of menstruation for 4 months or more, and delayed menstruation that may be accompanied by very little or heavy bleeding.[5] An increase in androgens or male hormones is another characteristic of this disease. High levels of male hormones can cause external symptoms such as excessive hair growth on the face and body (hirsutism), acne in adulthood or severe acne in adolescence, and male pattern baldness.[6]

With the help of ultrasound, large ovaries containing many small cysts can be identified. However, contrary to what its name suggests, a definite diagnosis cannot be made only by the presence of polycystic ovaries. Irregular menstrual periods or symptoms caused by high androgen levels are also required for a definite diagnosis of PCOS. Some women may not have PCOS despite having polycystic ovaries on ultrasound. On the other hand, in some people with this syndrome, the ovaries may be normal in ultrasound.[7]

Manuscript Received: September 26, 2023
Revised: October 23
Accepted: July 07, 2024
Address for correspondence
Dr. Reza Faryabi
Assistant Professor, Department of Public Health, School of Health, Jiroft University of Medical Sciences, Jiroft, Iran.
Ph: +983443318338
Email: rezafaryabi313@gmail.com

Among the other symptoms of PCOS can be problems getting pregnant, obesity (40 to 50% of women with this syndrome are obese), hair growth in the beard area, behind the lips, beard line, chest, and the area around the tip. Breasts or the lower part of the abdomen along the midline, dark and thick skin in the armpit area (sometimes has a velvety appearance), increased blood pressure, increased blood sugar and acne.[8]

Acne vulgaris is another common skin manifestation of hyperandrogenism. Acne vulgaris is usually a self-limiting disorder that mainly affects young adults. The factor that enables the appearance of this disease during puberty is the increase in sebum secretion by the sebaceous glands, which occurs after puberty.[9]

The prevalence of acne in women with PCOS is unknown. In a study, the rate of acne in women with PCOS and women in the control group was reported to be 83% and 19% respectively. Approximately 80% of women with severe acne, 50% with moderate acne, and 30% with mild acne have increased blood androgen levels. In Borgia *et al*.'s study, androgen increase was seen in most patients with acne, but only 19% of them had PCOS.[10] About 75% of women with acne have polycystic ovary manifestations in ultrasound.[11]

Due to the high prevalence of PCOS in acne sufferers, it is recommended that all women with acne complaints, menstrual status, symptoms of hyperandrogenism, and polycystic ovaries should be checked.[12]

Due to the high prevalence of PCOS, it may be possible to prevent its common complications, especially severe acne resistant to treatment in women, with timely diagnosis and treatment. Many times, even with the treatment of acne, the effects of acne remain as scars on the skin of the patients, and this issue can affect the patients mentally and the cost of cosmetic treatment, and ultimately cause a disturbance in the mental image of the person herself. According to what was said, timely diagnosis and effective treatment of polycystic ovary are of particular importance to prevent its complications. Therefore, this study was designed and implemented with the aim of determining the frequency of PCOS and its related factors in patients with severe acne who were referred to the skin clinic of Imam Khomeini Hospital (RA) in Jiroft in 2021.

Methods

This study was a cross-sectional study with a descriptive and analytical approach that was conducted using available sampling on 100 women with severe acne who referred to the skin clinic of Imam Khomeini Hospital (RA) in Jiroft in 2021

Consent to participate in the study, definite diagnosis of acne, completeness of medical documents of having PCOS with at least two diagnostic methods of polycystic ovary such as hyperandrogenism, menses disorder and ultrasound morphology were among the criteria for entering the study. Pregnancy and the use of oral contraceptives were also considered as exclusion criteria.

The collection tool was the checklist prepared by the researchers, detailed history and clinical examination, and based on that, patients with any specific symptoms were referred for diagnostic tests. This checklist includes age (1 to 15 years), ultrasound report (polycystic ovary report), duration of acne, menstrual disorder (oligomenorrhea in the form of a menstrual cycle of more than 40 days and amenorrhea in the form of no menstrual cycle in women with a history of previous menstruation with a duration of at least equal to the sum of three menstrual

cycles or at least 6 months), BMI classification was done. BMI less than 18.5 thin, BMI 18.5 to 24.9 normal, BMI 25 to 30 overweight and BMI above 30 were considered obese), exercise habits (rapid walking for 30 minutes a day, 5 days a week), infertility and fertility (absence of ovulation), TSH serum level, free and total testosterone level, LH and FSH.

To check the validity of the content, the checklist was given to 6 faculty members related to the topic of the research and they were asked about the relevance of each item from the checklist to a four-choice question including: 1) irrelevant, 2) relevant but needs serious revision, 3) it is relevant but it needs partial revision and 4) it is completely relevant to answer so that the Content Validity Index (CVI) index can be calculated to check the validity of the content and they were also asked that for the necessity of existence Each item should answer a three-choice question including: 1) necessary, 2) useful but unnecessary and 3) unnecessary so that the Content Validity Ratio (CVR) index can be calculated. CVI score was higher than 0.79, so validity of the content of the checklist is confirmed. Cronbach's alpha was used to measure the reliability that was higher than 0.75.

In order to consider ethical considerations, the data were collected without the names and characteristics of the patients, and all the information of the patients, including the name and national information, remained confidential both during the study and after the study was completed, and the results were reported in general. Data were analyzed using SPSS version 18 statistical software. For descriptive data, frequency, percent frequency, mean and standard deviation were reported. Chi-square test, independent t test and ANOVA were used for correlation between variables in parametric conditions and their non-parametric equivalent was used in non-parametric conditions. The significant level for all tests was considered P-value less than 0.05.

Results

In this study, 100 women with severe acne resistant to treatment referred to the skin clinic of Imam Khomeini Hospital in Jiroft were examined. The average age of the investigated patients was 25.35±6.1 years. Of the 100 people studied, 12 people (12%) are in the age group of 10-20 years, 60 people (60%) are in the age group of 20-30 years, 25 people (25%) are 30-40 years old and 3 people (3%) were in the age group of 40-50. 9 people had a BMI less than 18.5, 30 people had a BMI of 18.5-24.9, 53 people had a BMI of 25-29.9, and 8 people were in the group of more than 30 kg/m^2, and out of 100 people examined, 21 people had thyroid diseases, 29 patients (29%) had PCSO, 60 patients (60%) did not have PCSO, and 11 patients (11%) had an unknown status **(Table 1)**.

Of the 29 people with polycystic ovary with severe acne, 4 people (13.8%) in the age group of 10-20 years, 18 people (62.1%) in the age group from 20-30 years, 7 people (24.1%) were in the age group of 30-40 years, and statistically

Table 1 Demographic characteristics of the examined patients.

Variables Types	*Variables Situation*	*Frequency*	*Percent (%)*
PCSO	Yes	29	29
	No	60	60
	Unknown	11	11
	Total	100	100
Age	10-20	12	12
	20-30	60	60
	30-40	25	25
	40-50	3	3
BMI	<18.5	9	9
	18.5-24.9	30	30
	25-29.9	53	53
	>30	8	8
	Yes	21	21

there is a significant relationship between the distribution of people with PCOS with severe acne in the age groups under investigation (P-Value <0.05). Out of 29 people, 15 people (51.7%) had oligomenorrhea, 8 people (27.5%) had amenorrhea, 4 people (13.7%) had hypermenorrhea, and 2 people (6.1%) had regular periods. There is a statistically significant relationship between the distribution of people with PCOS with severe acne in the menstrual disorder groups under investigation (P-Value <0.05). Of the 29 people investigated, 10 people (34.5%) had physical activities and 19 people (65.5%) had no physical activities, and statistically there is a significant relationship between the distribution of people with PCOS and severe acne in groups with physical activities and without physical activities (P-Value<0.05). Out of 29 people investigated, 5 people (17.3%) were barren, 18 people (62.1%) were fertile, and 6 people (20.6%) were single, and statistically there is a significant relationship between the distribution of people with ovarian syndrome. Polycystic with severe acne is present in the studied infertile, fertile, and unmarried groups (P-Value <0.05). Of the 29 investigated people, 9 people (31.9%) were aware and 20 people (68.1%) were not aware, and statistically, there is a significant relationship between the distribution of people with PCOS with severe acne in the groups. There is a survey with awareness and without awareness (P-Value <0.05). Out of the 29 investigated people, 10 people (34.5%) from 1 to 5 years, 9 people (31%) from 5 to 10 years and 10 people (34.5%) from 10 to 15 years were resistant to acne treatment and terms of there is a statistically significant relationship between the distribution of people with PCOS with severe acne in the groups of treatment-resistant acne duration (P-Value <0.05). Of the 29 people investigated, 6 people (20.6%) were in the group less than 18.5, 5 people (17.2%) were in the group 18.5 to 24.9, 10 people (34.5%) were in the group 25 to 29.9 and 8 people (27.8%) were in the group of more than 30 kg/m^2 and statistically significant relationship between the distribution of people with PCOS with severe acne in the BMI groups. There are out of 29 people investigated, 21 people (72.41%) had thyroid and 8 people (27.58%) did not have thyroid and there is a statistically significant relationship between the distribution of people with polycystic ovary syndrome and severe acne in the two groups (P-Value<0.05). There is a study with thyroid and without thyroid (P-Value <0.05) **(Table 2)**.

The average LH was found to be 10.2±2.6, which is within the normal range, and the lowest LH value was 4 and the highest LH value was 15 in the examined patients. The average FSH was 5.98±2.11, which is within the normal range, and the lowest FSH value was 2 and the highest FSH value was 10 in the investigated patients. The average ratio of LH to FSH was found to be 1.82±0.611, the lowest value was 1 and the highest value was 4 in the investigated patients. The average free testosterone was found to be 3.27±5.08, which is more than the normal range, the lowest amount of free testosterone was 1 and the highest amount of free testosterone was 28 in the investigated patients. The average total testosterone was found to be 70.73±75.38, which is in the higher range than normal, the lowest total testosterone value was 10 and the highest total testosterone value was 400 in the studied patients **(Table 3)**.

Discussion

The aim of this study was to determine the status of PCOS with severe acne in 100 women with severe acne resistant to treatment who were referred to the skin clinic of Imam Khomeini Hospital in Jiroft. In the present study, the frequency of PCOS with severe acne in patients in the south of Kerman province was 29%. In this regard, Naderi *et al.* in their research

Table 2 Determining the status of PCOS with severe acne based on age, menstrual disorder, physical activity, fertility type, awareness of acne and PCOS, duration of treatment-resistant acne, BMI and thyroid status.

Variables	*PCSO*		
	Frequency	*Frequency percent*	*P Value*
Age			
10-20	4	13.8	
20-30	18	62.1	0.000
30-40	7	24.1	
Total	29	100	
Menstrual disorder			
Oligomenorrhea	15	51.7	
Amenorrhea	8	27.5	
Hypermenorrhea	4	13.7	0.000
Regular	2	6.1	
Total	29	100	
Physical Activity			
Yes	10	34.5	
No	19	65.5	0.000
Total	29	100	
Fertility type			
Infertile	5	17.3	
Fertile	18	62.1	0.000
Single	6	20.6	
Total	29	100	
Awareness of acne and PCOS			
Yes	9	31.9	
No	20	68.1	0.000
Total	29	100	
The duration of treatment-resistant acne			
1-5	10	34.5	
5-10	9	31	0.000
10-15	10	34.5	
Total	29	100	
BMI			
<18.5	6	20.6	
18.5-24.9	5	17.2	
25-29.9	10	34.5	0.000
>30	8	27.7	
Total	29	100	
Thyroid diseases			
Yes	21	72.41	
No	8	27.58	0.000
Total	29	100	

concluded that the prevalence of PCOS in people with acne was 29.5%[12] and this research finding is also consistent with the results of Chae's study in Korea that the frequency of PCOS was 31.3%[13] and Diamanti *et al*.[14] found the prevalence of this syndrome with acne symptoms to be 6.9%, and other studies include Pehlivanov *et al*.[15] in Bulgaria 10%, Shroff *et al*.[16] in America 14.3%, Belosi *et al*.[17] in Italy 3 33.0% and Hsu *et al*.[18] in Taiwan 28.2% mentioned. In a study that investigated the prevalence of polycystic ovaries through ultrasound in a population of 255 healthy women, the prevalence of polycystic ovaries with symptoms of early puberty and severe acne was reported 31%.[19] In this regard, in their study, Naderi *et al.* investigated the prevalence of facial and trunk acne in 14-18-year old high school girls and its relationship with polycystic ovaries the results of their study showed that facial and body acne was associated with the presence of polycystic ovary and this association was statistically significant.[12]

The results of the present study showed that the obesity rate in the examined people is 62.3%. but in Conway's study, the rate of obesity was reported to be 35-60%. In their study, they showed that this increase in BMI causes an increase in testosterone in obese women, which can be associated with a lack of ovulation.[20] Ghazanfarpour *et al.* showed in their study that waist size has a significant relationship with PCOS and for every centimeter increase in waist circumference, the probability of having PCOS increases by 7%.[21] Also, in previous studies, the prevalence of overweight and obesity in students was estimated at 17.3% and 3.6%.[22]

Table 3 Determining the status of PCOS and severe acne according to serum FSH-LH and testosterone levels.

Variables		*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Serum level FSH-LH	LH	10.2	2.6	4	15
	FSH	5.98	2.11	2	10
	LH to FSH ratio	1.82	0.611	1	4
Serum level	Free	3.27	5.08	1	28
Testosterone	Total	70.73	75.38	10	400

In other study, the prevalence of overweight and obesity was 15% and 2%, respectively.[23] PCOS and homocysteine levels increase with increasing waist size.[24] Obesity and Increased abdominal fat affect the clinical and biochemical manifestations of PCOS in different ways.[8] Coviello *et al.* believe that even a slight reduction in the weight of women with PCOS with acne can provide the patient with pregnancy by creating suitable ovarian cycles.[25] In the studies, the difference in the prevalence of overweight and obesity can be due to the difference in sample size and dietary patterns of people. Surveys show that obesity and overweight are among the most important public health issues in most countries in the world.

The present study results show that there is no significant relationship between the TSH hormone and PCOS with severe acne. In other studies, although it seems that thyroid disorders, including hyperthyroidism, can effects ovaries through a direct effect on their function and autoimmune pathways, however, no significant relationship between the occurrence of PCOS and thyroid hypothyroidism was determined.[26]

In the present study, the testosterone level was found to be more than normal in the studied subjects. In the study of Puzigaca *et al;* the levels of androstenedione hormones, and testosterone in patients who had polycystic ovaries in ultrasound were higher than in patients with normal ultrasound.[27] In Naderi *et al*.'s study, women with PCOS with acne had higher mean serum total testosterone than women without polycystic ovaries.[12] In Buncker *et al*.'s study, women who had acne and polycystic ovaries in ultrasound compared to women who had this syndrome and who went to the endocrinology clinic with non-skin symptoms showed higher hormone concentrations than normal, especially testosterone levels and high-level LH.[28]

The results of this study showed that 93.9% of people with polycystic ovaries with severe acne had menstrual disorders. In a study conducted by Conway *et al;* menstrual disorders were present in 80% of cases.[20] Also, in the study of Vashqani *et al;* menstrual disorders were present in 100% of cases.[29] The presence of symptoms of menstrual irregularities in the first years after menarche was associated with the lack of development of the hypothalamus, pituitary, and ovary axis, but new studies conducted recently in this field show that menstrual disorders, especially in the form of oligomenorrhea. It is the beginning of PCOS.[30,31]

In Van Hooff *et al*.'s study on 2248 female students aged 14-17 years with an average age of 15.6, the relationship between endocrine symptoms of PCOS and menstrual disorders was investigated. The results of this study showed that girls who had oligomenorrhea had higher blood levels of luteinizing hormone (LH), androstenedione, testosterone, and estradiol compared to girls with normal menstrual cycles. However, people with other menstrual disorders such as polymenorrhea and metrorrhagia were hormonally identical to people with normal menstruation.[31]

Conclusion

In the present study, the prevalence of PCOS with severe acne in patients from the south Kerman province, 29% was obtained. A statistically significant relationship was found between the severity of acne and polycystic ovaries. Doctors' awareness of this significant relationship between acne and polycystic ovary helps them to be aware of the factors affecting fertility and to be able to diagnose polycystic ovary as soon as possible and take appropriate treatment measures with the aim of improving the fertility of women of reproductive age. Considering the effects of acne on women's quality of life, hormonal screening, and

ultrasound are recommended in girls with severe acne. Therefore, it is necessary to conduct more studies on larger populations and more diverse races to confirm the findings. A systematic review study is recommended in line with the goals and results of the present study.

Acknowledgments This article was taken from the research project, which was done with the financial support of the Vice-Chancellor for Research and Technology of Jiroft University of Medical Sciences and has been approved by the ethics code IR.JMU.REC.1401.037 in the ethics committee of the Ministry of Health of Iran in 2022. The authors are pleased to thank the patients participating in the study and the staff of Imam Khomeini Hospital in Jiroft for their cooperation in the implementation of this study.

Declaration of patient consent The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship None.

Conflict of interest None.

Author's contribution

SD, MH, AAD, RR, MMA, VP, RF: Substantial contributions to concept, study design, critical review and has given final approval of the version to be published.

References

1. Maheshwari A, Stofberg L, Bhattacharya S. Effect of overweight and obesity on assisted reproductive technology- a systematic review. Hum Reprod Update. 2007;**13(5)**:433-44.
2. Dokras A, Bochner M, Hollinrake E, Markham S, VanVoorhis B, Jagasia DH. Screening women with polycystic ovary syndrome for metabolic syndrome. *Obstet Gynecol*. 2005;**106(1)**:131-7.
3. Legro RS, Kunselman AR, Dodson WC, Dunaif A. Prevalence and predictors of risk for type 2 diabetes mellitus and impaired glucose tolerance in polycystic ovary syndrome: a prospective, controlled study in 254 affected women. *J Clin Endocrinol Metab*. 1999;**84(1)**:165-9.
4. Wild RA, Painter P, Coulson PB, CARRUTH KB, Ranney G. Lipoprotein lipid concentrations and cardiovascular risk in women with polycystic ovary syndrome. *J Clin Endocrinol Metab*. 1985;**61(5)**:946-51.
5. Baillargeon J-P, Nestler JE. Polycystic ovary syndrome: a syndrome of ovarian hypersensitivity to insulin? *J Clin Endocrinol Metab*. 2006;**91(1)**:22-4.
6. Wu XK, Zhou SY, Liu JX, Pöllänen P, Sallinen K, Mäkinen M, *et al*. Selective ovary resistance to insulin signaling in women with polycystic ovary syndrome. *Fertil Steril*. 2003;**80(4)**:954-65.
7. Cattrall FR, Healy DL. Long-term metabolic, cardiovascular and neoplastic risks with polycystic ovary syndrome. *Best Pract Res Clin Obstet Gynaecol*. 2004;**18(5)**:803-12.
8. Hoeger KM. Obesity and lifestyle management in polycystic ovary syndrome. *Best Pract Res Clin Obstet Gynaecol*. 2007;**50(1)**:277-94.
9. Addor FASA, Schalka S. Acne in adult women: epidemiological, diagnostic and therapeutic aspects. *Anais Brasileiros de Dermatologia*. 2010;**85**:789-95.
10. Bunker C, Newton JA, Kilborn J, Patel A, Conway G, Jacobs H, *et al*. Most women with acne have polycystic ovaries. *Br J Dermatol*. 1989;**121(6)**:675-80.
11. Borgia F, Cannavò S, Guarneri F, Cannavò SP, Vaccaro M, Guarneri B. Correlation between endocrinological parameters and acne severity in adult women. *Acta Derm Vener Stockh*. 2004;**84(3)**:201-4.
12. Tahereh N, Marzieh A, Mohammad Hossein Dabagh M, Hamidreza T, Zahra Z. Frequency of facial and body acne in 14-to 18-year-old female high school students and its relationship to polycystic ovary syndrome. *J Dermatol Cosmet*. 2011;**2(2)**:124-31.
13. Chae SJ, Kim JJ, Choi YM, Hwang KR, Jee BC, Ku SY, *et al*. Clinical and biochemical characteristics of polycystic ovary syndrome in Korean women. *Hum Reprod*. 2008;**23(8)**:1924-31.
14. Diamanti-Kandarakis E, Panidis D. Unravelling the phenotypic map of polycystic ovary syndrome (PCOS): a prospective study of 634 women with PCOS. *Clin Endocrinol*. 2007;**67(5)**:735-42.

15. Pehlivanov B, Orbetzova M. Characteristics of different phenotypes of polycystic ovary syndrome in a Bulgarian population. *Gynecol Endocrinol*. 2007;**23(10)**:604-9.
16. Shroff R, Syrop CH, Davis W, Van Voorhis BJ, Dokras A. Risk of metabolic complications in the new PCOS phenotypes based on the Rotterdam criteria. *Fertil Steril*. 2007;**88(5)**:1389-95.
17. Belosi C, Selvaggi L, Apa R, Guido M, Romualdi D, Fulghesu A, *et al*. Is the PCOS diagnosis solved by ESHRE/ASRM 2003 consensus or could it include ultrasound examination of the ovarian stroma? *Hum Rep*. 2006;**21(12)**:3108-15.
18. Hsu M-I, Liou T-H, Chou S-Y, Chang C-Y, Hsu C-S. Diagnostic criteria for polycystic ovary syndrome in Taiwanese Chinese women: comparison between Rotterdam 2003 and NIH 1990. *Fertil Steril*. 2007;**88(3)**:727-9.
19. Farquhar CM, Birdsall M, Manning P, Mitchell JM, France JT. The prevalence of polycystic ovaries on ultrasound scanning in a population of randomly selected women. *Aust N Z J Obstet Gynaecol*. 1994;**34(1)**:67-72.
20. Conway G, Honour J, Jacobs H. Heterogeneity of the polycystic ovary syndrome: clinical, endocrine and ultrasound features in 556 patients. *Clin Endocrinol*. 1989;**30(4)**:459-70.
21. Ghazanfarpour M, Dolatabadi Z, Bamorovat Z, Mahmoodabadi M, Salari Nasab J, Basari S, *et al*. Prevalence of Symptoms of Polycystic Ovary Syndrome and Some Associated Factors in Medical Students. *J Babol Univ Med Sci*. 2022;**24(1)**:215-23.
22. Zar A, Karan KP, Ahmadi MA. Prevalence of obesity and overweight among female students of Shiraz University of Medical Sciences and its association with physical fitness factors. 2017.
23. Mohammadi M, Mahmoodi Darvishani S, Mirzaei M, Bahrololoomi Z, Sheikhi A, Bidbozorg H, *et al*. The prevalence of overweight and obesity among dental students Yazd University of Medical Sciences of Yazd in 2014. *J Rafsanjan Univ Med Sci Health Serv*. 2015;**14(3)**:189-98.
24. Ehrmann DA. Polycystic ovary syndrome. New England Journal of Medicine. 2005;352(12):1223-36.
25. Coviello AD, Legro RS, Dunaif A. Adolescent girls with polycystic ovary syndrome have an increased risk of the metabolic syndrome associated with increasing androgen levels independent of obesity and insulin resistance. *J Clin Endocrinol Metabol*. 2006;**91(2)**:492-7.
26. Du D, Li X. The relationship between thyroiditis and polycystic ovary syndrome: a meta-analysis. *Int J Clin Exp Med*. 2013;**6(10)**:880.
27. Puzigaić Z, Prelevic G, Stretenović Z, Balint-Perić L. Ovarian enlargement as a possible marker of androgen activity in polycystic ovary syndrome. *Gynecol Endocrinol*. 1991;**5(3)**:167-74.
28. Bunker C, NEWTON JA, Conway G, Jacobs H, Greaves M, DOWD PM. The hormonal profile of women with acne and polycystic ovaries. *Clin Exp Dermatol*. 1991;**16(6)**:420-3.
29. Vasheghani F, Jafari G. Polycystic ovarian disease in the females 15-45 years old referring to endocrine and gynaecology clinic of Imam khomeini hospital of Sari township. 2000-2001. *J Mazandaran Uni Med Sci*. 2002;**12(36)**:52-9.
30. Van Hooff M, Voorhorst F, Kaptein M, Hirasing R, Koppenaal C, Schoemaker J. Endocrine features of polycystic ovary syndrome in a random population sample of 14–16 year old adolescents. *Hum Reprod*. 1999;**14(9)**:2223-9.
31. Van Hooff M, Voorhorst F, Kaptein M, Hirasing R, Koppenaal C, Schoemaker J. Predictive value of menstrual cycle pattern, body mass index, hormone levels and polycystic ovaries at age 15 years for oligo-amenorrhoea at age 18 years. *Hum Reprod*. 2004;**19(2)**:383-92.