



Obstetrics & Gynaecology

A STUDY TO ASSESS THE ASSOCIATION OF POLYCYSTIC OVARIAN SYNDROME (PCOS) WITH BODY MASS INDEX (BMI) AND HYPERTENSION AMONG THE YOUNG WOMEN ATTENDING AGARTALA GOVERNMENT MEDICAL COLLEGE HOSPITAL & GOVIND BALLABH PANT HOSPITAL, AGARTALA, TRIPURA.

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| Dr Aghore Debbarma | Associate Professor, Physiology, Agartala Government Medical College & GBP Hospital, Tripura. |
| Dr. Banhishika Sircar | PGT, O&G, RIMS, Imphal, Manipur. |
| Dr. Taranga Reang* | Associate Professor, Community Medicine, Agartala Government Medical College & GBP Hospital, Tripura. *Corresponding Author |

ABSTRACT **Background:** Polycystic ovary syndrome, the major endocrinopathy among reproductive-aged women, is not yet perceived as an important health problem in the world. It affects 4%–20% of women of reproductive age worldwide. **Objective:** To assess the association of Polycystic ovarian syndrome with BMI and hypertension among young women. **Methodology:** A cross sectional study was conducted among the women diagnosed to be having polycystic ovarian syndrome, aged between 15 to 45 years, attending Obstetrics and gynaecology OPD and IPD of a tertiary care hospital of Agartala city. BMI is age and sex independent and a known epidemiological marker of nutritional status. Blood pressure readings greater or equal to 140 mm Hg systolic and 90 mm Hg diastolic was considered as hypertension. The subjects with systolic BP between 120 and 139 mm Hg or diastolic BP between 80 and 89 mm Hg were considered to have prehypertension. Statistical analysis of the obtained variables was done by SPSS software version 15.0 and MS office word 2007. The descriptive statistics like mean, percentage and inferential statistics like Chi-square test were used for data analysis. **Result:** A total of 56 women with PCOS were enrolled for the present study. The blood pressure was recorded and BMI calculated. There are 50% of the participants with PCOS within the age group of 21-25 years. The majority of overweight and obese participants were within the age group of 15-24 years. About 33.9% of them had overweight and 23.2% of them had been measured to be obese. About 28.6% of women with PCOS were hypertensive and as many as 55.4% of the participants were in Pre hypertensive stage. 28.5% were hypertensive as a whole, out of which 50.0% having hypertension were obese and 37.5% were overweight. **Conclusion:** The study revealed the association between BMI and hypertension among the women with PCOS attending tertiary care hospital. There was also association with the age and BMI among obese women. Hypertensive women were obese and overweight. It is recommended for further study involving more subjects and including other tertiary care hospital.

KEYWORDS : PCOS, Women of 15-45 years, BMI, Hypertension, life style.

INTRODUCTION:

Stein and Leventhal were the first to describe polycystic ovary syndrome (PCOS) more comprehensively in 1935.¹

Polycystic ovary syndrome (PCOS), the major endocrinopathy among reproductive-aged women, is not yet perceived as an important health problem in the world. It affects 4%–20% of women of reproductive age worldwide.²

Polycystic ovary syndrome (PCOS) is a heterogeneous disorder, where the main clinical features include menstrual irregularities, sub-fertility, hyperandrogenism and hirsutism.³

Polycystic ovary syndrome (PCOS) is a complex condition characterized by elevated androgen levels, menstrual irregularities, and/or small cysts on one or both ovaries.⁴

The disorder can be morphological (polycystic ovaries) or predominantly biochemical (hyperandrogenemia). Hyperandrogenism, a clinical hallmark of PCOS, can cause inhibition of follicular development, microcysts in the ovaries, anovulation and menstrual changes.⁵

In 2003, a workshop in Rotterdam formulated a new diagnostic criteria named Rotterdam criteria.⁶ This criterion requires the presence of two conditions out of the three: oligomenorrhea/ anovulation, clinical/biochemical hyperandrogenism and polycystic ovaries (≥ 12 follicles in each ovary measuring 2–9 mm).¹

Ferriman and Gallwey introduced a scoring system for hirsutism in 1961 incorporating eleven androgen dependent sites such as the lip, chin, chest, upper abdomen, lower abdomen, upper arm, forearm, thigh, lower leg, upper back and lower back.⁷

This scoring system evaluates eleven different body parts, with scores ranging from zero (no excessive terminal hair growth visible) to four (extensive hair growth visible) for each body part evaluated. A maximum score of 36 is possible, but a score of ≥ 8 typically indicates hirsutism, as defined by the 95th percentile of data initially collected by Ferriman.⁸

Polycystic ovaries on ultrasound scanning is defined as an ovarian volume greater than 10 cm³ and/or 10 or more 2 to 8 mm follicles in a single plane when ultrasonography is performed.⁹ Objectives: To assess the association of polycystic ovarian syndrome (PCOS) with BMI and hypertension among young women.

METHODOLOGY

A cross sectional study was conducted among the women with diagnosed polycystic ovarian syndrome (PCOS), aged between 15 to 45 years, attending Obstetrics and gynaecology OPD or IPD of Agartala Government Medical College Agartala Government Medical College & Govind Ballabh Pant Hospital, Agartala, Tripura. Considering the assigned study period of 2 months duration it was intended to survey 100 women with established to be having PCOS. However, total of 56 women with PCOS were available and have been thoroughly investigated for their BMI and blood pressure status.

Women diagnosed with Polycystic ovarian syndrome, by Rotterdam diagnostic criteria aged between 15 to 45 years were included for the study. Women with any acute illnesses and chronic diseases except for the PCOS were not considered in the study. Predesigned and pretested interview schedule was used for data collection. Each participant recruited was taken through the following procedure in a complete manner: age was recorded from the birthday by calendar to the nearest of the years (<6 months and >6 months). Standing heights were recorded without shoes and with light clothes on a wall mounted measuring tape to the nearest of the centimeters (<5mm and >5mm).

Weight was recorded without shoes and with light clothes on a standard electronic weighing machine with a least count of 500 grams. BMI was calculated by the formula = weight (kg)/ {height (m)}² Blood pressure was measured in the extended right arms, with the subject in sitting position with a minimum of five minutes of rest using standard mercury sphygmomanometer with appropriate cuff sizes. Three BP readings were recorded consecutively with at least 15 minutes interval and the average of three readings was taken. This procedure was repeated, to measure the BP, for another two days. Finally, the minimum value among the three day readings was taken as the blood pressure of the subject.¹⁰ Mercury sphygmomanometer Diamond

BPMR120 Deluxe conventional model was used for measuring the blood pressure. A prestige stadiometer 20-210 cm measuring slide with large head piece to rest on the top of the head, height graduation scale of 1mm for taking the height of the participants. A standard dial weighing scale made of Hardik Medi - Tech, Sonipat, Haryana, India was used for recording weight of the participants. Written informed consent was obtained from the individual before conducting the study. Confidentiality was maintained throughout the study. Approval from the Institutional Ethics committee was obtained before conducting the study.

BMI is age and sex independent and a known epidemiological marker of nutritional status. International obesity task force (IOTF-2000)¹¹ has proposed the standards for adult obesity in Asia and India as follows: A cut-off point of 18.5 kg/m² is used to define thinness or acute under nutrition and a BMI of 23kg/m² indicates overweight. A BMI of over 25 kg/m² refers to obesity. The international classification of adult underweight, normal, overweight and obesity according to BMI are <18.5, 18.5-24.99, ≥25.00 and ≥30.00 respectively. The BMI of participants was referred to the above classification and their association with PCOS was analyzed. Blood pressure readings greater or equal to 140 mm Hg systolic and 90 mm Hg diastolic was considered as hypertension. The subjects with systolic BP between 120 and 139 mm Hg or diastolic BP between 80 and 89 mm Hg were considered to have prehypertension.¹²

Statistical analysis was done by SPSS software version 15.0 and MS office word 2007. The descriptive statistics like mean, percentage and inferential statistics like Chi-square test were used for data analysis.

RESULT:

A cross sectional study was carried out among the women having polycystic ovary syndrome (PCOS) following Rotterdam diagnostic criteria during the period of August – September 2015. The participants were non-vegetarian, non alcoholic but with sedentary life style.

A total of 56 women with PCOS were enrolled for the present study. The blood pressure was recorded and BMI calculated. The descriptive statistics like mean, percentages were calculated and for inferential statistics like chi square test was used for data analysis.

A total of 56 responses were recorded and statistically analyzed by using SPSS version 15.0 and the results were detailed below:

Table 1. Age Group Distribution Of The Participants With Polycystic Ovarian Syndrome (PCOS)

| Age group (Years) | Number, (N) | Percentage (%) |
|-------------------|-------------|----------------|
| 15-20 | 16 | 28.6 |
| 21-25 | 28 | 50.0 |
| 26-30 | 07 | 12.5 |
| 31-35 | 03 | 5.4 |
| 36-40 | 02 | 3.4 |
| 41-45 | 00 | 0.0 |
| Total | 56 | 100.0 |

There are 50% of the participants with PCOS within the age group of 21-25years, followed by 15-20 years (28.6%), 26-30 years (12.5%), 31-35 years (5.4%) and 36-40 years (3.4%). (Table 1)

Table 2. The Distribution Of Body Mass Index (BMI) And Age Of Participants

| Age (Years) | BMI | | |
|-------------|---------------|-------------------|--------------|
| | Normal, n (%) | Overweight, n (%) | Obese, n (%) |
| 15-24 | 22(91.7) | 15(78.9) | 5(38.5) |
| 25-35 | 2(8.3) | 3(15.8) | 4(30.8) |
| 36-45 | 0 (0.0) | 1(5.3) | 4(30.8) |
| Total | 24(100.0) | 19 (100.0) | 13(100.0) |

The overweight and obese participants were within the age group of 15-24 years, 25-35 years and 36-45 years were (78.9%, 15.8%, 5.3%), (15.8%, 30.8%) and 5.3% 30.8%) respectively. (Table2)

Majority of participants were with normal BMI 24 (42.9%), however about 33.9% of them had overweight and 23.2% of them had been measured to be obese. (Fig 1)

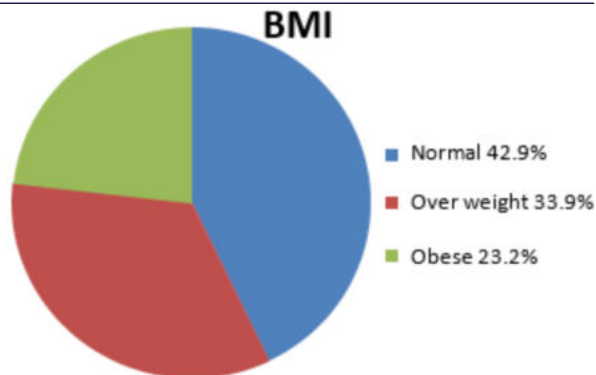


Figure 1. The Overall Distribution Of BMI Of Participants

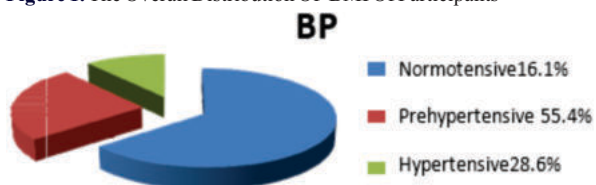


Figure 2: The Overall Distribution Of Blood Pressure (BP) Among The Participants

About 28.6% (n=16) of women with PCOS were hypertensive and as many as 55.4% of the participants were in Pre hypertensive stage. However 16.1% were found to have normal blood pressure. (Fig 2)

Table 3. Distribution Of Blood Pressure (both Systolic & Diastolic) Among Participants.

| Blood Pressure | Systolic BP | Diastolic BP |
|------------------|-------------|--------------|
| | Number, (%) | Number, (%) |
| Normotensive | 13(23.2) | 17(30.3) |
| Pre hypertensive | 30(53.6) | 31(55.3) |
| Hypertensive | 13(23.2) | 8(14.3) |
| Total | 56(100.0) | 56(100.0) |

About 23.2% of the participants were having hypertension when systolic blood pressure is (SBP) considered. Whereas 14.3% having hypertension when diastolic (DBP) blood pressure is considered. (Table3)

Table 4. The Association Of BMI With Hypertension Among The Participants. (N=56)

| BMI | Blood pressure | | P value |
|------------|------------------------|---------------------|---------|
| | Prehypertensive, N (%) | Hypertension, N (%) | |
| Normal | 14(42.4) | 2(12.5) | 0.002 |
| Overweight | 12(36.4) | 6(37.5) | |
| Obese | 5(15.2) | 8(50.0) | |
| Total | 33(100.0) | 16 (100.0) | |

When the distributions of BMI and the status of blood pressure (BP) among the participants with PCOS was analyzed it was found that 16 participants out of 56 (28.5%) were hypertensive as a whole, out of which 50.0% having hypertension were obese and 37.5% were overweight. None of the obese woman had normal blood pressure. (Table 4)

DISCUSSION

A cross sectional study was conducted among the women having polycystic ovary syndrome (PCOS) to assess the association of polycystic ovarian syndrome (PCOS) with BMI and hypertension.

In the present study the ages of participants' ranges from 18 to 39 years with the mean age of 23.16 years. The participants having PCOS attending a tertiary care hospital were in young age group. Fifty percent were within the age group of 21-25 years.

In a study conducted by Mellembakken JR et al the median age for women with PCOS were 28 years. The overall prevalence was found to be 10%. Maximum prevalence of PCOS was found in the age group of 15-24 years. This was followed by observed prevalence in age group of 25-34 years. The observed prevalence in the age group of 35-44 years was only 0.2%. No patient with PCOS were found above the age of 45

years.¹³ Joshi B et al showed that the mean age of the participants was 18.15 (± 2.4) years. Majority of the participants (73.2%) were adolescents (15-19 years) from lower socioeconomic strata.¹⁴ Aldossary K et al found that data on self-reported PCOS was collected from 100 Saudi national pharmacy students. Of total 74 (74%) were of age 21-25 and 16% reported having confirmed diagnosis of PCO.¹⁵

In this present study about 28.6% (n=16) of women with PCOS were hypertensive and as many as 55.4% of the participants were pre hypertensive stage. However 16.1% were found to have normal blood pressure. (Fig 2) About 23.2% of the participants were having hypertension when systolic Blood Pressure is (SBP) considered. Whereas 14.3% having hypertension when diastolic (DBP) is considered. (Table3) In a study conducted by Mellembakken JR et al showed that systolic BP was 118 (109, 128) mmHg in women with PCOS and diastolic BP was 74 (67, 81). The prevalence of women with BP $\geq 140/90$ mmHg was 11.1% (57/512) in women with PCOS. In women ≥ 35 years the prevalence of BP $\geq 140/90$ mmHg was 12.7%.¹³ A study conducted by Joshi B et al found that the prevalence of PCOS among study participants was 22.5% by Rotterdam. Non obese comprised 71.8% of PCOS diagnosed by Rotterdam criteria. Mild PCOS was the most common phenotype (52.6%). Obese girls with PCOS were more hirsute and hypertensive.¹⁴ A study conducted by Aldossary K et al showed that the prevalence of self-reported PCOS was found to be 16%. 19.4% were overweight and 6.1% were obese, while 28% of obese and overweight had PCOS. This indicates a positive association between obesity and PCOS, but no significant relationship between PCOS and being underweight was found.¹⁵ Systolic BP was 118 mmHg in women with PCOS compared to 110 mmHg in controls and diastolic BP was 74. The prevalence of women with BP $\geq 140/90$ mmHg was 11.1% in women with PCOS. Using multiple regression analyses, the strongest association with BP was found for age, waist circumference, and total cholesterol in women with PCOS.¹³

In our study 33.9% (n=19) of them had overweight and 23.2% (n=13) of them had been measured to be obese. 28.6% (n=16) of women with PCOS were hypertensive. 28.57% (n=16) hypertensive women as a whole, whereas 14.28% (n=8) women having hypertension were obese and 10.7% (n=6) were overweight. None of the obese had normal blood pressure. A study conducted by Joshi B found that the prevalence of PCOS among obese was 22.5% by Rotterdam criteria. Mild PCOS was the most common phenotype (52.6%). Obese girls with PCOS were more hypertensive.¹ Richard S Legro in USA reported that a positive relationship between obesity and PCOS.¹⁶ A study conducted by Kothare A et al showed that 22.33% of the respondents were reported positive for PCOS of which 23.87% respondents were obese. In PCOS positive respondents, 69.81% had BMI in the range 18-25. Seventy five percent of the PCOS positive respondents from all age groups did not follow any exercise regime and had sedentary life style. About 75% women with PCOS having sedentary life style.¹⁷ The sedentary life style of women participants in this present study is comparable with the observation of Kothare A et al, 2015.

Overweight or obesity affects approximately 23.87% of PCOS women as per the study, where as it has been found to affect approximately 60–80% of PCOS sufferers worldwide.^{18,19}

Shinde KS found that the incidence of Poly Cystic Ovarian Syndrome is high (26.22%) in the age group less than 24 years. Women belonging to the lower socio economic class had a significant 0.31 times lower risk of developing PCOS as compared to those belonging to higher socio economic. Risk factors include lack of physical activity, body mass index more than 25, and Waist-hip ratio above 0.86. It was seen that women with lack of physical exercise less than 3 days a week were at a 2.62 times higher risk of developing PCOS as compared to those who regularly exercised.²⁰ Among all the risk factors, BMI ≥ 25 and waist hip ratio ≥ 0.85 were strongly associated with the presence of PCOS.²¹

The observations in this study with positive relationship with BMI and hypertension as well as age related BMI might be with the background of life style, dietary habits etc. Although there had been opinions by Cooper et al²² who studied 18 patients with Stein Leventhal syndrome. Oligomenorrhea, hirsutism and enlarged ovaries were much more common in sisters of affected subjects. In the 1970s, Givens et al²³ using as diagnostic criteria hirsutism and either polycystic or bilaterally enlarged ovaries, published reports indicating that PCOS could be inherited in an X-linked dominant fashion. In the first report,²²

two families were described in which multiple individuals in more than two generations were affected. In one of these kindreds affected females also experienced an acanthosis nigricans, insulin resistance and hypertension were present in many family members.

CONCLUSION:

This study revealed the association between BMI and hypertension among the women with PCOS attending tertiary care hospital. There was also association with the age and BMI among obese women. Hypertensive women were obese and overweight. None of the obese had normal blood pressure. PCOS and BMI are highly interdependent and sedentary life style was found in most of the PCOS women. This study may not be generalizable due to small number of subjects were included and selected from a tertiary care hospital. It is recommended for further study involving more subjects and including more tertiary care hospitals.

Ethical Approval: Approved from the Institutional Ethics Committees of Agartala Government Medical College & GBP Hospital.

Conflict Of Interest: None Declared

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REFERENCES:

- Stein IF, Leventhal ML. Amenorrhea associated with bilateral polycystic ovaries. *Am J Obstet Gynecol* 1935; 29:181-91. Available at: <https://www.scirp.org>. (Accessed on 06/05/2015)
- Deswal R, Narwal V, Dang A, Pundir CS. The prevalence of polycystic ovary syndrome: a brief systematic review. *J Hum Reprod Sci* 2020;13:261-71. (Available at: <https://www.ncbi.nlm.nih.gov/pmc>. (Accessed on 05/09/2022).
- Palomba S, Santagni S, Falbo A, Sala GBL. Complications and challenges associated with polycystic ovary syndrome: current perspectives. *Int J Womens Health* 2015 ; 7:745-63. Available at: <https://www.ncbi.nlm.nih.gov/> (Accessed on 20/11/2022)
- Lin LH, Baracat MCP, Maciel GAR, Soares Jr JM, Baracat EC. Androgen receptor gene polymorphism and polycystic ovary syndrome. *Int J Gynaecol Obstet* 2013;120:115-118. PCOS is a heterogeneous disorder that affects at least 7% of adult women.
- Aubuchon M, Legro RS. Polycystic ovary syndrome: Current infertility management. *Clin Obstet Gynecol* 2011; 54(4):675-684. Available at: <https://pubmed.ncbi.nlm.nih.gov/> (Accessed on 12/05/2015)
- Umland EM, Weinstein LC, Buchanan EM. Menstruation related disorders. In: Di Piro JT, Talbert RL, Yee GC, et al. *Pharmacotherapy: A Pathophysiologic Approach*, 8th ed. New York: McGraw-Hill; 2011:1393. Available at: <https://accesspharmacy.mhmedical.com/> (Accessed on 12/05/2015)
- Azziz R, Carmina E, Dewailly D, Diamanti-Kandaraki E, Escobar-Morreale HF, Futterweit W et al. Positions statement: Criteria for defining polycystic ovary syndrome as a predominantly hyperandrogenic syndrome: An Androgen Excess Society guideline. *J Clin Endocrinol Metab* 2006; 91:4237-45. Available at: <https://pubmed.ncbi.nlm.nih.gov/16940456/> (Accessed on 4/02/2015)
- Swingler R, Awala A, Gordon U. Hirsutism in young women. *Obstet Gynaecol* 2009; 11:101-7. Available at: <https://obgyn.onlinelibrary.wiley.com/> (Accessed on 12/05/2015)
- Brodell LA, Mercurio MG. Hirsutism: Diagnosis and management. *Gend Med* 2010; 7: 79-87. Available at: <https://pubmed.ncbi.nlm.nih.gov/20435271/> (Accessed on 12/04/2015)
- Bentley-Lewis R, Seely E, Dunaif A. Ovarian Hypertension: Polycystic Ovary Syndrome, Endocrinology and Metabolic Clinic 2011; 40(2): 433-449. Available at: <https://pubmed.ncbi.nlm.nih.gov/21565677/> (Accessed on 14/6/2022)
- International Obesity Task Force, 2015; Brussels. Available at <https://ec.europa.eu/health> (Accessed on 6/5/2015)
- Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report, 2003; *JAMA* 289 (19): 2560-72. Available at: <https://pubmed.ncbi.nlm.nih.gov/12748199/> Accessed on 15/04/2015.
- Mellembakken JR, Mahmoudan A, Morkrid L, Sundström-Poromaa I, Laure Morin-Papunen, Tapanainen JS et al. Higher blood pressure in normal weight women with PCOS compared to controls. *Endocrine Connections* 2021; 10 (2): 154-163. (Available at: <https://ec.bioscientifica.com>) Accessed on 12/09/2022)
- Joshi B, Mukherjee S, Patil A, Purandare A, Chauhan S, Vaidya R. A cross-sectional study of polycystic ovarian syndrome among adolescent and young girls in Mumbai, India. *Indian J Endocr Metab* 2014;18:317-24. Available at: <https://www.ncbi.nlm.nih.gov/> (Accessed on 05/03/2020)
- Khlood Aldossary, Atheer Alotabi, Khlood Alkhalidi, Rahaf Alharbi. Prevalence of Polycystic Ovary Syndrome, and relationship with obesity/overweight: cross-sectional study in Saudi Arabia. *J Adv Pharm Edu Res* 2020;10(1):186-190. (Available at: <https://japer.in/>) Accessed on 07/06/2021.
- Richard S. Legro. Obesity and PCOS: Implications for Diagnosis and Treatment. *Semin Reprod Med.* 2012 ; 30(6): 496-506. Available at: <https://www.ncbi.nlm.nih.gov/>. Accessed on 09/05/2020.
- Kothare A, Jaisinghani C, Rane S, Harshal A. Inter-relationship of PCOS with BMI, obesity and exercise. *Int J Health Sci Res.* 2015; 5(6):545-553. Available at: cademia.edu/. Accessed on 10/06/2020.
- Kiddy DS, Sharp PS, White DM, Scanlon MF, Mason HD, Bray CS et al. Differences in clinical and endocrine features between obese and non-obese respondents with polycystic ovary syndrome: an analysis of 263 consecutive cases. *Clinical Endocrinology.* 1990;32(2): 213-220. Available at: <https://pubmed.ncbi.nlm.nih.gov/> (Accessed on 14/04/2015)
- Azziz R, Sanchez LA, Knochenhauer ES, Moran C, Lazenby J, Stephens KC et al. Androgen excess in women: experience with over 1000 consecutive patients. *Journal of*

- Clinical Endocrinology and Metabolism, 2004; 89(2): 453–462.
20. Shinde KS, Patil SS. Incidence and risk factors of polycystic ovary syndrome among women in reproductive age group attending a tertiary health care hospital in Western Maharashtra. *Int J Reprod Contracept Obstet Gynecol* 2019;8:2804-9. (Available at: jrcog.org/index.php/ijrcog/article/viewFile/6740/4659) (Accessed on 14/07/2022).
 21. Gupta M, Singh D, Toppo M, Priya A, Sethia S, Gupta P. A cross sectional study of polycystic ovarian syndrome among young women in Bhopal, Central India. *Int J Community Med Public Health* 2018;5:95-100. Available at: <https://www.researchgate.net/publication/321989435>. Accessed on 14/09/2022.
 22. Cooper HE, Spellacy WN, Prem KA, Cohen WD. Hereditary factors in the SteinLeventhal syndrome. *Am J Obst Gyn* 1968; 100(3): 371-387. (Available et: <https://pubmed.ncbi.nlm.nih.gov/>, Accessed on 15/09/2022)
 23. Givens JR. Ovarian hyperthecosis. *N Engl J Med* 1971; 285(12): 691. (Available et: <https://pubmed.ncbi.nlm.nih.gov/> Accessed on 15/09/2022)