International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Sonak M et al. Int J Reprod Contracept Obstet Gynecol. 2022 Sep;11(9):2487-2493
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20222315

Original Research Article

A prospective observational study of polycystic ovarian syndrome among adolescent and young girls at tertiary care hospital

Mangala Sonak[1]*, Pratima Devram Rathod[1], Ujjwala Samir Patankar[2]

[1]Department of Obstetrics and Gynecology, Government Medical College, Nagpur, Maharashtra, India
[2]Department of Obstetrics and Gynaecology, Salmania Medical Complex Government Hospital, Manama Kingdom of Bahrain

Received: 16 July 2022
Accepted: 05 August 2022

***Correspondence:**
Dr. Mangala Sonak,
E-mail: gamangala1973@gmail.com

ABSTRACT

Background: Adolescent polycystic ovarian syndrome (PCOS) has emerged as a serious problem that needs to be addressed with timely diagnosis, intervention, and appropriate treatment. Recently few studies have been conducted on adolescent PCOS in India. Hence the present study was undertaken to assess the prevalence and various clinical, biochemical, hormonal and ultrasonographic characteristics of adolescent and young adults with PCOS.
Methods: A total 86 adolescent girls and young women diagnosed clinically and ultrasonographically with PCOS enrolled in study. Clinical features, associated diseases, family history, hormone levels and USG results analysed.
Results: The prevalence of PCOS among adolescent and young girls was found to be 7.21%. The mean age at menarche was 13.7 years in early adolescents' girls, 13.9 years in late adolescent girls, and 14 years in young adult females. Dysmenorrhea (37.21%) was the most common presenting illness followed by amenorrhea (30.23%). The 45.35% of subjects had abnormal hair growth patterns, 48.84% hirsutism, 34.88% acanthosis nigricans, 66.28% acne and only 23.26% had androgenic alopecia. On USG, most of the patients (60.47%) had both increased ovarian volume and polycystic ovarian morphology. The comparison of mean fasting insulin, FSH and LH level, prolactin and testosterone level in early adolescent girls, late adolescent girls, and young adult females was statistically significant, ($p<0.05$). Most of the patients had features of hyperandrogenism and waist to hip ratio >0.87 (60.47%), although they were not overweight with normal body mass index (BMI).
Conclusions: Thus, early diagnosis is important for early lifestyle modifications i.e., weight reduction and dietary modifications and psychological counselling plays an important role to prevent long-term complications.

Keywords: Adolescent, PCOS, Ultrasonography, Dysmenorrhea, Hirsutism, Testosterone

INTRODUCTION

Adolescence in girls has been recognized as a special period which signifies the transition from girlhood to womanhood. This transitional period is marked with the onset of menarche, an important biological milestone. Menstrual abnormalities are the common problems of adolescents.[1] Adolescent girls during the early stages of puberty tend to have anovulatory menstrual cycles, higher androgen levels, and polycystic ovaries. Thus, PCOS symptoms tend to overlap with normal pubertal changes. Due to these variations, the practice of using adult diagnostic criteria raises the concern for misdiagnosis in adolescent age group. At the same time the diagnosis is important as behavioural modification and lifestyle changes in adolescent age group plays an important role for the prevention of future complications and morbidity.[2] Consensus on women health aspect of PCOS has suggested different criteria for diagnosis of PCOS in adolescents from those used for adults. According to its

suggestions PCOS in adolescent should include all the three elements of Rotterdam criteria in which oligomenorrhea should be present after two years of menarche/ primary amenorrhea at age 16 years; polycystic ovaries on ultrasound along with ovarian size of more than 10 cm^3 and hyperandrogenemia should be present.[3]

Clinical presentations of PCOS include abnormal facial and skin hair growth (hirsutism), acne, and irregular, or absence of menstrual periods. However, acne is most common during adolescent phase of life.[3] Obesity has been recognized as a major factor in the pathogenesis of PCOS. In the adolescent stage along with obesity it leads to menstrual irregularities and infrequent egg production-the so called PCOS. Many of these young girls show insulin resistance with high blood sugars when challenged with glucose load. These young girls when they go for infertility treatment produce fewer quality eggs despite high dose of hormones and medicines and have poor pregnancy rates. Adolescent obesity and PCOS individually and together have emerged as important public health issues in India.[4] Environmental changes within the past few decades, particularly easy access to high-calorie fast foods, increased consumption of sugary beverages, and sedentary lifestyles, are linked with rising obesity.[5]

Although the diagnosis of the PCOS can be challenging at this age due to overlap with predictable pubertal changes, early intervention, weight loss and use of hormonal methods can help to restore menstrual cyclicity and future concern related to childbearing. Hence, more widespread, and liberal screening for the disorder appears to be a cost-effective strategy, benefiting earlier diagnosis and intervention and possibly the amelioration and prevention of serious sequel.[4] Hence present study carried out to study the clinical, biochemical and ultrasonographic changes in adolescent PCOS patients. Also, to provide early screening and interventions to promote healthy lifestyle to prevent long term metabolic and reproductive complications.

METHODS

After obtaining institutional ethical committee approval and written informed consent from all the patients, this prospective observational cross sectional institutional study was conducted in the department of obstetrics and gynaecology, at tertiary care hospital in central India over a period of one year from January 2021 to December 2021. A total 86 adolescent girls and young women presenting with oligo/amenorrhea, adolescent girls who had attained menarche >2 years before study, unmarried, non-pregnant women between ages of 15-24 years, hyperandrogenism (clinical or biochemical), who diagnosed as PCOS by ultrasound and those willing to participate included in study. Patients having menarche <2 years before study, age >24 and <15 years, patients with symptomatic disease of liver, kidney and heart, congenital adrenal hyper-plasia, hypo-thyroidism, hyper-prolactinemia, androgen secreting tumours, pregnancy, and patients not willing to participate in study were excluded.

Socio-demographic information was gathered. Family history and chronic diseases, age at menarche, menstrual loss, dysmenorrhea, detail history regarding the menstrual pattern was taken and the features of hyperandrogenism (Acne, hirsutism, oily skin), dietary habits and lifestyle were recorded. The history of any previous illness, treatment sought were noted. The study participant's current history of having disease conditions including diabetes, hypertension, dyslipidemia, anorexia and hypothyroidism was gathered. Complaints of leukocoria, acanthosis nigricans (skin pigmentation) and presence of acne were also self-reported. Secondary amenorrhea was defined as an absence of menstrual cycles more than 6 months. Oligomenorrhea was defined as a delay in menstruation for >35 days to 6 months. Clinical hyperandrogenism was defined using a modified Ferriman-Gallwey (FG) score for evaluating and quantifying hirsutism in women using nine body areas (upper lip, chin, chest, upper and lower abdomen, thighs, upper and lower back and upper arm). Hair growth was rated from 0 to 4 in each of the nine locations. A score more than 8 was indicative of androgen excess. Evidence of galactorrhoea and thyroid disorders were noted.

All the enrolled girls were then subjected to clinical examination and investigations. Waist in centimetres (minimum circumference at the waist level) and hip circumference in centimetres (maximum circumference below the level of umbilicus) was measured. BMI was calculated and categories according to WHO-Underweight (<18.5), normal (18.5-24.9), overweight (25-29.9), obese (≥30). Blood pressure was measured in patients in sitting position, more than 140/85 was considered as hypertension. Patient was allowed to drink 75 gm glucose solution and blood was drawn after two hours i.e., 75 gm glucose tolerance test (GTT) and blood sugar values ≥200 were diagnosed as diabetic. Hormone assay was done in the early follicular phase samples which were taken on day 2 of menstruation for all women in the fasting state. FSH, LH, prolactin, DHEAS, total testosterone, fasting blood sugar (FBS) were done. The normal cut-off for FSH and LH was taken as 2:1 as significant. TSH was done irrespective of menstrual cycle, a TSH >4.5 was considered as hypothyroid. Fasting lipid profile (FLP) was done in PCOS patients to diagnose dyslipidemia and metabolic syndrome, normal values taken were TC<200, HDL>50, LDL<130, TG<150 and VLDL<50.

All the girls were then subjected to trans abdominal pelvic ultrasonography using 5 MHz convex probe for assessment of ovarian volume and the number of ovarian follicles and size of follicles also for the size of uterus and endometrium. Polycystic ovaries were defined as 12 or more follicles measuring 2 to 9 mm in diameter with or without ovarian volume >10 ml. PCOS was defined by Rotterdam's criteria as having the presence of any two of these features- Oligo/amenorrhea: Absence of menstruation for 45 days or more or less than 8 menses per year, clinical hyperandrogenism: Modified Ferriman-Gallwey (MFG) score of 8 or higher and polycystic

ovaries: presence of more than 10 cysts; 2-8 mm in diameter, usually combined with increased ovarian volume of more than 10 cm^3 and echo dense stroma in pelvic ultrasound scan.

Statistical analysis

Collected data were analysed using the professional statistics package EPI info 7.0 version for windows. Descriptive data were represented as mean ± SD for numeric variables, percentages and proportions for categorical variables. Appropriate tests of significance were used depending on the nature and distribution of variables like the Chi-square test, and Fisher exact test for categorical variables. A p value less than 0.05 was considered statistically significant.

RESULTS

Out of 86 cases of adolescent PCOS girls, 51 (59.30%) were newly diagnosed, whereas 35 (40.70%) were old patients and were under treatment. Adolescent PCOS was diagnosed in 45 (52%) by 2 out of 3 Rotterdam's criteria while it was diagnosed in 41(48%) by 3 out of 3 Rotterdam's criteria. Maximum 46 (53.48%) adolescent girls had features of Non-androgenic PCOS, 30 (34.88%) had features of classic PCOS while 10 (11.62%) had features of ovulatory PCOS. The prevalence of PCOS among the adolescent and young girls attending OPD was found to be 7.21% as shown in Table 1.

Table 1: Prevalence of PCOS in the study population.

Age group (Years)	No. of women enrolled	No. of PCOS cases	Prevalence (%)	95% CI (%)
15-17 (Early adolescent girls)	167	16	9.58	5.58-15.09
18-20 (Late adolescent girls)	349	32	9.17	6.36-12.70
21-24 (Young adult females)	677	38	5.61	4-7.62
Total	1193	86	7.21	5.31-8.33

Table 2 show the socio-demographic profile of the patients. The overall mean age of patients was 19.14 years, ranged from 15 to 24 years. The mean age of early adolescent girls, late adolescent girls and young adult females was 15.81±0.83, 19.03±0.82 and 22.58±0.95 years respectively. The maximum (91.86%) subjects being Hindu, 5 (5.81%) subjects were Muslim, and 1 (1.16%) subject each Christian and Sikh. The mean age at menarche was 13.7 years in early adolescents' girls, 13.9 years in late adolescent girls, and 14 years in young adult females which was statistically insignificant with p=0.4.

Table 2: Socio-demographic profile of the patients.

Socio-demographic profile		N	Percent (%)	P value
Age-group (Years)	15-17	16	18.60	0.0001
	18-20	32	37.21	
	21-24	38	44.19	
BMI category	≤18.5	03	3.49	0.246
	18.51-25	51	59.30	
	25.1-30	27	31.40	
	30.1-35	05	5.81	
Socio-economic status	Lower and lower middle class	13 and 10	15.12 and 11.63	0.001
	Middle class	12	13.95	
	Upper middle and upper class	20 and 31	23.26 and 36.05	
Area of residence	Urban	56	65.12	
	Rural	30	34.88	
Education	Middle school	04	4.65	0.0001
	High school	13	15.12	
	SSC	25	29.07	
	HSSC	20	23.26	
	Graduate	24	27.91	

Dysmenorrhea (37.21%) was the most common presenting illness followed by amenorrhea (30.23%) as depicted in Figure 1. The 24 (27.9%) subjects had history of intake of vegetarian diet and 30 (34.88%) had non-vegetarian diet and maximum had mixed diet (32; 37.2%). Majority of subjects (94%) had never done any exercise activity. 39 (45.35%) had childhood obesity. The 28 (32.5%) subjects had a family history of DM and HTN, 39 (45.35%) subjects had abnormal hair growth patterns.

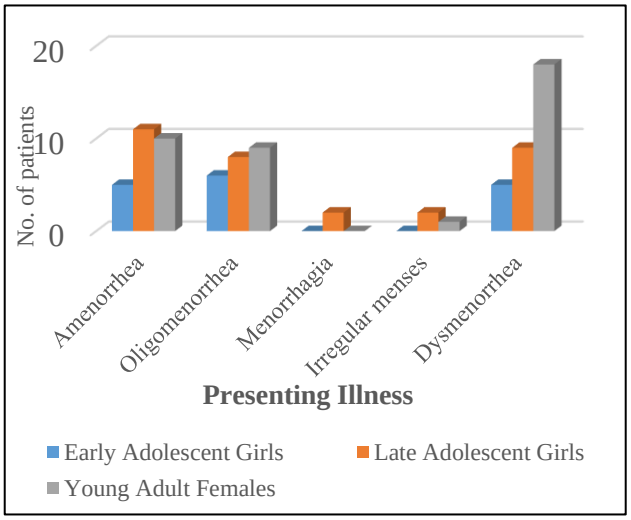

Figure 1: Distribution of subjects according to h/o of presenting illness.

The 42 (48.84%) subjects had hirsutism, of them 32 (37.21%) subjects had hirsutism score between 9 to 15 whereas 10 (11.63%) subjects had hirsutism score >15 while 44 (51.16%) subjects had normal (≤8) hirsutism scores with a p=0.779 which was statistically insignificant as shown in Table 3. Only 30 (34.88%) patients had acanthosis nigricans.

Table 3: Distribution of subjects according to hirsutism.

Hirsutism		N	Percentage (%)
Hirsutism	Lips	10	11.62
	Chin	07	8.13
	Chest	03	3.48
	Upper abdomen	02	2.32
	Lower abdomen	01	1.16
	Arms	02	2.32
	Thighs	05	5.81
	Upper back	10	11.62
	Lower back	02	2.32
Hirsutism score	Normal (≤ 8)	44	51.16
	Mild (9 - 15)	32	37.21
	Moderate to Severe (> 15)	10	11.63

Most of the patients (52; 60.47%) had both increased ovarian volume and polycystic ovarian morphology on USG as depicted in Figure 2. The maximum of subjects (52; 60.47%) had a waist-hip ratio>0.85 while 34 (39.53%) had waist to hip ratio of <0.85 with a p=0.19. Majority of (57; 66.28%) patients had acne, only 20 (23.26%) had androgenic alopecia.

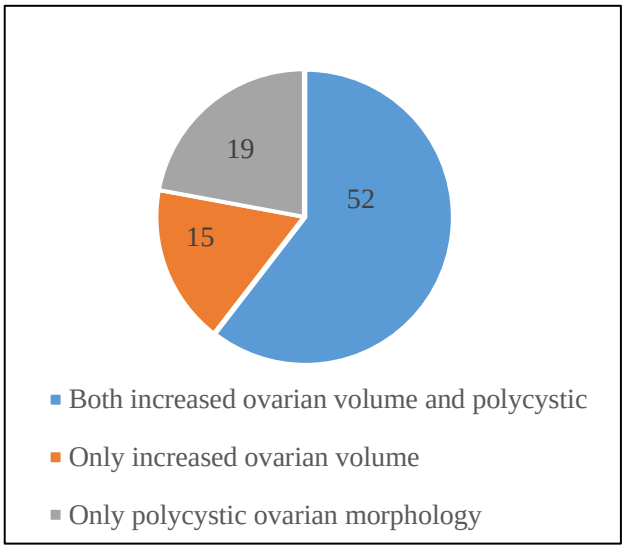

Figure 2: Distribution of subjects according to USG findings.

The association of mean fasting insulin, mean FSH and LH level, mean prolactin and testosterone level with early adolescent girls, late adolescent girls, and young adult females was statistically significant with p<0.05 (Table 4).

Table 4: Biochemical and hormonal features in adolescent PCOS.

Parameters (Mean ± SD)	Early adolescent girls	Late adolescent girls	Young adult females	P value
FBS (mg/dl)	101.87±19.64	96.75±10.92	97.87±11.7	0.6463
PPBS (mg/dl)	118.06±11.62	116.81±12.92	119.71±13.48	
Sr. TSH (mIU/ml)	2.32±1.17	2.76±1.12	3.23±1.64	0.077
Fasting insulin (mIU/L)	18.41±3.80	15.29±3.77	17.91±4.28	0.0098*
FBS/ fasting insulin ratio	5.53±1.31	6.33±1.01	5.46±1.21	>0.05
FSH in IU/L	6.09±1.31	6.56±1.01	5.82±1.21	0.0327*
LH in IU/L	14±3.35	14.68±1.82	13.23±2.23	0.0401*
LH/ FSH ratio (IU/L)	2.31±0.41	2.26±0.29	2.29±0.22	0.8335
Prolactin (µ/L)	18.43±3.99	15.96±3.37	14.75±3.85	0.0055*
Testosterone	28.1±8.11	40.25±14.41	40.88±11.55	0.0018*
DHEAS	6.98±21.62	2.55±1.57	8.83±22.39	0.3283
Total cholesterol	160.31±17.64	160.93±18.78	162.89±14.75	0.6362
HDL	60.04±10.22	59.47±8.7	61.6±9.94	
Triglycerides	127.37±19.77	127.28±21.33	132.13±21.17	0.5737

DISCUSSION

Adolescent girls with PCOS may present with abnormal menstrual periods, hirsutism, and/or acne. A stepwise diagnostic approach is recommended in these patients. Due to the familial, cultural, and societal restrictions, most adolescent girls are unable to share their menstrual related problems and therefore resulting in various morbid conditions. The rates of PCOS have been reportedly high among Indian women compared to their Caucasian counterparts with an estimated prevalence of 9.13% in Indian adolescents.[3] However, in adolescents the exact

prevalence of PCOS in India is unknown due to paucity of data. Different studies in India on PCOS have reported a prevalence of 3.7-22.5% and even up to 36% in adolescents.[2] In the present study, the overall prevalence of PCOS was found to be 7.21%. The prevalence of PCOS was 9.58% in early adolescent girls, 9.17% in late adolescent girls, and 5.61% in young adult females. These findings are comparable with the previous studies.[2,6-8]

PCOS is reported to be more prevalent in younger ages (<35) than among older women, proposing that due to a physiological decline of the follicular cohort leading to a normalized ovarian ultrasonographic appearance with advancing age.[8] The maximum (44.19%) cases were between age group 21-24 years, ranged from 15 to 24 years with mean age of 19.14 years which was statistically significant with p-value of 0.0001. While the mean age at menarche was 13.7 years in early adolescents' girls, 13.9 years in late adolescent girls, and 14 years in young adult females. These findings are correlated with the earlier studies.[3,4,8-11] The maximum subjects belonging to the upper class (36.05%), belongs to Hindu religion (91.86%) and from Urban area (65.12%) which is comparable with the study conducted by Balaji et al.[3] PCOS and its relationship with obesity is well established and can be supported well by the findings in various studies.[12-14] In current study BMI in early and late adolescent and young girls shows 3 (3.49%) subjects were underweight, maximum (59.30%) was having normal BMI, 31.40% of subjects were overweight, 5 (5.81%) were obese. 60.47% had a waist-hip ratio>0.85 while 34 (39.53%) had waist to hip ratio of <0.85 which is like the study done by Spandana et al and Mandrelle et al.[8,15]

Adolescents PCOS was diagnosed in 45 (52%) by 2 out of 3 Rotterdam's criteria while it was diagnosed in 41 (48%) by 3 out of 3 given by women health aspect of PCOS for adolescents. Hence accordingly 30 (34.88%) were classified as having classic PCOS, 10 (11.62%) were having ovulatory PCOS while 46 (53.48%) were having Non-androgenic PCOS. These findings correlated well with the previous studies.[3,4,16,17] On USG maximum patients (60.47%) had both increased ovarian volume and polycystic ovarian morphology, 15 (17.44%) subjects had only increased ovarian volume and 19 (22.09%) had only polycystic ovarian morphology which was statistically significant, (p=0.216) and comparable with the other studies.[3,8,18]

Puberty is a period when there is physiological hyperandrogenism and hyperinsulinemia which mimics some features of PCOS from Tanner stages I to III with return to prepubertal stage by Tanner stage V.[19] Hence, we enrolled girls 2 years post menarche when H-P-O axis settles down to normal. Due to this transitory appearance of symptoms and signs of PCOS during adolescence, care must be taken to avoid premature labelling of a case as PCOS to avoid over treatment and psychological stress. Presence of oligomenorrhea among adolescent girls, 2 years post menarche, can be a good screening indicator to diagnose a probable case of PCOS as reported earlier.[20,21] In current study, 30.23% of patients presented with amenorrhea and 26.74% of patients presented with oligomenorrhea, 2.33% of patients presented with menorrhagia, 3.49% of patients presented with Irregular menses. These findings are correlated well with previous studies.[15,17,22] Anovulation is the pathognomic feature of PCOS and results in irregular menstrual cycles. Therefore, persistent menstrual irregularities (resulting from anovulation) seem to be better predictors compared to biochemical parameter as evident in our as well as other studies. Thus, oligomenorrhoea is rightly considered as a highly predictive surrogate marker of PCOS.[17]

The maximum patients had mixed diet (37.2%) and had never done any exercise activity (94%) which is comparable with the study done by Balaji et al.[3] The 45.35% had childhood obesity. The 28 (32.5%) subjects had a family history of DM and HTN. The maximum patients had acne (66.28%), 23.26% had androgenic alopecia, 48.84% of subjects had hirsutism and only 30 (34.88%) patients had acanthosis nigricans which is accordance with other studies.[9,15,17]

The association of mean fasting insulin, mean FSH and LH level, mean prolactin and testosterone level in early adolescent girls, late adolescent girls, and young adult females was statistically significant with p-value of <0.05. While the association of mean LH/FSH, DHEAS, ratio of mean FBS/mean fasting insulin, TSH, total cholesterol and mean HDL among adolescent and young girls was found to be statistically insignificant, (p>0.05). Also. the association between blood sugar and adolescent PCOS was found to be statistically insignificant with p=0.4 and 0.6 for FBS and PPBS respectively. Abnormality of the hypothalamic-pituitary ovarian or adrenal axis has been implicated in PCOS. Disturbance in the pulsatility of gonadotrophin releasing hormone (GnRH) results in the relative increase in LH to FSH release. An abnormal feedback mechanism by ovarian estrogen is blamed to play role in this discriminated increase in LH release. Many researchers consider elevated LH: FSH (>2) diagnostic for PCOS. In the present study mean FSH was 6.09 IU/L in early adolescent girls, 6.56IU/L, in late adolescent girls, and 5.82 IU/L in young adult females which was statistically significant (p=0.03279). Mean LH in early adolescent girls was 14 IU/L, 14.68 IU/L in late-adolescent girls, and 13.23 IU/L in young adult females (p=0.0401), this was statistically significant. Thus, out of total 86 cases, 34.88% had impaired fasting glucose, 60% had WHR >0.85, 23.25% had triglycerides ≥150, these features were strongly associated with the presence of metabolic syndrome. All the above results are in accordance with the previous studies.[3,4,8,23-25]

The major strength of present study was the adolescent population while the sample is smaller as compared to similar studies. The reported younger onset of symptoms and prevalence of associated risk factors such as glucose intolerance in the Indian population signifies the need for

earlier detection. The increased risk of development of Type 2 diabetes mellitus as a result of PCOS is of important concern in Indian and the diagnosis of PCOS in adolescents remains a challenge because of overlapping pubertal changes in adolescence.

CONCLUSION

In the present study, the overall incidence of PCOS is low, there is an increase in trend in adolescents because of lifestyle changes. Most of the patients had features of hyperandrogenism and waist to hip ratio >0.87 although they were not overweight with normal BMI. Hence, early diagnosis is important for early lifestyle modifications i.e., weight reduction and dietary modifications and psychological counselling plays an important role to prevent long-term complications.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Dambhare DG, Wagh SV, Dudhe JY. Age at menarche and menstrual cycle pattern among school adolescent girls in Central India. Glob J Health Sci. 2012;4(1):105-11.
2. Singh A, Vijaya K, Laxmi KS. Prevalence of polycystic ovarian syndrome among adolescent girls: a prospective study. Int J Reprod Contracept Obstet Gynecol. 2018;7:4375-8.
3. Balaji S, Amadi C, Prasad S, Bala Kasav J, Upadhyay V, Singh AK et al. Urban rural comparisons of polycystic ovary syndrome burden among adolescent girls in a hospital setting in India. Biomed Res Int. 2015;2015:158951.
4. 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.
5. Kansra AR, Lakkunarajah S, Jay MS. Childhood and Adolescent Obesity: A Review. Front. Pediatr. 2021;8:581461.
6. Nidhi R, Padmalatha V, Nagarathna R, Amritanshu R. Prevalence of polycystic ovarian syndrome in Indian adolescents. J Pediatr Adolesc Gynecol. 2011;24(4):223-7.
7. Guraya SS. Prevalence and ultrasound features of Polycystic ovaries in young unmarried Saudi females. J Microscopy Ultrastructure. 2013;(1):30-34.
8. Spandana JC, Shetty PKK. A study on the clinical, biochemical and hormonal profile of polycystic ovary syndrome patients attending tertiary care hospital. Int J Reprod Contracept Obstet Gynecol. 2017;6:1986-92.
9. Himabindu Sangabathula, Neelima Varaganti. Clinical profile polycystic ovarian syndrome-100 cases. Int J Contemporary Med Res. 2017;4(6):1249-53.
10. Joshi AM, Yonzon P, Tandukar S. Clinical Profile of Patients with Polycystic Ovarian Syndrome in Nepal. Endocrinol Metab Int J. 2017;4(2):00083.
11. Christodoulopoulou V, Trakakis E, Pergialiotis V, Peppa M, Chrelias C, Kassanos D et al. Clinical and Biochemical Characteristics in PCOS Women with Menstrual Abnormalities. J Fam Reprod Health. 2016;10(4):184-90.
12. Legro RS. Polycystic Ovary Syndrome and Cardiovascular Disease: A Premature Association? Endocr Rev. 2003;24:302-12.
13. Moini A, Eslami B. Familial associations between polycystic ovarian syndrome and common diseases. J Assist Reprod Genet. 2009;26:123-7.
14. Bangal VB. Clinical Profile and Outcome of PCOS in Rural Population Sch. J App Med Sci. 2014;2(4E):1465-8.
15. Mandrelle K, Kamath MS, Bondu DJ, Chandy A, Aleyamma TK, George K. Prevalence of metabolic syndrome in women with PCOS attending an infertility clinic in a tertiary care hospital in south India. J Hum Reprod Sci. 2012;5:26-31.
16. Kar S. Anthropometric, clinical, and metabolic comparisons of the four Rotterdam PCOS phenotypes: A prospective study of PCOS women. J Hum Reprod Sci. 2013;6:194-200.
17. Alakananda, Das BP, Goel I. A Study on Clinical Profile of Patients with Polycystic Ovarian Syndrome. Int J Sci Res. 2017;6(10):1211-6.
18. Jain A, Garg S, Sharma U. Polycystic ovarian syndrome among adolescent and young women: a hospital based observational study in a tertiary care teaching Hospital. Int J Reprod Contracept Obstet Gynecol. 2020;9:1097-105.
19. Goran M, Gower BA. Longitudinal study on pubertal insulin resistance. Diabetes. 2001;50:2444-50.
20. Franks S, White DM. Prevalence of and etiological factors in polycystic ovarian syndrome. Ann N Y Acad Sci. 1993;687:112-4.
21. Taponen S, Martikainen H, Jarvilin MR, Laiatinen J, Pouta A, Hartikainen AL, et al. Hormonal profile of women with self-reported symptoms of oligomenorhea and/or hirsutism: Northern Finland birth cohort 1966 study. J Clin Endocrinol Metab. 2003;88:141-7.
22. Ramanand SJ, Ramanand JB, Ghongane BB, Patwardhan MH, Patwardhan VM, Ghanghas R et al. Correlation between serum adiponectin and clinical characteristics, biochemical parameters in Indian women 2with polycystic ovary syndrome. Indian J Endocr Metab. 2014;18:221-5.
23. 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 PCOS and healthy women. Int J Med Res Health Sci. 2016;5(12):370-5.
24. Gupta V, Sharma S, Raina SK, Bedi GK. Clinical, ultrasonographic, and biochemical correlates of

polycystic ovarian syndrome: a casecontrol study from a tertiary care center in North India. J Sci Soc. 2018;45:8-12.
25. Muralidhara KD, Adhikari PM, Muralidhara DV. Ind J Basic Appl Med Res. 2015;4(3):227-36.

Cite this article as: Sonak M, Rathod PD, Patankar US. A prospective observational study of polycystic ovarian syndrome among adolescent and young girls at tertiary care hospital. Int J Reprod Contracept Obstet Gynecol 2022;11:2487-93.