

Study of Polycystic Ovaries (PCO) in Mymensingh Medical College Hospital, Bangladesh

K NAHAR^a, H YASMIN^b, L PRAMANIK^c

Summary:

Background information: Polycystic ovaries (PCO) and their clinical expression (polycystic ovary syndrome) are conditions characterized by menstrual abnormality, clinical and biochemical features of hyperandrogenism. It is the killer of womanhood. Woman of any ethnic background can present with PCOS.

Objectives: To find out demographic characteristics such as age, BMI, clinical presentations like hirsutism, menstrual cycle pattern and fertility status and the hormonal changes like LH/FSH ratio and serum testosterone level.

Study design: A descriptive cross sectional study for 1 year from December 2009 to November 2010.

Study setting: Outdoor Department of obstetrics and gynaecology and center for Nuclear Medicine and Ultrasonography (CNMU) Mymensingh Medical College Hospital, Mymensingh.

Introduction:

Polycystic ovary syndrome is the most frequently encountered endocrinopathy in women of reproductive age. It is associated with significant morbidity in terms of both reproductive and non-reproductive events¹.

The condition was first described in 1935 by Stein and Leventhal as a syndrome manifested by amenorrhoea, hirsutism and obesity associated with enlarged polycystic ovary².

According to Rotterdam Criteria a refined definition of PCOS was the presence of two out of the following three criteria.

1. Oligomenorrhoea/or anovulation.
2. Hyperandrogenism (clinical and/or biochemical).

a. Prof. (Dr.) Kamrun Nahar, Professor & Head Dept. of Gyane & Obs, Green Life Medical College & Hospital, Green Road, Dhaka.

b. Dr. Halima Yasmin, Medical Officer, Upazilla Health Complex, Phulpur, Mymensingh.

c. Dr. Lita Pramanik, Consultant, Eshorganj Upazilla Health Complex, Mymensingh.

Address of Correspondence: Prof. (Dr.) Kamrun Nahar, E-mail: run@btcl.net.bd Mobile No: 0088-01711689778

Received: 01 June, 2013

Accepted: 12 January, 2014

Result: Total 55 patients were evaluated. Most common age was 20-29 years (72.7%) with mean age 23.55 years and mean BMI 27.12 kg/m². Clinical presentations were in this study hirsutism in 36.4%, irregular menstrual cycle in 63.6% and subfertility in 56.3%. Laboratory findings revealed testosterone level was more than normal range in 58% case, LH/FSH ratio was increased (more than 1:1) in 58.2% cases, 26 cases had both increased testosterone level and increased LH/FSH ratio. 17 cases had testosterone level within normal range and LH/FSH ratio less than 1:1.

Conclusion: There are significant relationship between irregular menstrual cycle pattern and hormonal changes such as testosterone level and LH/FSH ratio. There are also significant relationship between BMI and hirsutism with increased testosterone level.

Keywords: Polycystic ovary, irregular menstrual cycle, Hirsutism, subfertility LH/FSH ratio, testosterone level.

(J Bangladesh Coll Phys Surg 2014; 32: 142-148)

3. Polycystic ovaries with the exclusion of other aetiologies³.

Polycystic ovaries are seen at ultrasound in 20-25% women of reproductive age while PCOS occurs at least 4-6% of the population. The prevalence of polycystic ovary syndrome seems to be rising because of the current epidemic of obesity³.

Women of any ethnic background can present with PCOS. 4% to 4.7% of white women and 3.4% of African American women had PCOS⁴.

The aetiology of PCO is uncertain. There is some evidence of autosomal transmission related to strong familiar clustering. It also represents a complex trait in which a small number of major genes interact with environmental and other genetic factor to account for the heterogeneity⁵.

Family study has revealed that about 50% of first degree relatives have PCOS suggesting a dominant mode of inheritance⁶.

Although USG finding of PCO present in women but of them 66% notice abnormal menstrual pattern⁷. The menstrual cycle abnormality ranges from amenorrhoea, oligomenorrhoea to menorrhagia. Patient with PCOS

may experience endometrial hyperplasia. About 15% to 30% of women with PCOS may have regular cycle in spite of anovulation⁴.

Infertility is a common problem in women with PCOS. The syndrome accounts for 90-95% of women who attend infertility clinics⁸. The chance of pregnancy with PCOS women using fertility treatment is very good⁹.

The prevalence of obesity is high in patient with PCOS. The rate of obesity in PCOS population ranges from 38% to 87%. The cause of obesity in PCOS is not fully known. The obesity of PCOS is of the android type (central type). There is an increased waist to hip ratio associated with hyperandrogenemia, insulin resistance, glucose intolerance and dyslipidemia¹⁰.

Excessive hair growth is the most distinction and visible feature of PCOS. The hair growth usually are seen on the face, upper lip, chin and lower abdomen as an extension of pubic hair towards the umbilicus. Women with PCOS may experience increase skin oiliness secondary to excessive stimulation of the pilosebaceous unit. Acanthosis nigricans appears as symmetrical darkness that appears commonly on the nape of the neck¹¹.

PCOS are most often diagnosed by means of laboratory studies. The ratio of the LH to the FSH level is useful in the diagnosis. The ratio of LH to FSH is greater than 1:1, as tested on day 3 of the menstrual cycle. This change in LH to FSH ratio is enough to disrupt ovulation¹².

Serum level of androgens including androstenedione, testosterone and dehydro-epiandrosterone sulfate may be elevated. The free testosterone level is thought to be the best means¹³. Total testosterone ranges are 6-86 ng/dl. Free testosterone refers to the amount of testosterone that is unbound and actually active and its ranges from 0.7-3.6 ng/dl. Women with PCOS often have an increased level of both total testosterone and free testosterone¹².

According to the Rotterdam criteria the ultrasonic feature of PCO are defined and include either 12 or more follicles, measuring 2-9 mm in diameter and increased ovarian volume $>10\text{cm}^3$. It is essential that the ultrasound scans is performed at a time of ovaries quiescence such as during the early follicular phase of the menstrual cycle¹⁴.

Material and Methods:

It is Descriptive cross-sectional study conducted in the outdoor Department of Obstetrics & Gynecology and Center for Nuclear Medicine and Ultrasonography (CNMU) Mymensingh Medical College Hospital, Mymensingh for one year duration from December 2009 to November 2010. The present study includes the women of reproductive age (15 years to 45 years) who sonographically show PCO, excluding the woman with other medical disorders like ovarian tumour, hypothyroidism and hyperprolactinoma. Purposive sampling technique was followed for selection of sample.

Measurement of LH, FSH and Testosterone Level: 5ml venous blood was collected from each subject with all aseptic precaution using sterile disposable plastic syringe by antecubital venipuncture and poured into a clean glass test tube. The collected blood was allowed to clot at room temperature. Serum was separated and taken in other three plastic test tube. Each test tube is leveled separately for LH, FSH and testosterone. Antibody of LH, FSH and testosterone were added to these serum and mixed well. Then these test tube are kept for 2 hours at 37⁰ C temperature. After that I¹²⁵ were added to these test tube and incubated at 4⁰-7⁰ C temperature. Duration of incubation time was different for each hormone. After that incubation time the serum was kept in room temperature for 30 minutes. Then 500 microliter precipitating solution was added in each test tube and mixed well. These test tube were kept in centrifuge machine and centrifuge it at 3500 Rpm. Precipitant were appeared at the bottom test tube. The level of these hormones were measured from these Precipitant.

Transabdominal ultrasonography was performed with 3.5MHz curvilinear electronic probe in the Center for Nuclear Medicine and Ultrasonography (CNMU), MMCH to all the women of this study in full bladder. The diagnosis of PCO was done by ovarian volume ($e^{10}\text{cm}^3$), stromal echotexture and follicular number (>10).

Data were collected using a structured questionnaire containing all the variables of interest. Collected data were processed and analyzed using computer based software SPSS (Statistical Package for Social Sciences) version 12. A probability value of <0.05 was considered significant. The summarized data were presented in the form of tables and graphs with due interpretation.

Results:

Fifty five (55) women with PCO were selected from outdoor department of Obs and Gynae MMCH having USG report from Centre for Nuclear Medicine and Ultrasonography MMCH during the period of December 2009 to November 2010. All cases were evaluated clinically (age, BMI, hirsutism, menstrual cycle pattern and fertility status). Hormonal level (LH/FSH ratio and total testosterone level) were done for all cases.

The findings and related interpretation are presented in tables and figures according to the objectives of the study.

Table-I: Respondents by age: Regarding age distribution of the respondents in the study group it was observed that most of the women were within 20-29 years (72.7%).

Table-I*Respondents by age.*

Age (Years)	Numbers	Percentage
15-19	09	16.4
20-24	22	40.0
25-29	18	32.7
30-34	05	9.1
>35	01	1.8
Total	55	100.0

Mean \pm SD of age distribution was 23.55 \pm 4.62 years.

Table-II: Respondents on the basis of BMI: Most of the respondents 26 (47.3%) were over weight (BMI 25.1-30kg/m²), 12(21.8%) were obese having BMI more than 30kg/m² & 17(30.9%) cases had normal BMI. Mean \pm SD of BMI was 27.12 \pm 3.52 kg/m².

Table-II*Respondents on the basis of BMI.*

BMI (kg/m ²)	Numbers	Percentage
20.0-25	17	30.9
25.1-30.0	26	47.3
>30.1	12	21.8
Total	55	100.00

Table-III: Respondents by hirsutism: Hirsutism was present in 20 (36.4%) cases and absent in 35 (63.6%) cases.

Table-III*Respondents by hirsutism.*

Hirsutism	Numbers	Percentage
Present	20	36.4
Absent	35	63.6
Total	55	100.00

Table-IV: Respondents by menstrual cycle pattern: 31 (56.3%) women were presented with oligomenorrhoea and 03 (5.5%) women had amenorrhoea. Here 35(63.6%) women had irregular menstrual cycle. On the other hand 20 (36.4%) women had regular menstrual cycle.

Table-IV*Respondents by menstrual cycle pattern.*

Menstrual cyclepattern	Numbers	Percentage
Regular	20	36.4
Oligomenorrhoea	31	56.3
Amenorrhoea	03	5.5
Menorrhagia	01	1.8
Total	55	100.00

Table-V: Respondents by fertility status: Regarding fertility status of the women, primary subfertility was found in 28 (50.8%) cases and secondary subfertility was found in 03 (5.5%) cases. Total subfertility cases were 31 (56.3%). Satisfactory fertility was present in 9 (16.4%) cases. Fertility status of 15 (27.3%) respondents was not concerned as they were unmarried.

Table-V*Respondents by fertility status.*

Fertility status	Numbers	Percentage
Fertile	09	16.4
Primary subfertility	28	50.8
Secondary subfertility	03	5.5
Not concern	15	27.3
Total	55	100.00

Fig-1: The testosterone level & LH/ FSH ratio of the respondents: 26 women had LH/FSH ratio more than 1:1 and testosterone level more than normal limit. 17 women had LH/ FSH ratio at or less than 1:1 and testosterone level within normal limit.

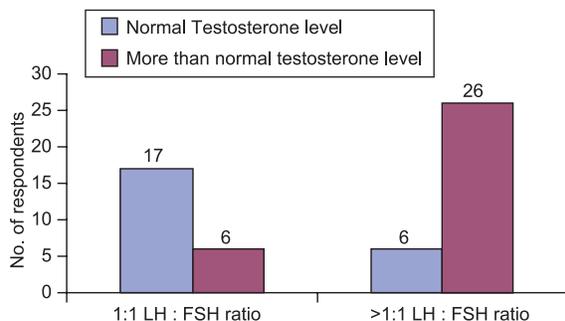


Fig-1: The testosterone level & LH/ FSH ratio of the respondents.

Table -VI: Relationship between menstrual cycle pattern with levels of testosterone (N=54):

In case of menstrual cycle pattern, 29 (53.8%) women with oligomenorrhoea and 2 (3.7%) women with amenorrhoea had increased testosterone level. The relationship between menstrual cycle pattern and

testosterone level was also statistically significant ($X^2 = 39.31$, $df = 2$, p value < 0.05).

Table-VII: Relationship between BMI, hirsutism and fertility status with levels of testosterone (N=55): 27 (49%) women with increased BMI ($> 25 \text{ kg/m}^2$) had increased testosterone level. The overall relationship between BMI and level of testosterone was statistically significant. 16(29%) women with hirsutism had increased testosterone level. The relationship between the present or absent of hirsutism with testosterone levels were statistically significant ($X^2 = 6.149$, $df = 1$, p value < 0.05). 15(27.5%) women with primary subfertility and 1(1.8%) women with secondary subfertility had increased testosterone level. Fertility status with testosterone level were statistically non-significant.

Table-VIII: Relationship between menstrual cycle pattern with LH/FSH ratio (N=54): For menstrual cycle pattern, 25(46.4%) women with oligomenorrhoea and 2(3.6%) women with amenorrhoea had LH/FSH ratio more than 1:1. The relationship between menstrual cycle pattern and LH/FSH ratio was statistically significant ($X^2 = 16.96$, $df = 2$, p value < 0.05).

Table-IX: Relationship between BMI, hirsutism and fertility status with LH/FSH ratio (N=55): Though more

Table-VI

Relationship between menstrual cycle pattern with levels of testosterone (N=54).

Menstrual Cycle Pattern	Testosterone (n %)		X^2 (df)	p-value
	Normal	> Normal		
Regular	19 (35.2)	1 (1.8)	39.31 (2)	0.000
Oligomenorrhoea	2 (3.7)	29 (53.8)		
Amenorrhoea	1 (1.8)	2 (3.7)		
Total= 54 (100%)	22 (40.7)	32 (59.3)		

Table-VII

Relationship between BMI, hirsutism and fertility status with levels of testosterone (N=55).

Clinical Characteristics	Testosterone (n %)		X^2 (df)	p-value
	Normal	> Normal		
BMI	Normal	> Normal		
	20-25 kg/m^2	12 (22.0)	05 (09.0)	8.371 (1)
	$> 25 \text{ kg/m}^2$	11 (20.0)	27 (49.0)	
Total=55(100%)	23 (42.0)	32 (58.0)		
Hirsutism	Present	4 (7.0)	16 (29.0)	6.149 (1)
	Absent	19 (34.54)	16 (29.46)	
	Total= 55(100%)	23 (41.54)	32 (58.46)	
Fertilitystatus	Primary subinfertility	13 (23.6)	15 (27.5)	1.76 (2)
	Secondary subfertility	2 (3.6)	1 (1.8)	
	Others	8 (14.5)	16 (29.0)	
	Total= 55 (100%)	23 (41.7)	32 (58.3)	

Table-VIII

<i>Relationship between menstrual cycle pattern with LH/FSH ratio (N=54).</i>				
Menstrual cycle pattern	LH: FSH (n %)		X ² (df)	p-value
	≤1:1	>1:1		
Regular	15 (27.8)	05 (9.3)	16.96 (2)	0.001
Oligomenorrhoea	6 (11.1)	25 (46.4)		
Amenorrhoea	1 (1.8)	2 (3.6)		
Total= 54(100%)	22(40.7)	32 (59.3)		

Table-IX

<i>Relationship between BMI, hirsutism and fertility status with LH/FSH ratio (N=55).</i>					
Clinical Characteristics	LH: FSH (n %)		X ² (df)	p-value	
	≤1:1	> 1:1			
BMI	20-25 kg/m ²	09 (16.4)	08 (14.5)	1.251 (1)	0.263
	>25 kg/m ²	14 (25.5)	24 (43.6)		
	Total=55(100%)	23 (41.9)	32 (58.1)		
Hirsutism	Present	5 (9.0)	15 (27.0)	3.654 (1)	0.056
	Absent	18 (33.0)	17 (31.0)		
	Total= 55(100%)	23 (42.0)	32 (58.0)		
Fertility status	Primary subfertility	12 (22.0)	16 (29.2)	.958 (2)	0.505
	Secondary subfertility	2 (3.6)	1 (1.8)		
	Others	9 (16.4)	15 (27.0)		
	Total=55 (100%)	23 (42.0)	32 (58.0)		

than 40% women had increased BMI and increased LH/FSH ratio, but statistically the relationship between BMI and LH/FSH ratio was not significant. 15(27%) women with hirsutism and 16(29.2%) women with primary subfertility had increased LH/FSH ratio. The relationship between the present or absent of hirsutism and fertility status of the women with LH/FSH ratio were also statistically non-significant.

Discussion:

Polycystic ovaries are seen by USG finding in 20-25% women of reproductive age. PCOS occur in at least 5% women of the population. Polycystic ovaries can be diagnosed in patient of any age from menarche. Typically women in their 20s present with polycystic ovary syndrome¹⁵. In present study among 55 women, 72.7% were within the age of 20-29 years. The mean age was 23.55 years. In another study, the mean \pm SD

of age distribution was 21.9 ± 3.06 ¹⁶, which is nearer to present study. A recent study showed that the common age of PCO women were 21-25 years¹⁷. This result is also close to the present study.

In the present study, thirty eight out of the fifty five women were overweight and obese with mean BMI of 27.12 ± 3.52 kg/m². In another study mean BMI was 27.1 kg/m²¹⁷. Mean BMI of PCO women were 28.98 kg/m² in an Indian study¹⁶. Both the results are nearer to present study.

In the present study hirsutism was present in 36.4% cases. In a study at BSMMU 50% women had hirsutism¹⁷. The percentage was more than the present study because asymptomatic women with PCO were included. The presence of hirsutism was significant among women with PCO than without PCO in an Indian study¹⁸.

The common presentation of the women having PCO was menstrual disturbance⁷. In the present study out of 55 women, 35 (63.6%) women attended in outdoor department with irregular menstrual cycle.

Among them 56.3% women had oligomenorrhoea. The study at BSMMU showed that women with PCOS had oligomenorrhoea in 28% cases¹⁷. The percentage was less than the present study. In a study in Iraq, oligomenorrhoea was prevalent in 43.93% women, nearer to the present study¹⁹.

56.3% women with PCO attended in outdoor department due to subfertility (both primary and secondary) during the study time period. Among them about 28 (50.8%) women had primary subfertility and 3(5.5%) women had secondary subfertility. In the study of BSMMU, primary subfertility was found in 90% cases and secondary subfertility was found in 10% cases¹⁷. According to a literature, 16-25% of normal ovulatory women have polycystic ovaries without evidence of the syndrome, a subgroup of women with PCO (up to 30%) may have PCOS¹. In present study out of 55 women, 60% women had PCOS and 40% women had only PCO, not similar to the literature review.

In the present study, 58.2% women with PCO had LH/FSH ratio more than 1:1. Increased testosterone level was found in 58% women with PCO. In an Indian study, 55.55% women had increased LH/FSH ratio and 64.44% women had increased testosterone level which is closed to present study¹⁶. 53.8% women with oligomenorrhoea and 3.7% women with amenorrhoea had increase testosterone level in present study. The result is significant. In another study 73% girl with irregular menstrual cycle (oligomenorrhoea and amenorrhoea) had the highest androgen level, nearer to present study¹⁷.

In the present study 49% cases with increased testosterone level were over weight and obese (BMI>25kg/m²) and 20% cases with normal testosterone level were overweight and obese. The result is significant. Increased testosterone levels among overweight and obese women were found in 59.18% cases in another study¹⁶. The result of the present study is nearer to this study.

In the present study hirsutism was present in 36.4% cases. In relation with hirsutism and testosterone level,

29% women with increase testosterone level had hirsutism whereas 7% women with normal testosterone level had hirsutism. The result is significant. In an Indian study, 44.2% women with hirsutism had significantly high testosterone level¹⁶. The result is more than the present study.

In the present study 27.5% women with primary subfertility and 1.8% women with secondary subfertility had increased testosterone level. The result is not significant. Other study showed 36% subfertile women with PCO and 28% subfertile women without PCO had increased testosterone level²¹. So their result supports present study.

In the relation between menstrual cycle pattern and LH/FSH ratio, 46.4% women with oligomenorrhoea and 3.6% women with amenorrhoea had increase LH/FSH ratio in present study and 11.1% women with oligomenorrhoea and 1.8% women with amenorrhoea had LH/FSH ratio at or less than 1:1. The result is significant. Study in Iraq about correlation between LH/FSH ratio and disease manifestation showed no significant correlation between menstrual cycle pattern and LH/FSH ratio²⁰.

In present study 43.6% obese and overweight women had > 1:1 LH/FSH ratio. On the other hand 25.5% obese and overweight women had at or less than 1:1 LH/FSH ratio. The result is not significant. In a study in Iraq, they also found that there was no significant correlation between BMI and LH/FSH ratio²⁰. This result has similarity to present result.

About the correlation between hirsutism and LH/FSH ratio, 27% women with hirsutism had increased LH/FSH ratio and 9% women with hirsutism had LH/FSH ratio at or below 1:1. The result is not significant. Statistical correlation between LH/FSH ratio and hirsutism was not significant in a study in Iraq²⁰.

In the present study, 29.2% women with primary subfertility and 1.8% women with secondary subfertility had LH/FSH ratio more than 1:1. Whereas 22% women with primary subfertility and 3.6% women with secondary subfertility had LH/FSH ratio at or less than 1:1. The result was not significant. Another study had increased LH/FSH ratio in 60% subfertile women with PCO and 70% women without PCO²¹. So their result supports the present study.

The required size was not possible to collect because of limitation of time and financial constrains. All the facts and figures mentioned here may considerably vary from those of large series covering wide range of time.

Conclusion:

Irregular menstruation, increased BMI, hirsutism and subfertility are the common presentation of women with PCOS. There are significant relationship between irregular menstrual cycle pattern and hormonal changes such as testosterone level and LH/FSH ratio. There are also significant relationship between BMI and hirsutism with increased testosterone level. Common future outcome of PCOS are type 2 diabetes mellitus, hypertension, cardiovascular disease and endometrial carcinoma. Early diagnosis and proper preventive management of these patients with PCO will reduce reproductive and non reproductive morbidity.

References:

- Carmina, E. and Lobo, R.A. Polycystic ovary syndrome (PCOS): Arguably the most common endocrinopathy is associated with significant morbidity in women. *The Journal of clinical Endocrinology & Metabolism*, 1999; 84(6): 1897-1899.
- Dutta, D.C. Text book of Gynecology including contraception. 5th ed. Kolkata, India: New Central Book Agency (P) Ltd. 2009; 440-443.
- Kumar, P. and Malhotra, N. Jeffcoatee's Principles of Gynecology. 7th ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 2008; 384-393.
- Attaran, M., 2009. Polycystic ovary syndrome. Publications: disease management project center for continuing education. [Online] Available at <http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/womens-Health> [Accessed 1 Jan 2009]
- Hopkinson, Z.E., Sattar, N., Fleming, R. and Green, I.A. Polycystic ovarian syndrome: the metabolic syndrome comes to gynecology. *BMJ*, 1998; 317: 329-332.
- Balen, A.H., 2007. Polycystic ovary syndrome and secondary amenorrhoea. In: D.K.Edmond, ed. Dewhourt's text book of obstetrics and gynecology. 17th ed. Oxford: Blackwell Publishing Ltd.Ch.39.
- Cahill, D., 2009. Polycystic ovary syndrome (PCOS). *Women's Health Net doctor*. [Online] Available at <http://www.netdoctor.co.uk/womenshealth/facts/pcos.htm> [Accessed 14 December 2009]
- Editorial. Should obese women with polycystic ovary syndrome receive treatment for infertility? *BMJ*, 2006; 332: 434-435.
- Advanced Fertility center, 2010. Polycystic ovarian syndrom, PCOS and infertility and pregnancy what is PCOS syndrom. Chicago: Advanced Fertility center. [Online] Available from <http://www.advancedfertility.com/PCOS.htm> [Accessed 11 January 2010]
- Ehrmann, D.A. Polycystic ovary syndrome. *The New England Journal of Medicine*, 2005; 352: 1233-1236.
- Chang, R. and Kazer, R., 2008. Polycystic ovary syndrome. *Glob. Libr. Women's med* [Online] Available from <http://www.glowm.com/?p=glowm.cml/sectioniew&artical=300&SESSID=rtk2svqrc> [Accessed 30 October 2010]
- Sterling, E., 2010. Hormone levels and PCOS. *OBGYN. Net: The Universe of Women's Health*, [Online] Available from www.obgyn.net/pcos/pcos.asp?page=/pcos/articles/hormone-level-sterling [Accessed 31 August 2010].
- Wikipedia, 2010. Polysystic ovary syndrome, Wikipedia, the free encyclopedia, [Online] Available from. <http://en.wikipedia.org/wiki/polycysticovarysyndrom> [Accessed 11 July 2009]
- Balen, A.H. et al. Ultrasound assessment of polycystic ovary:international consensus definition. *Oxford Journal Medicine Human Reproduction Update*, 2003; 9(6): 505-514.
- Marrinan, G. and Stein, M., 2009. Polycystic ovarian disease (stein-leventhal syndrome) [Online] Available at <http://Emedicine medscape.com/article/404754-overview> [Accessed 11 August 2009]
- Dipankar, B. et al. Clinical correlation with biochemical status in polycystic ovarian syndrome. *The Journal of Obstetrics and Gynecology of India*, 2005; 55(1): 67-71
- Hooff, M.H. et al. Polycystic ovaries in adolescents and the relationship with menstrual cycle patterns, luteinizing hormone, androgens and insulin. *The Official Journal of the American Society for Reproductive Medicine*, 2000; 74(1): 49-58.
- Anwary, S.A., Alfazzaman, M. and Begum, N. A clinical study on PCOS patients in a Tertiary Hospital. *Medicine Today*, 2009; 22(1): 34-37.
- Zargar, A.H. et al. Prevalance of ultrasonography proved polycystic ovaries in North Indian Women with type 2 diabetes mellitus. *Reproductive biology and Endocrinology*, 2005; 3: 35-45.
- Alnakash, A.H. and Al-Tae'e, N.K. Polycystic ovarian syndrome: the correlation between the LH/FSH ratio and disease manifestations. *Middle East fertility society Journal*, 2007; 12(1): 35-39
- Speranda, Z. and Papic, Z. Effect of increased testosterone level on women's fertility. *Preliminary Communication*, 2004; 33(2): 53-58 [Online] Available from <http://www.idb.hr/diabetologia/04no2-3pdf> [Accessed 11 January 2010].