



Original Research Article

## Inter-Relationship of PCOS with BMI, Obesity and Exercise

Amruta Kothare<sup>1</sup>, Chandni Jaisinghani<sup>2</sup>, Shailaja Rane<sup>3</sup>, Anupma Harshal<sup>4</sup>

<sup>1</sup>Assistant Professor, MSc. Department of Biotechnology, K.C College, Mumbai 400020.

<sup>2</sup>Science Honors Student, Department of Biotechnology, K.C College, Mumbai 400020.

<sup>3</sup>Assistant Professor, Department of Statistics, K.C College, Mumbai 400020.

<sup>4</sup>Assistant Professor, PhD. Department of K.C College, Mumbai 400020.

Corresponding Author: Amruta Kothare

Received: 05/05/2015

Revised: 26/05/2015

Accepted: 27/05/2015

### ABSTRACT

**Objective:** Polycystic ovarian syndrome (PCOS) has emerged as a global women health problem affecting female from younger age to women of various age groups. The present study was undertaken to compile the data and to study parameters and to identify inter-relationship of parameters like BMI, obesity and exercise as contributing factor to PCOS. Aim was also to create awareness about PCOS amongst women from age groups ranging from 12-52.

**Methods:** Project was conducted in Mumbai city across various schools, colleges, hospitals, etc. Questionnaire was designed and data distributed in respondents was collated from 994 female respondents and was analyzed statistically.

**Results:** The study revealed that 22.33% of the respondents were reported positive for PCOS of which 23.87% respondents were obese against 18.52% in PCOS negative respondents. In PCOS positive respondents, 69.81% have BMI in the range 18-25, whereas PCOS negative respondents with BMI in the range of 18-25 is 60.8%. 75% of the PCOS positive respondents from all age groups did not follow any exercise regime and had sedentary life style.

**Conclusion:** The study revealed that level of PCOS awareness was found to be low amongst the PCOS negative respondents. It was concluded that PCOS and BMI are highly interdependent. In our study, an interrelationship was observed between frequency of exercise and PCOS affliction.

**Keywords:** PCOS, BMI, Obesity, Awareness.

### INTRODUCTION

Polycystic ovarian syndrome (PCOS) is a true syndrome, being a heterogeneous collection of signs and symptoms which together form a spectrum of a disorder with a mild presentation in some, whilst in others there is a severe disturbance of reproductive, endocrine and metabolic function. [1] PCOS was first

described in the United States in 1935. [2]

PCOS is the most common female endocrine disorder which is a complex, multifaceted, heterogeneous disorder affecting approximately 5% - 10% of respondents of reproductive age. [3,4] The clinical features include menstrual irregularities, hirsutism, acne and anovulatory infertility. The endocrine features include insulin resistance,

obesity, lipid abnormalities and impaired glucose tolerance. [5] PCOS has a link with ovarian tumor in its final stage, endometrial cancer, cardiovascular diseases, diabetes mellitus, obesity, etc. which has a dangerous effect on women. [6] PCOS is commonly found in women of all ages, from teenage years to the menopause stage, but its prevalence is much higher in women of reproductive age. Some symptoms are: Secondary amenorrhea, body hair growing on the chest, belly, face, and around the nipples, decreased breast size, irregular

## **MATERIALS AND METHODS**

**Survey and Sample Collection:** 994 female respondents were interviewed and questioned. Women in the early menses stage as well as women in post menopause stage contributed majorly to the data collection. The project was undertaken in Mumbai City between July2013-June2014. The study was a closed-ended questionnaire based survey because of easy preliminary analysis. The questions are ideal for calculating statistical data and percentages, as the answer set is known. The data from questionnaire was compiled to include questions based on various parameters like BMI, obesity and exercising. **Awareness:** Information about PCOS was given with the help of placards and presentations in various institutions, hospitals, schools, banks in locality.

**Data Analyses:** For analysis, the data collected was categorized in to four age groups: 10-20, 20-30, 30-40 and 40 plus. Post classification, the data of PCOS positive and PCOS negative respondents was segregated and analyzed. Each attribute was taken into account for the analysis. Percentages of the PCOS positive as well as PCOS negative parameters were calculated. The statistical approach consisted hypothesis- proposed explanation made on the basis of limited evidence as a starting

periods, male-like characteristics, enlargement of the clitoris, male-pattern baldness, acne, cysts on the ovaries, obesity, skin tags, anxiety or depression, voice gets deeper, dark or thick skin markings and creases around the armpits, groin, neck, and breasts ,dandruff, patches of skin on the neck, arms, breasts, thighs, pelvic pain, sleep apnea. [7-10] hence, the aim of our study was to create awareness about PCOS amongst all age groups of female population.

point for further investigation, analysis plan-containing a more technical and detailed elaboration of the principal features of the analysis described and includes detailed procedures for executing the statistical analysis, analyzing population data, interpreting results.

### **Statistical Tools:**

- Chi square test of independence was used for all the variables selected from the questionnaire; for both the group (independent) and the test variable (dependent) which could be nominal, dichotomous, ordinal, or grouped interval. [11]
- Standard deviation- measures the amount of variation from the average. [8]
- z-test- a statistical test used to determine whether two population means are different when the variances are known and the population size is large. [12]
- Mean, median, mode are all estimates of where the middle of a set of data is. These values are useful when creating groups or bins to organize larger sets of data.

## **RESULTS:**

PCOS being a hormonal disorder can cause serious health problems like insulin

resistance, metabolic syndrome, type 2 diabetes, cardiovascular disease and complications like unwanted hair growth, balding, skin darkening and acne. Of the total 994, the number of respondents who reported suffering with PCOS was 222, which translates to 22.33%. The parameters evaluated were:

- 1) BMI
- 2) Frequency of exercising
- 3) Obesity

➤ BMI

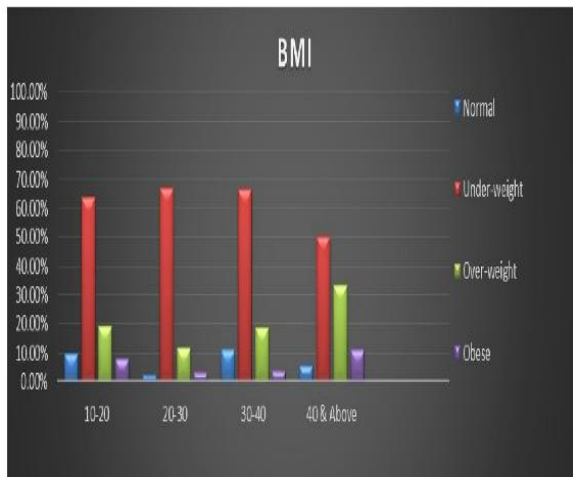


Figure 1: Distribution of BMI amongst various age groups.

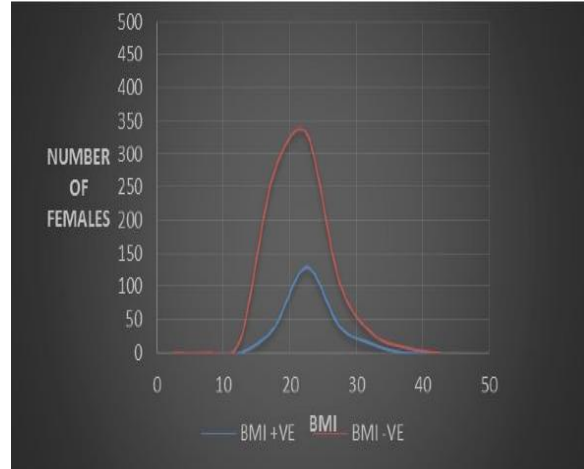


Figure 2: BMI Vs number of female respondents.

From figure 2 it is evident that, BMI for PCOS positive respondents is almost normally distributed.

The mean BMI of PCOS positive respondents is 22.973 with interval of  $22.973 \pm 4.0$  and the mean BMI of PCOS negative respondents are 21.5985 with interval of  $21.5985 \pm 4.3727$  was calculated using confidence interval.

Table 1: Statistical result of BMI.

AGE GROUP	CHI SQUARE CAL	CHI SQUARE TAB	INTERPRETATION
A	32.5323	7.815	Chi square cal > chi square tab reject H <sub>0</sub> . Thus PCOS and BMI are dependent on each other
B	14.6537	7.815	chi square cal > chi square tab reject H <sub>0</sub> thus PCOS and BMI are dependent on each other
C	1.6321	7.815	chi square cal < chi square tab do not reject H <sub>0</sub> thus PCOS and BMI are not dependent on each other
D	5.9862	7.815	chi square cal < chi square tab do not reject H <sub>0</sub> thus PCOS and BMI are not dependent on each other

A total of 23.87% (Number of respondents with BMI and PCOS /PCOS affected) PCOS positive respondents had BMI more than 25kg/m<sup>2</sup> as compared 18.52% in PCOS negative respondents (P = 0.0392). Since p value is less than 0.05 we can say that there is moderate evidence against the null hypothesis in favor of the alternative hypothesis by testing the hypothesis.

In PCOS positive respondents, 155/222 i.e. 69.81%, have BMI in the range 18-25, whereas PCOS negative with BMI in the range of 18-25 is 470/722 i.e. 60.8%. In PCOS negative female respondents, 183/722 i.e. 25.34%, have BMI less than 18.5 which indicated that they were underweight. In PCOS positive respondents 14/222 i.e. 6.30% had a BMI less than 18.5 which indicated that they are underweight. From table 1, we

can interpret that in age group 10-30 a correlation was observed between PCOS and BMI whereas, in age group 30 and above no correlation was observed between PCOS and BMI.

**Obesity:**

Overweight or obesity affects approximately 23.87% of PCOS respondents as per the study, where as it has been found to affect approximately 60–80% of PCOS sufferers worldwide. [13,14]

Using normal test z statistic, -0.2857 obtained is less than z tabulated at 5% level of significance which is 1.65, therefore our study grants evidence that among obese respondents mean BMI does not differ significantly between PCOS positive and PCOS negative respondents.

**Frequency of exercise:**

Practicing daily exercise was comparatively at a lower rate in respondents with PCOS than with negative respondents. 3/4<sup>th</sup> i.e. 75% of the respondents did not follow exercise patterns since they were

working and under continuous work load of either family or occupation, whereas only 18.46% followed exercise patterns daily since they were aware and conscious about their health.

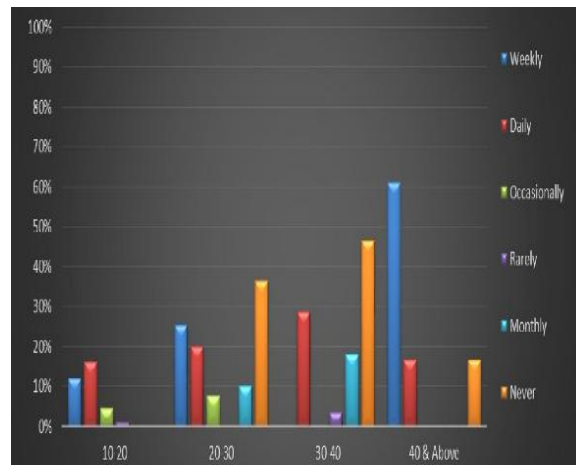


Figure 3: Frequency of exercise.

A total of 123/222 i.e. 55.40% were indulged in physical activity. The distributions of those 55.40% are as follows:

Table 2: Percent of exercise of PCOS positive respondents.

FREQUENCY P.C.O.S	AGE GROUP	DAILY	WEEKLY	MONTHLY	RARELY & OCCASIONALLY	NEVER
POSITIVE	10-20	6.30%	8.10%	1.80%	2.25%	25.67%
POSITIVE	20-30	7.20%	9.45%	3.60%	3.15%	12.61%
POSITIVE	30-40	3.6%	0.00%	2.25%	0.9%	5.855%
POSITIVE	40 +	1.35%	4.50%	0.00%	0.9%	1.35%
TOTAL		18.45%	22.05%	7.65%	7.20%	45.45%

**DISCUSSIONS**

A total of 994 female respondents were evaluated in order to examine various parameters that affect PCOS. Age range of respondents is 12 – 52 with mean standard deviation 22.9807±9.2095. Out of total 994, number of respondents who were reported suffering with PCOS was 222, which translates to 22.33%. Interval of BMI in overweight PCOS positive and PCOS negative respondents calculated is 28.5002±3.5318 kg/m<sup>2</sup> versus 28.6577±3.2384kg/m<sup>2</sup>, which gives us evidence for the hypothesis: H<sub>0</sub>;

$\mu_1 = \mu_2$  against  $H_1: \mu_1 > \mu_2$  ( $\mu$  = Mean of population) testing the hypothesis.

BMI more than 25kg/kg/m<sup>2</sup> was observed in PCOS positive respondents which was higher compared to PCOS negative respondents. This was mainly due to irregular exercise regime, poor lifestyle habits, stress level, anger levels, excess intake of junk food, improper diet, as observed from the studies. The reason that the number of PCOS positive respondents had BMI within the normal range of 18-25kg/m<sup>2</sup> than that of PCOS negative respondents was may be due to the fact that

the population of the study consists of more respondents in the age group 10-30 years, who are usually weight conscious. Regular exercise being the reason for controlled weight and proper diet followed by level of awareness and concern about one's health as reported in the study. The numbers of PCOS negative respondents being underweight with BMI under 18.5kg/m<sup>2</sup> were more than PCOS positive because in lean respondents, there was a statistically significant difference in terms of BMI. From statistics it is clear that respondents suffering from PCOS may be prone to an increase in weight. A sudden increase in weight is indicative of PCOS which signifies that respondents experiencing the same should undergo a screening process.

The study grants the evidence that Obesity may be one of the contributing factors of PCOS as confidence level obtained is 95%. Obesity contributes to elevated body mass index (BMI) in PCOS respondents. Obesity increases hyperandrogenism, hirsutism, infertility and pregnancy complications both independently and by exacerbating PCOS. [15,16] Women with PCOS are more likely to have upper-body fat distribution compared with weight-matched controls. [17,18] Causes of obesity are associated with certain lifestyle factors such as sedentary habits and decreased physical activity. Important life style modifications in young people, particularly, have seen a decrease of time dedicated to organized physical exercise and an increase in hours spent watching TV, playing video games or using PCs. [19,20] Sedentary habits and decrease physical activity, in turn, have been reported to be associated with unhealthy food consumption. It was observed that obese PCOS positive respondents have a greater prevalence of certain clinical manifestations, such as hirsutism and menstrual disorder compared to non-obese PCOS positive respondents [21] However,

other studies have not found such differences. [13] Weight loss improves practically every parameter of PCOS. [22,23] It was observed that mean BMI difference between PCOS and non-PCOS obese respondents was statistically significant, although the difference was not statistically significant between lean PCOS positive and PCOS negative subject. It seems that obese PCOS patients had some negative factors which acted against long term maintenance of weight loss. Our results are in accordance with Wright et al. results as it confirms our findings about BMI difference between PCOS positive obese and PCOS positive non-obese respondents. After dividing the study population to lean and obese subgroups, they concluded that energy intake of normal-weight women with PCOS was significantly lower than that of normal-weight women without PCOS. Conversely, the energy intake of obese women with PCOS was greater than that of obese women without the syndrome, although the difference was not statistically significant. They emphasized that women with PCOS should restrict significantly energy intake in order to maintain a normal weight. [24]

In the same way, the effect of exercise in long term could be less efficient in obese patients. Long-term maintenance of weight loss among obese population is less likely. [25] This issue is exaggerated in obese PCOS respondents due to impressive interrelationship between metabolic characteristics, lifestyle such as physical activity and dietary intake, and obesity. Although lifestyle modifying measures, such as diet control and exercise, could play an important role in treatment of PCOS, adding more special programs to overcome non-compliance and to lower dropout rates of trials for weight loss is necessary. [26] Further research is necessary to determine the relative contributions of lifestyle including exercise and dietary intake, and PCOS.

Designing cohort studies to determine which factors influence weight loss and/or long term maintenance of weight loss in PCOS respondents will clarify the degree of exercise effectiveness. The importance of obesity in PCOS is emphasized by the efficacy of lifestyle intervention and weight loss. [27] The increasing prevalence of obesity among adolescent and young respondents with PCOS may partly depend on the increasing worldwide epidemic of obesity. Lower quality of life related to increased BMI in PCOS adolescents and general lack of concrete information for providers to access when attempting to diagnose and treat. Increasing the proportion of adolescents meeting recommended dietary and physical activity guidelines has been identified as an important strategy to contrast the epidemic increase in obesity. [20] One of the major causes of obesity is the changes in the diet, in terms of quantity and quality, which has become more Westernized. [28] Obese PCOS respondents show more difficulty in losing weight by exercise than lean PCOS respondents. It is emphasized that the most preferred and most effective method of treatment for PCOS is lifestyle modification. [29] It seems that obese PCOS respondents had some negative factors which acted against long term maintenance of weight loss. Although lifestyle modifying measures, such as diet control and exercise, could play an important role in treatment of PCOS. [30] Lifestyle change is first line treatment of the majority of PCOS respondents who are overweight. Incorporating simple moderate physical activity including structured exercise (at least 30 min/day) and incidental exercise increases weight loss and improves clinical outcomes in PCOS, compared to diet alone. [31] An interrelationship was observed in our study between frequency of exercise and PCOS. Weight loss may indirectly affect mood as well, as even a

small (i.e., 2% to 5%) reduction in weight greatly improves metabolic and menstrual cycle abnormalities. Weight loss is an important treatment strategy. Although the mean time of exercise did not differ significantly between PCOS positive and PCOS negative subgroups, frequency of obesity in respondents with PCOS was higher than PCOS negative subgroup of the same population. This difference could be contributed to interaction between metabolic disturbances and lifestyles such as dietary intake and exercise. One can lose weight by exercising regularly and by having a healthy balanced diet. Diet should include lots of fruit and vegetables, whole foods (such as whole meal bread, wholegrain cereals and brown rice), lean meats, fish and chicken. As in the general population, goals for exercise must focus on overall health benefits. [32]

Although weight loss improves practically every parameter of PCOS, Wright et al. concluded that differences in dietary intake and physical activity alone are not sufficient to explain differences in weight between women with and without PCOS. [33] Our study is in accordance with Wright et al. as it confirms the findings about lifestyle. It was observed that although the mean time of exercise did not differ significantly between PCOS positive and PCOS negative subgroups, frequency of obesity in women with PCOS was higher than PCOS negative subgroup of the same population. This difference could be contributed to interaction between metabolic disturbances and lifestyles such as dietary intake and exercise. Thus, knowledge about PCOS and risk associated with it is important for respondents.

## CONCLUSION

PCOS needs to be an area of concern for health care providers. In addition to the support groups, sex education and awareness

initiatives must also be offered. State government should propagate knowledge about it by Sex education and workshops which underlines our point how necessary is it to spread awareness to everyone, and have sex education in schools for girls, explaining them about their periods and related facts. Hence, our role was to make the current population aware of such increasing syndromes like PCOS. Due to greater prevalence, it has become a necessity, not only for women but also men, to be aware of PCOS. A regular medical check-up is very important to trace any abnormalities present, so that the same can be detected and treated at the earliest.

#### ACKNOWLEDGEMENT

We express our gratitude to SHP (Science Honors Program) K.C College, for providing research opportunity. We also thank various doctors and hospitals like Holy Family Hospital & Research Centre, Dr. C. J. Thakkar of Joint Masters, Breach Candy Hospital & Research Centre, Lake Side Nursing Home, Dr. Neeta Agarwal and Dr. Meera Agarwal of Agarwal Nursing Home, Dr. Raju Shah & Dr. Deepak Shah of Belfer Clinic, Dr. Jai Prakash Hebbar for helping validate our study. We would like to thank all the female respondents who contributed for data building for the project work undertaken.

#### REFERENCES

1. Adam Balen and Kathy Michelmores. Polycystic ovary syndrome national views important. Oxford Journals, Medicine & Health, Human Reproduction. 2010:17(9).
2. Stein IF, Leventhal NL. Amenorrhea associated with bilateral polycystic ovaries. Am J Obstet Gynecol. 1935: 29:181-91.
3. Renato Pasquali, Elisabet Stener-Victorin, Bulent O. Yildiz, et al. PCOS Forum: research in polycystic ovary syndrome today and tomorrow. Clinical Endocrinology. 2011:74:424-433.
4. Esther Eisenberg. Polycystic Ovary Syndrome (PCOS) factsheet (Internet). 2014(Update on 23<sup>rd</sup> December 2014) Women's health, US department of Health and Human services.
5. Poehlman ET, Dvorak RV, DeNino WF, et al. Effects of resistance training and endurance training on insulin sensitivity in non-obese, young women: a controlled randomized trial. J Clin Endocrinol Metab. 2010;85:2463-2468
6. Cindy Ta Pau, Candace C. Keefe, and Corrine K. Welt. Cigarette smoking, nicotine levels and increased risk of metabolic syndrome in women with polycystic ovary syndrome. Gynecol Endocrinol Journal. 2013;29(6):551-555.
7. Mark P. Trolice. Defining prediabetes in polycystic ovarian syndrome. Open Journal of Obstetrics and Gynecology. 2011;(1)36-41.
8. Bland, J.M, Altman. Statistics notes; measurement error. 2013. Bmj, 312(7057) 1654.
9. Mohammad Hasan Sheikhha, Seyed Mehdi Kalantar, Nasrin Ghasemi. Genetics of polycystic ovary syndrome. Iranian Journal of Reproductive Medicine. 2007;5(1):1-5.
10. Theresa L. Marx, Adi E. Mehta. 2013. Polycystic ovary syndrome: Pathogenesis and treatment over the short and long term. Cleveland Clinic Journal of Medicine. 70(1):31 - 45.
11. Kendall, M.G. and Stuart, D. The Advanced Theory of Statistics. Vol 2: Inference and Relationship. 1973. Section 20.4
12. Sprinthall, R.C. Basic Statistical Analysis. 9th Edition. Pearson Education Group. 2010. Pp 672 .
13. D. S. Kiddy, P. S. Sharp, D. M. White 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. 1999;32(2): 213-220.

14. R. Azziz, L. A. Sanchez, E. S. Knochenhauer et al. Androgen excess in women: experience with over 1000 consecutive patients. *Journal of Clinical Endocrinology and Metabolism*, 2004;vol. 89. no. 2. pp. 453–462.
15. Teede H, Hutchison SK, Zoungas S. The management of insulin resistance in polycystic ovary syndrome. *Trends EndocrinolMetab*.2004;18:273-279.
16. Deeks AA, Gibson-Helm ME, Teede HJ. Anxiety and depression in polycystic ovary syndrome: a comprehensive investigation. *Fertil Steril* .2010;93:2421-2423.
17. Elting MW, Kwee J, Korsen TJ, et al. Aging women with polycystic ovary syndrome who achieve regular menstrual cycles have a smaller follicle cohort than those who continue to have irregular cycles. *FertilSteril*. 2003;79: 1154–60.
18. Bart C. J. M. Fauser, M.D. Basil C. Tarlatzis , Robert W. Rebar, et al. Consensus on women’s health aspects of polycystic ovary syndrome (PCOS): the Amsterdam ESHRE/ASRM-Sponsored 3rd PCOS Consensus Workshop Group.2012, *Fertility and Sterility*. 97(1).
19. Obinson TN. Reducing children’s television viewing to prevent obesity. *JAMA* 2009;282:1561-67.
20. EnzaSidoti, PatriziaMangiaracina, Gabriele Paolini, et al. Body Mass Index, family lifestyle, physical activity and eating behaviour on a population of primary school students in a small town of Western Sicily. *JPH- 2010;7(6) 3*.
21. K. B. Singh, D. K. Mahajan, and J. Wortsman. Effect of obesity on the clinical and hormonal characteristics of the polycystic ovary syndrome. *Journal of ReproductiveMedicine*.1994. vol. 39. no.10. pp. 805–808.
22. Clark AM, Ledger W, Galletly C, et al. Weight loss results in significant improvement in pregnancy and ovulation rates in anovulatory obese women. *Hum Reprod*. 1995;10:2705–12.
23. Apter D. How possible is the prevention of polycystic ovary syndrome development in adolescent patients with early onset of hyperandrogenism. *J Endocrinol Invest*.1998;21:613–7.
24. Faloia E, Canibus P, Gatti C, et al. Body composition, fat distribution and metabolic characteristics in lean and obese women with polycystic ovary syndrome. *J Endocrinol Invest*. 2004: 27:424-9.
25. Ayyad C, Anderson T.2000. Long-term efficacy of dietary treatment of obesity: a systematic review of studies. *Obes Rev*. 1931-1999:1:113-9.
26. Stern L, Iqbal N, Seshadri P, et al. The effects of low-carbohydrate versus conventional weight loss diets in severely obese adults: one-year follow-up of a randomized trial. *Ann Intern Med*.2004;140:778-85.
27. Abdallah S Al-Rethaiaa1, Alaa-EldinA Fahmy, Naseem M Al-Shwaiyat. Obesity and eating habits among college students in Saudi Arabia: a cross sectional study. *Nutr J*. 2010; 9: 39.
28. Moran LJ, Pasquali R, Teede HJ, et al. Treatment of obesity in polycystic ovary syndrome: a position statement of the Androgen Excess and Polycystic Ovary Syndrome Society. *FertilSteril*. 2009: 92:1966-1982
29. Balen AH, Dresner M, Scott EM, et al. Obese women with polycystic ovary syndrome receive treatment for infertility. *BMJ*.2006;332:434–5.
30. Afsaneh Khademi, Ashraf Alleyassin, MarziehAghahosseini, et al. The Effect of Exercise in PCOS Women Who Exercise Regularly. *Asian Journal of Sports Medicine*.2010;1(1):35-40.
31. Emans, S.J., Laufer, M.R., and Goldstein, D.P. Androgen abnormalities in the adolescent girl, *Pediatric and Adolescent Gynecology*. 5th ed. Chapter 9.2009.
32. Andrea Hsu Roe and Anuja Dokras. *The Diagnosis of Polycystic Ovary*



Syndrome in Adolescents. Rev Obstet Gynecol. 2011; 4(2): 45–51.  
33. Wright CE, Zborowski JV, Talbott EO, et al. Dietary intake, physical activity

and obesity in women with polycystic ovary syndrome. Int J ObesRelat Metab Disord. 2005;28:1026–32.

How to cite this article: Kothare A, Jaisinghani C, Rane S et. al. Inter-relationship of PCOS with BMI, obesity and exercise. Int J Health Sci Res. 2015; 5(6):545-553.

\*\*\*\*\*

**International Journal of Health Sciences & Research (IJHSR)**

**Publish your work in this journal**

The International Journal of Health Sciences & Research is a multidisciplinary indexed open access double-blind peer-reviewed international journal that publishes original research articles from all areas of health sciences and allied branches. This monthly journal is characterised by rapid publication of reviews, original research and case reports across all the fields of health sciences. The details of journal are available on its official website ([www.ijhsr.org](http://www.ijhsr.org)).

Submit your manuscript by email: [editor.ijhsr@gmail.com](mailto:editor.ijhsr@gmail.com) OR [editor.ijhsr@yahoo.com](mailto:editor.ijhsr@yahoo.com)