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Effect of Polycystic Ovarian Syndrome on Exercise Capacity

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Abstract

Polycystic Ovarian Syndrome (PCOS) is a common endocrinal problem leading to improper, anovulatory menstrual cycle, moreover some individuals may begin to develop cysts. Other changes observed are weight gain, fatigue as well as feeling of low energy levels. These could partially be due to loss of sleep, infertility and skin problems. The current study aims to study the effect of PCOS on the functional capacity as predicted by aerobic capacity. Further the results will increase awareness about the capacity to undergo physical tasks and therefore the cardiovascular health. Twenty-six women participated in the current cross-sectional study, who were in the age group of 18–40 years, with body mass index between 18.5–24.9. The participants were divided into two groups those diagnosed with PCOS and those without it. The study infers that the women with diagnosis of PCOS brought no disparity in VO_{2max}. This examination likewise signified that the PCOS diagnosis is not related with aerobic exercise capacity and it is anticipated that endurance exercise performance and the deduced effort required amid exercise do not have any distinction between both the groups.

Keywords: PCOS; VO_{2max}; BMI; Pulse Rate; Blood Pressure.

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Introduction

Polycystic ovary syndrome (PCOS) is a composite condition which is characterised by increase in levels of androgen, irregularities in menstrual cycle, and small cysts which can be found either in one or both of the ovaries with prevalence ranging from 2.2% to 26%.[1,2] It is mainly a biochemical disorder known as hyperandrogenaemia or it is a morphological disorder (polycystic ovaries). Also, the clinical hallmark of PCOS is inhibiting the development of follicles, ovaries having micro-cysts- Hyperandrogenism, leading to the restraint in the development of follicles, anovulation, ovaries having micro-cysts and changes in the menstruation.[1] Women who have PCOS [5–10% of females in the age of 18–44 years[3]] may encounter unpredictable menstrual cycles i.e., menstrual cycle might be less or maybe more recurrent because of less repetitive ovulation, amenorrhea– a few women with PCOS do not have menstrual cycle, for many years in some of the cases. Additionally, one can have uncontrolled facial or body hair development (or both), can have acnes on the skin and hair loss from scalp. Women also finds difficulty in conception as there is an absence of ovulation or ovulation is less recurrent. Women may also have changes in the mood like depression or anxiety.

PCOS is also reported to be associated with obesity, insulin resistance and type II diabetes[4] and women with PCOS appears to be characterised by a reduced cardiopulmonary fitness as CRF is impaired in metabolic and endocrine disorders. Further studies need to be done in this area.[5] Cardiorespiratory fitness (CRF) or maximum aerobic capacity (VO_{2max}) is one of the strong independent indicator of cardiovascular disease (CVD) and a significant reason of death in women.[6] CVD and mortality depend on the extent of CRF which a strong predictor is, so the prognostic consequence for the events of cardiovascular may be carried out if CRF is impaired. Aside from being a solid indicator of CVD and mortality it is likewise the best indicator of functional capacity and is a main determinant or main factor of a

person's capacity to withstand activities (physical activities).[7–9] Henceforth, the cardiorespiratory system can meet increased metabolic needs by having its involvement in the cardiovascular health and also has an impact on the ability to perform the daily life activities and undertake exercise training thus the last mentioned being the fundamental or core management widely accepted for the management of PCOS.

Studies till date have been done that evaluate the effects of PCOS on exercise function of obese/ overweight women but not on women with normal weight (BMI < 18.5 or BMI > 24.9) The purpose of this study is to check if women with PCOS have any effect on aerobic exercise capacity and also to find the most extreme high-impact limit in populace with PCOS. Since the functional capacity can be best predicted by maximum aerobic capacity and also tells us about the person's capacity to undergo physical tasks. So cardiovascular heath can be determined with the help of VO_{2max}.

Materials and Methods

Cross-Sectional study design was done on women between the age of 18–40 years, with BMI between 18.5–24.9 in Amity Institute of Physiotherapy Research Lab. The Sample Sizewas taken 10 and 16 for women with PCOS and NPCOS (women without PCOS) respectively. The selection criteria includedthat participants should have any of the two findings- Hyperandrogenism, Oligomenorrhoea and polycystic ovaries as per the Rotterdam Criteria as well as Non-Uniformity in menstruation (having the length of cycle of less than 21 days or more than 35 days). Any Neurological deficits, orthopaedic conditions, cardiovascular conditions, pregnancy and Individuals who are suffering or have a past medical history of angina, or any other disease involving any cardiac, physical or pulmonary manifestations were excluded as these conditions can lead to limitation of exercise performance eventually. A step of 41.3 cm height, metronome, stadiometer, weighing machine (electronic), inch tape, heart rate monitor and stopwatch was used during the procedure.

Procedure

- *Pre-test:* The subjects were instructed and well explained about the procedures before the initiation of the test. Consents regarding the research were obtained in which the height and body weight for calculation of BMI, ages were noted down. The metronome was set for the test. The heart rate, systolic and diastolic BP were recorded and noted down with the help of heart rate monitor and sphygmomanometer respectively.
- *Test:* The participants were divided into two groups of PCOS and NPCOS. They were asked to move on the step, up and down for 3 minutes at the speed of 22 steps in a minute. The participants were asked to stop as soon as the test was completed and with the help of heart rate monitor the heart beats were recorded, and with the help sphygmomanometer systolic and diastolic blood pressure were noted.
- *Scoring:* VO_{2max} was recorded in the form of kg body mass (ml/kg/min) (McArdle et al., 1972). VO_{2max} (ml/kg/min) = 65.81 - [0.1847 x heart rate (bpm)][10]

Data Analysis

Data was checked for normal and PCOS women and changed in the form of log. Before analysis women with a BMI < 18.5 or BMI > 24.9 were excluded from the analysis. Unpaired t-tests were done to calculate differences in the group. Paired *t*-tests were done to calculate the null hypothesis. Statistical analyses were performed using Office 365 Excel, Windows (Excel, Delhi, India). Information is exhibited in the form of mean ± SD and the significance was kept at $p \leq 0.05$.

Results

Table 1: Demographic Details of the participants of the two groups

	PCOS	NPCOS
n	10	16
Weight (Mean)	54.25	52.25
Height (Mean)	162.40	159.19
BMI (Mean)	20.50	20.61
Age (Mean)	23.10	25.38

BMI: Body mass index; PCOS: polycystic ovarian syndrome; NPCOS: Non-polycystic ovarian syndrome

Table 2: Showing the Paired *t*-test for PCOS

	RPR	EPR	RSBP	ESBP	RDBP	EDBP
Mean	83.30	146.10	122.30	164.00	78.40	59.00
Variance	108.90	442.32	221.79	532.22	39.38	743.33
SD	10.44	21.03	14.89	23.07	6.28	27.26
df	9.00		9.00		9.00	
P	0.00		0.00		0.05	
t Critical	2.26		2.26		2.26	

PCOS: polycystic ovarian syndrome; SD: Standard Deviation; df: degrees of freedom; RPR: Resting Pulse Rate; bpm; EPR: Exercise Pulse Rate; bpm; RSBP: Resting Systolic Blood Pressure, mm Hg; ESBP: Exercise Systolic Blood Pressure, mm Hg; RDBP: Resting Diastolic Blood Pressure, mm Hg; EDBP: Exercise Diastolic Blood Pressure, mm Hg.

Table 3: Showing Paired *t*-test for NPCOS

	RPR	EPR	RSBP	ESBP	RDBP	EDBP
Mean	82.94	133.50	120.50	153.13	76.88	72.06
Variance	83.66	496.67	262.00	522.92	51.45	70.73
SD	9.15	22.29	16.19	22.87	7.17	8.41
df	15.00		15.00		15.00	
P	0.00		0.00		0.01	
t Critical	2.13		2.13		2.13	

NPCOS: Non-polycystic ovarian syndrome; SD: Standard Deviation; df: degrees of freedom; RPR: Resting Pulse Rate; bpm; EPR: Exercise Pulse Rate; bpm; RSBP: Resting Systolic Blood Pressure, mm Hg; ESBP: Exercise Systolic Blood Pressure, mm Hg; RDBP: Resting Diastolic Blood Pressure, mm Hg; EDBP: Exercise Diastolic Blood Pressure, mm Hg.

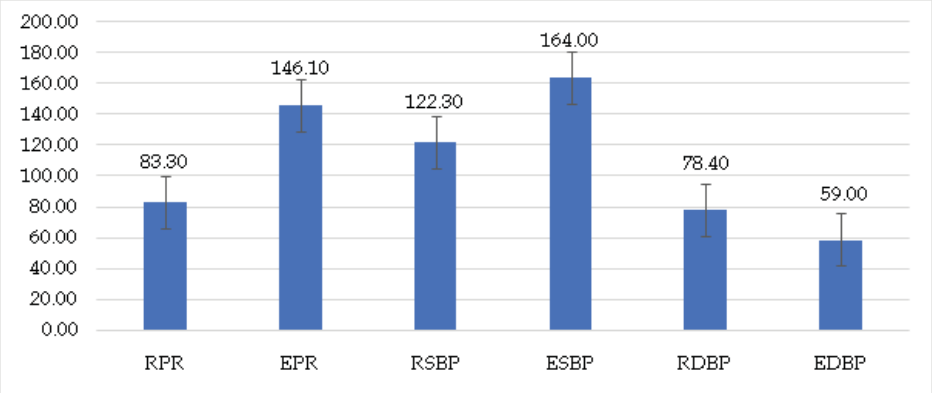
Table 4 has two groups i.e., I and II which stands for Group I (women with PCOS) and Group II (women without PCOS or NPCOS) where unpaired t test is performed. The analysis was done on 26 participants. Paired and Unpaired T test were performed on Resting heart rate, RHR and Exercise Heart rate, EHR; Resting Systolic Blood Pressure, RSBP and Exercise Systolic Blood Pressure, ESBP, Resting Diastolic Blood Pressure, RDBP and Exercise Diastolic Blood Pressure, EDBP. The Mean and SD between PCOS and NPCOS in VO_{2max} are also given in Table 2 & 3). The RPR, RSBP and RDBP between PCOS and NPCOS was found to be significant in Paired t test (Table 2 & 3). The EPR, ESBP and EDBP was found to be non-significant in PCOS (I) and NPCOS (II) in Unpaired *t* test (Table 4).

The Grrpah 1 and Graph 2 illustrates two graphs which signifies PCOS and NPCOS women RPR, EPR, RSBP, ESBP, RDBP and EDBP. Overall there is an increase in the pulse rate and systolic blood pressure post exercise (Graph 1 & 2) but a decrease in diastolic blood pressure after exercise in PCOS and NPCOS women (Graph 1 & 2). The RPR, RSBP, RDBP of PCOS and NPCOS pre and post exercise is almost same (Graph 1 & 2) whereas there is and sharp increase in EDBP of NPCOS women (Graph 2). The EPR is slightly more in PCOS women as compared to EPR of NPCOS women (Graph 1 & 2 respectively). There is an upward trend seen in PCOS women with regards to mean pulse rate and systolic bp but mean ESBP I of the PCOS women seem to have high bp as compared to mean ESBP II of NPCOS women (Graph 3).

Table 4: Showing Two-Sample T-t-test Results Assuming Unequal Variances in PCOS and NPCOS

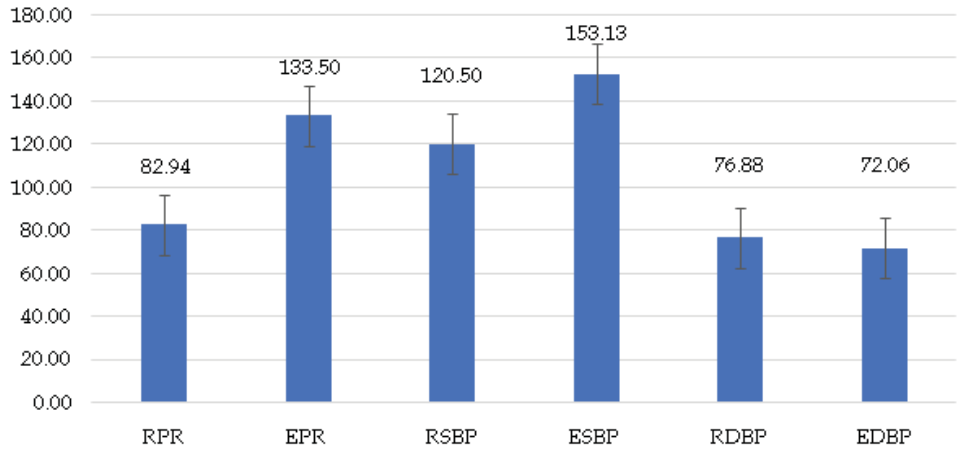
	EPR I	EPR II	ESBP I	ESBP II	EDBP II	EDBP II
Mean	146.1	133.5	164.00	153.13	59.00	72.06
Variance	442.32	496.67	532.22	522.92	743.33	70.73
SD	21.03	22.29	23.07	22.87	27.26	8.41
n	10	16	10	16	10	16
df	20		19.00		10.00	
P	0.16		0.26		0.17	
t Critical	2.09		2.09		2.23	

PCOS: Polycystic ovarian syndrome; NPCOS: Non-polycystic ovarian syndrome; n: no. of observations, SD: Standard Deviation; df: degrees of freedom; EPRI (Group 1): Exercise Pulse Rate; bpm; ESBPI (Group 1): Exercise Systolic Blood Pressure, mm Hg; EDBPI (Group 1): Exercise Diastolic Blood Pressure, mm Hg; EPRII (Group 2): Exercise Pulse Rate; bpm; ESBPII (Group 2): Exercise Systolic Blood Pressure, mm Hg; EDBPII (Group 2): Exercise Diastolic Blood Pressure, mm Hg.



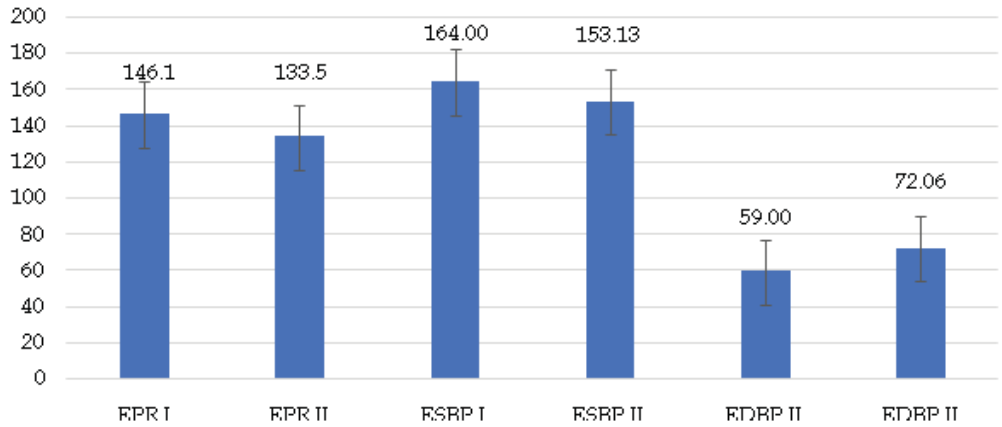
Graph 1: Comparison of pre and post results in PCOS

PCOS: Polycystic ovarian syndrome; NPCOS: Non-polycystic ovarian syndrome; RPR: Resting Pulse Rate; bpm; EPR: Exercise Pulse Rate; bpm; RSBP: Resting Systolic Blood Pressure, mm Hg; ESBP: Exercise Systolic Blood Pressure, mm Hg; RDBP: Resting Diastolic Blood Pressure, mm Hg; EDBP: Exercise Diastolic Blood Pressure, mm Hg.



Graph 2: Comparison of pre and post results of NPCOS

PCOS: Polycystic ovarian syndrome; NPCOS: Non-polycystic ovarian syndrome; RPR: Resting Pulse Rate; bpm; EPR: Exercise Pulse Rate; bpm; RSBP: Resting Systolic Blood Pressure, mm Hg; ESBP: Exercise Systolic Blood Pressure, mm Hg; RDBP: Resting Diastolic Blood Pressure, mm Hg; EDBP: Exercise Diastolic Blood Pressure, mm Hg.



Graph 3: Comparison between PCOS and NPCOS (Post-Exercise)

PCOS: Polycystic ovarian syndrome; NPCOS: Non-polycystic ovarian syndrome; EPRI(Group 1): Exercise Pulse Rate; bpm; ESBPI(Group 1): Exercise Systolic Blood Pressure, mm Hg; EDBPI(Group 1): Exercise Diastolic Blood Pressure, mm Hg; EPRII(Group 2): Exercise Pulse Rate; bpm; ESBPII(Group 2): Exercise Systolic Blood Pressure, mm Hg; EDBPII(Group 2): Exercise Diastolic Blood Pressure, mm Hg.

Discussion

Cardiovascular Chronotropy (i.e., rise and fall in heart rate) and inotropy (i.e., contractility) falls under humoral (plasma norepinephrine) and autonomic (sympathetic and parasympathetic) system while exercising. A portion of the past investigations have recommended thoughtful hyperactivity in over weight/hefty young people.[11]

The present examination does not demonstrate any huge contrast in resting beat rate and systolic BP values between both the values ($p > 0.05$). Small sample size may be the factor in charge of this.

Initially during exercise, the rate of heart rapidly elevates because the parasympathetic tone is inhibited due to the mechanism known as central command feed forward as the message from the vagus nerve is reduced since this mechanism is responsible for the rise in heart rate nearly to 100 beats/minute. As the work rate rise, there

is an increase in the heart rate above this level because of the withdrawal of the continued parasympathetic system and also because of increase in the added effects by the stimulation of concomitant sympathetic system by the help of cardiac accelerator nerve.[11]

Amid the 3-Minute Step Test which is a sub-maximal type of activity testing technique, there is an increased interest in the body for oxygen in ordinary weight group. This leads to sympathetic over activity and norepinephrine discharge. It causes an increase in the size of heart chamber, therebyseeing a considerable rise in the stroke volume.[12]

When the cardiac output reaches 50% of its maximum, the stroke volume also increases by that limit. Hence, if there is any increase in heart rate then only the cardiac output will increase further.[12]

Accordingly, practice pulse reactions of PCOS ladies are extraordinarily typical with those of ladies with Non PCOS ladies BMI ($p > 0.05$).

A slow, gradual increase in heart rate with large increases in work load signifies extremely high level of fitness. Level of physical fitness was found to be poor in both the groups although the test was not symptom limited. Women with PCOS reached the near normal maximal heart rate values very early in sub-maximal exercise. Exercise of maximum intensity in such individuals will show even more marked abnormal responses. Marked increase in heart rate at sub-maximal exercise indicates poor exercise tolerance which is a result of poor cardiovascular endurance. An increased heart rate shortens the diastolic period, thus coronary artery filling time is shortened. Therefore, perfusion would be disrupted, and myocardial oxygen demands are increased. This may predispose an individual to the development of potential cardiomyopathies.[13]

SBP shows more marked increase in PCOS women than in Non PCOS women. SBP rises during exercise because there is in increase in cardiac output (CO) which is greater than decrease in total peripheral vascular resistance (TPR) as evident by the formula: Mean BP = CO* TPR. TPR is the quantification of after-load which is the resistance to ventricular emptying. Stimulation of sympathetic nervous system (SNS) increases myocardial contractility which results in enhanced stroke volume, which is further increased by depth of breathing, the muscle pump and change in venous compliance. Auto-regulatory mechanism in muscles causes peripheral vasodilation due to increased muscle metabolism with exercise. This allows reduction in TPR and more blood to the delivered to skeleton muscles. Finally, SNS causes vasoconstriction in the viscera, thereby shunting blood away from the less essential organs to the working muscles.[13]

DBP was observed to be significant in the present investigation as $p < 0.05$. Just 3 tests had anomalous decreased DBP. Change of ± 10 mmHg is viewed as a typical DBP reaction. An anomalous reaction would be decline of more than 10 mmHg (in an untrained populace or more seasoned populace).

Pulse pressure comparison was significant with $p < 0.02$. In well-conditioned athletes and younger persons, the DBP may fall precipitously during exercise, sometimes to level approaching 0 mmHg creating an abnormally wide pulse pressure.

The mechanism behind the progressive rise in DBP is thought to be a response to the need for an increased driving pressure in the coronary arteries, which is necessary to overcome the demands of myocardium.

Whenever there is an increase in the pulse pressure the arteries are stretched maximally, cause fatigue and also fractures of the elements that are elastic, also there is a likely chance of accelerating the development and rupture of aneurysms, and also there is a more likely chance of advancing the development of intimate injury which can lead to thrombotic events and atherosclerosis.[13]

Limitation of the study was that though the test was a paced form of field test, fatigue was the limiting factor with some PCOS and Non PCOS women. Although the number of steps were same for all the subjects, but the beat of metronome cadence could not be followed by everyone.[1]

Other limitation was that as the step is the same size for all the subjects, therefore, characteristics of biomechanics such as height and lower limb length were maybe preferred.

Conclusion

Thus, the study infers that the women with PCOS and Non PCOS have no distinction in VO_{2max}. This examination likewise demonstrated that the PCOS diagnosis isn't related with aerobic exercise capacity. Since there was discovered no distinction in VO_{2max} in PCOS and Non PCOS, it was expected that endurance exercise performance and the deduced effort required amid exercise do not have any difference between both the groups. Since it was a small sample size study therefore the only limitation is to increase the sample size.

References

1. Dunaif, A. Insulin resistance and the polycystic ovary syndrome: mechanism and implications for pathogenesis. Endocr Rev. 1997 Dec;18(6):774–800.
2. Nidhi R, Padmalatha V, Nagarathna R, et al. Prevalence of polycystic ovarian syndrome in Indian adolescents. J Pediatr Adolesc Gynecol. 2011 Aug;24(4):223–7.
3. Norman, RJ, Dewailly, D, Legro, RS, Hickey, TE. Polycystic ovary syndrome. Lancet. 2007 Aug 25;370(9588):685–97.
4. Khademi A, Alleyassin A, Aghahosseini M, Tabatabaeefar L, Amini M. The Effect of Exercise in PCOS Women Who Exercise Regularly. Asian J Sports Med. 2010;1(1):35–40.
5. Pappalardo MA, Vita R, Di Bari F, Gly972Arg of IRS-1 and Lys121Gln of PC-1 polymorphisms act in opposite way in polycystic ovary syndrome.J Endocrinol Invest. 2017 Apr;40(4):367–376.
6. Aukkanen,JA,Kurl,S,Salonen,JT.Cardiorespiratory fitness and physical activity as risk predictors of future atherosclerotic cardiovascular diseases. Curr Atheroscler Rep. 2002 Nov;4(6):468–76.
7. Blair SN, Kohl HW, Paffenbarger RS, et al. Physical fitness and all-cause mortality. A prospective study of healthy men and women. JAMA. 1989 Nov 3;262(17):2395–401.
8. Wei, M, Gibbons, LW, Kampert, JB, Nichaman, MZ, Blair, SN. Low cardiorespiratory fitness and physical inactivity as predictors of mortality in men with type 2 diabetes. Ann Intern Med 2000;132:605–11.
9. Lakka TA, Venalainen JM, Rauramaa R, et al. Relation of leisure-time physical activity and cardiorespiratory fitness to the risk of acute myocardial infarction in men. N Engl J Med. 1994 Jun 2;330(22):1549–54.
10. Setji TL, Brown AJ. Polycystic ovary syndrome: update on diagnosis and treatment. American Journal of Medicine 2014;127(10)10:912–19.
11. Brown SP, Hash DE, Lyons B. Clinical exercise physiology: current perspectives on exercise prescription. Phys Ther Rev. 2001;6:189-214
12. David A. Robinson. Quantitative Analysis of the Control of Cardiac Output in the Isolated Left Ventricle. Circulation Research. 1965;17:207–221
13. Lembo M, Sicari R, Esposito R, et al. Association Between Elevated Pulse Pressure and High Resting Coronary Blood Flow Velocity in Patients With Angiographically Normal Epicardial Coronary Arteries. J Am Heart Assoc. 2017;6(7):e005710.