Effect of Aerobic Exercise on Metabolic Aspects in Women With Polycystic Ovary Syndrome-A Randomized Control Study

[1]Princy Merlyn.G, [2]Ponmathi.P, [3]Venkatesh.N, [4]Dhanalakshmi M.G, [5]Malathi.S

[1]Princy Merlyn,Postgraduate,Faculty of Physiotherapy,Sri Ramachandra Institute of Higher Education and Research,Chennai-116.

Corresponding author: Ponmathi.P,Assistant Professor,Faculty of [2]Physiotherapy,SriRamachandra Institute of Higher Education and Research,Chennai-116.

[3]Venkatesh.N,Professor,Faculty of Physiotherapy,SriRamachandra Institute of Higher Education and Research,Chennai-116.

[4]Dhanalakshmi.M.G,Professor,Department of Obstetrics and Gynaecology,Sri Ramachandra Institute of Higher Education and Research,Chennai-116.

[5]Malathi.S,Clinical nutritionist,Sri Ramachandra Institute of Higher Education and Research,Chennai-116.

ABSTRACT

Background: Polycystic ovary syndrome is a hormonal disorder that affects ovaries in women during childbearing years. This results in an irregular menstrual cycle. Around 1/3 women across the world suffer from this hormonal disorder. The prevalence of PCOS ranges from 2.2% to 26% worldwide. **Aim:** The aim of the study is to assess the effect of aerobic exercise on women with polycystic ovary syndrome.**Methodology:** The study was conducted at Sri Ramachandra Institute of Higher Education and Research, Chennai. Subjects were included in the study after satisfying the inclusion and exclusion criteria. An informed consent was obtained from the participants who are willing to participate in the study Subjects will be divided into two groups by A pretest measurement of fasting insulin and fasting glucose, LDL, HDL was taken. One group will be trained with moderate intensity steady training (MIST) aerobic exercise, physical activity and diet advice while the other group will be receiving low intensity steady training (LIST) aerobic exercise, physical activity and diet advice. The post-test measures will be taken following eight weeks of intervention.**Results & Discussion:** There is no statistically significant difference between pretest and posttest measures of HDL, FI, FG and HOMAIR values in both low intensity and Moderate intensity Aerobic training ($p>0.05$).There was a statistically significant difference between pretest and posttest measures of LDL in MIST($p<0.05$). When both the groups were compared there was no significant difference between them ($p>0.05$). LIST is found to be clinically effective in LDL, FI and HDL, thus quite beneficial in improving insulin sensitivity in women with PCOS. Future studies with longer duration can bring a better understanding of low intensity steady state training which the patient found comfortable to exercise for prolonged time.**Conclusion:** There was no significant effect of aerobic exercises and no significant difference between LIST and MIST over metabolic parameters in women with PCOS.

1. Introduction

Polycystic ovary syndrome is a hormonal disorder that affects ovaries in women during childbearing years which results in irregular menstrual cycles. It is a hormonal disorder that is very common among women during their reproductive age.(1)

The World Health Organization (WHO) estimates that PCOS has affected 118 million women (4.4%) worldwide in 2012. Globally, prevalence of PCOS is highly variable, ranging from 3.2% to as high as 26%. In India, experts claim 12% of the women to be affected by PCOS(2).A pilot cross-sectional study conducted in Tamil Nadu assessed young adolescent females they found a prevalence of 18% for PCOS.

Polycystic ovary syndrome (PCOS) is currently known to be a genetically complex endocrine disorder with a complicated pathophysiology. The diagnostic criteria for PCOS have been offered by three groups. The National Institutes of Health/National Institute of Child Health and Human Disease (NIH/NICHD) (3), the European Society for Human Reproduction and Embryology/American Society for Reproductive Medicine (ESHRE/ASRM) or the 'Rotterdam Criteria' (4) and the Androgen Excess Society (AES). (5)(Table 1)

Up to 70% of PCOS patients develop insulin resistance, which prevents their cells from adequately using insulin. The pancreas secretes the hormone insulin to facilitate the body's utilization of dietary sugar for energy.

The body requires more insulin when cells can't adequately use it. To make up for this, the pancreas produces extra insulin. The ovaries create more male hormones in response to increased insulin levels.

The main contributor to insulin resistance is obesity. Your risk of developing type 2 diabetes can be increased by both weight and insulin resistance. (11)

Treatment goals for PCOS include diminishing clinical hyperandrogenism, managing menstrual dysfunction, preventing endometrial hyperplasia and carcinoma and regulating metabolic issues in the long term. Lifestyle changes and weight loss are the cornerstones of treatment. Oral contraceptives (OCs) are the first line of PCOS pharmacotherapy due to their effect on hyperandrogenism, menstrual irregularity, and endometrial carcinoma prevention. (12)

The research has found that aerobics is always the greatest option for patient benefit. Low intensity training has not yet been investigated while moderate intensity training is the focus of the majority of study. Therefore, the purpose of this study is to compare the impact of low-intensity training and moderate-intensity training on different metabolic markers in PCOS women.

2.Methodology

The study was conducted at Sri Ramachandra Institute of Higher Education and Research, Chennai. Initially a Screening was done in the young female population aged between 18-26 years (306 subjects) for their menstrual history, about 30 subjects were found

with irregular menstrual history and they were evaluated by gynecologist with ultrasound examination and out of the 30 subjects 21 were diagnosed with PCOS and 9 with no pathology. Those who have no pathology were treated with medications and lifestyle advice.

This research study was explained to all 21 diagnosed PCOS and those who are willing to participate were obtained with informed consent. Out of 21, 6 subjects were not willing to participate in the study due to fear of taking lab tests and 12 gave their consent and were included for the study. Demographic data age, height, weight, Body Mass Index were documented.

All the subjects were initially screened for Metabolic parameters, Blood pressure, Oxygen saturation, IPAQ and vo2 max by a second assessor who is blinded to the type of intervention that the 12 subjects will be receiving.

As a pretest measurement of metabolic parameters, blood sample was taken from all the subjects and the following were measured for which 50% of concession was sponsored by Sri Ramachandra Institute of Higher Education and Research

1.Fasting Insulin (FI)
2.Fasting glucose (FG)
3.Low Density Lipoprotein (LDL)
4.High Density Lipoprotein (HDL)

Blood pressure was evaluated with a sphygmomanometer and Oxygen saturation with pulse oximeter. Vo2 max is calculated with a step test. Diet education were given (low fat high carb diet by dietitian (Annexure 1)

Then the samples were randomly allocated to two groups by computer generated simple random sampling method.6 subjects were allocated to Low Intensity Steady State Training (LISST) and 8 subjects were allocated to Medium Intensity Steady State Training (MISST).

Step test:

Resting heart rate: After 20 minutes upon arrival to the demonstration area, heart rate was monitored and documented.

Equipment required: Step height-16 inches, stopwatch, and metronome

Procedure: Subjects were given instructions about the procedure and given a trial to do the step up and down with the beat of metronome (84 bpm). The subjects were instructed to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The subjects stop immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery. Multiplying 15 second readings by 4 will give the beats per minute (bpm) value to be used in the calculation below. (Reliability: r = 0.92 validity r = -0.75).

Scoring: VO2max(ml/kg/min) = 65.81 - (0.1847 x heart rate (bpm))

Then 12 subjects were explained again of objectives, procedures, benefits of the study and was randomly divided into two groups by computer generated method. One group was trained with moderate intensity steady training (MIST) while the other group will be receiving low intensity steady training (LIST) on a treadmill.

Treadmill training

40 min of walking on the treadmill at 60–70% HRmax as calculated individually using Karvonen formula, and followed by 5 mins of cool-down by slowing down the treadmill

WARMUP (Table 3&4)

- **Treadmill training**

40 min of walking on the treadmill at 50–60% HRmax as calculated individually using Karvonen formula, and followed by 5 mins of cool-down by slowing down the treadmill

- The post-test measures will be taken following eight weeks of intervention.
  1. Fasting Insulin (FI) 2. Fasting glucose (FG)
  3.Low Density Lipoprotein (LDL) 4. High Density Lipoprotein (HDL)

Ethics clearance: The study was approved by the Institutional Ethics committee of ICMR-**CSP/22/AUG/115/477**

3.Results

In our study 12 polycystic ovary syndrome diagnosed subjects were included and randomly allocated in two groups Low intensity steady state training (LIST)and Moderate intensity steady state training (MIST)

Baseline characteristics of Low Intensity Steady State Training Group and Moderate Intensity Steady State Training group (Table 5)

Pre-test and Post-test measures of Fasting Insulin (FI), Fasting Glucose (FG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) in Low Intensity Steady State Training group (LIST).(Table 6)

Pre-test and Post-test measures of Fasting Insulin (FI), Fasting Glucose (FG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Homeostasis Model Assessment of Insulin Resistance (HOMAIR) in Moderate Intensity Steady State Training group (MIST).(Table 7)

Comparison of Posttest measures of Fasting Insulin (FI), Fasting Glucose (FG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) between Low Intensity Steady State Training group (LIST) and Moderate Intensity Steady State Training group (MIST).(Table 8)

4.. Discussion

PCOS is an endocrine abnormality found mostly in childbearing age of women. Hyperinsulinemia, dyslipidemia and infertility are quite commonly found in women with PCOS (13). Decrease in HDL, increase in TG LDL are usually found in PCOS (14). PCOS is

also highly associated with insulin resistance which quite easily turns to glucose intolerance later.

7 subjects were trained with Moderate Intensity Steady State training and 5 subjects were trained with Low Intensity Steady State training. Two dropouts in study were noted and the reason for discontinuing is lack of time and lack of interest.

Lipoproteins

These study results show no statistically significant difference between pretest and posttest measures of LDL and HDL in both the groups ($p>0.05$). Aerobic exercises so far in many studies had found the effect over Lipoproteins but no study to our knowledge had compared the different intensity of aerobic training over LDL levels, so this study compared the low intensity with moderate intensity aerobic training over LDL and HDL.

LDL increases fat deposition within the arteries which increase the risk of cardiovascular diseases. HDL clears the fat from the body and transports it to the liver from where it is eliminated. This good cholesterol should be of higher value and LDL should be of low value to maintain the body healthy and free from heart diseases.

In LIST two subjects were found to have normal LDL value whereas the other three were found to have borderline LDL values whereas in MIST six subjects were found to have normal value whereas one subject is found to have borderline LDL value.

In LIST three subjects reported an increase in LDL levels, one was found with a reduction in LDL levels and one with no change. In the MIST group all seven subjects were found to have an increase in LDL levels after eight weeks of training. There was a statistically significant difference in MIST which was caused by a rise in LDL in all subjects when compared to LIST ($p<0.05$). In the LIST group there found no statistical difference between pretest and posttest measures of LDL as only three subjects had an increase in LDL levels and one was found with increase in level and with no change. ($p>0.05$).

Exercise enhances the ability to utilize lipids thus causing a reduction in lipid levels, also there will be an increase in the lecithin cholesterol acyl trans which transform the ester in to HDL which will increase the elimination of cholesterol through the liver which is known as “Reverse Cholesterol Transport” (15). Smaller the particle of LDL, it will seep through arteries and get deposited which will eventually lead to blocking of arteries, Exercise eventually increases the size of LDL thus above complication rate is lowered.

Varady et al discussed in his research that the small dense LDL particles number would have been reduced even though LDL values as a total might not have decreased (16).

One more cause is physiologically that cholesterol levels rise while there is a reduction in weight as fat cells shrink which causes fat and cholesterol to be displaced. Thus, they get released into the bloodstream which shows a high cholesterol level. This strongly supports this study results where there is an increase in LDL values with a reduction in weight in both the groups. Diet would not have influenced the increase in LDL as we had followed a high carbohydrate and low cholesterol diet.

Also, few studies quote that LDL particle size changes only after 24 weeks of training and this study has only 8 weeks of training and also moderate intensity training (60-75% of HR max) and low intensity training (50-60 % of HRmax) is targeted here but few research says more than 75% produces changes in LDL. In our research both intensity of training had shown changes but MIST with diet has shown better changes than LIST with diet.

The LIST group has 2 subjects with normal HDL level and three subjects with borderline HDL levels whereas in the MIST group all the subjects (7) had borderline HDL values. There was no statistically significant difference between pretest and posttest values of HDL in both LIST and MIST group post eight weeks of training ($p>0.05$)

HDL has increased in three subjects in the LIST group and four subjects have shown an increase in values of HDL in the MIST group. The increase in HDL is always good for the subjects. But most of the research quotes that HDL is the last type of lipoprotein to respond positively which takes three months to show some improvement (17).

In this eight week of training about 50%in each group had shown an improvement in HDL values and if the duration had been longer, more positive results could have been anticipated.

Fasting Insulin and Fasting Glucose

The study results show no statistically significant difference between pretest and posttest measurement of Fasting Insulin and Fasting Glucose in both LIST and MIST groups($p>0.05$).

In the LIST group out of 5 subjects 4 were found to have borderline FG level and in the MIST group out of 7 subjects 6 were found to have normal values and one was found with high levels of insulin.

Insulin is quite necessary to store glucose, which increases blood sugar, the liver is in need to pump more insulin and with increased insulin the cells become resistant to insulin which after a due course of time results in increase in both fasting insulin and fasting glucose levels. This high insulin stimulates ovaries to produce more testosterone which leads to excess hair growth, acanthosisnigri, more menstrual disturbances and acne.

Post LIST training there was a reduction of FI levels for three subjects and increase of FI levels for other subjects. After 8 weeks of MIST training there was a reduction in FI values for 5 subjects and increase in FI levels for 2 subjects which shows a better result than LIST (49).

Tabari et al concluded that aerobic training at 60% of their maximum heart rate for a period of eight weeks reduces insulin resistance significantly (18).

Exercise improves translocation of insulin stimulated GLUT4 and GLUT4 muscle protein increase which helps in reduction of insulin level. Also exercises deplete the glycogen storage and this indirectly reduces the amount of insulin, also changes in lipids by exercise changes the hepatic glucose output which also favors insulin reduction (19).

Fasting Glucose values are quite normal in all 12 subjects present in both the LIST &MIST groups. Fasting blood glucose. There was no statistically significant difference between LIST and MIST groups post 8 weeks of training($p>0.05$).

In LIST group three was found to have got increased FG values and two reduced values post eight weeks of training whereas in MIST 5 subjects reported a reduction in FG levels and two showed an increase in FG level post training.

Our results go in hand with Huo et al who concluded regular exercise reduces fasting blood glucose levels.

HOMAIR

Many studies have shown that HOMAIR which is calculated based on FI and FG estimates the insulin sensitivity better. This study shows that there was no difference between pre and post -test measures of HOMAIR in both LIST and MIST groups after eight week of training($p>0.05$). HOMA IR values of identification of Insulin Resistance is 2.6(20).

With their cutoff value, there were about 6 subjects in MIST group who have insulin resistance and 4 subjects in LIST have HOMA IR values more than 2.6. Nearing all have been found to have IR which shows their role in PCOS.

HOMAIR values have been reduced in both types of training for a period of 8 weeks. Although there exists no statistically significant difference between pretest and posttest

(p>0.05) due to small sample size, changes in HOMAIR exist.in MIST training group two subjects have returned to their normal HOMAIR value post training.

Heba concluded that insulin resistance calculated by HOMAIR had significantly reduced post exercise training for a period of 24 weeks (21).

Bhattacharya showed that PCOS patients have higher HOMAIR results and less tolerance to glucose (22)

In both the groups insulin sensitivity is improved although not statistically significant we can mark a good clinical difference between pretest and posttest. This is in agreement with Garcia who discussed that after an aerobic program of 12 weeks with three sessions per week there occurs an improvement in insulin sensitivity (23). When clinically compared LSIT is found to have a better reduction in HOMAIR than MIST.

When both the groups are compared there exists no statistical difference between the values of LDL, HDL, FI, FG & HOMA IR. BMI has reduced dramatically in both the group after exercises, LIST has given a better reduction of BMI than MIST .so far, many studies have found the effect of moderate intensity steady state training on metabolic aspects in PCOS women but to our knowledge no study has found the effect of low intensity steady state training on metabolic aspects in PCOS women.

According to the effect size calculation for HDL (0.42), LDL (0.05), FI (1.82), FG (0.02), HOMA-IR (1.66), LIST is found to have a trivial effect over LDL, FG values and moderate effect over HDL and large effect over FI and HOMAIR.

Although no statistically significant results can be identified in any of the parameters, clinically Low Intensity training was comfortable and easy for the subjects, furthermore more subjects resumed regular menstrual cycle form LIST group, In MIST subjects found it harder to move beyond 60% of maximum heart rate as it is very difficult for them to maintain the heart rate for prolonged time till the end of treatment session. LIST has a very good benefit in improving insulin sensitivity than MIST clinically.

5.Conclusion

There is no significant difference on effect of aerobic exercise on metabolic aspects and when comparing the intensity, the list is found good over lipoproteins and MIST is better on blood sugar

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