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COMPARISON OF EFFECTS OF HIGH INTENSITY INTERVAL TRAINING AND CIRCUIT TRAINING ON HORMONAL IMBALANCE AND CARDIOPULMONARY FITNESS IN WOMEN WITH POLYCYSTIC OVARIAN SYNDROME

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Abstract:

Background: Polycystic Ovary Syndrome (PCOS) is the most common endocrinopathy which causes metabolic disturbances in women of mostly reproductive-age. It affects 9-18% reproductive-aged women. Characteristic features of PCOS include obesity, menstrual irregularity and hyperandrogenism. The aim of this study is to compare the effects of High Intensity Interval Training and Circuit Training on women affected with PCOS.

Objectives: The study is undertaken to compare the effects of High Intensity Interval Training and Circuit Training on Polycystic Ovarian Syndrome.

Materials and Methods: Thirty participants were selected according to the exclusion and inclusion criteria. The participants were randomly allocated into 2 groups, Group A (High Intensity Interval Training) and Group B (Circuit Training). In Group A, Participants were trained on a treadmill for 3 sessions/week for a total of 6 weeks. In Group B, participants were trained on both treadmill as well as cycle, along with that strengthening exercises of major muscle groups were performed for 3 sessions/week for 6 weeks. FSH and LH values were taken for outcome measures. Chester Step Test is also taken as outcome measure for cardiopulmonary fitness.

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Results: The mean±SD scores of Pre-intervention and post- intervention FSH of group A were group A were 10.02±3.23 and 8.75±2.19 respectively (p= <0.005). Similarly, FSH of group B are 4.28±1.56 and 4.12±1.21 respectively (p=0.2682), and LH values are 10.47±1.93 and 9.29±2.112 respectively (p= <0.005). When the group A and group B post- intervention results were compared, there was no statistically significant difference seen in LH values (p= 0.4217) and hence both the groups showed equal improvement.

Conclusion: The study concluded that High Intensity Interval Training and Circuit Training were both equally effective in improving hormonal imbalance and cardio respiratory fitness in women with Polycystic Ovarian Syndrome.

Keywords: High Intensity Interval Training, Circuit Training, Chester Step Test, Polycystic ovarian syndrome.

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is the most common endocrinopathy which causes metabolic disturbances in women of mostly reproductive-age.[1] It affects 9-18% reproductive-aged women.[2] According to the Rotterdam criteria, the prevalence of PCOS is approximately 20%. [1] Characteristic features of PCOS include obesity, menstrual irregularity and hyperandrogenism.[3] Excessive body fat and central adiposity is also seen in lean women with PCOS.[1] Endocrinological changes include LH (Luteinizing Hormone) level raised over 10UI/ml, FSH/LH ratio fall, fasting blood glucose <4.5 which suggests IR (Insulin Resistance).[3] Insulin resistance is a main etiological feature in PCOS, both weight-dependent and weight-independent, which contributes particularly to the reproductive and metabolic complications of the syndrome. [2]

In PCOD the ovaries are enlarged up to 5 times their normal size and this enlargement is usually bilateral and symmetrical in nature and rarely unilateral. The shape of normal ovaries is slightly flattened compared to those of Polycystic ovarian syndrome in which the ovaries are ovoid or globular. Larger macro follicular subcortical cysts with clear or yellow fluid may also be present which causes the bulging of the ovarian surface but are not completely visible before sectioning because of thickened ovarian capsule. [4]

VO_2max is defined as maximal oxygen uptake of the body. VO_{2max} is reduced due to a lot of factors such as age, sex, presence of any disease or consumption of medication, hormonal imbalance, etc.[5] Functional Capacity is also decreased in individuals suffering from PCOS due to obesity and other factors. [5] There is increased risk of cardiovascular mortality due to decreased functional capacity in healthy individuals as well as the ones with coronary heart disease. [5] There is a significant amount of reduction in VO_2max in sedentary individuals. Also it is reported that IR causes reduction in VO_2max .[5] IR results in reduced function of mitochondria which is the reason for reduced functional capacity of the lungs in PCOS.[5] A study also shows that there is impairment of sub-maximal and maximal cardiopulmonary responses to exercise in PCOS compared to normal healthy women.[5] Obesity is major cause of early ventricular abnormalities, endothelial dysfunction, carotid and coronary atherosclerosis in women with PCOS. [6]

Change in the lifestyle has been considered as first-line treatment and proved to be beneficial in improvement of reproductive and metabolic complications of the disorder in PCOD. [1] Many endocrinologists and gynecologists suggests diet and exercise for reduction of manifestations in PCOS such as oligomenorrhea, hirsutism, infertility, and obesity. [7] There are few studies which portrays the effects of exercises which proved to be of great significance in PCOS.

There has been greater improvement in components of body image and physical fitness when participants training for 12 weeks using combination of aerobic, anaerobic and strength circuit training compared to aerobic alone or strength training alone in healthy individuals. [8] There is lack of knowledge on the effects of Circuit Training on Polycystic ovarian syndrome.

Previously, studies have been done on effect of High Intensity Interval Training (HIIT) and Strength Training (ST) on PCOS which resulted in improvement in HOMA-IR after HIIT also there was improvement in VO_2max after strength training.[1] The article also found positive changes in reproduction-related hormones after HIIT and ST.[1] Another study tested HIIT and moderate intensity training between healthy non-PCOS women and PCOS women, found that IR improved with exercise by 16% in PCOS women. [2] BMI was significantly reduced in PCOS group with VO_2max improved across the whole group with no differences between 2 groups. [2]

High Intensity Interval Training increases VO_{2max} significantly compared to moderate intensity training. [9] For reducing the BMI circuit training protocol is significantly effective. [10] Therefore, the objective of this study is to assess the effects of High Intensity Interval Training versus Circuit Training for 6 weeks on hormonal imbalance and VO_{2max} in women with PCOS.

METHODOLOGY:

Source of Data:

The source of data will be collected from patients with polycystic ovarian syndrome from A.P.J Abdul Kalam, college of physiotherapy, loni, Taluka-Rahata, district-Ahemadnagar-413736, and Maharashtra.

Method of collection of data

Type of Data: The data collected will be primary which will be collected from principal investigator.

Study Design: The study is a randomized clinical trial.

Sample size: 30participants.

Participants: female of age group 18-25 years

Sampling Method: Simple random convenient sampling.

Study Duration: 4 months

Equipments to be used:

Treadmill

Cycle Ergometer

Polar heart rate monitor (watch and belt)

Materials to be used:

Consent form

Pen and paper

Measuring tape

Polar Heart Rate monitor

12 inch stepper for Chester step test

Weighing machine

SELECTION CRITERIA:

Inclusion criteria: women who were diagnosed with PCOS, individuals willing to participate in the study, age group 18-25years old female

Exclusion criteria: women not willing to participate, women who are taking oral contraceptive or other medication, past history of cardiovascular complications, orthopedic complications or Pulmonary disease.

PROCEDURE:

Ethical form registration no. BPT/INT/2018/29

The participants were screened, and after finding their suitability according to the inclusion and exclusion criteria, they were requested to participate in the study and were also explained about the study and intervention .The participants were given detailed information about the nature and duration of study and the intervention being used in the language best understood by the participants. They were also encouraged to ask queries regarding the study, if any. An informed written consent form, previously approved by the institutional ethical committee of Pravara Institute of Medical Sciences was then obtained from the participants. The demographic data was obtained and a detailed assessment was done before starting with the intervention.

The primary outcome measure used in this study is the values of FSH and LH with their ratios. Invasive blood testing was done to measure the values. The women underwent the same test at the beginning (0 week) as well as the ending of the exercise protocol (6 weeks). The tests were done in the morning to avoid the influence of circadian variations. Participants did not perform any exercises 48hours before testing and were informed to avoid consumption of alcohol and nicotine. Due to the unpredictable nature of the menstrual cycles, it wasn't possible to control for menstrual cycle phases in most of the participants. however, few were tested on the 2nd day of the menstrual cycle. The post-testing of all the women were scheduled at the same time in the menstrual cycle as the baseline tests.

The other measure used in this study is Chester Step Test. The test was done in Dr. APJ Abdul Kalam College of Physiotherapy on the stepper with 12 inches high step. Polar heart rate monitor with the belt and watch were used to monitor and note the heart rate. The participants were informed not to consume alcohol or nicotine before the test at the baseline (0 week) as well the post-test (6 week). Participants were asked to have proper food before the test to avoid weakness or dizziness which might be felt during or after the test. The participants were explained the RPE and were asked to say "STOP" if they felt uncomfortable or dizzy while performing the test. The test was also stopped if the participant's heart rate exceeded the maximum heart rate which was calculated before starting the test.

Group A Intervention:

Group A was given High Intensity Interval training. The training protocol consists of 3 sessions/week for 6 weeks. The sessions were given on alternate day to avoid physical discomfort. Warm-up was done for few minute. The intensity for the HIIT protocol was 50-60% of HRR for 2 minutes followed by 1 minute of 85% HRR. The Heart Rate$_{max}$ was calculated by the formula,

HR_{max} = 206.9 - (Age/0.67)

HRR was calculated by the Karvonen Formula,

Target Heart Rate= HR_{rest} + [(HR_{max} - HR_{rest}) / intensity]

The training protocol for each session lasts for about 20 minutes followed by 5 minutes of cool down. The total duration for each training sessions will be 30 minutes. Polar heart rate monitor was used to note the heart rate.

Group B Intervention:

Group B was given Circuit Training for 3 sessions/week for 6 weeks. The Circuit have alternate aerobic (2minute) and strength (10 reps) components. In each session, there are 2 cycles of the Circuit Training. The total duration of the per session is 20 minutes with 5 minutes of warm up before the circuit and 5 minutes of cool down after the circuit is completed. In aerobic component, the intensity is ~70% of HRR which will be done on a treadmill and cycle Ergometer. The Target Heart Rate is calculated by **Karvonen Formula.** The Strength

component consists of strengthening exercises of all the major muscle groups such as biceps, quadriceps, abdominal muscles, calf muscles, etc. The exercises given in Strength component are, Push-ups (10reps), Planks (30seconds), squats (10reps), heel raising (10reps), crunches (10 reps), Twisted crunches (10 reps).

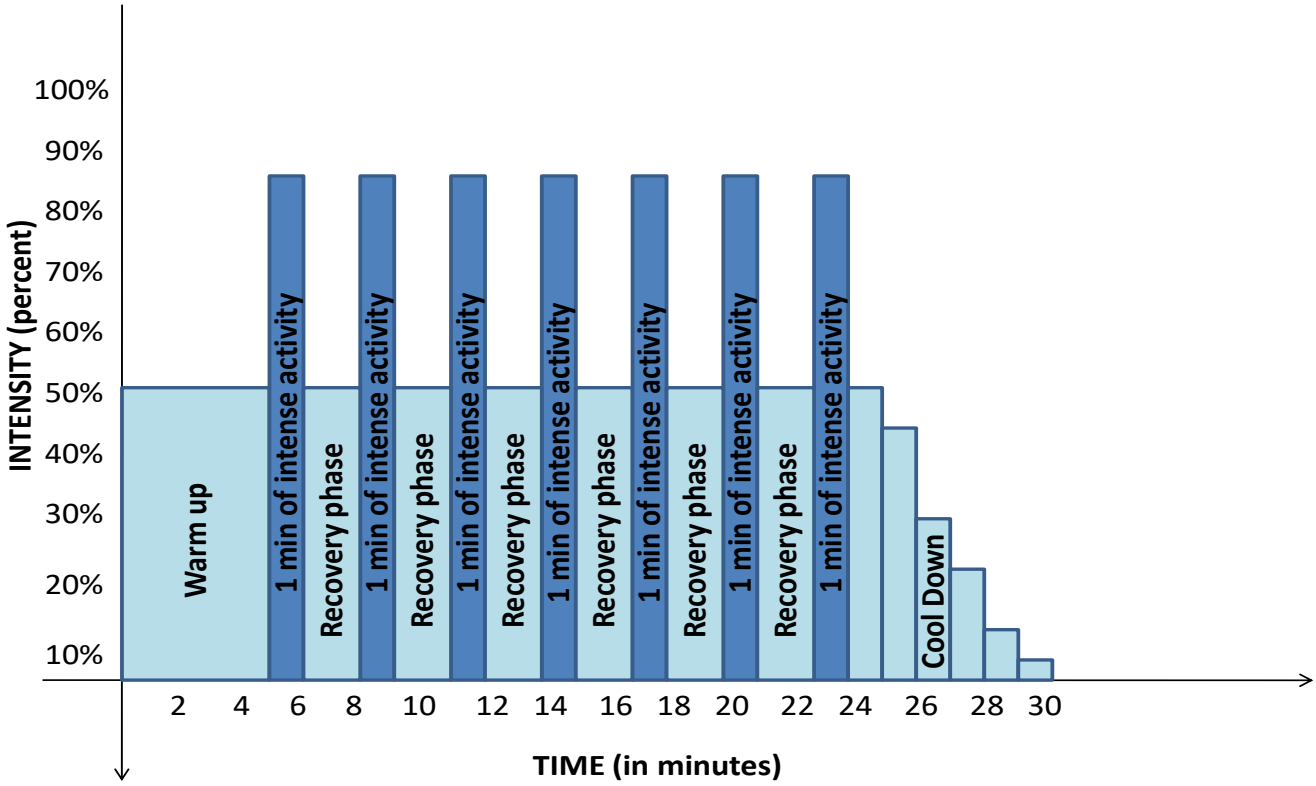

Fig 1: HIIT with 5 mins of warm up, 1 min of intense activity followed by 2 mins of recovery phase.

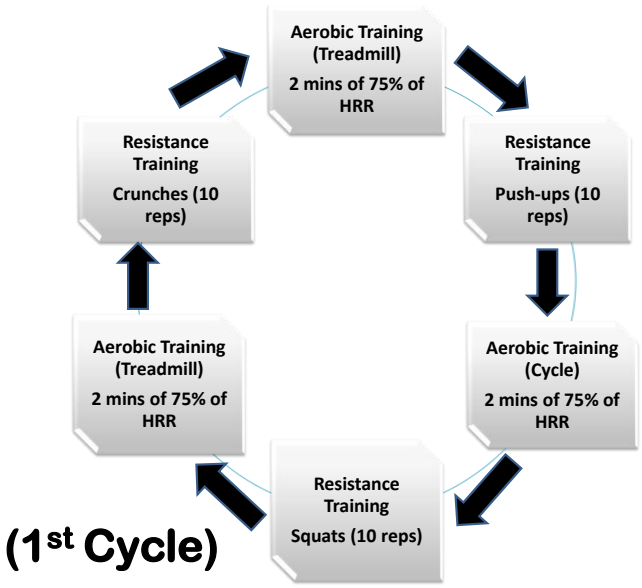

Fig 2: 1st cycle of CT with alternative aerobic activity followed by strength training.

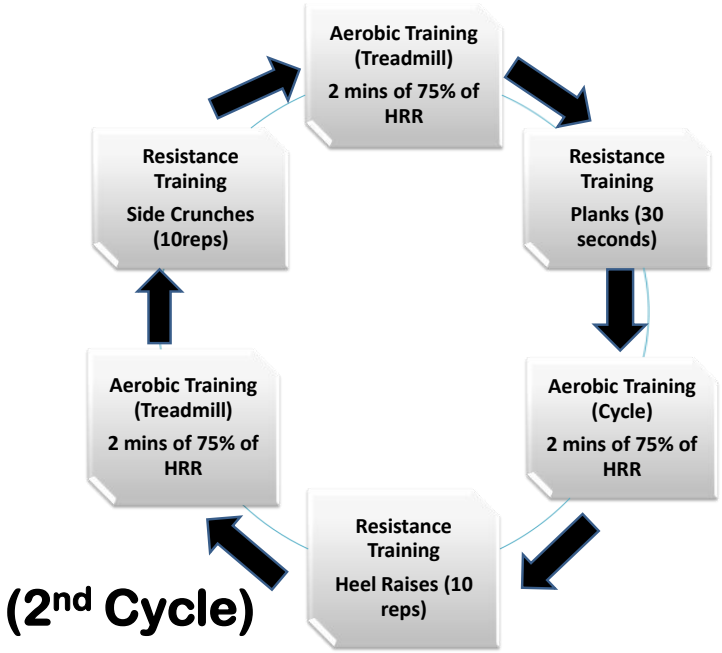

Fig 3: 2nd cycle of CT with alternative aerobic activity followed by strength training.

RESULT:

Outcome measure:	Pre-mean±SD	Post-mean±SD	P-value	t-value
Weight (kg)	61.6±7.091	61.06±9.917	0.5659	0.5807
BMI (kg/m^2)	25.8±3.13	25.7±3.044	0.1709	1.404
FSH (IU/mL)	3.91±1.454	3.78±1.349	0.6386	0.4747
LH (IU/mL)	10.2±3.237	8.75±2.913	0.0001	8.513
LH:FSH	2.94±1.512	2.801±1.993	0.6183	0.5037
Chester step test	24.3±3.019	29.4±2.581	0.0001	15.624

Table 1: Outcome measures at baseline(0 week) and after intervention (6 week) in women who completed HIIT (Group A).

Outcome measure	Pre-mean±SD	Post-mean±SD	P-value	t-value
Weight (kg)	58.83±8.952	58.33±8.503	0.0409	2.14
BMI (kg/m^2)	25.11±2.393	24.97±2.496	0.245	2.373
FSH (IU/mL)	4.282±1.564	4.118±1.211	0.2682	1.129
LH (IU/mL)	10.47±1.93	9.29±2.112	<0.005	7.299
LH:FSH ratio	2.83±1.32	2.91±1.147	0.77	0.2952
Chester step test	22.4±2.283	26.9±2.964	0.0001	10.019

Table 2: Outcome measures at baseline(0 week) and after intervention (6 week) in women who completed CT (Group B)

Outcome measures:	Group A mean±SD	Group B mean±SD	P-value	t-value
Weight; kg	61.06±9.917	58.33±8.503	0.2565	1.146
BMI; kg/m^2	25.3±3.041	24.97±2.496	0.6543	0.4501
FSH; UI/mL	3.789±1.349	4.118±1.211	0.3253	0.9921
LH; UI/mL	8.75±2.913	9.29±2.112	0.4127	0.8093
LH:FSH ratio	2.801±1.993	2.436±0.8643	0.3623	0.9218
Chester Step Test	29.4±2.581	26.9±2.964	0.0009	3.484

table 3: Comparison of mean and SD of group A and B with the P and t value

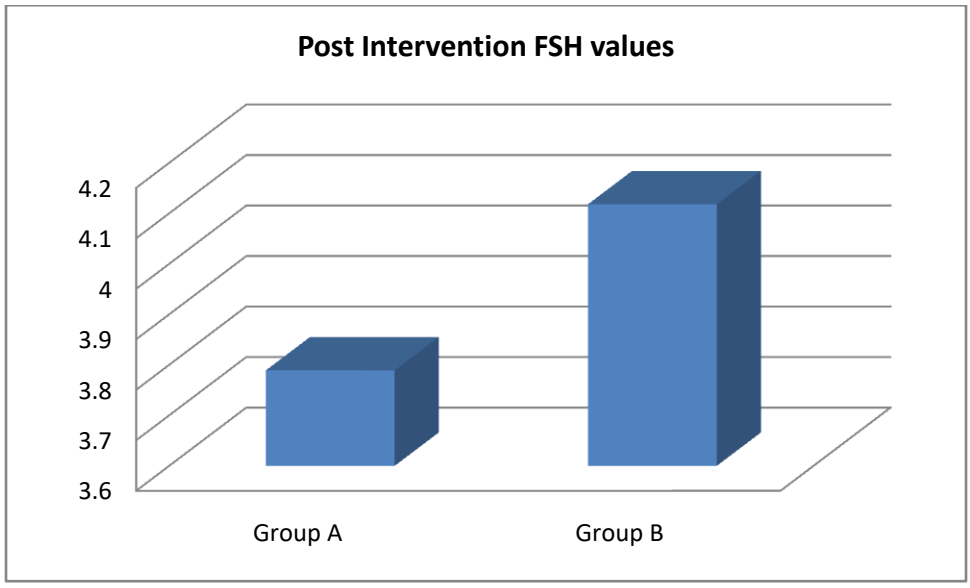

fig 8: Post-Intervention values in Group A and B.

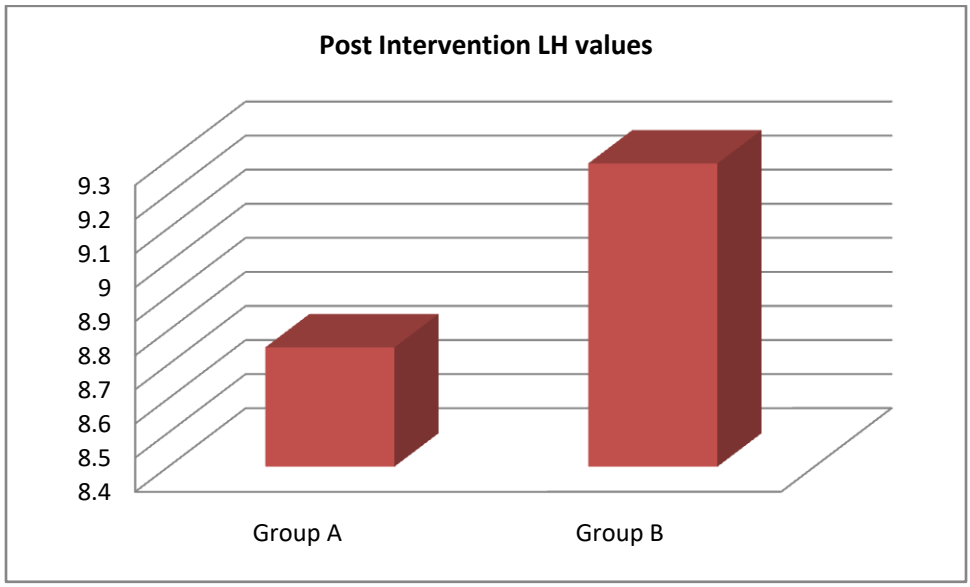

fig 9: Post-Intervention values of LH in group A and B.

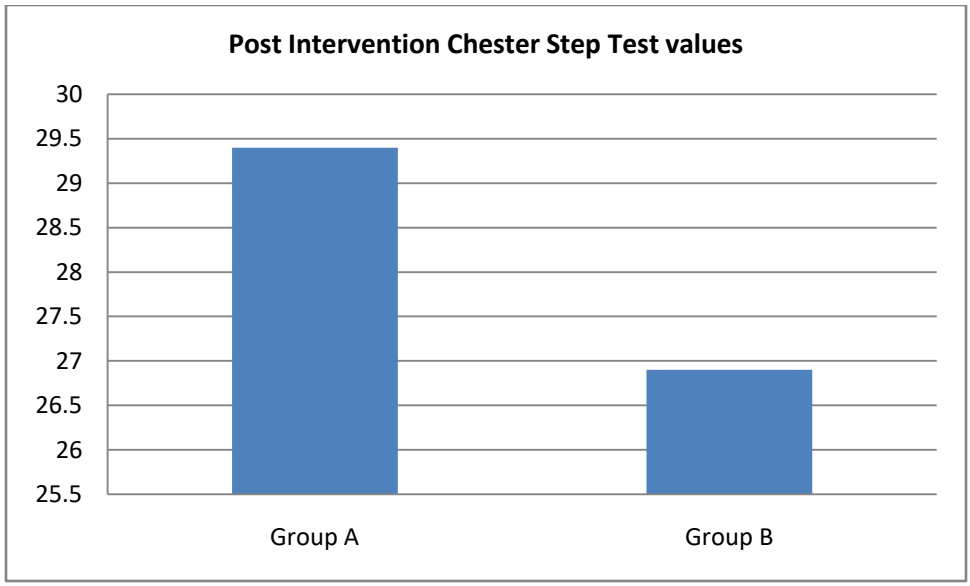

fig 10: Post-Intervention Chester Step Test values in Group A and B

During the study, there was no adverse events experienced by the participants. *GraphPad Instat version 3.06, 32 bit for Windows* was used for all the statistical analysis of the study. Paired t-test was used for in-between group analysis of the data and un-paired t-test was used for between groups analysis of the data with two-tail P value.

In group A, There was significant amount of improvement in LH values, the pre and post intervention mean scores were 10.02±3.23 and 8.75±2.91 respectively (p= <0.005; 95% CI). However, there was no significant difference in FSH values, the scores of baseline and post-intervention were 3.91±1.45 and 3.78±1.34 respectively (p= 0.63). There was noticeable difference seen in Chester Step Test values, with the baseline score of 24.3±3.019 and post-intervention score of 29.4±2.581 (p= <0.005). There was no statistically significant improvement seen in weight (p=0.5659; 95%CI) and BMI (p= 0.1709; 95% CI).

In group B, it was observed that there was significant improvement in LH values after the intervention compared to the baseline (p = 0.005; 95% CI) with pre-intervention score of 10.47±1.93 and post-intervention score of 9.29±2.112. There wasn't any change in the FSH values (p = 0.2682; 95% CI), 4.282±1.564 and 4.118±1.211 value of pre and post intervention respectively. Chester step test values were also improved (p = 0.0001; 95% CI) with pre and post

intervention score of 22.4±2.283 and 26.9±2.964 respectively. There was no statistically significant improvement observed in weight (p = 0.0409; 95% CI) and BMI (p = 0.245; 95% CI). When both the groups were compared the post intervention scores for LH in group A and group B, there was no statistically significant changes seen (0.4127). FSH remained constant throughout the study with hardly any difference observed in either of the two groups (p = 0.3253; 95% CI). Chester step test values improved after HIIT and Circuit training but it was more prominently improved in group A (p = 0.0009; 95% CI).

DISCUSSION:

The main finding of the study is the improvement in LH levels after both High Intensity Interval Training and Circuit Training, as well as the significant improvement in Chester Step Test (CST) values after both the interventions. We have demonstrated that 6 week long structured exercise program encouraged a significant improvement in LH values along with greatly improved cardiopulmonary endurance and fitness, although there wasn't significant difference in LH:FSH ratio. These improvements were observed without any major change in body weight and BMI of the participants. In this study, we observed that High Intensity Interval Training as well as Circuit Training proved to be equally efficient in improving the hormonal imbalance and cardiopulmonary fitness in women with Polycystic ovarian syndrome.

This study is one of the few studies done for hormonal imbalances in women with polycystic ovarian syndrome. Circuit Training compared with HIIT as independent interventions has never been tested in women suffering from Polycystic ovarian syndrome.

There was a significant amount of improvement in VO_2 values after both the interventions which leads to improvement in Insulin Resistance in PCOS which have been observed in a study that have successfully proved a significant correlation between exercise and VO_{2max} along with Insulin Resistance which has been improved after a 3-month long structured exercise program [6] Exercise benefits the overall symptoms of PCOD and help women to regulate their menstrual cycles. As FSH and LH values are essential part of diagnosing and treating women with PCOS, also there was correlations between LH value and Insulin Resistance the study involves

observation on LH value difference after High Intensity Interval Training and Circuit Training. In few studies, High Intensity Interval Training (HIIT) has caused significant difference in the insulin resistance and other components. [1] Along with HIIT other interventions such as Strength Training and Moderate Intensity Training has been compared with each other. Researchers has found that HIIT has superior benefits compared to other protocols. [1,2]

The effects of High Intensity Interval Training and Circuit Training which was observed in this study were because of adaptations of skeletal muscle. It was observed in a study that the endurance exercise encourages adaptations of skeletal muscles and exercise-induced peroxisome proliferator-activated receptor ϒ coactivator-1α (Pgc-1α) gene expression may play a important role in adaptive processes. [11]

There was a equal LH value decrement because of High Intensity Interval and Circuit Training both which was seen in our study which may have positive effects on Insulin Resistance, as it is suggested that Insulin facilitates pituitary to secrete more LH hormone and Insulin Resistance in Polycystic ovarian syndrome causes hyperinsulinaemia which leads the gonadotroph to hyper-secrete LH. [12] Oestrogens causes pituitary to become sensitive to gonadotrophin (Gn)RH, which causes elevated sensitivity and reserve of pituitary gland. Elevated circulating oestrone levels found in women with the PCOS results in hyper-secretion of LH. [12] Insulin Resistance was not measured in this study.

High Intensity Interval Training and Circuit Training both resulted in significant amount of drop in LH values which may cause fertility and reduce the chances of miscarriage as it was observed in a study which concluded that infertility and miscarriage is most significantly related to elevation of LH which is most probably due to disturbed timing of oocyte maturation. [12] In 1985, it was first demonstrated that there was significantly reduced rate of fertilization due to values of serum LH greater than one standard deviation above mean on the day of administration of hCG in the oocytes obtained from women who were undergoing vitro fertilization. [12]

This study strengthens the recommendation to adopt the aerobic training or circuit training as it causes reduction in cardio respiratory, metabolic and reproductive complications specially the

obese women affected with PCOS. In this study it has been seen that even though there wasn't significant amount of weight reduction, there was considerate amount of reduction in biochemical imbalance which will lead to improvements in menstrual cyclicity, ovulation and biochemical hyperandrogenism also it leads to improvement in glucose tolerance and eventually will reduce the risk of cardiovascular diseases in future. [13]

It was also observed that adherence to High Intensity Interval Training was more compared to Circuit Training due to the intense strengthening exercises in circuit and quick change from alternating aerobic and strength component. Along with this, HIIT was more enjoyable compared to Circuit Training. There was very no statistically significant improvement in weight as women need to continue the exercises for longer period for that to happen. A study showed that there was significant amount of difference in hormonal values and lipid profile without any change in weight after 10 weeks of exercise protocol which included aerobic training. [14] The study proves that there is no correlation between weight loss and improvement in cardiovascular and hormonal problems. There was no statistically significant amount of difference seen in both the groups. Group A as well as group B showed similar improvements in the women.

CONCLUSION:

In conclusion, this study showed that 6 weeks of exercise training improved the LH values which are affected in PCOS. It was observed that there wasn't any statistically significant changes in LH:FSH ratio. However, both the protocols are equally effective in reducing the LH values and improving overall cardiac fitness. Chester Step Test concluded that cardiopulmonary fitness was improved after both HIIT as well as CT, but it was evident that VO_2 was increased more in HIIT compared to CT. There were no changes in the body weight and BMI in any of the two groups. Further studies are needed to advance our conclusion and establish proper and accurate exercise training program for the women with PCOS.

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