Effect of Circuit Training on Inflammatory marker and Insulin resistance Among Young Adults with Polycystic Ovarian Syndrome- A Randomized Controlled trial

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Abstract: The present study was conducted to find the effect of circuit training on inflammatory marker and insulin resistance among young adults with PolyCystic Ovarian Syndrome. Habitual low-grade inflammation has been intertwined as a threat factor of endothelial dysfunction, atherosclerosis, and coronary heart disease and is linked to insulin resistance(IR) and abdominal rotundity. Diagnosed cases of PCOS were included in the study following gynecological examination . Samples were selected using random sampling technique into two groups. Blood evaluation of inflammatory marker and insulin resistance is taken us outcome measure. The collected data was subjected to statistical analysis by using mean, standard deviation,'t' test and non parametric test. Results reveal that circuit training as significant effect on insulin resistance than inflammatory marker. Eight weeks of Circuit training has a significant effect on insulin resistance and does not have a significant effect over inflammatory marker among young adults with PolyCystic Ovarian Syndrome

Key words: PolyCystic Ovarian Syndrome, fasting insulin, fasting glucose, Homeostatic Model Assessment of Insulin Resistance, inflammatory marker, C- reactive protein, circuit training.

Introduction:

About 5–15% of women in their reproductive age experience hormonal abnormalities, that can cause menstrual irregularities, ovarian cysts, infertility, and other health issues such as cardiovascular issues, type 2 diabetes mellitus (T2DM), and endometrial cancer .During the reproductive period, females are commonly affected by the complex and prevalent endocrine disorder known as Polycystic Ovarian Syndrome . Women who have PCOS may exhibit a variety of traits in the form of metabolic, reproductive, and psychological issue. World Health Organization (WHO) estimates that 4 to 26% of women worldwide is affected by PCOS. It is as high as 10-12% in India.

PCOS is characterized by hyperandrogenism (hirsutism, acne, and alopecia) and menstrual abnormalities (secondary amenorrhea, oligomenorrhea, irregular periods, and excessive menstrual flow).Pathophysiology of PCOS is insulin resistance (IR) and hyperandrogenism, and the condition's long-term metabolic repercussions are attributed to chronic low-grade inflammation. Different criteria can be used to diagnose PCOS, but

according to worldwide evidence-based recommendations, the Rotterdam criteria is the widely accepted and practiced.

A recent study discovered that the majority of PCOS women experience insulin resistance, which results in hyperinsulinemia and has an impact on lipid metabolism, androgen production, and protein synthesis .Through the synthesis of adipocytokines, adipose tissue plays a role in the control of insulin sensitivity, lipid metabolism, inflammatory reactions, and reproduction.

Inflammatory indicators such High-Sensitive C-Reactive Protein (HS-CRP), Interleukin 6 (IL-6), and Tumour Necrosis Factor Alpha (TNF-α) are elevated in women with PCOS.Visceral adipose tissue in PCOS women has enhanced catecholamine-mediated lipolysis, which promotes the growth of insulin resistance and inflammation.

Decreased hyperandrogenism, menstrual dysfunction management, and long-term metabolic repercussions regulation are among the treatment objectives for PCOS. The initial goal of treatment is to improve one's lifestyle and lose weight. The pharmaceutical therapy of PCOS is oral contraceptives (OCs) .

Among physiotherapy management, aerobic exercise has the highest evidence for the management of PCOS. Resisted training employed in several trials requires more added research to prove its benefits .Circuit training over PCOS is still under drift, which need to be studied in a better way .Therefore, the focus of this study is to find the effect of circuit training on inflammatory marker and insulin resistance among young adults with Polycystic Ovarian Syndrome.

Statement of problem:

Effect of Circuit Training on Inflammatory marker and Insulin resistance among young adults with polycystic ovarian syndrome-A Randomized control trail

Objectives of the study:

- To determine the effect of Circuit training on High Sensitive C Reactive Protein among young adults with PolyCystic Ovarian Syndrome.
- To determine the effect of Circuit training on Insulin Resistance among young adults with PolyCystic Ovarian Syndrome

Hypothesis:

Based on the above mentioned objectives the following hypothesis were formulated

Alternate Hypothesis:

- There will be an effect of circuit training on inflammatory marker and insulin resistance in young adults with PCOS.

Null Hypothesis:

- There will be no effect of circuit training on inflammatory marker and insulin resistance in young adults with PCOS.

Operational Definitions:

Inflammatory Marker: Inflammatory marker in the present study represent High Sensitive C Reactive Protein (HSCRP)

Insulin Resistance: Insulin resistance in the present study represent HOMAIR (fasting insulin, fasting glucose)

Delimitations of the Study

Keeping in view the availability of time, budget schedule and limited resources, the present study has been delimited to:

1. Diagonsed case of PolyCystic Ovarian Syndrome , age of 18-24 years .
2. Students from Sri Ramachandra college of physiotherapy, Sri Ramachandra college of nursing, Department of obstetrics and gynecology.

Methodology: Keeping in view the research evidences, objectives and hypothesis, descriptive survey method was used for sample collection.

Sample: In the first phase samples were recruited via google forms containing 3 sections - demographic data, hirsutism, IPAQ. The age of the subjects between 18 to 24 years. Totally 300 participants were invited for gynecological examination in the outpatient department of gynecology. 90 participants with menstrual irregularity taken up for further investigation.36 participants were found to be classical case of PCOS Took them for randomization In the second phase 30 reinterred, 6 no response.

Physical activity recommendation/aerobic exercises:

WHO recommends adults of 18-24 years should engage in at least 150 to 300 minutes of moderate-intensity aerobic activity, or 75 to 150 minutes of vigorous-intensity aerobic activity, or an equivalent combination of both in a week .Increase the time of physical activity and be active.

Intervention group: Group B, the intervention is circuit training. The exercise sessions are through, group therapy with direct sessions and 5-8 participants per group. Exercise duration is one hour a day, consist of 10 minutes of warm up,40 minutes of exercise,10 minutes of cool down. 40 minutes of training sessions is divided into circuits consisting of 10 exercises (5 aerobic and 5 body weight resisted exercises).

Tools Used: Blood samples were taken from all the subjects and the following were measured

1.Fasting Insulin(FI)
2.Fasting Glucose(FG)
3.High Sensitive C Reactive Protien(HSCRP)

Anthropometric measures such as BMI, WHR, body fat percentage were also measured

Statistical techniques employed: Statistical analysis by SPSS software version 28 by computing mean, SD and test of significance(t-test), non parametric(Mann Whitney U test).

Figure 1: Pre and post test measure of Body Mass Index (BMI), Waist Hip Ratio (WHR), body fat percentage, HOMAIR in control group

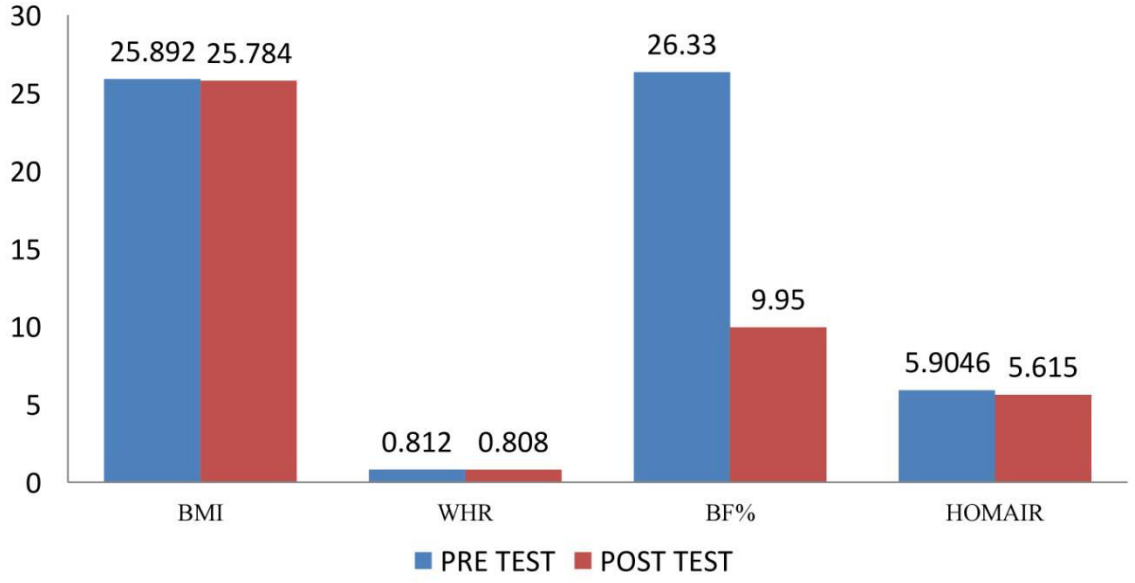


Figure 2: Pre and post measure of inflammatory marker in control group

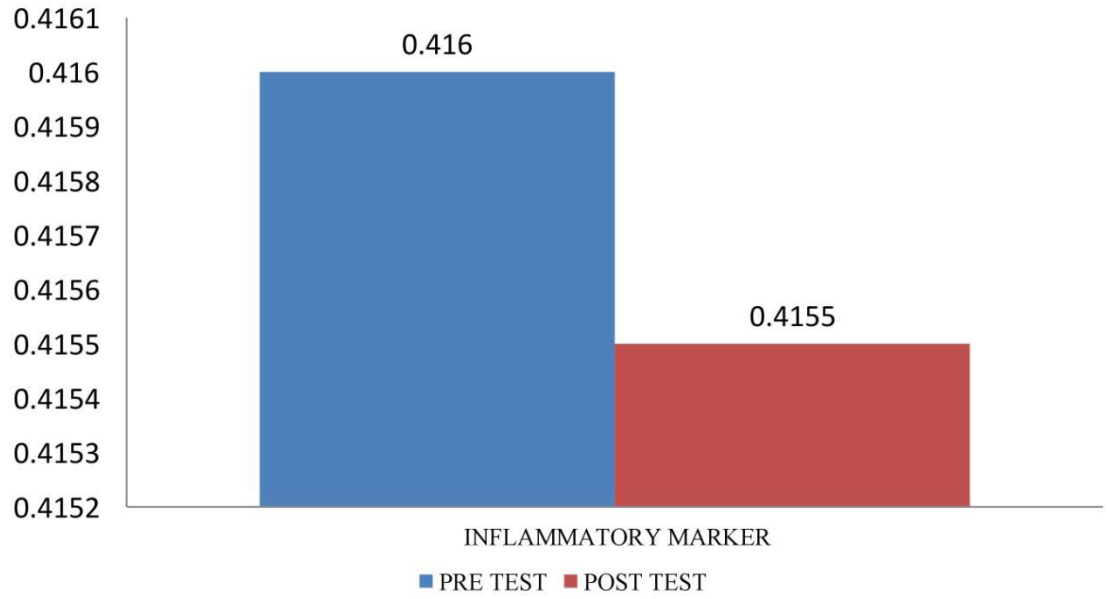


Figure 3: Pre and post test measure of Body Mass Index (BMI),Waist Hip Ratio (WHR),body fat percentage, HOMAIR in intervention group

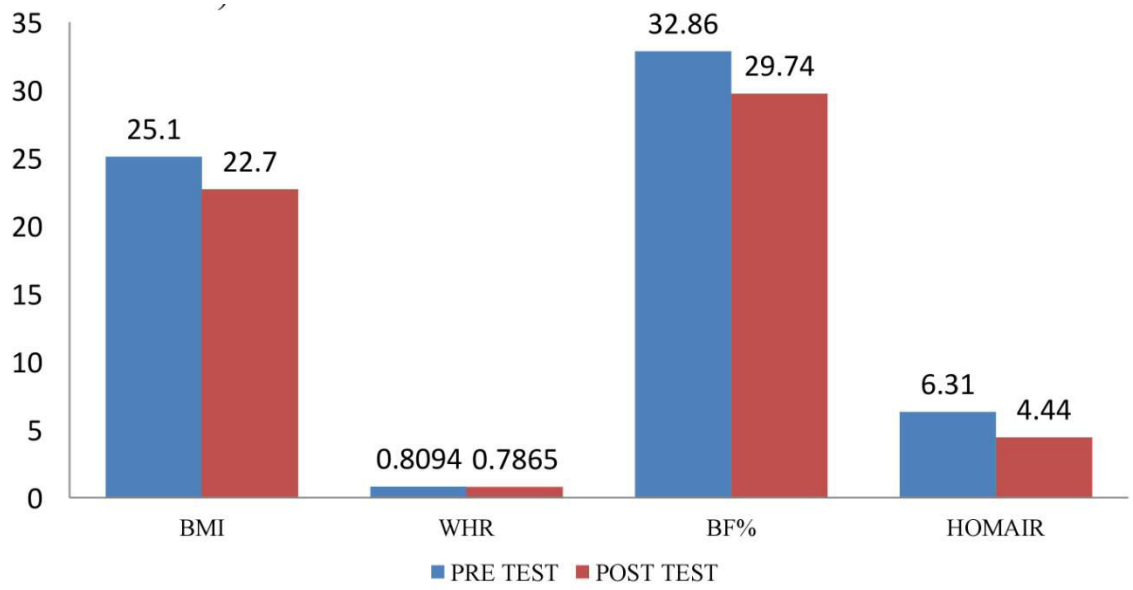


Figure 4: Pre and post test measure of inflammatory marker of intervention group

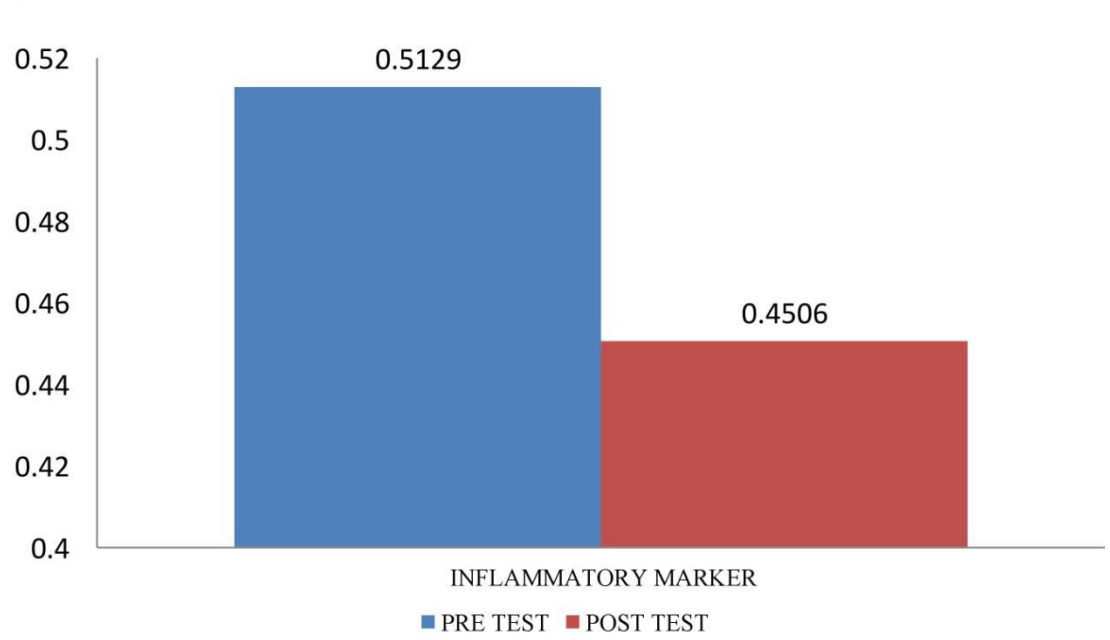


Figure 5: Comparison of post test measure of Body Mass Index (BMI), Waist Hip Ratio(WHR),body fat percentage, HOMAIR in control and intervention groups

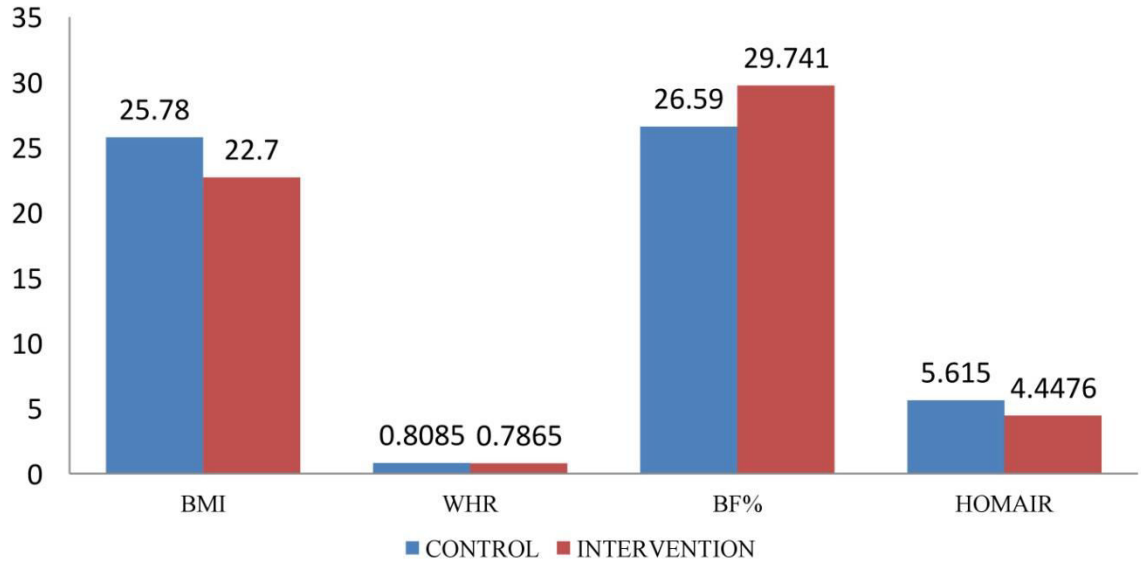
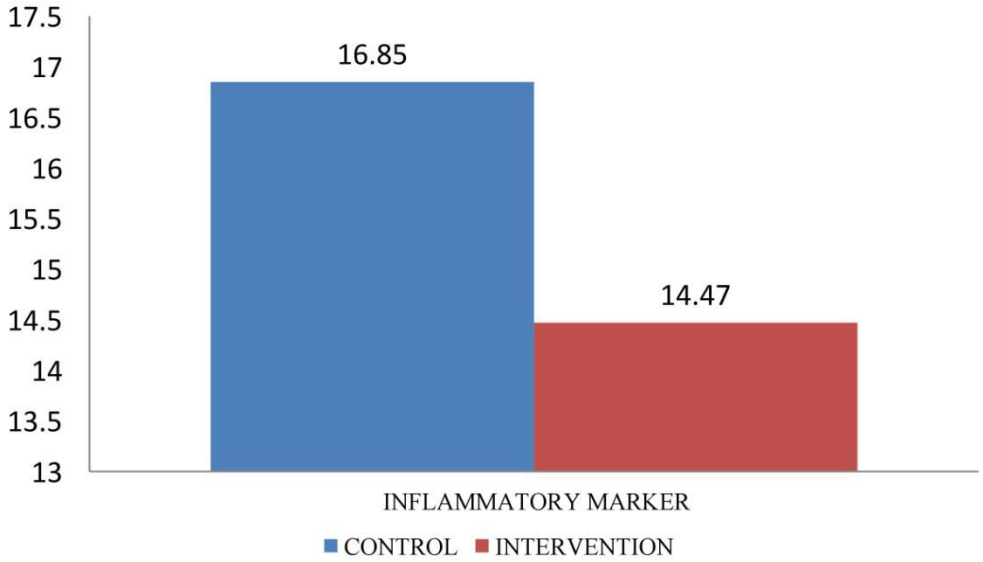


Figure 6: Comparison of pre and post test measure of inflammatory marker between control and intervention group



Interpretation of Data:

Table 1 describes baseline characteristic of control and intervention group. The mean Body Mass Index in control group is 25(4.1). Mean WHR of the participants belonging to control group is 0.812(0.066). Mean body fat percentage of control group is 26.33(9.77). Mean of Inflammatory marker of control group is 0.462(0.502).Mean of HOMAIR of control group is 5.9(1.04).Mean of Intervention group Body Mass Index is 25.1(6.5), Waist Hip Ratio is 32.86(9.57), body fat percentage is 32.86(9.57), Inflammatory marker is 0.513(0.56) and of HOMAIR is 6.31(1.6).

Table 2 describes pre and post test measures of Body Mass Index, Waist Hip Ratio, body fat percentage , Inflammatory marker and HOMAIR of Control Group

The mean of pre test BMI is 25.892(4.12) and of post test 25.784(4.278).The significance of P value 0.729.This shows clinical significance of 0.1 and there is no statistical significance. The mean of pre test measure of WHR is 0.812(0.663) and of post test 0.808(0.066).The significance of P value 0.209.This shows clinical significance of 0.004 and there is no statistical significance. The mean of pre test of body fat percentage is 26.33(9.77) and of post test 26.59(9.95).There is no clinical as well as statistical significance. The mean of pre test of Inflammatory marker is 0.4616(0.502) and of post test 0.4155(0.47).The significance of P value is 0.387.There is clinical significance of 0.046 and no statistical significance. The mean of HOMAIR pre test is 5.904(1.046) and of post test 5.615(0.995) There is a clinical significance 0.2 and no statistical significance.

Table 3 describes pre and post test measures of Body Mass Index, Waist Hip Ratio, Body fat percentage, Inflammatory marker and HOMAIR of Intervention group

The mean of Pre test BMI is 251(6.5403) and of post test 22.7(5.7229).The significance of P value 0<0.001.This shows clinical and statistical significance. The mean of Pre test WHR is 0.8094(0.0717) and of Post test 0.7865(0.0675).The significance of P value is <0.001 This shows clinical and statistical significance. The mean of pre test body fat percentage is 32.859(9.5752) and of post test 29.74(8.99).There exist clinical as well as statistical significance. The mean of Pre test of Inflammatory marker is 0.5129(0.5599) and of post test 0.4506(0.6495).The significance of P value 0.84.There is clinical significance of 0.0623 and no statistical significance. The mean of HOMAIR pre test is 6.31(1.87) and of post test 4.44(1.31) The significance of P value <0.001.There is a clinical and statistical significance.

Table 4 Comparison of post test measure of Body Mass Index, Waist Hip Ratio, Body fat percentage, and HOMAIR between Control and Intervention group

The mean of Post test BMI of control group is 25.785(4.2784) and of intervention group is 22.706(5.7229) .The significance of P value is 0.116 .This shows clinical significance and no statistical significance. The mean of Post test WHR of control group is 0.8085(0.0668) and of Post test of intervention group 0.7865(0.0675).The significance of P value 0.382. The mean of Post test of Body Fat Percentage of control group is 26.592(9.9559) and of post test of intervention group is 29.74(8.7472).The significance of P value is 0.365. The mean of HOMAIR Post test of Control group is 5.615(0.995) and of post test 4.447(1.31) The significance of P value >0.01.There exist a clinical and statistical significance.

Table 5 shows post test measure of Inflammatory marker between Control and Intervention groups The mean rank is 14.47 (23.635) , Mann-Whitney U test 93.The significance of P value 0.483.

There is a significant effect of Circuit training on insulin resistance in intervention groups. But there is clinical significance and no statistical significance was noted when compared the control and intervention groups.. There is no significant effect of Circuit training on Inflammatory marker.

PCOS is an endocrine abnormality found mostly in childbearing age of women In this study 17 subjects were trained with Circuit training and 13 subjects were trained with Physical Activity Recommendation. No dropouts were noted. Insulin resistance may result in increased synthesis of acute-phase proteins such as CRP. Cytokines are yet another potential mechanism IL-1, IL-6, and TNF-, in particular, may exert stimulating impact of acute-phase proteins on hepatic protein synthesis

Inflammatory Marker:

This study result shows no statistically significant difference between pre and post test measure of inflammatory marker in both the groups also there was no statistical significant difference between two groups after eight week of intervention.($p>0.05$)

CRP is an indicator of systemic inflammation. This occurs due to an increase in pro-inflammatory cytokines, namely IL-6 which is derived from adipocytes **(Kim, Li and Sim, 2020)**. Increased IL-6 secretion which is an adipocytokine secreted by adipocytes will trigger an increase in lipolytic enzymes and insulin resistance which will increase CRP levels.

Exercise can reduce the inflammatory process by increasing protein synthesis and fat burning (**Michigan, Johnson and Master, 2011**) The levels of inflammatory cytokines are inversely related to abdominal lipolysis and the expression of lipase-sensitive hormones so that a decrease in inflammatory cytokines is expected to increase fat burning and lose weight Apart from the type of muscle contraction, the increase in IL-6 is directly related to exercise intensity, duration, and mass of muscle recruited[11]

Fedewa et al. found that CRP had a significant and small decrease following training,. regular exercise presents a global positive anti-inflammatory effect, however high-intensity exercise, especially when performed with reduced recovery periods has significant effect over inflammatory markers

This study results go in hand with **Kwi Baek Kim et al** who did a study on female population and discussed that CRP and IL-6 level were not reduced after a 12 week of Circuit training . Physiology suggest that decrease in IL-6 promote reduction of CRP .There were improvement in anthropometric measurements between groups, but no difference in blood inflammatory marker.

In our study we observed that CRP was significantly higher in Obese PCOS individual than lean ,normal BMI PCOS individuals. This study result goes in hand with **Asli Nehir Aytan et al** did a prospective study on obese and non obese PCOS and healthy individuals to determine the levels of circulating inflammatory, found that obese PCOS women had significantly increased level of CRP and glycoprotein than lean PCOS and healthy individual. But when mean are compared circuit training has a better clinical significance in intervention(0.06) than control(0.04).Thus future research with circuit training for more than 12 week can yield more significant results.

HOMAIR:

Insulin resistance (IR) is a key etiological feature in PCOS contributing significantly to the reproductive and metabolic complications of the disorder. This study result shows statistically significant improvement between pre and post test measure of HOMAIR in both the groups and also there is a significant difference between two groups which shows 8 weeks of circuit training reduces the insulin resistance significantly.

Regular exercise helps reduce body fat, which raises cellular insulin sensitivity, even though excess waist fat contributes to insulin resistance. After exercise, glucose uptake can stay elevated for up to 120 minutes because of an increase in the presence of GLUT4 (glucose transporter type 4) in T-tubules and plasma membranes. After exercise, insulin sensitivity rises for at least 16 hours. A single bout of moderate-intensity exercise has been shown to increase glucose uptake by at least 40%, according to Perseghin G et al. [20]. Exercise also encourages weight loss, which counteracts the insulin resistance. Therefore, the advantages of regular exercise on insulin resistance would be amplified if linked to a reduction in body fat.

This study results goes in hand with **Ramin Shabani et al** who did a study on obese population to find the effect of circuit training. After a period of 12 weeks there were statistical significance . HOMAIR index decreased in the intervention group and **Alireza Safarzade1 et al** who did a study and discussed that 8 weeks of circuit training in obese men decreased insulin resistance .Improved BMI, WHR and body fat %.

Najmeh Rezaeinezhad et al did a study on male population, randomly divided into 5 groups one control and four intervention group performing circuit training at various intensity. This study result shows that circuit training improves insulin resistance following 6 weeks of circuit training programme. **Gustavo Osorio Zanina** Et al did a study on overweight women to find a effect of 24 week circuit training, conclude that there is a significance effect in HOMAIR, anthropometric measures.

Correlation of circulating inflammatory markers with obesity and insulin resistance are common findings in PCOS .It is still not known whether these parameters of chronic inflammation are primary or secondary to obesity and/or insulin resistance especially since short term administration of IL-6 in humans failed to impair insulin sensitivity .The adipose tissue plays a central role in the relationship between cytokines and insulin resistance. So 8 weeks of circuit training produces a significant changes in HOMAIR

Anthropometric Measurements:

The most common characteristic of PCOS is obesity, which as a impact on reproductive, gestational, metabolic and psychological well being of the individual. A women is considered obese when the body mass index (BMI) is equal to or greater than 25 kg/m2 by WHO (2000). Anthropometric measurements are the non-invasive quantitative measurements of the body consisting of height, weight, body mass index (BMI), body circumferences, body fat percentage .Many studies have shown that anthropometric measurements reduced significantly following circuit training.

This study result shows statistically significant improvement between pre and post test measure of BMI,WHR,BF% in intervention group. No statistical significance was observed between the groups and within the control group.

S. Christy Sopna1Et al did a study in obese PCOS population and discussed that 6 weeks of circuit training had a effect on anthropometric measures. Minimal Clinical Important Difference was more in the intervention group than the control. **Ji-Woon Kim, Et al** did a study on college going female and discussed that 12 weeks of circuit training had significance on body mass index, body fat percentage ,low density lipoprotein shows statistical significance than control group

Irene-Chrysovalanto Themistocleous1 Et al did a Randomised control trail study on overweight and obese females and discussed that 8 weeks of circuit training had significant effect on BMI, Body Fat Percentage and cardiorespiratory fitness than control group **Young-Gyun Seo et al** did a quasi experimental study ,this study result goes in hand with our study. Found that after 6 months of circuit

training BMI showed statistical significance, where as no significance was noted in the control group. Body fat percentage showed no clinical as well as statistical significance.

Therefore 8 weeks of circuit training as significant effect in improving anthropometric measures in young adults with PCOS .

Conclusion of the study:

Eight weeks of Circuit training has a significant effect on insulin resistance and does not have a significant effect over inflammatory marker among young adults with PolyCystic Ovarian Syndrome

Educational Implication:

1. The knowledge about exercise and benefits to be taught to students.
2. Effects of increased inflammatory marker and insulin resistance need to be educated , to prevent its long term complication.

Suggestions for further research:

1. Other inflammatory markers like IL 6 and TNF-alpha can also be studied
2. New markers of insulin resistance such as resistin,leptin, ghrelin ,kisspetin can also studied.
3. Studies of longer duration can also done

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Analysis of Data:

Table1: Baseline characteristic of Body Mass Index (BMI), Waist Hip Ratio (WHR), body fat percentage ,inflammatory marker, HOMAIR (HOMEOSTATIC MODEL ASSESSMENT OF INSULIN RESISTANCE)

	CONTROL	INTERVENTION
VARIABLE	MEAN±SD	MEAN±SD
BODY MASS INDEX	25.89±4.1	25.1±6.5
WAIST HIP RATIO	0.812±0.066	0.809±0.072
BODY FAT PERCENTAGE	26.33±9.77	32.86±9.57
INFLAMMATORY MARKER	0.462±0.502	0.513±0.56
HOMAIR	5.9±1.04	6.31±1.6

Table 2: Pre and post test measures of Body Mass Index (Bmi), Waist Hip Ratio (WHR), body fat percentage, inflammatory marker, HOMAIR in control group

VARIABLES	N	PRE TEST		POST TEST		t	P VALUE
		MEAN	SD	MEAN	SD		
BODY MASS INDEX	13	25.892	4.127	25.784	4.278	0.355	0.729
WAIST HIP RATIO	13	0.812	0.663	0.808	0.066	0.1015	0.209
BODY FAT PERCENTAGE	13	26.33	9.77	26.59	9.95	-1.286	0.233
INFLAMMATORY MARKER	13	0.4616	0.502	0.4155	0.47	0.898	0.387
HOMAIR	13	5.9046	1.046	5.615	0.995	2.123	0.055

Table 3: Pre and post test measures of Body Mass Index (BMI), Waist Hip Ratio (WHR), body fat percentage, inflammatory marker, HOMAIR in intervention group

VARIABLES	N	PRE TEST		POST TEST		t	P VALUE
		MEAN	SD	MEAN	SD		
BODY MASS INDEX	17	25.1	6.5403	22.7	5.7229	9.654	<0.001
WAIST HIP RATIO	17	0.8094	0.0717	0.7865	0.0675	12.257	<0.001
BODY FAT PERCENTAGE	17	32.859	9.5752	29.74	8.7472	8.999	<0.001
INFLAMMATORY MARKER	17	0.5129	0.5599	0.4506	0.6495	1.84	0.84
HOMAIR	17	6.31	1.87	4.44	1.31	12.272	<0.001

Table 4: Comparison of post test measures of Body Mass Index(BMI), Waist Hip Ratio(WHR), body fat percentage and HOMAIR (Homeostatic Model Assessment of Insulin Resistance) between control and intervention groups

VARIABLES	N	CONTROL GROUP		INTERVENTION GROUP		t	P VALUE
		MEAN	SD	MEAN	SD		
BODY MASS INDEX	30	25.785	4.2784	22.706	5.7229	1.621	0.116
WAIST HIP RATIO	30	0.8085	0.0668	0.7865	0.0675	0.888	0.382
BODY FAT PERCENTAGE	30	26.592	9.9559	29.741	8.7472	0.921	0.365
HOMAIR	30	5.615	0.995	4.4476	1.31	2.66	0.1

Table 5: Comparison Of Post Test Measure Of Inflammatory Marker Between Control And Intervention Groups

VARIABLES	N	MEAN RANK	STANDARD ERROR	Mann-Whitney U Test	P VALUE
INFLAMMATORY MARKER	30	14.47	23.635	93	0.483