

## Effect of High Intensity Interval Training on Body Mass Index, Plasma Glucose and Insulin Among Individuals with Polycystic Ovary Syndrome Living in the South Indian Coast

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### Key Words:

High intensity interval training, Polycystic ovary syndrome, Body mass index, Plasma glucose, Insulin

### Abstract:

**BACKGROUND** Coastal life may offer chances for physical exercise, such as swimming or strolling on the beach, which can be helpful for treating PCOS. 15% to 20% of women of reproductive age are affected by the common metabolic and endocrine disorder known as polycystic ovarian syndrome (PCOS). It is linked to an increase in the occurrence of a number of clinical issues, such as infertility, insulin resistance, menstrual irregularities, and obesity. For women with PCOS, The most common methods remain dietary adjustments and weight loss.. Any form of special education may benefit this category of patients as intense physiotherapy.

**AIM:** The present investigation sought to determine how high-intensity interval training affected body mass index, plasma glucose and insulin levels in people with polycystic ovarian syndrome..

**METHODOLOGY:** The population comprised of 30 individuals who were aged between 18 to 40 and diagnosed with PCOS were included and divided into two groups i.e., group A -(experimental group) (n=15) and group B - (control group) (n=15). Group A participants performed high intensity interval training along with medications while group B participants followed the medications alone. Intervention was done for 40 minutes every day, 4 days per week for the duration of 6 weeks. Body mass index, plasma venous glucose and insulin were measured before and after the intervention period.

**RESULTS:** Group A (experimental group) has shown significant reduction in body mass index, plasma glucose and insulin compared to the baseline ( $p < 0.05$ ). However, group B (the control group) did not experience any significant changes in body mass index, plasma glucose, or insulin.) ( $p > 0.05$ ).

**CONCLUSION:** In polycystic ovarian syndrome patients, high-intensity interval exercise improved metabolic health and body weight.

### 1. Introduction:

Coastal life may offer chances for physical exercise, such as swimming or strolling on the beach, which can be helpful for treating PCOS. Furthermore, spending time outdoors and close to the ocean may be advantageous to mental health and general wellbeing, which can be advantageous for controlling the stress that frequently goes along with PCOS. A prevalent

metabolic and endocrine condition called polycystic ovary syndrome (PCOS) affects 15 to 20% of women of reproductive age <sup>[1]</sup>. Stein- Leventhal syndrome, the original name of this illness, was identified in 1935. In polycystic ovary syndrome, the ovaries create an excessive number of androgens. Polycystic ovarian syndrome refers to the condition in which the ovaries generate a large number of little cysts. Women with PCOS are more likely to develop, menstrual

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irregularity, acne, hirsutism, obesity, type 2 diabetes, cardiovascular diseases, infertility and have a greater risk of developing anxiety, depression and mood disorder [2].

Anovulation, a high level of androgen levels and polycystic ovaries are the three main diagnostic characteristics of PCOS, according to the Rotterdam criteria. Two of the three features must be present in the patient for PCOS to be diagnosed. Up to 90% of women with PCOS experience some form of anovulation, making it the most common phenotype among PCOS patients [3]. It frequently manifests as oligomenorrhea, or having fewer than eight menstrual cycles in a year. Usually, one and a half years following menarche, a regular bleeding pattern develops, if it takes longer than three years, PCOS must be suspected [4]. With a prevalence of 15% which occurs in almost all races and nationalities and is the leading cause of infertility, in India, the prevalence of PCOS is from 9.13 to 36%, approximately 50% PCOS women are overweight or obese and most of them have the abdominal phenotype [5]. In addition to concerns about infertility, hyperandrogenism and menstrual irregularity, PCOS is also recognized as a metabolic disorder as these women have increased prevalence of insulin resistance, hyperinsulinemia, dyslipidemia and low-grade inflammation [6] [7] [8]. Women with PCOS are at a two to eight times greater risk of developing impaired glucose tolerance and type 2 diabetes mellitus compared to women without PCOS [9]. The prevalence of obesity is also higher in PCOS women, and even lean women with PCOS frequently show excessive body fat and central adiposity [10] [11].

Women's body weight changes during the course of their lives due to a variety of factors, including physical activity, ambient circumstances, diet, psychological, social problems, and environmental conditions. Weight loss of 5 to 10% has demonstrated good outcomes on reproductive, metabolic, and psychological levels in women with polycystic ovarian syndrome (PCOS), where obesity has detrimental impact on clinical characteristics. For PCOS-afflicted women, losing weight requires a nutritious diet, enhancing physical exercise, and altering dysfunctional mental habits.

A lifestyle intervention comprising of dietary modifications and exercise is advised to manage PCOS and enhance the quality of life, mitigate cardiovascular

and metabolic abnormalities that may develop as a result of the condition. For PCOS-afflicted women, exercise training is a proven therapy for controlling and avoiding chronic illnesses. To enhance overall health, hormonal and metabolic results, and general quality of life, the international evidence-based guidelines advocate lifestyle therapies, comprising exercise training and food, as the primary line of therapy.

A time-effective substitute for typical exercise regimens that call for low to moderate intensity training over a protracted period of time is high-intensity interval training (HIIT). HIIT allows sedentary overweight/obese people enough time to recover and undertake additional high-intensity bouts since it is performed above the lactate threshold, near the maximum oxygen consumption (VO<sub>2</sub> max), and with intermittent intervals of rest. HIIT might have the biggest effects on insulin resistance, composition of the body, and cardiovascular health.

For PCOS-afflicted women, a weekly minimum of 120 minutes of vigorous intensity is required for positive health effects. A possible method for bringing about the metabolic changes usually associated with low-intensity exercise training has been suggested: HIIT. HIIT has been associated with a number of skeletal muscle adaptations that enhance glucose tolerance and boost skeletal muscle fat oxidation.

According to reports in the scientific literature, HIIT exercise has highly beneficial impacts on PCOS, diabetes, and cardiometabolic disorders. Therefore, the purpose of this study was to look at how high-intensity interval training affected women with PCOS's body mass index, blood sugar, and insulin levels.<sup>12-22</sup>.

## 2. Materials and Methods:

In order to determine how high intensity interval training affects body mass index, plasma glucose, and insulin levels in people with polycystic ovarian syndrome, the current study used a quasi-experimental design. Thirty women who were aged between 18 and 40 and diagnosed with PCOS were selected and enrolled in this study. The diagnosis was made by the gynecologists in the Department of Obstetrics & Gynecology OPD of our hospital. Participants included for the study were women with PCOS aged from 18 to 40, BMI levels ranged between 25 and 35, and participants who were willing to participate in the study

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till the completion. The exclusion criteria were participants with thyroid dysfunction, hyperprolactinemia, uncontrolled hypertension, cardiac illness, cognitive dysfunction, psychiatric condition, any medical condition that would be a contra indication to exercise, participants under antihypertensives, lipid lowering agents and any medications which can alter the results of laboratory tests. Participants' informed consent was acquired. The selection criteria were met by a total of 30 individuals, who were split into two groups, group A (the experimental group) and group B (the control group). Group A (n=15) and Group B (n=15) each include 15 participants. Before the first exercise training session began, baseline measurements of body mass index, fasting plasma glucose, and fasting insulin were taken and evaluated. We did not advise the participants to change their diets in any way. The participants were told to stick to their usual eating habits without any advice or limits about calorie intake.

Experimental group participants were performed HIIT for a period of 6 weeks along with the recommended medications while the control group participants were recommended to follow the medications alone. Participants in the experimental group completed a series of high-intensity interval training activities, including jumping jacks, high knees, mountain climbers, rear lunges, and plank taps. These exercise routines were followed for a total of six weeks. Four

days a week for six weeks, each practise lasted 40 minutes, including warm-up and cool-down periods. All of the final indicators were reviewed for both groups upon completion of the 6-week exercise regimen was complete.

### 3. Statistical Analysis:

Descriptive statistics were used to describe continuous variables (mean, standard deviation). The Shapiro – Wilk test was used to determine data normality and the data were normally distributed. A paired t test was performed for within group analysis of body mass index (BMI), plasma glucose and insulin. The statistical significance level was determined as 0.05. Analyzes were performed using SPSS software 17.

### 4. Results:

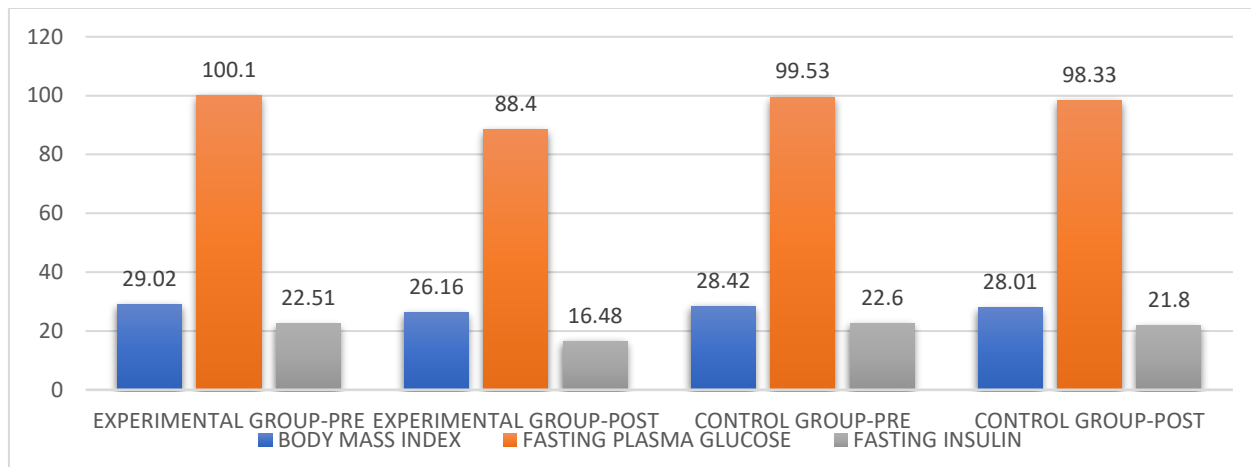
Table 1 and figure 1 represents the analysis and comparison of pre and post interventional scores of BMI, fasting plasma glucose and fasting insulin within experimental and control group. The and standard deviation values of BMI, fasting plasma glucose and fasting insulin levels at baseline in the experimental group has shown significant reduction after 6 weeks of HIIT, i.e., p value is < 0.05. However, in control group, no such significant reduction of BMI, fasting plasma glucose and fasting insulin levels were observed, i.e., p value is > 0.05.

**Table 1:** Analysis of outcome measures within experimental and control group

GROUP	OUTCOME MEASURES	PRE TEST (MEAN±SD)	POST TEST (MEAN±SD)	P VALUE
Experimental group	Body Mass Index	29.02±1.744	26.16±2.471	0.001
	Fasting Plasma Glucose	100.1±17.97	88.4±13.26	0.03
	Fasting Insulin	22.51±7.122	16.48±6.432	0.02
Control group	Body Mass Index	28.42±2.133	28.01±2.238	0.61
	Fasting Plasma Glucose	99.53±15.00	98.33±12.10	0.81
	Fasting Insulin	22.6±8.024	21.8±7.67	0.78



**Figure 1:** Analysis of outcome measures within experimental and control group



## 5. Discussion:

This study looked at how high-intensity interval training affected body mass index, plasma glucose levels, and insulin levels in people with polycystic ovarian syndrome. In the current study, we discovered that PCOS patients who combined high-intensity interval exercise with medication saw improvements in their body mass index, fasting plasma glucose, and fasting insulin levels. The positive change and superior health benefits was not observed significantly in the group that followed medications alone.

PCOS is the most common endocrine abnormality in reproductive age women. It is a leading cause of anovulatory infertility all over the world. It has been associated with a number of reproductive complications or issues due to its early development during pre-pubertal years. A paradigm change in thinking has occurred through time, that PCOS is no longer just a gynecological concern but also has significant metabolic components. Infertility affects 40% of PCOS patients whereas the prevalence of metabolic syndrome is two to four times higher in PCOS patients compared to weight matched healthy women [23].

Approximately one-third of PCOS patients also have insulin resistance and hyperinsulinemia, demonstrating the tight association between insulin resistance and PCOS. In turn, hyperinsulinemia and hyperandrogenism are getting worsened by obesity, which also raises insulin resistance. Certain obese PCOS women's metabolic abnormalities are thought to play a role in the mechanism of anovulation than

hyperandrogenemia [24]. So, considering all these factors, we have included body mass index, plasma glucose and insulin as outcome measures in this study.

The primary line of treatment for PCOS is a change in lifestyle and exercise. HIIT has recently been shown to be more efficient, along with a range of other fitness regimens. It is a sort of aerobic workout that involves doing cycles of high and low speed in succession. According to numerous studies, HIIT increases quality of life by lowering the risk of death from cardiovascular diseases, obesity, and type 2 diabetes mellitus. [25].

This study reported that there was a significant difference was found when compared the baseline and post intervention data of BMI, plasma glucose and insulin in group A (experimental group). In group B (the control group), there was a little difference between the pre- and post-intervention mean values of BMI, plasma glucose, and insulin, but no statistically significant difference was seen.

When Hamasaki et al. conducted a similar co-related study on diabetes patients to ascertain the effects of HIIT, they discovered that it had a positive impact on blood glucose control, weight loss, and improved insulin sensitivity in diabetic patients. These results are comparable to those of this study, which showed that after 6 weeks of HIIT, BMI, fasting plasma glucose, and fasting insulin levels were decreased in women with PCOS. [26].

Dominic et al (2021) suggested that performing 6 weeks of HIIT has shown significant decrease in the

adiposity levels and anthropometric parameters as well [27].

The effects of HIIT and ST on serum testosterone, body fat percentage, and physical activity levels in PCOS-affected women were compared by Mubarra Rao et al in 2022. While both HIIT and ST improved the results, they discovered that HIIT was more successful than ST at lowering serum testosterone levels, decreasing body fat percentage, and increasing physical activity in PCOS women. [28].

High intensity interval training results in the following changes in skeletal muscle cells: reduced glycogenolysis, elevated pyruvate oxidation during exercise, elevated carbohydrate metabolizing enzyme activity in mitochondria, and elevated glycogen buffering at rest [29] [30] [31].

There are a lot of studies regarding PCOS with phenotypic changes and with periodontitis<sup>32-34</sup>. The current study has some limitations. The study population was relatively small, as many of the PCOS patients had associated problems such as hypothyroidism. The study period was not long enough to establish long term effect of high intensity interval training. Although ultrasound imaging provides the confirmatory diagnosis and prognosis state of the PCOS patients, this study does not involve any ultrasound imaging procedure post intervention to assess the prognosis of the condition.

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## 6. Conclusion:

HIIT participants had significantly lower BMI, fasting blood glucose, and fasting insulin levels than control group participants who followed a medication-only programme, according to the study. HIIT promotes weight loss and the improvement of other metabolic parameters, which may reduce the risk of type 2 diabetes mellitus and other PCOS-related problems. Given that HIIT demands strong performance, it may be recommended as a kind of exercise therapy for PCOS women who face severe time restrictions and who are physically capable of engaging in vigorous exercise. HIIT, as a specific educational strategy, positively impacted PCOS women's body weight loss and metabolic wellness.

## Conflict of Interest:

The author declare that they have no conflict of interest.

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## Author Contribution:

Murugaraj T; designed the treatment, setting, methodology and supervised throughout the study.

Ashila A; conceived the concept, performed treatment, data collection, results interpretation and wrote the paper.

Shanmuganath E; overall supervision and design suggestion.

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