

## IMPACT OF HIGH-INTENSITY INTERVAL TRAINING WITH ADJUNCT RELAXATION THERAPY ON METABOLIC PARAMETERS, STRESS LEVELS, AND HEALTH-RELATED QUALITY OF LIFE IN WOMEN WITH POLYCYSTIC OVARY SYNDROME

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### KEYWORDS

*Polycystic Ovary Syndrome, HIIT, relaxation therapy, stress, quality of life, physiotherapy*

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### Abstract

**Background:** Polycystic Ovary Syndrome is a common endocrine-metabolic disorder characterized by insulin resistance, obesity, psychological stress, and reduced health-related quality of life. While exercise is a cornerstone of management, the combined effect of high-intensity training and stress-reduction strategies remains underexplored.

**Objective:** To evaluate the impact of High-Intensity Interval Training (HIIT) with adjunct relaxation therapy on metabolic parameters, stress levels, and health-related quality of life in women with PCOS.

**Methods:** A randomized controlled trial was conducted on 60 women with PCOS aged 18–35 years, who were randomly allocated into an experimental group (HIIT + relaxation therapy) and a control group (moderate-intensity continuous training). The intervention was carried out for 12 weeks. Outcome measures included Body Mass Index (BMI), Waist–Hip Ratio, Perceived Stress Scale (PSS), and Polycystic Ovary Syndrome Health-Related Quality of Life Questionnaire (PCOSQ). Statistical analysis was performed using paired and unpaired t-tests with significance set at  $p < 0.05$ .

**Results:** Both groups showed significant improvements in all outcome measures ( $p < 0.05$ ). However, the experimental group demonstrated significantly greater reductions in BMI ( $p = 0.038$ ), Waist–Hip Ratio ( $p = 0.017$ ), and PSS scores ( $p < 0.001$ ), along with a significantly higher improvement in PCOSQ scores ( $p < 0.001$ ) compared to the control group.

**Conclusion:** HIIT combined with relaxation therapy is more effective than conventional exercise alone in improving metabolic health, reducing stress, and enhancing quality of life in women with PCOS. This combined approach offers a holistic and time-efficient strategy for physiotherapy management.

## INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is a complex and heterogeneous endocrine disorder affecting approximately 6–20% of women of reproductive age worldwide<sup>1</sup>. It is diagnosed based on the Rotterdam criteria, which include hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology<sup>2</sup>. Beyond reproductive abnormalities, PCOS is increasingly recognized as a metabolic disorder characterized by insulin resistance, central obesity, dyslipidemia, and an elevated risk of type 2 diabetes mellitus and cardiovascular disease<sup>3</sup>.

Insulin resistance plays a central role in the pathophysiology of PCOS, affecting nearly 50–70% of affected women regardless of body mass index<sup>4</sup>. Hyperinsulinemia exacerbates androgen production, thereby worsening clinical symptoms such as hirsutism, acne, and menstrual irregularities<sup>5</sup>. Additionally, chronic low-grade inflammation and oxidative stress further contribute to metabolic dysfunction and disease progression<sup>6</sup>.

In parallel with metabolic disturbances, women with PCOS frequently experience psychological impairments, including increased levels of stress, anxiety, depression, and reduced health-related quality of life (HRQoL)<sup>7</sup>. The bidirectional relationship between stress and PCOS is mediated through dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in elevated cortisol levels, which further aggravate insulin resistance and hormonal imbalance<sup>8</sup>. Therefore, addressing both

physiological and psychological components is essential for comprehensive management.

Lifestyle modification, particularly exercise, is considered first-line therapy in PCOS management<sup>9</sup>. Among various exercise modalities, High-Intensity Interval Training (HIIT) has gained significant attention due to its time efficiency and superior metabolic benefits. HIIT involves short bursts of vigorous activity interspersed with periods of recovery, leading to improved insulin sensitivity, enhanced mitochondrial biogenesis, and greater fat oxidation compared to moderate-intensity continuous training (MICT)<sup>10</sup>. Studies have demonstrated that HIIT significantly improves glucose metabolism, reduces visceral adiposity, and enhances cardiovascular fitness in women with PCOS<sup>11</sup>.

Despite these benefits, exercise interventions alone may not adequately address psychological stress, which is a key contributor to disease burden. Relaxation therapies including deep breathing exercises, progressive muscle relaxation, and guided imagery have been shown to reduce sympathetic overactivity, decrease cortisol levels, and improve emotional well-being<sup>12</sup>. These techniques promote parasympathetic activation and help restore autonomic balance, thereby improving both mental and physiological outcomes<sup>13</sup>.

Emerging evidence suggests that combining physical exercise with stress-reduction strategies may produce synergistic effects in chronic conditions, including PCOS<sup>14</sup>.

However, limited studies have explored the integrated effect of HIIT and relaxation therapy on metabolic parameters, stress levels, and HRQoL in women with PCOS.

Therefore, the present study aims to evaluate the effectiveness of a combined intervention of HIIT and relaxation therapy, providing a holistic and evidence-based physiotherapy approach for the management of PCOS. Polycystic Ovary Syndrome (PCOS) is a prevalent and complex endocrine-metabolic disorder affecting approximately 8–13% of women of reproductive age globally<sup>1</sup>. It is characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology, as defined by the Rotterdam criteria<sup>2</sup>. Beyond reproductive abnormalities, PCOS is increasingly recognized as a multisystem disorder associated with insulin resistance, obesity, dyslipidemia, and increased risk of type 2 diabetes and cardiovascular disease<sup>3</sup>.

Insulin resistance is a central feature of PCOS, present in up to 70% of affected individuals, independent of obesity<sup>4</sup>. Hyperinsulinemia contributes to ovarian androgen overproduction, thereby exacerbating clinical manifestations such as menstrual irregularities, hirsutism, and infertility<sup>5</sup>. Additionally, chronic low-grade inflammation and oxidative stress further aggravate metabolic dysfunction and disease progression<sup>6</sup>.

In addition to metabolic disturbances, women with PCOS exhibit significantly higher levels of psychological distress, including stress,

anxiety, and depression, which adversely impact health-related quality of life (HRQoL)<sup>7</sup>. Recent evidence suggests that dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis plays a crucial role in linking stress with metabolic and endocrine abnormalities in PCOS<sup>8</sup>. Elevated cortisol levels associated with chronic stress may worsen insulin resistance and contribute to abdominal adiposity<sup>9</sup>.

Lifestyle modification remains the first-line management strategy for PCOS, with exercise being a cornerstone intervention<sup>10</sup>. High-Intensity Interval Training (HIIT) has emerged as a superior exercise modality due to its time efficiency and potent metabolic effects. Recent systematic reviews and randomized controlled trials have demonstrated that HIIT significantly improves insulin sensitivity, reduces visceral fat, enhances cardiorespiratory fitness, and improves lipid profiles in women with PCOS<sup>11,12</sup>.

Despite these physiological benefits, conventional exercise programs often fail to address the psychological burden associated with PCOS. Mind-body interventions, including relaxation therapy, have gained increasing attention for their role in stress reduction and autonomic regulation<sup>13</sup>. Techniques such as diaphragmatic breathing, progressive muscle relaxation, and guided imagery have been

shown to reduce cortisol levels, improve parasympathetic activity, and enhance emotional well-being<sup>14</sup>.

Emerging evidence indicates that combined interventions targeting both physical and psychological domains yield superior outcomes in chronic metabolic disorders<sup>15</sup>. However, there remains a paucity of high-quality studies investigating the integrated effects of HIIT and structured relaxation therapy on metabolic, psychological, and quality-of-life outcomes in women with PCOS.

Therefore, this study aims to evaluate the effectiveness of a combined HIIT and relaxation therapy program, offering a holistic, evidence-based physiotherapy approach for comprehensive PCOS management.

**METHODOLOGY:**

- **Study Design:**  
Randomized controlled trial (RCT)
- **Participants:**  
Women with polycystic ovary syndrome
- **Sample Size:**  
Total sample = 60
- **Sampling Method**  
Participants were selected using purposive sampling and randomly allocated into 2 groups using a computer-generated randomization sequence:

**Group A (Experimental):**  
High-Intensity Interval

Training  
(HIIT)+Relaxation Therapy

**Group B (Control):**  
Moderate-intensity  
continuous training

▪ **Inclusion Criteria**

- Women aged 18–35 years
- Diagnosed with PCOS (Rotterdam criteria)
- BMI ≥ 25 kg/m<sup>2</sup>
- Sedentary lifestyle

**Exclusion Criteria**

- Pregnancy
- Cardiovascular disorders
- Severe psychiatric illness
- Participation in structured exercise programs

**INTERVENTION  
PROTOCOL**

**GROUP A  
(EXPERIMENTAL  
GROUP)**

**High-Intensity Interval  
Training (HIIT) + Relaxation  
Therapy**

**1.HIGH-INTENSITY  
INTERVAL TRAINING (30–  
35 minutes)**

The HIIT protocol was designed according to recent clinical trials and exercise guidelines for metabolic disorders and PCOS populations

**Protocol Structure:**

- **Warm-up:** 5 minutes (light aerobic activity and mobility exercises)
- **High-intensity intervals:**
  - **Intensity:** 85–95% of maximum heart rate (HRmax)
  - **Duration:** 1 minute
- **Active recovery intervals:**
  - **Intensity:** 50–60% HRmax
  - **Duration:** 2 minutes
- **Cycles:** 6–8 intervals
- **Cool-down:** 5 minutes

**Mode of Exercise:** Treadmill walking or stationary cycling

**2. Relaxation Therapy (15–20 minutes)**

Relaxation therapy was administered immediately after HIIT sessions to promote recovery and reduce stress.

**Components:**

**a. Diaphragmatic Breathing**

Slow, controlled breathing  
 Inhale: 4 seconds, Exhale: 6–8 seconds

**b. Progressive Muscle Relaxation (PMR) (5–7 minutes):**

- Sequential contraction and relaxation of major muscle groups

**c. Guided Imagery (5–8 minutes):**

- Visualization of calming scenarios under therapist guidance

**Total Session Duration:** 45-60 minutes; 3 session/weekly, 12 weeks

**GROUP B (CONTROL GROUP)**

**MODERATE-INTENSITY CONTINUOUS TRAINING (MICT)**

Participants in the control group received moderate-intensity continuous training consisting of:

- **Intensity:** 60–70% HRmax
- **Duration:** 30–40 minutes
- **Frequency:** 3 sessions/week

This protocol aligns with current international physical activity recommendations for metabolic health<sup>10</sup>.

**OUTCOME MEASURES**

- Metabolic Parameters: Body Mass Index (BMI), Waist–Hip Ratio
- Perceived Stress Scale
- Polycystic Ovary Syndrome Health-Related Quality of Life Questionnaire

**STATISTICAL ANALYSIS**

Data were analysed using SPSS version 26.0. Normality of distribution was assessed using the Shapiro-Wilk test, which demonstrated normal distribution of all outcome variables ( $p > 0.05$ ). For within-group comparisons, a paired t-test was used and for between-group comparisons, Independent t-test was applied. The level of statistical significance was set at  $p < 0.05$ .

**Table 1: Baseline Characteristics**

Variable	Experimental Group (n=30)	Control Group (n=30)	p-value
Age (years)	25.6 ± 3.2	26.1 ± 3.5	0.54
BMI (kg/m <sup>2</sup> )	28.4 ± 2.1	28.1 ± 2.3	0.62
Waist–Hip Ratio	0.89 ± 0.04	0.88 ± 0.05	0.48
PSS Score	26.5 ± 4.2	25.9 ± 4.5	0.57
PCOSQ Score	102.4 ± 10.5	104.1 ± 11.2	0.49

Interpretation: No significant difference ( $p > 0.05$ ) → groups are comparable

**TABLE 2: Within-Group Comparison - Experimental Group**

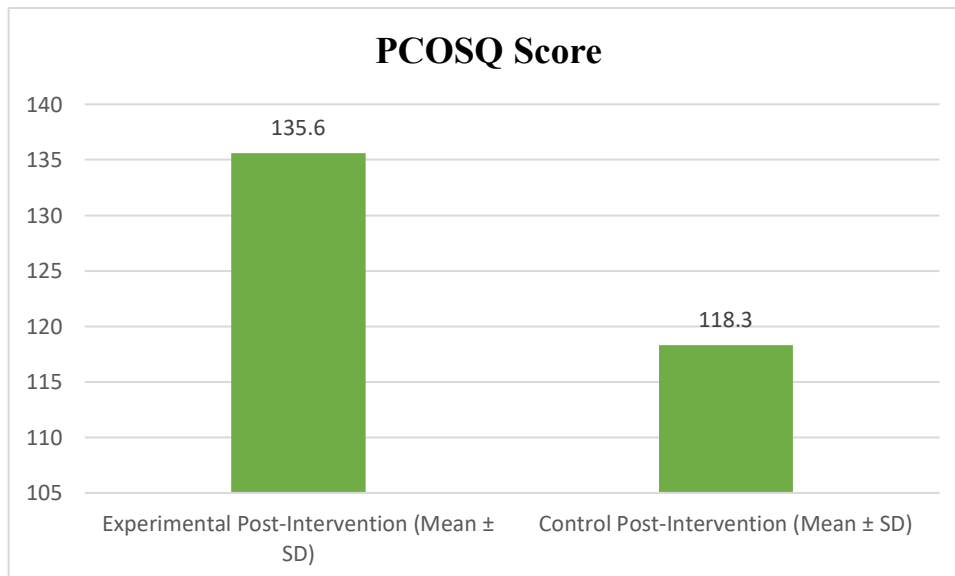
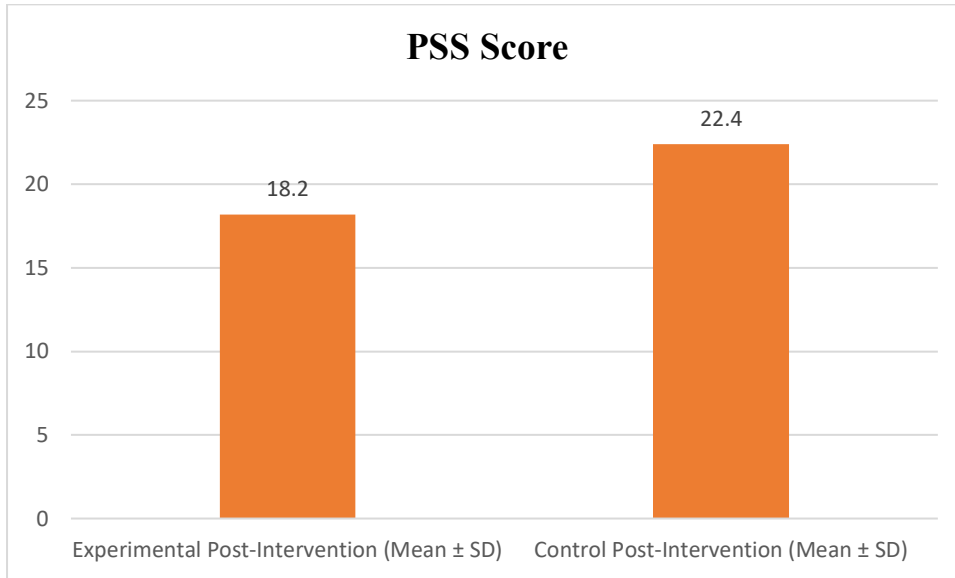
Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
BMI (kg/m <sup>2</sup> )	28.4 ± 2.1	25.9 ± 1.8	2.5	8.12	<0.001
Waist–Hip Ratio	0.89 ± 0.04	0.84 ± 0.03	0.05	7.45	<0.001
PSS Score	26.5 ± 4.2	18.2 ± 3.5	8.3	9.65	<0.001
PCOSQ Score	102.4 ± 10.5	135.6 ± 12.3	33.2	10.21	<0.001

**TABLE 3: Within-Group Comparison - control Group**

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
BMI (kg/m <sup>2</sup> )	28.1 ± 2.3	26.9 ± 2.0	1.2	4.25	0.001
Waist–Hip Ratio	0.88 ± 0.05	0.86 ± 0.04	0.02	3.12	0.004
PSS Score	25.9 ± 4.5	22.4 ± 3.9	3.5	4.89	<0.001
PCOSQ Score	104.1 ± 11.2	118.3 ± 10.6	14.2	5.67	<0.001

**Table 4: Between-Group Comparison of Post-Intervention Scores Using Independent t-Test**

Outcome Measure	Experimental Post-Intervention (Mean ± SD)	Control Post-Intervention (Mean ± SD)	Mean Difference	t-value	p-value
BMI (kg/m <sup>2</sup> )	25.9 ± 1.8	26.9 ± 2.0	1.0	2.12	0.038
Waist–Hip Ratio	0.84 ± 0.03	0.86 ± 0.04	0.02	2.45	0.017
PSS Score	18.2 ± 3.5	22.4 ± 3.9	4.2	4.56	<0.001
PCOSQ Score	135.6 ± 12.3	118.3 ± 10.6	17.3	5.78	<0.001



## RESULTS

The present study demonstrated significant improvements in metabolic parameters, stress levels, and health-related quality of life in both groups following the intervention; however, the experimental group receiving High-Intensity Interval Training combined with relaxation therapy showed superior outcomes. Within-

group analysis using paired t-tests revealed a statistically significant reduction in Body Mass Index (BMI) and Waist–Hip Ratio, along with a marked decrease in Perceived Stress Scale (PSS) scores and a significant improvement in Polycystic Ovary Syndrome Health-Related Quality of Life (PCOSQ) scores in the

experimental group ( $p < 0.001$ ). The control group also showed significant improvements, but the magnitude of change was comparatively lower. Between-group analysis using unpaired t-tests of post-intervention values indicated a statistically significant difference favoring the experimental group for BMI ( $p = 0.038$ ), Waist–Hip Ratio ( $p = 0.017$ ), PSS ( $p < 0.001$ ), and PCOSQ scores ( $p < 0.001$ ). These findings suggest that the addition of relaxation therapy to HIIT yields greater benefits in improving both physiological and psychological outcomes in women with PCOS.

### **DISCUSSION:**

The present study evaluated the combined effect of High-Intensity Interval Training (HIIT) and relaxation therapy on metabolic parameters, stress levels, and health-related quality of life (HRQoL) in women with Polycystic Ovary Syndrome. The findings demonstrated that although both groups showed significant improvements, the experimental group exhibited significantly greater reductions in Body Mass Index (BMI), Waist–Hip Ratio, and perceived stress levels, along with superior enhancement in quality-of-life scores compared to the control group.

The significant reduction in BMI and Waist–Hip Ratio observed in the experimental group can be attributed to the metabolic adaptations induced

by HIIT. High-intensity training has been shown to enhance mitochondrial biogenesis, increase fat oxidation, and improve insulin sensitivity, which collectively contribute to reductions in adiposity<sup>11,12</sup>. These findings are consistent with previous randomized controlled trials and systematic reviews reporting that HIIT is more effective than moderate-intensity continuous training in improving body composition and cardiometabolic risk factors in women with PCOS<sup>12,16</sup>. Furthermore, improved central adiposity, as reflected by Waist–Hip Ratio, is particularly important given its strong association with insulin resistance and cardiovascular risk in this population<sup>3</sup>.

A notable finding of this study was the significant reduction in Perceived Stress Scale (PSS) scores in the experimental group, which was substantially greater than that observed in the control group. This highlights the added benefit of relaxation therapy in modulating psychological stress. Stress is known to exacerbate PCOS symptoms through dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, leading to increased cortisol secretion and worsening insulin resistance<sup>8,9</sup>. Relaxation techniques such as diaphragmatic breathing, progressive muscle relaxation, and guided imagery promote parasympathetic activation and reduce sympathetic

overactivity, thereby lowering cortisol levels and improving stress resilience<sup>13,14</sup>. These findings are supported by recent studies demonstrating that mind-body interventions significantly reduce stress and improve psychological outcomes in women with PCOS<sup>14</sup>

In addition to physiological and psychological improvements, the experimental group showed a marked enhancement in HRQoL, as measured by the PCOSQ. This improvement can be explained by the combined effect of reduced physical symptoms and improved emotional well-being. Women with PCOS often experience poor quality of life due to body image concerns, menstrual irregularities, and psychological distress<sup>7</sup>. By addressing both metabolic and psychological domains, the combined intervention produced a more holistic improvement in patient outcomes. Similar findings have been reported in recent literature, where integrated lifestyle and behavioral interventions resulted in significant improvements in HRQoL among women with PCOS<sup>10,14</sup>.

The superior outcomes observed in the experimental group suggest a synergistic effect between HIIT and relaxation therapy. While HIIT primarily targets metabolic dysfunction, relaxation therapy addresses stress-related neuroendocrine disturbances, thereby providing a comprehensive treatment approach. Emerging evidence supports the concept that interventions targeting both physiological and psychological pathways yield greater benefits in chronic metabolic disorders<sup>15</sup>. This integrative approach is particularly relevant in PCOS, where both metabolic and psychosocial factors play a critical role in disease progression.

Overall, the findings of this study are consistent with current evidence and reinforce the importance of incorporating both structured exercise and stress management strategies in the physiotherapy management of PCOS. The results highlight that a combined intervention approach is more effective than conventional exercise alone in improving metabolic health, reducing stress, and enhancing quality of life.

## CONCLUSION

The findings of the present study conclude that a combined intervention of High-Intensity Interval Training (HIIT) and relaxation therapy is more effective than conventional moderate-intensity exercise in

improving metabolic parameters, reducing stress levels, and enhancing health-related quality of life in women with Polycystic Ovary Syndrome. The experimental group demonstrated significant reductions in Body Mass Index and Waist–Hip Ratio, along with a marked decrease in perceived stress and substantial improvement in quality-of-life scores. These outcomes suggest that integrating structured high-intensity exercise with relaxation techniques provides both physiological and psychological benefits, addressing the multifactorial nature of PCOS. Therefore, this combined approach can be recommended as an effective, time-efficient, and holistic physiotherapy intervention for the comprehensive management of women with PCOS.

**CONFLICT OF INTEREST:**

None

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None

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