

The Effects of High-Intensity Interval Training (HIIT) on Ovarian Function and Fertility Potential in Women



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Abstract

Background: High-Intensity Interval Training (HIIT) has recently been recognized as one of the regimens encompassing various benefits for maintaining health across diverse populations. It is based on intense exercise with brief periods of rest or low-intensity activity, offering a time-efficient approach that appeals to individuals seeking maximal benefits with minimal time commitment.

Methodology: Women aged 18-40 years with regular menstrual cycles and sedentary or moderately active lifestyles attending outpatient physiotherapy clinics in Lahore were divided into HIIT groups which engaged in supervised sessions for 4 days/week for 12 weeks, performed alternating periods of high-intensity exercise on a stationary bike for 1 minute with periods of active recovery for 30 seconds at 80-90% THR. Participants in the control group performed supervised aerobic exercise sessions 5 days/week for 12 weeks and performed moderate-intensity continuous exercises on a stationary cycle at 70-75% THR for 30 minutes. The hormonal markers and the regularity of menstruation were assessed at baseline and post-intervention.

Results: Within-group analysis showed a notable increment in the level of estradiol and progesterone in both groups ($p < 0.05$). Between-group analysis also exposed the HIIT group as being superior to the aerobic. ($p < 0.001$).

Conclusion: The findings of the study demonstrated the effectiveness of HIIT and aerobic exercise in impacting the hormonal markers and the regularity of menstruation among obese women. Although, the HIIT showed greater efficacy in improvising estradiol and progesterone levels and reducing menstrual cycle length

Keywords

Aerobic Exercise, Fertility, Interval Training, Obesity.



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Introduction

High-Intensity Interval Training (HIIT) has gained recognition as one of the most effective exercise regimens with diverse health benefits across various populations. It is an exercise program designed so that intense alternative intervals with brief rest periods are performed with minimal time consumption¹. The significance of enhancing cardiovascular fitness, insulin sensitivity, and metabolic health is being documented extensively²⁻³. However, there is a gap in exploring HIIT's effect on ovarian function and fertility potential.

One of the critical aspects of reproduction and its association with fertility is significantly impacted by the interplay of hormonal, metabolic, and lifestyle factors⁴. Hormones and their imbalance play a vital part in the regulation⁵⁻⁷. Other metabolic factors such as insulin sensitivity and body composition also signify and impact fertility, as some disturbances in such areas can damage the balance and may also impair the systems⁸. During these years, interest has been developed in how interventions can modify these factors to increase fertility. HIIT is identified by intense exercise and recovery periods, offering a time-effective alternative to traditional continuous exercise modalities⁹⁻¹⁰.

While existing studies have demonstrated HIIT's beneficial effects on metabolic parameters and cardiovascular health, its direct influence on ovarian function and fertility remains relatively underexplored¹¹⁻¹². The mechanisms through which HIIT may impact fertility involve improvements in insulin sensitivity, alterations in hormonal profiles, and enhanced metabolic function. These physiological changes could potentially contribute to optimizing reproductive health in women¹³.

Given the limited research specifically addressing HIIT's effects on fertility, particularly in women without specific reproductive disorders like PCOS, there is a need for well-designed studies to elucidate its direct impact on ovarian function and fertility potential. Such investigations are crucial for understanding the broader implications of HIIT on reproductive health and informing exercise recommendations tailored to women seeking to optimize their fertility through lifestyle interventions. Thus, the target is to assess the effectiveness of HIIT on the function of ovaries and fertility potential in women. The focus will be on the mechanism on which HIIT works. In summation, this study will also evaluate the efficacy of different HIIT protocols in elevating fertility outcomes, including measures of menstrual regularity and reproductive biomarkers. By advancing our understanding, this paper tries to give an insight into the positive outcomes of HIIT as an intervention that is not pharmacological. These insights may guide the development of personalized exercise prescriptions tailored to optimize fertility outcomes, thereby supporting overall reproductive wellness.

Methodology

Study Design

This randomized controlled trial (RCT) was conducted to investigate the effectiveness of High-Intensity Interval Training (HIIT) on the functioning of ovaries and fertility potential in women. The following study was conducted over 12 weeks, with assessments conducted at baseline and the end of the intervention period.

Participants Recruitment

A total of 20 subjects were enrolled via consecutive sampling techniques from private physiotherapy clinics in Lahore based on the following criteria:

Inclusion Criteria

- Women aged 18-40 years.
- Diagnosis of regular menstrual cycles (21-35 days).
- Lifestyle is sedentary or moderately active (not currently engaged in structured exercise ≥ 3 days per week).
- Willingness to participate in physical activity.

Exclusion Criteria

- Pregnant or breastfeeding.
- With a history of cardiovascular disease or other chronic medical conditions that may affect exercise tolerance.
- Usage of hormonal contraceptives or any medications affecting reproductive hormones within the past three months.
- Any musculoskeletal injuries or conditions that may be impairing participation in exercise.
- Participation in vigorous exercise training programs within the past 6 months.

Interventions

The participants were divided into two groups using computerized-generated sampling as follows:

- **High-Intensity Interval Training (HIIT)**
Participants in the HIIT group engaged in supervised sessions 4 days/week for 12 weeks. HIIT sessions were structured using the FIIT (Frequency, Intensity, Time, Type) principle. The intensity was set at 80-90% of the target heart rate (THR), involving alternating periods of high-intensity exercise on a stationary bike for 1 minute with periods of active recovery for 30 seconds. Each session lasted approximately 10 minutes, including a warm-up and cool-down period. The primary exercise modality used was a stationary cycle¹⁴.

- **Aerobic Exercise (Control Group)**

Participants in the control group performed supervised aerobic exercise sessions 5 days/week for 12 weeks. These sessions consisted of moderate-intensity continuous exercises on a stationary cycle, with an intensity set at 70-75% of the target heart rate (THR). Each session lasted approximately 30 minutes, including a warm-up and cool-down period. The primary exercise modality used was also a stationary cycle¹⁵.

Outcome Measures

- **Hormonal Markers**

Estradiol and progesterone levels were assessed via blood samples at baseline and post-intervention to evaluate changes in ovarian function.

- **Menstrual Regularity**

Changes in menstrual cycle length and regularity were documented throughout the 12-week intervention period to evaluate fertility potential.

Data Analysis

Data was analyzed using SPSS version 24. Demographic details were shown in the form of mean and standard deviation. Inferential statistics was performed for within and between-group analysis. A paired t-test was performed for within-group analyses, whereas an independent t-test was run for between-group analyses. The level of significance was kept at $p < 0.05$.

Ethical Consideration

The study upheld the guidelines in the Helsinki Declaration for human subjects. All participants were given a complete description of the purpose of the study. Written consent was taken before induction, and all participants were given full autonomy to leave the study at any stage without assigning any reason.

Results

The demographic description of the participants revealed that the average age was 31.25 ± 2.5 in the HIIT group and 30.55 ± 2.8 in the aerobic group. Further demographic descriptions were provided in Table-1.

Table-1 Demographic Description of Participants		
Variables	BMI	Regular Menstrual Cycle
HIIT	30.25±3.22	10 (100%)
Aerobic Exercises	30.14±3.5	10 (100%)

On within-the-group analysis, the findings revealed that the levels of estradiol and progesterone hormones were significantly increased in both groups ($p < 0.05$). In addition, the length of the menstrual cycle was decreased considerably ($p < 0.05$) (Table-2).

Table-2 Within-the-Group Analysis			
HIIT			
Variables	Mean±SD Pre	Mean±SD Post	p-value
Estradiol (pg/mL)	75.54±5.56	93.56±4.58	0.001
Progesterone (ng/mL)	10.56±5.54	16.58±5.52	0.001
Menstrual Cycle Length (days)	32.56±3.56	27.58±2.58	0.001
Aerobic Exercises Group			
Estradiol (pg/mL)	76.58±4.54	91.54±3.25	0.001
Progesterone (ng/mL)	11.25±2.25	15.65±4.1	0.001
Menstrual Cycle Length (days)	30.25±2.58	28.32±3.8	0.001

The between-group comparison provided evidence that HIIT was significantly effective ($p < 0.005$) in increasing the levels of hormones compared to aerobic exercises. In contrast, the length of days of the menstrual cycle decreased more in the HIIT group than in the aerobic group (Table-3).

Table-3 Between-the-group analysis			
Variables	HIIT	Aerobic Exercises	p-value
Estradiol (pg/mL)	93.56±4.58	91.54±3.25	<0.001
Progesterone (ng/mL)	16.58±5.52	15.65±4.1	<0.001
Menstrual Cycle Length (days)	27.58±2.58	28.32±3.8	<0.001

Discussion

The findings from this study provide compelling evidence that HIIT exerts a more significant positive impact on ovarian function and fertility potential in women compared to moderate-intensity aerobic exercise. The demographic description revealed that both groups were comparable in age and BMI, ensuring that the observed outcome differences were likely due to the intervention rather than baseline disparities.

The analysis showed an increment in the levels of both hormones in both groups receiving different interventions ($p < 0.05$). However, between-group comparisons identify the HIIT group as the most beneficial and superior group to increase the hormonal markers discussed ($p < 0.001$). Our paper suggests that increasing the HIIT protocol's time, variability, or intensity may also stimulate the endocrine responses through the mechanism. A decrement in the length of the menstrual cycle has been observed in both groups and mentions an improvement in regulation, which is also a marker of enhanced fertility potential. The HIIT group was more effective than the aerobic group ($p < 0.001$), further underscoring the superior efficacy of HIIT in regulating menstrual cycles. The findings also corroborate other studies about the effects of exercise intensity and volume and that greater exercise intensity could lead to increased physiological adaptations that positively affect reproductive health¹⁶. The biochemical alterations observed in the form of enhancements in hormonal profile and menstrual cycling suggest that HIIT is a time-efficient and effective intervention to improve women's ovarian dynamics and fertility capacity. This systematic review assessing the effect of PA was conducted using qualitative evidence whereby evidence based on ovarian cancer females showed a significant positive aspect emphasizing the need to maintain or even enhance the intensity of PA post-diagnosis. This work established that increased PA was significantly linked with enhanced Health-related Quality of Life (HRQOL)¹⁷.

Therefore, there is a need for the general population to engage in more physical activities to improve their health-related quality of life. The authors also highlighted that self-rated PA was inversely related to several symptoms of anxiety and depression and stated that PA could help address mental health issues. This is very crucial because women with ovarian cancer are randomly stressed and emotionally challenged more often as compared to other women. Furthermore, the studies of exercise interventions during and after treatment were established to be safe and involving. Such interventions were also beneficial in supporting PA while also subsequently affecting quite several physical and psychological aspects. The uptake session decreased fatigue levels, improved HRQOL status, and improved physical functioning among the participants¹⁸. This phenomenon signifies that structured exercise programs can act as an effective strategy for managing the adverse effects of ovarian cancer together with the treatment processes. In other research, key findings noted the impact of exercise on female fertility in people with obesity and concluded that there existed a vital aspect of exercise. Different fertility measures were used, but conception, pregnancy, and live birth rate were the most frequently reported conception indicators¹⁸. These outcomes lend credence to the notion that exercise can have a big part to play in helping women with obesity who want to get pregnant. The study recommended that these key fertility outcomes remain consistently reported to ensure future research reproducibility. The first key strength of the study is the ability to isolate the effects of HIIT compared to aerobic exercise using an RCT design and deliver strong evidence on how HIIT impacts ovarian function and fertility in women. Also, the advocacy for universal fertility indicators like hormonal data and menstrual cycle yielded quantifiable results. However, it has some limitations: The sample size was relatively low ($n=20$); hence, the present study's findings might not be generalizable to similar clinical settings. It cannot be established whether or not the intervention has a long-term impact on fertility due to the short period of the study set at 12 weeks. Moreover, the study was not very diverse in its subject, which could indicate some bias

in the results. The fact that such individuals who take any medication or have certain medical illnesses are excluded from the study, as well as women who take hormonal birth control, also limits the generality of the conclusion.

Conclusion

This research confirmed that HIIT and aerobic exercise have beneficial effects, considering hormonal and menstrual cycle alterations in obese women. Yet, HIIT was proven more effective in improving estradiol and progesterone concentrations and decreasing the duration of the menstrual cycle. These discoveries imply that weight training sessions and systematic HIIT can boost fertility competency among women in the obese bracket. Subsequent studies should sample more extensive populations and have extended follow-up periods to prove such findings and investigate physical exercise's chronic effects on fertility.

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Conflict of Interest

None.

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None.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

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Acquisition, Analysis or Interpretation of Data: Afzal S, Kalsoom F, Atif N, Noor A

Manuscript Writing & Approval: Razzaq S, Atif N, Noor A, Mahmood A

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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