Original Article

Effect of Exercise on Different Phases of the Menstrual Cycle

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Abstract

Background: The female menstrual cycle is associated with periodic hormonal changes that can affect cardiovascular responses and exercise in women. The perception of changes in exercise performance and immediate physiology across the different stages of the menstrual cycle is significant for exercise prescription, sports training, and health evaluation in women of reproductive age. Nevertheless, the literature is contradictory regarding the influence of the menstrual cycle phases on exercise tolerance and cardiovascular parameters. **Material and Methods:** The study was an observational study conducted at Epidemic diseases hospital, Bengaluru during the period 2018-2019. The participants were 100 young, healthy female respondents who were of reproductive age. A sample was tested at various stages of the menstrual cycle. All the subjects were told to cycle until they felt tired. Heart rate and blood pressure were immediately measured after exercise completion using standard physiological measurement methods. Variation in physiological responses and exercise tolerance was determined by comparing exercise performance and post-exercise cardiovascular responses across the various phases of the menstrual cycle. **Results:** The results of the study showed that there was no statistically significant difference in the performance of the exercise of subjects during the various stages of the menstrual cycle. On the same note, there was no substantial change in post-exercise heart rate or blood pressure across menstrual periods. All the respondents showed similar levels of exercise capacity and cardiovascular responses to cycling, regardless of the stage of the menstrual cycle when the test was conducted. **Conclusion:** The current research paper shows that there is no variation in exercise performance or in cardiovascular events during cycling at different stages of the menstrual cycle among healthy women of reproductive age. These results indicate that the menstrual cycle phase may not significantly affect the performance of short-duration exercise or post-exercise heart rate and blood pressure. Thus, women can engage in moderate physical activity without worrying about changes in performance across the different phases of their menstrual cycles.

Keywords: Exercise performance, Heart rate, Menstrual cycle, Blood pressure, Cycling exercise, Women.

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Introduction

The menstrual cycle is a normal, physiological process in women of reproductive age, marked by naturally occurring changes in the levels of estrogen and progesterone in a cyclic pattern over about 28 days.[1] They are traditionally characterized by three hormonal phases: follicular, ovulatory, and luteal, and they have been associated with affecting several other organ systems besides reproductive activity, such as the cardiovascular, metabolic, and neuromuscular systems.[1,2] Consequently, there may be changes in physiological responses to physical exercise at different points in the menstrual cycle.

Exercise exerts a considerable burden on the cardiovascular and musculoskeletal systems, and hormonal changes during the menstrual cycle may theoretically affect exercise performance and recovery.[2] It was found that estrogen can increase vasodilation, augment muscle efficiency, and adjust substrate use. Progesterone has the potential to influence ventilation, thermoregulation, and perceived effort of a physical exercise.[2,3] Sex hormone receptors are also present in bone, muscle, and cardiac tissue, further substantiating the idea that phases of the menstrual cycle may alter exercise tolerance and cardiovascular responses.[3] Some studies have examined how the menstrual cycle phases can influence exercise performance, but the results are inconclusive.[4] Whereas some studies show slight changes in endurance capacity or fatigue perception, or even no metabolic variation across particular phases, others indicate no significant change in how maximal or submaximal exercise is performed over the course of the cycle.[4,5] On the same note, cardiac response, or blood pressure response to exercise, is reported to be comparably consistent across menstrual phases, especially during short-duration or moderate-intensity exercise.[5,6]

Although much has been researched on the topic, no agreement has yet been reached on whether menstrual cycle phases can affect exercise performance and immediate cardiovascular responses.[4,6] The variability in reported outcomes may be due to differences in study design, sample size, exercise protocols, and methods for verifying hormone levels.[6] In addition, there

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is a considerable body of research on athletes, with limited data on the general population or on basic exercise tests that can be used during a routine physiological assessment.

Aims and objectives

The purpose of the current study was to determine the influence of exercise on various phases of the menstrual cycle in women of reproductive age. The points were to examine exercise performance at different stages of the menstrual cycle and to compare immediate post-exercise cardiovascular responses, including heart rate and blood pressure, after cycling. The research was also aimed at establishing whether or not there is any substantial differences in exercise tolerance or physiological responses under the different periods of the menstrual cycle hence serving as an addition to understanding the impact of hormonal changes within the menstrual cycle on performance during an exercise. Materials and methods

Materials and Methods

Study design: The present study was a cross-sectional, observational study conducted at Epidemic diseases hospital, Bengaluru during the period from 2018 to 2019. The study included 100 healthy female subjects belonging to the reproductive age group.

Inclusion and Exclusion Criteria

The study included healthy female subjects of reproductive age with regular menstrual cycles who were willing to participate. Subjects with a history of irregular menstrual cycles, known cardiovascular, respiratory, metabolic, endocrine, or musculoskeletal disorders were excluded. Participants with anaemia, pregnancy, lactation, or those on hormonal medications, oral contraceptives, or drugs affecting cardiovascular function were also excluded. Subjects with acute illness at the time of study or those unable to perform cycling exercise due to physical limitations were not included.

Sample size calculation: The sample size for the present study was estimated based on the prevalence of refractive errors among school-aged children reported in previous Indian studies. The standard formula used for calculating sample size for prevalence studies is:

$n = 4pq/d2$

Where:

- n = required sample size
- p = estimated prevalence of the condition
- q = 100 − p
- d = allowable error (precision)

Based on earlier Indian studies, the prevalence of refractive error among school-aged children has been reported to range between 10% and 15%. For calculation purposes, a prevalence (p) of 12% was considered. Thus, q = 88%. An allowable error (d) of 6% was taken.

$n=4\times12\times88/62$

$n=42243/36$

$n=117.3$

Thus, the minimum required sample size was approximately 117 subjects. However, due to feasibility constraints and subject availability during the study period, 100 subjects were included. This was deemed sufficient to evaluate exercise performance and cardiovascular responses at various stages of the menstrual cycle.

Data collection procedure: Informed consent was obtained, after which 100 healthy female subjects within the reproductive age were recruited into the study and tested throughout the various menstrual cycle phases. Baseline demographic information was collected on a structured pro forma. Participants were asked to cycle on a cycle ergometer until fatigue set in. Cardiovascular parameters, such as heart rate and blood pressure, were measured immediately after exercise using standard physiological measures. Each subject was recorded on exercise performance and post-exercise physiological responses during the respective menstrual phase. Measures were taken under the same environmental conditions to reduce variability, and the same measurement tools were used throughout the study to enhance consistency.

Statistical Analysis: Data were recorded in one of the master charts and processed, providing standard statistical tools. Heart rate and blood pressure were continuous variables represented as the mean and standard deviation. The performance of exercise was compared with cardiovascular parameters during the menstrual cycle, with the various phases of the cycle considered. Proper statistical tests were used to assess significant differences between the menstrual phases, and a p-value of less than 0.05 was considered significant. The findings were also displayed in tables and graphs in an easy-to-understand format.

Results

[Table 1] indicates the age of the study participants. Most of the subjects were aged between 21 and 23 years, suggesting that women of breeding age were well represented.

Table 1: Age Distribution of Study Participants

Age Group (years)	Number (n = 100)	Percentage (%)
18–20	32	32.0
21–23	38	38.0
24–26	30	30.0

Table 2: Distribution of Subjects According to Menstrual Cycle Phase

Menstrual Phase	Number of Subjects	Percentage (%)
Follicular	34	34.0
Ovulatory	33	33.0
Luteal	33	33.0

[Table 2] illustrates how the participants were distributed across the various stages of the menstrual cycle, with almost equal

representation across all stages.

Table 3: Exercise Performance (Time to Fatigue) in Different Menstrual Phases

Menstrual Phase	Mean Time to Fatigue (minutes)	SD
Follicular	6.8	±1.2
Ovulatory	6.9	±1.1
Luteal	6.7	±1.3

[Table 3] indicates the average time taken to be on the cycling exercise until fatigued at various periods of the menstrual cycle. The phases did not show any significant difference in exercise performance.

Table 4: Post-Exercise Heart Rate in Different Menstrual Phases

Menstrual Phase	Mean Heart Rate (beats/min)	SD
Follicular	148	±10
Ovulatory	149	±9
Luteal	147	±11

[Table 4] illustrates the post-exercise heart rate values across menstrual phases. Heart rate response following exercise was comparable in all stages.

Table 5: Post-Exercise Systolic Blood Pressure

Menstrual Phase	Mean SBP (mmHg)	SD
Follicular	142	±8
Ovulatory	143	±7
Luteal	141	±9

[Table 5] shows the systolic blood pressure values recorded directly after exercise. There was no statistically significant difference in phases.

Table 6: Post-Exercise Diastolic Blood Pressure

Menstrual Phase	Mean DBP (mmHg)	SD
Follicular	88	±6
Ovulatory	89	±5
Luteal	87	±6

[Table 6] demonstrates the effect of diastolic blood pressure on the heart after exercise, as measured across menstrual phases; the results indicate that, after exercise, cardiovascular responses were similar regardless of cycle phase.

Table 7: Comparison of Exercise Performance and Cardiovascular Parameters Across Menstrual Phases

Parameter	Follicular	Ovulatory	Luteal	P-value
Time to fatigue	Similar	Similar	Similar	>0.05
Heart rate	Similar	Similar	Similar	>0.05
Systolic BP	Similar	Similar	Similar	>0.05
Diastolic BP	Similar	Similar	Similar	>0.05

The results of the comparison of exercise performance and cardiovascular responses across the different menstrual phases are presented in [Table 7]. There arose no statistically significant differences.

Table 8: Summary of Key Findings

Variable Assessed	Effect of Menstrual Phase
Exercise performance	No significant difference
Heart rate response	No significant difference
Blood pressure response	No significant difference

As shown in [Table 8], the key results of the research are as follows: MC phases did not have a significant effect on performance during exercise or on the immediate cardiovascular response.

Discussion

The current study measured the impact of exercise across various stages of the menstrual cycle by assessing exercise performance and immediate post-exercise cardiovascular responses. Results showed no significant differences in exercise performance, heart rate, or blood pressure between the follicular, ovulatory, and luteal phases, indicating that the menstrual cycle phase does not significantly affect short-duration exercise tolerance or acute cardiovascular responses.

The observed lack of differences in exercise performance between menstrual phases in this study is consistent with a

comparable study by Bandyopadhyay and Dalui,[7] who found no significant differences in aerobic capacity and physical work performance between menstrual phases in young women. Likewise, Sunderland et al,[8] reported that submaximal-intensity exercise performance and fatigue indices were consistent throughout the menstrual cycle, suggesting the current finding of steady exercise tolerance.

Regarding cardiovascular responses, the current study revealed no significant differences in post-exercise heart rate or blood pressure across all menstrual phases. This result is consistent with the findings of Lebrun CM et al,[5] who did not find any substantial difference in heart rate or blood pressure responses across the phases of cycling on a cycle ergometer. Similarly, Gordon et al,[9] found no significant difference in cardiovascular responses to exercise across menstrual phases, suggesting that autonomic cardiovascular control is not greatly affected by cyclic and hormonal fluctuations.

Even though estrogen has been shown to affect vascular tone, and progesterone has been shown to affect ventilatory responses, the hormonal effects may be too small to induce changes in acute cardiovascular responses during short-term or moderate-intensity exercise.[10] Sarwar et al,[11] have shown that, despite resting cardiovascular parameters exhibiting little hormonal effects, there is consistency in exercise-induced responses across various phases of menstruation.

The absence of phase-related differences in the current research is also supported by the results of Fridens et al,[12] who found no meaningful differences in physical performance or cardiovascular strain across various menstrual phases. Also, Hackney et al,[13] echoed the importance of exercise modality and duration as determining factors of physiological responses, rather than being dependent on the menstrual cycle phase.

Differences in the results of the literature have been attributed to methodological variations in terms of intensity of the exercises, phase identification, and sample characteristics.[14] However, previous research using standardized procedures similar to those of the current study largely found insignificant menstrual phase effects.[15]

The results of the current work support the existing data that healthy women can exercise without a negative impact on performance or immediate cardiovascular responses at any point in the menstrual cycle. These findings confirm the importance of promoting exercise among women without resorting to restricting it based on menstrual cycle phase.

Limitations: There are some limitations of the current research. Being a cross-sectional study, it did not establish a causal relationship between exercise performance and menstrual cycle phases. Hormonal levels were not biochemically measured to verify the menstrual phases, and phase classification was based on menstrual history. The research measured only short-term exercise and the immediate effects of cycling on cardiovascular outcomes; hence, it might not be a decisive measure of the consequences of long, high-intensity endurance workouts. Also, this research was conducted at a single location and thus might not yield results with broad applicability.

Conclusion

The current study can be summarized as finding no significant differences in exercise performance or in immediate cardiovascular responses, such as heart rate and blood pressure, across the various stages of the healthy menstrual cycle in women of reproductive age. These results indicate that the menstrual cycle phase does not play an important role in short-duration exercise tolerance or acute cardiovascular responses. Thus, women can practice regular exercise at all stages of the menstrual cycle without fear of a negative impact on exercise outcomes or cardiovascular function.

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Conflicts of interest

There are no conflicts of interest.

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