Journal of Orthopedics Research and Rehabilitation

Original Article

DOI: 10.51271/JORR-0050

The comparison of changes in fatigue, physical activity and mood in different phases of menstrual cycle

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Cite this article as: Alkan Yılmaz ZB, Başar S. The comparison of changes in fatigue, physical activity and mood in different phases of menstrual cycle. *J Orthop Res Rehabil.* 2025;3(2):44-47.

Received: 29.01.2025 ◆ **Accepted**: 15.04.2025 ◆ **Published**: 25.04.2025

ABSTRACT

Aims: The aim of this study is to compare fatigue, physical activity and mood among the menstrual, early luteal and follicular phases of menstrual cycle.

Methods: A total of 32 women (age: 23±2.91 years) with a regular menstrual cycle (26-32 days) were included in the study. Menstrual phase was determined as the 2nd-4th days of bleeding, while early luteal phase was determined based on the positive result seen on the ClearBlue ovulation kit. Follicular phase, on the other hand, was determined 7 days after the early luteal phase. Fatigue level was measured with the modified Borg Scale. Physical activity level was determined with the International Physical Activity Questionnaire (IPAQ), and mood was determined with the Beck Depression Scale.

Results: It was found that fatigue level increased during the early luteal phase and menstrual phase ($p<0.05$). Physical activity and mood did not change among the phases ($p>0.05$).

Conclusion: This study revealed that fatigue level increased, while physical activity and mood did not change. Thus, while health professionals plan sports activities for women, they should consider these changes that occur during the menstrual phase.

Keywords: Menstrual cycle, physical activity, fatigue, depression

INTRODUCTION

The menstrual cycle is basically divided into three phases: the menstrual phase, the follicular phase, and the luteal phase. This natural process ideally lasts 28 days in women and involves fluctuations in hormone levels.[1,2] During these phases, the levels of sex hormones-progesterone, estrogen, and testosterone-change. Estrogen levels are low in the menstrual phase and higher in the follicular and early luteal phases. Progesterone levels are higher in the early luteal phase compared to other phases, while testosterone levels peak in the follicular phase.[3] These hormonal fluctuations are known to affect various parts of the cerebrum (cerebral cortex, hippocampus, corpus callosum), leading to changes in physiological, neurological, and motor functions.[4,5] Consequently, shifts in sex hormone levels in women can influence perceived fatigue, physical activity levels, and mood.

Several studies suggest that physical performance varies throughout the menstrual cycle. It is reported that physical performance is higher in the menstrual phase compared to other phases and lower in the early luteal phase.[6] Doohan et al.[7] noted that menstrual symptoms caused a decrease in physical activity levels. A meta-analysis published in 2020 found that exercise performance decreases in the early follicular phase.[8] Furthermore, physiological symptoms such as mild depression, fatigue, anxiety, and insomnia may occur in the late menstrual phase.[9] Domínguez-Muñoz et al.[10] showed that fatigue was highest in the menstrual phase and lowest in the follicular phase. A meta-analysis conducted in 2023 revealed that fatigue increases in the luteal phase and mood disorders rise in the premenstrual phase.[11] These physiological symptoms are attributed to increases[12] or decreases[13] in progesterone levels.

Examining the literature reveals different results concerning perceived fatigue, physical activity levels, and mood changes across the menstrual cycle's phases. Our study aims to explore these parameters, which we believe will guide activity modifications between phases. We aim to compare fatigue, physical activity levels, and mood changes in the different phases of the menstrual cycle.

METHODS

The study included women between the ages of 20-30 who had regular menstrual cycles (26-32 days) and no diagnosis. In order to conduct this study, the necessary permission and approval were obtained from the Gazi University Faculty

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of Medicine Clinical Researches Ethics Committee (Date: 21.01.2025, Decision No: 2025-72). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. Those who wanted to participate in the study filled out the voluntary consent form. Changes across menstrual cycle phases is detectable with a sample size of 32 subjects at 85% power and a significance level of 0.05

Participants

The study involved women aged 20 to 30 who had regular menstrual cycles (26-32 days) and did not have any diagnoses that would affect the study focus. Participants provided voluntary consent by completing a consent form.

Exclusion criteria included the use of oral contraceptives, menstrual cycles outside of 26-32 days, musculoskeletal disorders, pregnancy, cardiovascular or neurological diseases, any pain or limitation in the upper extremities, and left-handed dominance. Because left-handed individuals exhibit greater individual differences in brain lateralization and motor control strategies compared to right-handed individuals, only right-handed dominant individuals were included to ensure homogeneity of neuromotor control and hemispheric lateralization. Of the 39 women evaluated, 3 were excluded due to irregular menstrual cycles, and 1 due to wrist instability. Additionally, 3 women whose follicular phases could not be determined were excluded. As a result, 32 women (age 24.3±4.2 years; height 16±0.7 cm; weight 57±10.1 kg) were evaluated across their menstrual, follicular, and early luteal phases for general fatigue, physical activity levels, and emotional states.[14] All participants were sedentary individuals and did not engage in regular sports activities.

Determination of Menstrual Phases

Participants were informed about how to determine the phases of the menstrual cycle, use the ovulation kit, and understand the assessments involved. Two consecutive menstrual cycles were questioned. The phases of the menstrual cycle were determined based on the first day of bleeding, with days 2-4 defined as the menstrual phase. A urine test was conducted with the ClearBlue Ovulation Kit (Clearblue digital ovulation test, SPD Development Company, Bedford, UK), beginning on the 10th day of the cycle. Ovulation was considered to have started when a 'smiley face' appeared on the kit's screen, marking the follicular phase. If no smiley face appeared, the test was repeated on days 11, 12, and 13. The 7th day after a positive result was marked as the beginning of the early luteal phase. All assessments occurred on the 2nd, 3rd, or 4th day of the menstrual phase, within 24-48 hours of the start of the follicular phase, and on the first day of the early luteal phase. The ovulation kit cannot measure hormone levels in different phases and does not provide as accurate results as hormone evaluations in the blood.[2]

Determination of Fatigue, Physical Activity Level, and Mood

The Modified BORG Scale was used to assess general fatigue levels. Participants rated their fatigue on a scale from 0 to 10 at the same time each day. 0 indicates 'not tired at all', 0.5 indicates 'very, very little tired' and 10 indicates 'extremely tired'.[15] The International Physical Activity Questionnaire (IPAQ), consisting of 5 sections and 27 questions including work, transportation, leisure, housework, and sitting time, was used to determine physical activity levels (r=0.81). It is scored with a met-minute score. The duration of vigorous physical activity, moderate physical activity, and walking in all sections is determined in minutes and days. The MET value corresponding to the intensity of each of these activities is calculated.[16] The Beck Depression Inventory, comprising 21 questions with 4 options each, was used to assess mood (r=0.65). Its scoring ranges from 0 to 63. Scores between 10-16 indicate mild depressive symptoms, scores between 17-29 indicate moderate depressive symptoms, and scores between 30-63 indicate severe depressive symptoms.[17]

Statistical Analysis

Data analysis was conducted using the statistical package for social sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL, USA). A power analysis conducted prior to the study indicated that a minimum of 32 participants was required for 85% power at a 5% margin of error. The normality of data distribution was evaluated using analytical and visual methods. Descriptive statistics for normally distributed numerical variables were presented as mean±standard deviation, while categorical variables were expressed as percentages and frequencies. Measurements from the early luteal, menstrual, and follicular phases were compared using the Friedman test, with statistical significance set at $p<0.05$. The Wilcoxon rank-order sign test with Bonferroni correction was applied in post hoc analysis to identify specific group differences, with statistical significance set at $p<0.017$.

RESULTS

The physical characteristics (age, height, weight, BMI) of the women included in the study are shown in Table 1.

Table 1. Physical characteristics and menstruation information of individuals

	Median (IQR)
Age (years)	23 (22-25)
BMI (kg/m^2)	21.25 (19.35-22.75)
Age at menarche (years)	12.78±0.83
Menstruation duration (days)	6.15±0.95

IQR: Inter quantile range, BMI: Body-mass index

When the fatigue levels felt by the individuals were compared, a significant difference was found between the 3 phases ($p<0.05$). It was determined that the intensity level felt by the individuals in the ovulation phase was less than in the other phases ($p<0.0170$). Physical activity levels and moods did not differ between the three phases ($p>0.05$) (Table 2).

DISCUSSION

In this study, which was planned to compare the changes that occur throughout the cycle between the menstrual phase, follicular phase and early luteal phases, it was determined that the fatigue level decreased in the early luteal and menstrual phases, while the physical activity level and mood did not change.

Fatigue is difficult to evaluate clinically because it gives subjective and imprecise symptoms. Using self-assessment and repeatable measurements gives more accurate clinical results.[18] Therefore, the modified BORG scale was preferred to determine the fatigue severity.

Table 2. Comparison of fatigue, physical activity level, and mood between phases

	Median (IQR)	p*	Measurement	p¥
mBorg menstrual	2 (0.5-3)		1-2	0.052
mBorg early luteal	2.5 (16-21.8)	<0.001	1-3	0.001
mBorg follicular	1 (0.5-2)		2-3	<0.001
UFAA£ early luteal	1786.5 (1189-2850)			
UFAA£ menstrual	1820 (1403-2850)	0.208		
UFAA£ follicular	2203 (1220-3819)			
BDI early luteal	5 (1.25-11)			
BDI menstrual	7.5 (3-12.5)	0.118		
BDI follicular	5 (2.25-8.7)			

*Friedman test, ¥Bonferroni-corrected Wilcoxon test, 1: Early Luteal phase, 2: Menstrual phase, 3: Follicular phase, IQR: Inter quantile range, mBorg: Modified Borg, UFAA: International physical activity level, BDI: Beck depression inventory

In the studies, definitive results about fatigue levels between menstrual phases were not obtained. This situation may be due to the fact that some studies evaluated the general fatigue level, while some studies evaluated muscle strength fatigue, and other studies evaluated the exercise fatigue period. Different results were found in studies where women evaluated the fatigue level themselves, as we applied in our study. In the study of Ziomkiewicz et al.,[19] where they compared the fatigue level in three different phases, they found it to be high in the menstrual phase when progesterone levels were low. Sanders et al.[20] showed that the fatigue level was high in the early luteal phase. Morales et al.[21] have shown that the level of fatigue felt is higher in the premenstrual phase. In our study, the level of fatigue was found to be higher in the follicular and menstrual phases than in the early luteal phase. The reason for the high level of fatigue in the menstrual phase may be the decreased progesterone and estrogen levels. Allopregnanolone, one of the metabolites of progesterone, binds to the GABAA receptor and activates the effect of GABAA. GABAA is an inhibitory transmitter in nerve conduction and has a sedative effect. Therefore, it is thought that the decrease in the level of progesterone in the blood eliminates the sedative effect and increases the level of fatigue felt.[22] In addition, since it has been determined that the estrogen hormone also increases sleep quality by decreasing body temperature,[23] it was decided in our study that low estrogen levels may have decreased sleep quality and as a result, may cause fatigue. In addition, a study has shown that fatigue level increases the risk of injury in sports activities, but this study did not provide information about the phase in which the evaluation was made and the risk of injury.[24] Future studies should investigate the effect of fatigue levels in different phases of the menstrual cycle on injury rates in sports activities.

Our study included young adult sedentary women and did not evaluate the changes in menstrual cycle caused by age and physical activity level. Studies in the literature show that these variables may have effects on fatigue and mood. For example, It is reported that PMS symptoms may change with age, and mood disorders may increase in older ages.[25] Similarly, studies have shown that increasing physical activity levels have a mitigating effect on fatigue and mood disorders in the menstrual phases.[26,27] Therefore, future studies may consider that changes in fatigue and mood during the menstrual cycle may be affected by age and physical activity level.

According to our literature review, although studies are comparing the relationship between hormone levels and physical activity levels,[28,29] limited studies are comparing physical activity levels in the cycle (6).[7] Ahrens et al.[30] found no significant difference between phases in their study. Similarly, in our study, physical activity levels were similar between phases.

In the study of Ross, Coleman, and Stojanovska, it was observed that mood disorders were higher in the premenstrual and menstrual phases compared to the follicular phase.[31] Rubinow and Schmidt showed that depression levels increased in the menstrual phase.[32] Garcia et al.[33] also showed that mood was more impaired in the menstrual phase. Pletzer and Noachtar[11] showed that mood was more impaired in the menstrual phase. In this study, unlike other studies; mood was found to be similar between phases. Therefore, our results differ from the literature. The cut-off point for depression in the beck depression inventory is 17. Scores above 10 are interpreted as the presence of depression symptoms. The reason for the different results in our study is thought to be that the median score of the beck depression inventory is 5-7.5 and that no depressive symptoms were detected in any of the women.

Limitations

Limitations of this study include a relatively small sample size and reliance on self-report instruments, which may introduce response biases and limit the accuracy of the outcomes. Additionally, the severity of menstrual symptoms was not evaluated. Menstrual symptoms, which vary in intensity among women, may influence fatigue and depression levels. As a result, the impact of menstrual symptoms on fatigue, physical activity, and depression levels remains undetermined. The mood during the menstrual cycle may be influenced by age and physical activity levels. Furthermore, we did not assess participants' daily life habits (e.g., sleep quality, dietary habits, caffeine or alcohol consumption), which could potentially affect fatigue and mood.

CONCLUSION

Our study showed that fatigue levels increased, and physical activity and mood did not change in the menstrual phase compared to the other phases. Since fatigue levels are known to increase the risk of injury in women's sports activities, these changes in the menstrual phase must be taken into consideration while planning sports activities for women.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Gazi University Faculty of Medicine Clinical Researches Ethics Committee (Date: 21.01.2025, Decision No: 2025-72).

Informed Consent

All participants signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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