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Research Article

SPORT PERFORMANCE DURING MENSTRUATION: A SCALE DEVELOPMENT STUDY

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ABSTRACT

In recent years, the increasing participation of women in sports and the lack of consensus in the literature regarding the effects of the menstrual cycle on athletic performance have necessitated more comprehensive research on this topic. A review of the existing literature reveals that studies investigating the impact of the menstrual cycle on sports performance have primarily been conducted through experimental research designs, while some studies have also employed interviews and scale-based assessments. In the context of Turkey, no scale development study has been identified that specifically evaluates the effects of the menstrual cycle on athletic performance. Accordingly, the aim of this study is to develop a psychometrically valid and reliable measurement tool to assess and evaluate the impact of the menstrual cycle on athletic performance. This cross-sectional study was conducted using a survey model with the voluntary participation of 260 female athletes aged 18–45 years. The scale items were developed based on an extensive literature review and expert opinions. To assess construct validity, exploratory factor analysis was performed, resulting in a 12-item measurement structure comprising three subdimensions: physical performance, psychological state, and symptoms. The validity of the scale was further tested through confirmatory factor analysis, which confirmed the proposed structure. Reliability analyses were conducted using the test-retest method, Cronbach's alpha internal consistency coefficient, and AVE and CR values, all of which were found to be within acceptable ranges. Therefore, the developed scale can be considered a valid and reliable instrument for assessing the impact of the menstrual cycle on athletic performance.

INTRODUCTION

Menstruation is a physiological process characterized by periodic renewal of the endometrial lining via hormonal interactions between the hypothalamus, pituitary gland, and ovaries (Mihm, Gangooly, & Muttukrishna, 2011), and typically involves bleeding that lasts between 3 and 7 days (Fritz & Speroff, 2011). This cyclical process occurs monthly from menarche (ie, the first menstrual bleeding during puberty) to menopause, encompassing the reproductive years during which the individual is fertile (Schmalenberger et al., 2021; Fritz & Speroff, 2011). Although the average menstrual cycle is approximately 28 days, it can vary from 21 to 45 days (Attia et al., 2023; Grieger & Norman, 2020).

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The menstrual cycle consists of three main phases based on hormonal fluctuations: the early follicular phase, ovulatory phase, and luteal phase. The early follicular phase is marked by low levels of both estrogen and progesterone, the ovulatory phase is characterized by high estrogen and low progesterone levels, and the luteal phase involves elevated levels of both hormones (de Jonge et al., 2019). Beyond their reproductive functions, these hormones are known to exert complex effects on the cardiovascular, metabolic, respiratory, and neuromuscular systems (Ansdell et al., 2019; Davis & Hackney, 2017); therefore, it is plausible that the physiological changes occurring throughout the menstrual cycle can influence exercise performance (Constantini et al., 2005; ; Frankovich et al., 2000; Janse de Jonge, 2003;Lebrun et al., 2013). However, research on the relationship between menstrual cycle phases and sports performance remain inconsistent. Some studies report enhanced performance during the early follicular phase (Campbell et al., 2001; Pallavi et al., 2017; Tenan et al., 2016), the ovulatory phase (Bambaeichi et al., 2004), or the luteal phase (Ekenros et al., 2013; Oosthuyse et al., 2005), whereas others have found no significant differences in these phases (de Jonge et al., 2012; McLay et al., 2007; Vaiksaar et al., 2011).

The increasing participation of women in sports and the lack of consensus regarding the effect of the menstrual cycle on athletic performance underscores the need for more comprehensive research on this topic (McNulty et al., 2020). Considering the physiological differences in female athletes—particularly the effects of menstruation on physical performance—there is a clear need for sex-specific research and practical guidelines (Pitchers et al., 2019; Knowles et al., 2019).

A review of the literature reveals that most studies examining the effects of the menstrual cycle on athletic performance are experimental in nature (Dibrezzo & Brown, 1988; de Jonge et al., 2012; Frandsen et al., 2020; Julian et al., 2017; Mattu et al., 2019). In contrast, few studies have used interviews (Findlay et al., 2018; Maekawa et al., 2023) or scale-based assessments (Mizuta et al., 2022; Cockerill et al., 1994). Specifically in the Turkish context, no scale development that evaluates athletic performance during the menstrual period currently exists. Therefore, it is essential to develop a culturally appropriate and practical instrument to assess the effects of menstruation on sports performance among female athletes. As such, this study aimed to develop a valid and reliable scale to assess how the menstrual cycle affects athletic performance in female athletes.

MATERIAL AND METHOD

Research design

This cross-sectional study, designed within the framework of a survey model, was conducted in five stages to develop the proposed scale. The first stage was a comprehensive literature review to generate an item pool appropriate for measuring the targeted construct. The items were evaluated for content validity by three field experts. The second stage was a draft version of the scale that was pilot tested with a sample of 30 participants, with modifications made based on the feedback obtained. In the third stage, the finalized scale was presented to a sample of 260 amateur athletes from various age groups. The fourth stage was an examination of the construct validity of the scale using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Reliability analyses included test–retest reliability, Cronbach's alpha coefficient, average variance extracted (AVE), and composite reliability (CR) values. In the fifth and final stage, based on the analytical results, the items were reviewed, the subdimensions clarified, and the scoring system finalized to produce the completed measurement instrument.

Participant group

The minimum required sample size for the study was calculated using G*Power software (version 3.1.9.7; University of Düsseldorf, Germany). Based on an effect size of 0.15, an alpha level of 0.05, and a power of 0.95, the minimum sample size was 204 participants. To prevent data loss, 260 volunteers were included in the study. All procedures were performed in accordance with the Declaration of Helsinki and ethical research principles.

The inclusion criteria were: age 15–45 years, having a regular menstrual cycle, not having any chronic health conditions, not having any injury or health issue within the past 6 months, and having been actively involved in a sport for at least 1 year. Descriptive characteristics of the participants are presented in Table 1.

Table 1: Descriptive Characteristics

Variable		f	%
Age (years)	**≤18**	40	15.4
	19–25	134	51.5
	26–30	27	10.4
	≥31	59	22.7
	Total	260	100.0
Type of sport	**Team sports**	167	64.2
	Individual sports	93	35.8
	Total	260	100.0
Sports experience (years)	**1**	16	6.2
	2–3	22	8.5
	4–5	39	15.0

	≥6	183	70.4
	Total	260	100.0
Weekly training frequency (days)	**1–2**	76	29.2
	3–4	97	37.3
	5–6	78	30.0
	7	9	3.5
	Total	260	100.0
Menstrual cycle regularity	**Regular**	186	71.5
	Irregular	74	28.5
	Total	260	100.0

f= frequency

An examination of the participants' age distribution revealed that the largest group (51.5%) was of ages 19–25 years, while the least represented group (15.4%) was age 18 years or younger. Most participants (64.2%) were involved in team sports, while 35.8% participated in individual sports. Regarding sports experience, 70.4% had over 6 years of experience, 15% had 4–5 years, 8.5% had 2–3 years, and 6.2% had only 1 year. Weekly training frequency analysis showed that 37.3% trained 3–4 days per week, 30% trained 5–6 days, 29.2% trained 1–2 days, and 3.5% trained daily. Additionally, 28.5% of the participants reported having an irregular menstrual cycle.

Limitations of the study

The study is limited given that the sample consists solely of female athletes aged 15–45 years, and that participants did not exhibit a demographically homogeneous distribution. Moreover, the scale items were developed based on a literature review and expert opinions from fields, including exercise science, sports and health sciences, and psychometrics, which might also be considered as a limitation.

Ethical considerations

Ethical approval for this study was obtained from the Research and Publication Ethics Committee of the Social and Human Sciences at Inonu University (date: 13-11-2024; session number: 18; decision number: 17).

RESULT

Content validity

Content validity refers to the extent to which each item within a scale accurately represents the construct intended to be measured (Yeşilyurt & Çapraz, 2018). In this context, a draft form was developed to establish whether the items adequately assessed female athletes' sport performance during the menstrual period. The form included three options for expert

evaluation of each item's appropriateness: "Appropriate," "Inappropriate," or "Needs revision." An additional space was also provided for experts to submit comments and suggestions.

The evaluation process included three female experts who had at least 1 year of sports experience and were knowledgeable in the field of measurement and evaluation. Their opinions were analyzed using the Lawshe method, which calculates the content validity ratio (CVR) for each item based on expert judgment. According to Lawshe's (1975) criteria, items with a CVR lower than 0.99 were excluded from the scale. As a result, four items that did not meet the CVR threshold were removed, and the scale was reduced to a 12-item Likert-type draft.

A pilot test of the draft scale was conducted with 30 female athletes to assess the clarity and phrasing of the items. Based on participant feedback, three items were revised to improve their comprehensibility.

Construct validity

Construct validity was assessed using both EFA and CFA. Before conducting these analyses, the suitability of the dataset was evaluated via tests of normality, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, Bartlett's test of sphericity, and Cronbach's alpha reliability coefficient. The results of the normality tests are presented in table 2.

Table 2: Results of Normality Tests for Scale Items Based on the Responses of 260 Participants

Item number	Participants (n)	Mean ($\bar{x}$)	SD	Skewness	Kurtosis
M1	260	3.19	1.076	–0.063	–0.675
M2	260	3.65	1.124	–0.642	–0.503
M3	260	3.43	1.047	–0.192	–0.929
M4	260	3.24	1.027	–0.061	–0.840
M5	260	3.91	0.996	–0.932	0.366
M6	260	3.46	1.262	–0.438	–0.974
M7	260	3.13	1.190	–0.109	–1.098
M8	260	3.44	1.172	–0.343	–0.912
M9	260	2.62	1.100	0.563	–0.500
M10	260	2.98	1.221	0.042	–1.130
M11	260	3.06	1.243	0.060	–1.124
M12	260	2.48	1.232	0.528	–0.819

SD= standard deviation.

As shown in table 2, the mean values of the 12 items ranged from 2.48 to 3.91, while standard deviations varied between 0.996 and 1.262. Skewness values ranged from –0.642 to 0.563, and kurtosis values ranged from –1.130 to 0.366. Based on these values, the data were assumed to follow a normal distribution (Tabachnick, Fidell, & Ullman, 2013).

The KMO measure of sampling adequacy was 0.889, and Bartlett's test of sphericity yielded a value of 1849.672 with a significance level of $p<0.001$, indicating that the data were suitable for factor analysis. Furthermore, the Cronbach's alpha coefficient was 0.902, showing

excellent internal consistency. These results confirmed that the dataset was appropriate and sufficient for conducting EFA (Streiner, Norman, & Cairney, 2024).

Table 3: Explained Total Variance

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	6.069	50.574	50.574	6.069	50.574	50.574	3.971	33.089	33.089
2	1.352	11.263	61.837	1.352	11.263	61.837	2.306	19.214	52.303
3	1.002	8.347	70.184	1.002	8.347	70.184	2.146	17.881	70.184

As shown in table 3, the factor structure of the Menstrual Period Sport Performance Scale revealed that those three components had eigenvalues greater than 1, collectively accounting for 70.18% of the total variance. The first component alone explained 50.57% of the variance, while the second and third components contributed an additional 11.26% and 8.35%, respectively.

These variance explanations remained unchanged after the extraction process. However, following rotation, the variance explained by the first component decreased to 33.09%, while the second and third components accounted for 19.21% and 17.88%, respectively. This redistribution indicates that the rotation contributed to a more balanced explanatory power across the factors. Overall, the three-factor structure explained 70.18% of the total variance, which indicated a robust factor structure for the scale (Çokluk et al., 2012).

Table 4: Rotated Component Matrix

Item	1. Factor	2. Factor	3. Factor
1. My athletic performance clearly decreases during my menstrual period	0.808		
2. My energy levels are lower during menstruation compared to other times	0.839		
3. My endurance in sports decreases during menstruation	0.837		
4. My muscle strength is reduced during my menstrual period	0.694		
5. I feel more fatigued during my menstrual period	0.767		
6. My desire to participate in competitions decreases during menstruation		0.658	
7. My motivation to engage in sports decreases during menstruation		0.733	
8. I become more emotional while exercising during my menstrual period		0.675	
9. I feel less confident while exercising during menstruation		0.711	
10. I frequently experience cramps during exercise in my menstrual period			0.762
11. I experience intense pain while exercising during menstruation			0.623
12. I frequently feel nauseous while exercising during menstruation			0.771

Table 4 displays the results of principal component analysis with varimax rotation. Five items loaded on factor 1, four items on factor 2, and three items on factor 3. The items obtained from the EFA were then input into the AMOS software (version 24.0) for CFA.

The CFA results yielded a Chi-squared (χ^2) value of 120.702, degrees of freedom (df)=48, and χ^2/df=2.515, indicating an acceptable model fit. Additional fit indices further supported this finding: RMSEA=0.076, NFI=0.936, RMR=0.08, GFI=0.928, and AGFI=0.884, all within the acceptable range. The IFI and CFI values were both 0.960, indicating excellent fit. These results collectively show that the model meets the recommended thresholds for goodness-of-fit (Bayram, 2010; Bentler, 1990; Erkorkmaz et al., 2013; Hooper et al., 2008; Steiger, 2007).

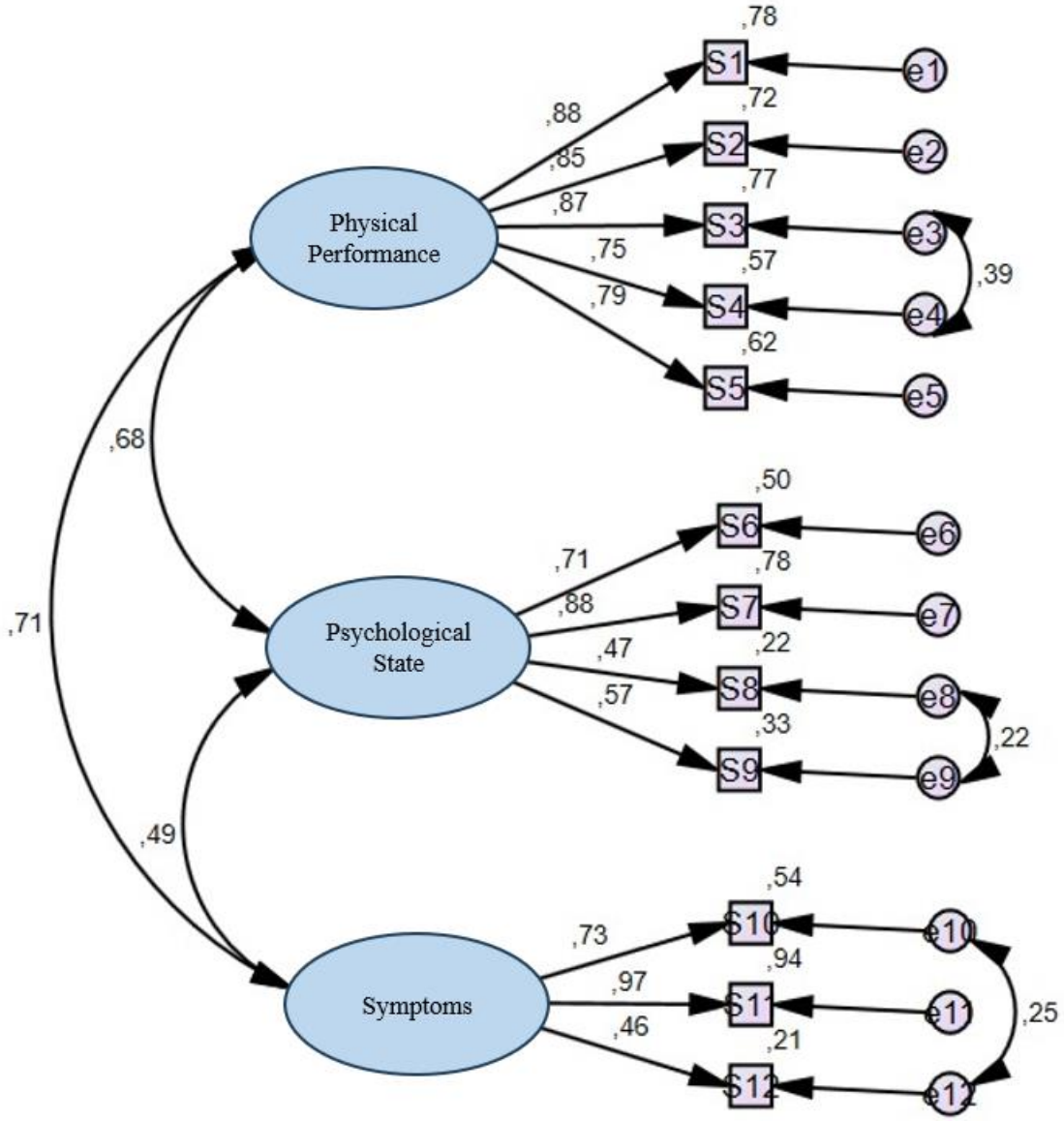

Figure 1: Standardized Factor Loadings

Figure 1 shows that the standardized factor loadings obtained from the CFA ranged between 0.46 and 0.97. According to Hair et al. (2010), factor loadings between 0.40 and 0.50 are considered acceptable in CFA. Similarly, Kline (2015) also considers factor loadings of 0.40 and greater to be acceptable. Therefore, the lowest observed factor loading of 0.46 was deemed within an acceptable range for this scale.

The R^2 values for the items ranged between 0.21 and 0.94, indicating varying levels of explained variance. Additionally, standard errors ranged between 0.031 and 0.108. Overall, these results obtained within the scope of construct validity suggest that the Menstrual Period Sport Performance Scale is a valid measurement instrument (Brown, 2015; Hair et al., 2010; Kline, 2023; Meydan & Şeşen, 2011).

Reliability

To assess the reliability of the Menstrual Period Sport Performance Scale, the test–retest method was applied to 25 female athletes at 2-week intervals. In addition, the AVE, CR values, and Cronbach's alpha coefficients were examined. The test–retest procedure yielded a Pearson's correlation coefficient (r) of 0.92, which indicated that the scale showed a high degree of consistency over time and reliably measures the same characteristics in individuals (Cohen & Swerdlik, 2018).

For the physical performance subdimension, the AVE value was 0.69 and the CR value as 0.92, for psychological state the AVE was 0.46 and the CR was 0.76, and for symptoms the AVE was 0.56 and the CR was 0.78. The overall scale had an AVE of 0.58 and a CR of 0.94. According to Hair et al. (2010) and Fornell and Larcker (1981), AVE values between 0.40 and 0.50 are considered acceptable. A CR value greater than 0.70 indicates strong internal consistency and high reliability of the measurement tool (Hair et al., 2010; Büyüköztürk, 2009).

Cronbach's alpha coefficients were 0.920 for the physical performance subdimension, 0.754 for psychological state, 0.784 for symptoms, and 0.902 for the combined scale. Experts suggest that a Cronbach's alpha coefficient of $\alpha \geq 0.70$ indicates acceptable reliability (Hair et al., 2010; George & Mallery, 2003).

In light of the findings related to the test–retest correlation, AVE, CR, and Cronbach's alpha values, the Menstrual Period Sport Performance Scale is a reliable measurement instrument.

CONCLUSION

This study aimed to develop a valid and reliable measurement instrument to assess the extent to which female athletes' sports performance is affected during the menstrual period. As a result of the EFA, a 12-item scale structure comprising three subdimensions—physical performance, psychological state, and symptoms—was identified. These three factors together explained 70.18% of the total variance. CFA further confirmed the construct validity of the scale, with model fit indices indicating an acceptable and well-fitting structure.

The reliability of the scale was evaluated using test–retest analysis, Cronbach's alpha internal consistency coefficient, AVE, and CR values. The test–retest method showed a high temporal consistency while Cronbach's alpha coefficients confirmed high internal consistency for the combined scale.

Overall, the findings suggest that the developed scale is a valid and reliable tool for evaluating the effects of the menstrual cycle on female athletes' sport performance. The scale uses a 5-point Likert format, with response options ranging from 1 (Strongly disagree) to 5 (Strongly agree). The total score ranged from a minimum of 12 to a maximum of 60.

This scale can be used effectively to assess the impact of menstruation on physical performance, psychological state, and symptom experiences in female athletes. The full-scale form is given in Appendix 1.

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Appendix 1. Menstrual Period Sport Performance Scale (MPSPS)

	Strongly Disagree (1)	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**
Physical Performance					
1. My athletic performance significantly declines during my menstrual period./ Regl dönemimde sportif performansım belirgin bir şekilde düşer.	(1)	(2)	(3)	(4)	(5)
2. My energy levels are lower than usual during my menstrual period./ Regl dönemimde enerjim, diğer zamanlara göre daha düşüktür.	(1)	(2)	(3)	(4)	(5)
3. My endurance in sports decreases during my menstrual period./ Regl dönemimde spordaki dayanıklılığım azalır.	(1)	(2)	(3)	(4)	(5)
4. My muscle strength decreases during my menstrual period./ Regl dönemimde kas kuvvetim azalır.	(1)	(2)	(3)	(4)	(5)
5. I feel more fatigued during my menstrual period./ Regl dönemimde yorgunluk hissim artar.	(1)	(2)	(3)	(4)	(5)
Psychological State					
6. My willingness to participate in competitions decreases during menstruation./ Regl dönemimde müsabakalara katılma isteğim azalır.	(1)	(2)	(3)	(4)	(5)
7. My motivation to engage in sports decreases during my menstrual period./ Regl dönemimde spora katılım motivasyonum azalır.	(1)	(2)	(3)	(4)	(5)
8. I become more emotional while exercising during my menstrual period./ Regl dönemimde spor yaparken daha duygusal olurum.	(1)	(2)	(3)	(4)	(5)
9. My self-confidence decreases while exercising during my menstrual period./ Regl dönemimde spor yaparken özgüvenim düşer.	(1)	(2)	(3)	(4)	(5)
Symptoms					
10. I frequently experience cramps while exercising during my menstrual period./ Regl	(1)	(2)	(3)	(4)	(5)

dönemimde spor yaparken vücudumda sık sık kramplar yaşarım.					
11. I experience intense bodily pain during exercise in my menstrual period./ Regl dönemimde spor yaparken vücudumda yoğun ağrılar yaşarım.	(1)	(2)	(3)	(4)	(5)
12. I frequently feel nauseous while exercising during my menstrual period./ Regl dönemimde spor yaparken sık sık mide bulantısı yaşarım.	(1)	(2)	(3)	(4)	(5)

Note: This scale was developed for use in scientific research and may be used freely in academic studies without prior permission from the authors, provided it is cited appropriately.