KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 02 January 2025
Revised 21 August 2025
Accepted 25 August 2025
Initial Published 26 August 2025
Final Publication 10 August 2025

Journal of Adolescent and Youth Psychological Studies

Volume 6, Issue 9, pp 1-12

E-ISSN: 2981-2526

The Mediating Role of Anxiety in the Relationship Between Physical Activity and Premenstrual Syndrome in Female Students

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A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Rahimi, P., Abdi, H., & Nasery, M. (2025). The Mediating Role of Anxiety in the Relationship Between Physical Activity and Premenstrual Syndrome in Female Students. *Journal of Adolescent and Youth Psychological Studies, 6*(9), 1-12.
http://dx.doi.org/10.61838/kman.jayps.4393

A B S T R A C T

Objective: The aim of the present study was to investigate the mediating role of anxiety in the relationship between physical activity and symptoms of premenstrual syndrome among female students.

Methods and Materials: This study was conducted using a descriptive–analytical design. The statistical population consisted of all female students of Islamic Azad University, Shahroud Branch, in the academic year 2023–2024, from whom 145 individuals were selected through convenience sampling. The instruments used included the International Physical Activity Questionnaire (IPAQ), the Beck Anxiety Inventory (BAI), and the Premenstrual Symptoms Screening Tool (PSST). Data were analyzed using linear regression, path analysis, and bootstrapping.

Findings: The results showed that there was a significant negative relationship between physical activity and the severity of premenstrual syndrome symptoms ($\beta = -0.654$, $p < 0.001$); that is, with an increase in physical activity levels, the severity of the syndrome's symptoms decreased. In addition, anxiety was also found to be a significant negative predictor of premenstrual syndrome symptoms ($\beta = -0.441$, $p < 0.001$), indicating that lower anxiety levels were associated with reduced syndrome symptoms. Furthermore, physical activity was positively and significantly associated with the reverse anxiety score (indicating an actual reduction in anxiety) ($\beta = 0.591$, $p < 0.001$). Path analysis confirmed the partial mediating role of anxiety in the relationship between physical activity and premenstrual syndrome, with the indirect path effect being $\beta = -0.260$, which was statistically significant.

Conclusion: Overall, the findings indicated that increasing physical activity can reduce the severity of premenstrual syndrome symptoms both directly and indirectly through reducing anxiety, thereby contributing to the improvement of women's psychosomatic well-being.

Keywords: *physical activity, anxiety, premenstrual syndrome, female students*

1. Introduction

Premenstrual syndrome (PMS) is a multifaceted condition that encompasses a broad spectrum of physical, emotional, and behavioral symptoms recurring in the luteal phase of the menstrual cycle and dissipating shortly after menstruation begins. Its impact on women's well-being and functioning is substantial, making it a pressing issue in both clinical practice and public health. Estimates suggest that up to 75% of women of reproductive age experience at least some PMS-related symptoms, though severity and functional impairment vary widely (Gnanasambanthan & Datta, 2019; Zehravi et al., 2023). The diversity of symptom presentation—ranging from irritability, anxiety, and mood swings to fatigue, bloating, and sleep disturbances—underscores the complexity of this syndrome and complicates both diagnosis and management (Bosman et al., 2016; Hofmeister & Bodden, 2016).

The global prevalence of PMS highlights its status as a universal reproductive health concern, yet the condition has particular sociocultural dimensions in specific populations. In Iran, systematic reviews have reported high prevalence rates, pointing to PMS as a common but often underrecognized disorder among adolescents and university students (Ranjbaran et al., 2017; Valizadeh & Ahmadi, 2021). Cultural attitudes toward menstruation, mental health stigma, and limited access to tailored health interventions exacerbate the burden of PMS in Middle Eastern contexts (Dashti et al., 2023; Gharibi et al., 2023). Moreover, the transition to university life, characterized by academic stress, irregular sleep, and lifestyle changes, intensifies the risk and expression of PMS among female students (Dózsa-Juhász et al., 2023; Rosner et al., 2019).

Biological mechanisms underlying PMS remain incompletely understood, but evidence points toward hormonal fluctuations in the menstrual cycle, particularly interactions of estrogen and progesterone with serotonergic and GABAergic systems, as critical contributors (American College of & Gynecologists, 2023; Andrade, 2016). These neuroendocrine processes intersect with psychosocial stressors, lifestyle factors, and individual differences in emotional regulation, thereby producing a wide range of symptom experiences (Dashti et al., 2023). Stress has emerged as one of the most consistent correlates of PMS, not only exacerbating symptom severity but also mediating the relationship between lifestyle behaviors such as sleep quality and PMS manifestations (Gharibi et al., 2023). Given that university students frequently report elevated stress levels, PMS management in this demographic requires particular attention.

Management approaches to PMS are diverse, ranging from pharmacological interventions such as selective serotonin reuptake inhibitors to non-pharmacological strategies that focus on lifestyle modification and complementary therapies (American College of & Gynecologists, 2023; Chen et al., 2023). While medications can be effective, their side effects and the reluctance of many women to rely on long-term pharmacological treatment make alternative and supportive strategies increasingly attractive (Amasha et al., 2017; Saki et al., 2015). Traditional and herbal remedies have also been explored with varying levels of success, particularly in Middle Eastern and Asian contexts where cultural acceptance of such methods is high (Maleki-Saghooni et al., 2018).

Among non-pharmacological strategies, physical activity has garnered substantial research attention. Exercise is known to modulate neurotransmitter systems, reduce stress, and enhance mood regulation, making it a promising candidate for PMS management (Pearce et al., 2020; Tian et al., 2022). Several meta-analyses and randomized controlled trials suggest that regular physical activity, particularly aerobic exercise and yoga, can significantly alleviate both physical and psychological symptoms of PMS (Tsai, 2016; Yorulmaz et al., 2024). Exercise enhances blood circulation, improves sleep quality, and contributes to hormonal balance, while simultaneously fostering psychological resilience against stress and anxiety (Pourhaghighi et al., 2024; Rassolnia & Nobari, 2024). Importantly, the beneficial effects of physical activity extend beyond PMS to broader domains of women's health, including dysmenorrhea, cortisol regulation, and quality of life (Solmaz et al., 2025; Wang, 2025).

The role of anxiety as both a predictor and outcome of PMS has received growing scholarly attention. Anxiety symptoms are highly prevalent among women with PMS and can significantly amplify the severity of mood disturbances and functional impairment (Bosman et al., 2016; Zehravi et al., 2023). Some scholars argue that anxiety is not merely a comorbidity but a central mechanism linking psychosocial stressors and PMS symptom expression (Dashti et al., 2023; Dózsa-Juhász et al., 2023). For instance, studies indicate that women with high perceived stress and poor emotion regulation capacities experience disproportionately severe PMS symptoms, often mediated by heightened anxiety levels (Dashti et al., 2023; Gharibi et al., 2023). This underscores the importance of conceptualizing anxiety not

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only as a symptom but also as a mediator in explanatory models of PMS.

Physical activity's capacity to reduce anxiety is well-documented, particularly among university students facing academic and social pressures (Tian et al., 2022; Wang, 2025). Exercise stimulates endorphin release, enhances self-efficacy, and provides a coping mechanism against stress, thereby lowering anxiety levels (Pourhaghighi et al., 2024; Solmaz et al., 2025). The mediating role of anxiety in the relationship between physical activity and PMS severity therefore represents a compelling avenue for investigation. A growing body of evidence suggests that part of the beneficial effect of exercise on PMS may operate through its ability to attenuate anxiety (Chen et al., 2023; Yorulmaz et al., 2024). Identifying and quantifying this indirect effect is critical for advancing intervention design and tailoring physical activity recommendations for women with PMS.

The multidimensional burden of PMS also necessitates consideration of quality of life outcomes. Research demonstrates that PMS is associated with academic underperformance, absenteeism, interpersonal conflicts, and reduced psychological well-being (Gnanasambanthan & Datta, 2019; Hofmeister & Bodden, 2016). Among university students, these consequences are particularly disruptive, affecting not only educational attainment but also long-term personal and professional development (Dózsa-Juhász et al., 2023; Rassolnia & Nobari, 2024). As such, effective management strategies must go beyond symptom reduction and encompass improvements in psychosocial adjustment and daily functioning.

In this regard, integrative models that link physical activity, anxiety, and PMS severity can provide valuable insights. By situating anxiety as a mediating variable, researchers can better understand the pathways through which lifestyle modifications such as exercise exert their effects (Dashti et al., 2023; Tian et al., 2022). Such models align with contemporary psychosomatic perspectives that emphasize the interplay between physiological processes, psychological states, and behavioral practices in shaping health outcomes (American College of & Gynecologists, 2023; Rosner et al., 2019). They also reflect broader trends in women's health research that prioritize holistic and non-invasive approaches to managing chronic and recurring conditions (Chen et al., 2023; Maleki-Saghooni et al., 2018).

Moreover, the exploration of exercise-based interventions resonates with international recommendations promoting physical activity as a cornerstone of preventive health care (Andrade, 2016; Pearce et al., 2020). Physical activity is low-cost, accessible, and culturally adaptable, making it especially suitable for student populations with limited access to specialized medical care (Pourhaghighi et al., 2024; Valizadeh & Ahmadi, 2021). Yoga, for instance, has demonstrated particular promise in alleviating PMS symptoms and enhancing quality of life through its combined physical, psychological, and mindfulness-based effects (Tsai, 2016; Yorulmaz et al., 2024).

Taken together, the literature points to a robust theoretical and empirical rationale for examining the mediating role of anxiety in the relationship between physical activity and PMS symptoms. Previous studies have highlighted the effectiveness of physical activity in reducing PMS severity (Pearce et al., 2020; Shi et al., 2023), the centrality of anxiety in shaping PMS experiences (Bosman et al., 2016; Dashti et al., 2023), and the complex psychosocial consequences of PMS in university settings (Dózsa-Juhász et al., 2023; Ranjbaran et al., 2017). However, few studies have systematically integrated these strands into a unified analytical framework, particularly in Middle Eastern populations where cultural factors and stress exposures may uniquely shape outcomes (Amasha et al., 2017; Valizadeh & Ahmadi, 2021). Addressing this gap is critical for designing effective, evidence-based interventions that not only alleviate PMS symptoms but also promote broader mental health and academic success among female students.

In summary, PMS is a widespread condition with profound implications for women's health and quality of life. Physical activity has consistently demonstrated positive effects on both PMS symptoms and anxiety, while anxiety itself appears to serve as a key mediator in this relationship.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a descriptive–correlational design with a path analysis approach (mediating role modeling). The statistical population consisted of all female students of Islamic Azad University, Shahroud Branch, in the academic year 2023–2024.

In this study, the sample was selected using a convenience sampling method. According to Klein's (2011) recommendation, the sample size should be at least two and a half times the number of questionnaire items. Considering the potential for incomplete or invalid questionnaires, 20 additional cases were anticipated, resulting in an estimated sample size of 270. Ultimately, 145 students completed the questionnaires. Inclusion criteria were: age range of 18 to 30

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years, absence of severe physical or psychological disorders (especially anxiety disorders or endocrine problems), having a clear history of performing or not performing physical activity during a defined period (at least the past three months), having a regular menstrual cycle during the last six months (21 to 35 days), not taking hormonal medications or medications affecting anxiety and menstrual symptoms, not being pregnant or breastfeeding, and avoiding drug or alcohol use that might influence anxiety or premenstrual syndrome (PMS) symptoms. Exclusion criteria included failure to complete questionnaires properly or inadequate cooperation during the study, performing unusually intense or unconventional physical activity outside the study framework, absence of PMS symptoms, or having severe sleep disorders. For ethical considerations, before the start of the study, the research objectives and procedures were fully explained to the participants, and they were reminded that they could withdraw from the study at any stage.

2.2. Measures

Depression Anxiety Stress Scales (DASS-21): The short form of the Depression Anxiety Stress Scales (DASS-21) was developed by Lovibond and Lovibond (1995) and is one of the most widely used psychometric instruments for simultaneously assessing three psychological constructs: depression, anxiety, and stress. This questionnaire is the shortened version of the original DASS-42 and consists of 21 items divided into three subscales: depression (7 items), anxiety (7 items), and stress (7 items).

Respondents are required to rate each item based on their experiences and conditions during the past week using a four-point Likert scale from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). To obtain the score of each subscale, the sum of the relevant items is calculated and then multiplied by two to ensure comparability with the original 42-item form.

This tool is used both clinically and in psychological and psychiatric research. Due to its simplicity, short response time, and high accuracy, it has been widely applied in various studies. Its strong correlations with the Beck Depression Inventory (BDI) and the Eysenck Anxiety Inventory (EAI) demonstrate its convergent validity and reliability. Studies conducted in Iran have also reported Cronbach's alpha coefficients within an acceptable range for all three subscales, confirming the reliability and validity of this tool in the Iranian population.

International Physical Activity Questionnaire (IPAQ): The International Physical Activity Questionnaire (IPAQ) is one of the most accurate questionnaires for evaluating physical activity and can be applied to a wide range of age groups. Its reliability has been reported as very high, while its validity is comparable to most other self-report questionnaires (Craig et al., 2003). In this study, the short form of the IPAQ was used to assess participants' weekly physical activity. The questions address time spent in vigorous activity, moderate activity, and walking. Subsequently, participants' metabolic equivalents (METs) were calculated according to IPAQ guidelines.

Activities were categorized into vigorous (items 1 and 2), moderate (items 3 and 4), and walking (items 5 and 6). The multipliers used were 8 for vigorous activity, 4 for moderate activity, and 3.3 for walking. The total MET-minutes were then calculated (Lee et al., 2011).

In scoring the anxiety subscale of DASS-21, scores of 0–7 indicate normal anxiety, 8–9 mild anxiety, 10–14 moderate anxiety, 15–19 severe anxiety, and above 20 extremely severe anxiety.

For the PSST, responses were scored from 0 to 3. The minimum possible score was 0, and the maximum was 57. A score of 0–19 indicated mild PMS symptoms, 19–28 moderate symptoms, and above 28 severe symptoms.

For the IPAQ, the total metabolic equivalent (MET) score for each participant was calculated as follows:

Total MET-min/week = (Walking METs × minutes × days) + (Moderate METs × minutes × days) + (Vigorous METs × minutes × days)

According to these calculations, <600 MET-min/week indicates low physical activity, 600–3000 MET-min/week moderate physical activity, and >3000 MET-min/week high physical activity.

Premenstrual Symptoms Screening Tool (PSST): The Premenstrual Symptoms Screening Tool (PSST) is a 19-item self-report instrument designed to assess PMS and premenstrual dysphoric disorder (PMDD), as well as the impact of these symptoms on individuals' lives. It consists of two sections: the first (14 items) addresses mood, physical, and behavioral symptoms, while the second (5 items) evaluates the impact of these symptoms on functioning and quality of life. Responses are rated on a four-point Likert scale (not at all, mild, moderate, severe), with scores ranging from 0 to 3. Therefore, the minimum possible score is 0 and the maximum is 57.

According to the scoring guidelines, 0–19 represents mild PMS symptoms, 19–28 moderate symptoms, and above 28

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severe PMS symptoms. For diagnosing moderate or severe PMS and PMDD, specific combinations of criteria from both sections are required. A study by Siahbazi et al. (2011) examined the validity and reliability of this tool among Iranian female students and reported a Cronbach's alpha coefficient of 0.90. In addition, the Content Validity Ratio (0.70) and the Content Validity Index (0.80) confirmed its validity.

2.3. Data Analysis

To investigate the mediating role of anxiety, path analysis and the Bootstrap method were used. Before the main analysis, the validity of the instruments was confirmed based on reputable internal and external sources, and their reliability was calculated using Cronbach's alpha coefficient. The Kolmogorov–Smirnov test was used to assess the normality of data distribution. Pearson's correlation coefficient was used to examine the relationships among the study variables. Furthermore, linear regression analysis was conducted to evaluate the predictive role of physical activity and anxiety in the severity of PMS symptoms. The mediating role of anxiety in the relationship between physical activity and PMS symptoms was examined using path analysis. Data analysis was performed using SPSS version 26.

3. Findings and Results

The demographic characteristics of the participants showed that the majority of students were in the age group of 31–35 years (27.6%), followed by 21–25 years (22.8%), 26–30 years (16.6%), 36–40 years (13.8%), 18–20 years (11.7%), 41–45 years (6.9%), and the lowest proportion belonged to the 46–50 age group (0.7%). Regarding marital status, most participants were married (75.9%), while 21.4% were single, and 2.8% reported other marital statuses. In terms of educational level, more than half of the students held a bachelor's degree (51.7%), followed by those with a master's degree (35.8%), and 12.4% were doctoral students.

Table 1

Descriptive Statistics of Research Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Anxiety	6.86	4.39	0	17
Physical Activity	9.45	6.52	0	24
Premenstrual Syndrome	28.04	10.55	12	57

The results of Table 1 indicate that the mean score of anxiety was 6.86 with a standard deviation of 4.39, which reflects a relatively moderate dispersion among the respondents.

Table 2

Kolmogorov–Smirnov Test for Normality

Research Variable	Statistic	Significance Level
Anxiety	0.148	0.157
Physical Activity	0.112	0.449
Premenstrual Syndrome	0.128	0.289

The results of Table 2 show the one-sample Kolmogorov–Smirnov test. As can be seen, the distribution of the scores of the research variables is normal with 95% confidence. Since the significance levels of the normality statistics are greater than 0.05 ($p > 0.05$), the score distributions are normal; therefore, parametric tests can be used and the results derived from these statistical analyses are reliable.

Table 3

Durbin–Watson Test for Error Independence

Research Variables	Durbin–Watson (Autocorrelation)
Anxiety	2.192
Physical Activity	2.085
Premenstrual Syndrome	2.041

Based on Table 3, if the Durbin–Watson statistic falls between 1.5 and 2.5, independence of errors can be assumed, and Pearson correlation and multiple regression analyses may be pursued. Independence means that the result of one observation does not influence the results of other observations. In regression, when the dependent variable is studied over time, autocorrelation may occur, meaning that errors are not independent. If autocorrelation exists in the errors, linear regression cannot be used. Since the Durbin–Watson statistics are between 1.5 and 2.5, it indicates that autocorrelation is rejected, and errors are independent. Therefore, the use of parametric tests is appropriate and the results are reliable.

Table 4

Tolerance and Variance Inflation Factor (VIF) of Research Variables

Research Variable	Tolerance	Variance Inflation Factor
Anxiety	0.159	3.561
Physical Activity	0.215	3.604
Premenstrual Syndrome	0.140	2.731

Multicollinearity refers to a situation in which two or more predictor variables are highly correlated. Multicollinearity can distort the interpretation of results. To examine multicollinearity, tolerance and VIF were tested, and the results are shown in Table 7. None of the tolerance values are smaller than the threshold of 0.10, and none of the VIF values are greater than the threshold of 10. Since no multicollinearity was observed among predictor variables, parametric tests such as Pearson correlation can be used, and the results are reliable.

The most appropriate method to calculate reliability is Cronbach's alpha coefficient. Accordingly, the reliability of the questionnaires was calculated and confirmed using Cronbach's alpha in SPSS.

Table 5

Reliability of Research Variables

Research Variables	Cronbach's Alpha	Acceptable Range	Stability
Anxiety	0.86	$0.70 \leq \alpha < 0.90$	Good
Physical Activity	0.82	$0.70 \leq \alpha < 0.90$	Good
Premenstrual Syndrome	0.83	$0.70 \leq \alpha < 0.90$	Good

According to the results in Table 5, the instruments used in this study demonstrated acceptable reliability.

Table 6

Correlation Matrix of Research Variables

Research Variables	1	2	3
Anxiety	1		
Physical Activity	0.696	1	
Premenstrual Syndrome	0.507	0.738	1

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Based on Table 6, the correlation coefficient between anxiety and physical activity is 0.696, indicating a positive and relatively strong relationship between the two variables. A relatively strong correlation of 0.738 was also found between physical activity and PMS, while a moderate positive correlation of 0.507 was found between anxiety and PMS. All coefficients are positive, suggesting a direct relationship among variables; in other words, an increase in one variable is associated with an increase in another.

Table 7

Direct Effect of Physical Activity on PMS

Model	Predictor Variable	Criterion Variable	β	R^2	Significance Level
1	Physical Activity	PMS	-0.654	0.428	0.001

The results of Table 7 showed that physical activity negatively and significantly predicts PMS symptoms; as physical activity increases, the severity of PMS symptoms decreases.

Table 8

Effect of Physical Activity on Anxiety (Mediator)

Model	Predictor Variable	Criterion Variable	β	R^2	Significance Level (p)
2	Physical Activity	Anxiety (Reverse Score)	0.591	0.349	0.001

Table 8 shows the relationship between physical activity and anxiety. Physical activity significantly and positively predicts anxiety scores. Since the anxiety scale in this study was reverse-scored (a higher score indicates lower actual anxiety), the positive coefficient indicates that increased physical activity leads to reduced actual anxiety.

Table 9

Simultaneous Effect of Physical Activity and Anxiety on PMS

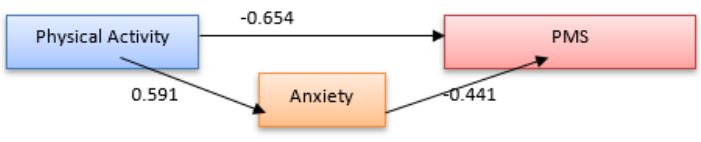
Model	Predictor Variables	Criterion Variable	β (Physical Activity)	β (Anxiety)	R^2	Significance Level (Physical Activity)	Significance Level (Anxiety)
3	Physical Activity + Anxiety	PMS	-0.410	-0.441	0.537	0.003	0.001

Based on the results of Table 9, after adding anxiety to the model, the effect of physical activity remained significant, and anxiety also negatively and significantly affected PMS. Therefore, anxiety plays a mediating role.

Regression and path analysis results indicated that there is a significant direct relationship between physical activity and PMS symptoms; as physical activity increases, PMS severity decreases. Findings also showed that physical activity significantly increases the reverse anxiety score, meaning that actual anxiety decreases as physical activity increases. Path analysis further indicated that anxiety significantly predicts PMS symptoms. These results suggest that anxiety partially mediates the relationship between physical activity and PMS symptoms; part of the effect of physical activity on PMS improvement is due to anxiety reduction. Overall, the statistical analyses confirm the main hypothesis of the study.

Figure 1

Mediation Path of Anxiety in the Relationship Between Physical Activity and PMS



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In this study, path analysis and direct/indirect effect testing were used to examine relationships among variables. The direct path between physical activity and PMS symptoms was significant, with $\beta = -0.654$ and $p < 0.001$, showing that increased physical activity is associated with decreased PMS symptoms.

In the indirect path, the mediating role of anxiety in the relationship between physical activity and PMS symptoms was tested. The indirect effect was calculated as follows:

- Path: Physical Activity → Anxiety = $\beta_1 = 0.591$
- Path: Anxiety → PMS Symptoms = $\beta_2 = -0.441$
- Indirect Effect = $\beta_1 \times \beta_2 \approx -0.260$

Since both paths were significant in regression analyses, the indirect effect was statistically significant.

Therefore, the final result of the bootstrap mediation analysis confirms that anxiety partially mediates the relationship between physical activity and PMS symptoms. This indicates that increased physical activity exerts part of its effect by reducing anxiety, which in turn decreases PMS symptoms.

Table 10

Test of the First Hypothesis

Model	Predictor Variable	Criterion Variable	β	R^2	Significance Level
1	Physical Activity	PMS	-0.654	0.428	0.001

Table 10 shows that physical activity negatively and significantly predicts PMS symptoms, meaning that increased physical activity reduces PMS severity. Thus, the first hypothesis is supported: there is a significant relationship between physical activity and PMS symptoms among female students.

Table 11

Test of the Second Hypothesis

Model	Predictor Variable	Criterion Variable	β	R^2	Significance Level
1	Anxiety	PMS	-0.441	0.342	0.001

Simple regression analysis in Table 11 showed a significant negative relationship between anxiety and PMS symptoms. The β coefficient of -0.441 indicates that as anxiety scores increase (reflecting reduced actual anxiety), PMS symptoms decrease. The R^2 value of 0.342 indicates that about 34% of the variance in PMS symptoms is explained by anxiety. Since $p < 0.001$, this relationship is statistically significant. Therefore, the second hypothesis is supported.

Table 12

Test of the Third Hypothesis

Model	Predictor Variable	Criterion Variable	β	R^2	Significance Level
1	Physical Activity	Anxiety (Reverse Score)	0.539	0.378	0.001

The regression analysis results in Table 12 showed a significant positive relationship between physical activity and anxiety (reverse scoring). The β coefficient of 0.539 indicates that as physical activity increases, reverse anxiety scores increase, meaning actual anxiety decreases. The R^2 value of 0.378 indicates that about 37.8% of the variance in anxiety is explained by physical activity. Since $p < 0.001$, this relationship is statistically significant. Therefore, the third hypothesis is supported.

4. Discussion and Conclusion

The results of this study provided compelling evidence that physical activity exerts a significant negative association with the severity of premenstrual syndrome (PMS) symptoms among female students, both directly and indirectly through its impact on anxiety levels. Specifically, the regression analyses and path models confirmed that higher levels of physical activity were associated with a reduction in PMS symptom severity, and that anxiety played

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a partial mediating role in this relationship. These findings are consistent with a broad body of literature emphasizing the role of lifestyle factors in shaping women's reproductive and mental health outcomes.

The finding that increased physical activity predicted lower PMS severity corroborates prior research that has identified exercise as a protective factor against PMS symptomatology. Systematic reviews and meta-analyses have consistently demonstrated that physical activity, particularly aerobic exercise, leads to reductions in both the physical and psychological manifestations of PMS (Bosman et al., 2016; Pearce et al., 2020). For instance, Pearce et al. demonstrated through randomized controlled trials that exercise interventions effectively alleviated mood-related symptoms such as irritability, depression, and anxiety, while simultaneously reducing somatic complaints including breast tenderness and bloating (Pearce et al., 2020). Similarly, Shi et al. found that physical activity levels were inversely associated with PMS severity among Chinese female college students, further reinforcing the cross-cultural generalizability of this association (Shi et al., 2023). The present findings thus add to the growing evidence that exercise may serve as a low-cost, accessible, and non-pharmacological method of mitigating PMS among young women.

Beyond the direct relationship, the mediating role of anxiety is particularly noteworthy. The results showed that higher physical activity levels were significantly associated with reduced anxiety scores, which in turn predicted lower PMS severity. This aligns with theories suggesting that anxiety not only co-occurs with PMS but also exacerbates symptom severity through heightened stress reactivity and impaired emotion regulation (Bosman et al., 2016; Dashti et al., 2023). By demonstrating that part of the effect of physical activity on PMS is mediated through anxiety, this study confirms prior findings highlighting the role of psychological mechanisms in the exercise–PMS link. Tian et al., for example, found that mental well-being mediated the relationship between physical activity and anxiety among university students, underscoring that psychological variables are crucial pathways in these associations (Tian et al., 2022). Likewise, Wang demonstrated that behavioral systems mediate the effect of exercise on anxiety symptoms in college populations, a finding directly consistent with the present results (Wang, 2025). Taken together, this evidence suggests that physical activity does not only improve PMS outcomes through physiological processes such as hormonal regulation or improved circulation but also by targeting psychological vulnerability factors such as anxiety.

The partial mediating role of anxiety further highlights the interplay between psychological stress, emotion regulation, and PMS. Dashti et al. found that perceived stress mediated the association between mindfulness and PMS, reflecting that stress and anxiety represent central psychological mechanisms through which psychosocial and behavioral interventions operate (Dashti et al., 2023). Similarly, Gharibi et al. showed that perceived stress and poor sleep quality predicted PMS severity, emphasizing how anxiety-related processes worsen reproductive health outcomes (Gharibi et al., 2023). The present study extends these findings by demonstrating that exercise is effective not only as a direct intervention but also through its influence on anxiety, thereby confirming the psychosomatic model of PMS (Rosner et al., 2019).

The reduction of anxiety through physical activity has been consistently documented in both clinical and non-clinical populations. Exercise stimulates endorphin production, regulates the hypothalamic–pituitary–adrenal (HPA) axis, and fosters greater resilience against stress, thereby lowering anxiety levels (Pourhaghighi et al., 2024; Solmaz et al., 2025). This is particularly relevant in student populations, where academic demands, irregular sleep, and social pressures heighten anxiety levels (Rassolnia & Nobari, 2024). Consistent with the present study, Yorulmaz et al. demonstrated that long-term yoga interventions significantly reduced PMS symptoms, improved quality of life, and alleviated dysmenorrhea, with reductions in anxiety being a key mechanism of action (Yorulmaz et al., 2024). Similarly, Tsai showed that yoga practice decreased premenstrual symptoms among female employees in Taiwan, once again pointing to anxiety regulation as a mediating factor (Tsai, 2016). These findings collectively reinforce the conclusion that anxiety is both a target and mediator in the relationship between physical activity and PMS symptom reduction.

The evidence also confirms earlier studies on the effectiveness of complementary and alternative therapies in PMS management. Herbal remedies, dietary supplements, and mind–body practices have all been proposed as safe and culturally acceptable alternatives to pharmacological treatment (Amasha et al., 2017; Maleki-Saghooni et al., 2018; Saki et al., 2015). While the present study did not directly examine such therapies, it shares conceptual similarities with this line of research by emphasizing non-pharmacological strategies to reduce PMS symptoms.

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Importantly, the inclusion of anxiety as a mediator underscores the need to address both psychological and physiological dimensions simultaneously, an approach also advocated by the American College of Obstetricians and Gynecologists in its guidelines for managing premenstrual disorders (American College of & Gynecologists, 2023).

The relationship between PMS and quality of life also warrants attention. PMS has been shown to adversely affect academic performance, interpersonal relationships, and overall well-being (Gnanasambanthan & Datta, 2019; Zehravi et al., 2023). Hofmeister and Bodden reported that severe PMS and premenstrual dysphoric disorder (PMDD) are associated with high levels of functional impairment, sometimes comparable to major depressive disorder (Hofmeister & Bodden, 2016). Dózsa-Juhász et al. similarly found that PMS severity was strongly linked to perceived stress and poorer mental health outcomes among university women (Dózsa-Juhász et al., 2023). By demonstrating that physical activity mitigates both anxiety and PMS, the present study contributes to the evidence base for interventions that not only reduce symptoms but also improve daily functioning and psychosocial adaptation.

Importantly, these findings align with broader global health perspectives on women's health and preventive medicine. Exercise is universally accessible, low-cost, and culturally adaptable, making it an ideal intervention for addressing PMS among diverse populations (Chen et al., 2023; Pearce et al., 2020). While pharmacological treatments remain effective for severe cases (Andrade, 2016), non-pharmacological approaches are often preferable in university populations, given concerns about side effects, adherence, and long-term medication use. Research on Iranian populations has further emphasized the importance of culturally sensitive interventions, including herbal remedies and exercise-based approaches, that resonate with women's health beliefs (Maleki-Saghooni et al., 2018; Valizadeh & Ahmadi, 2021). The present findings strengthen the case for incorporating structured physical activity programs into university health services as a means of supporting female students' reproductive and psychological health.

Finally, the mediating effect of anxiety provides an important conceptual advance. While earlier research has established the beneficial effects of exercise on PMS, fewer studies have systematically examined the psychological pathways through which this occurs. By demonstrating that anxiety partially mediates this relationship, the current study offers a more nuanced understanding of the biopsychosocial mechanisms underlying PMS and contributes to integrative models of women's health (Dashti et al., 2023; Tian et al., 2022; Wang, 2025). These insights are vital for designing targeted interventions that simultaneously address physical activity, psychological distress, and reproductive health.

5. Limitations & Suggestions

Despite its contributions, this study has several limitations that must be acknowledged. First, the use of a convenience sampling method from a single university limits the generalizability of the findings. The sample may not fully represent the diversity of female students across different cultural, socioeconomic, and academic contexts. Second, reliance on self-report measures such as the International Physical Activity Questionnaire (IPAQ), the Depression Anxiety Stress Scales (DASS-21), and the Premenstrual Symptoms Screening Tool (PSST) may have introduced response biases, including recall bias and social desirability effects. Third, the cross-sectional design restricts causal inferences; although path analysis supports a mediating role of anxiety, longitudinal and experimental studies are needed to confirm temporal and causal relationships. Fourth, the study did not control for potentially confounding variables such as nutritional status, sleep quality, or body mass index, all of which are known to influence both PMS severity and anxiety. Finally, cultural factors unique to the Iranian context may shape both symptom reporting and engagement in physical activity, limiting the applicability of results to other populations.

Future research should adopt longitudinal or experimental designs to establish causality in the relationship between physical activity, anxiety, and PMS. Randomized controlled trials could provide stronger evidence for the mediating role of anxiety by manipulating physical activity interventions and tracking symptom changes over multiple menstrual cycles. Researchers should also expand samples to include women from diverse cultural, educational, and socioeconomic backgrounds to enhance generalizability. It would be valuable to compare the effectiveness of different forms of physical activity, such as aerobic exercise, strength training, yoga, and mind–body practices, in alleviating PMS symptoms. Additionally, future studies should explore multi-mediator models that incorporate other psychological and physiological variables, such as sleep quality, cortisol levels, and emotion regulation, to provide a more comprehensive picture of how physical activity influences PMS. Integration of objective measures

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of physical activity, such as accelerometers, and biological markers, such as hormonal assays, would also strengthen validity. Finally, cross-cultural comparative studies could shed light on how cultural beliefs, stigma, and health-seeking behaviors shape the PMS experience and its management.

The findings of this study suggest that incorporating structured physical activity programs into university health services may be an effective and practical strategy to reduce PMS severity and enhance psychological well-being among female students. Universities should consider offering group exercise sessions, yoga classes, and wellness workshops that emphasize the dual benefits of physical and mental health. Health practitioners working with young women should routinely assess PMS and anxiety levels and recommend lifestyle modifications, particularly regular physical activity, as part of holistic care plans. Public health initiatives could also promote physical activity through awareness campaigns and peer-led interventions tailored to women's reproductive health. Moreover, policy makers should integrate exercise promotion into broader strategies for women's health, recognizing its role not only in chronic disease prevention but also in improving reproductive and psychosocial outcomes.

Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

Authors' Contributions

All authors equally contributed to this article.

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