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Original Article

The Effectiveness of Pilates Exercises on Emotion Regulation and Distress Tolerance in Students with Premenstrual Syndrome

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Abstract

Background: This study aimed to investigate the effectiveness of Pilates exercises on emotion regulation and distress tol89erance in female students with premenstrual syndrome (PMS).

Methods: The present study used a quasi-experimental pretest-posttest design with a nonequivalent control group. The research population consisted of female students with PMS at the Islamic Azad University of Doroud during the academic year of 2021-2022. A convenience sampling method was employed, and 30 individuals were selected and randomly assigned to either the Pilates or control group. The research tools included the Premenstrual Symptoms Screening Tool (PSST), Distress Tolerance Scale (DTS), and Emotion Regulation Questionnaire (ERQ). These tools were administered to both the Pilates group and the control group in 3 stages: pretest, posttest, and follow-up. Pilates exercises were taught to the Pilates group by a professional instructor at the university gymnasium. Data analysis for this study was conducted using repeated measures analysis of variance (ANOVA) using SPSS version 22.

Results: The findings showed that considering $P \leq 0.05$, there were significant changes in the variable of emotion regulation. In the Pilates group, the mean score of the emotion suppression subscale increased from 12 in the pretest to 15.33 in the posttest and 16.8 in the follow-up. Similarly, the mean score of the emotion reappraisal subscale increased from 22.4 in the pretest to 26.26 in the posttest and 26.06 in the follow-up. Additionally, the distress tolerance in the Pilates group showed an increase from 40.93 in the pretest to 47.06 in the posttest and 47 in the follow-up.

Conclusion: Pilates exercise has an effective role in improving emotion regulation and distress tolerance in female students with PMS.

Keywords: Pilates exercises, Emotion regulation, Distress tolerance, Premenstrual syndrome

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Introduction

Premenstrual syndrome (PMS) is a common disorder that occurs during the luteal phase of the menstrual cycle. It is characterized by moderate to severe physical, emotional, or behavioral symptoms that can significantly impact daily activities and quality of life (1). Studies have shown that PMS affects approximately 20%-40% of menstruating women, causing physical, psychological, and social challenges. Common symptoms include fatigue, irritability, mood swings, depression, changes in appetite, severe mental weakness, impaired self-care, communication difficulties, and shifts in thinking patterns (2,3).

Furthermore, women with PMS may experience intense emotional states and mood disorders throughout their menstrual cycle, primarily due to dysfunctions in emotional regulation (4).

Emotion regulation plays a crucial role in helping women with PMS adapt to stressful life events (5). Psychological studies highlight the significance of emotion regulation in influencing physical health, psychological well-being, interpersonal relationships, and social interactions. Studies also indicate that women with PMS tend to use maladaptive strategies in regulating their emotions, both through emotion suppression and cognitive reappraisal (6-8). Therefore, learning techniques to regulate emotions can help these women in coping with stressful situations in their lives.

Furthermore, distress tolerance is a characteristic that can aid in managing these challenges and positively coping with this phase in women. It refers to an individual's perceived ability to experience and tolerate

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negative emotional states or the mental and objective capacity to withstand adverse internal states and external events (9,10). Since it is the ability to withstand obstacles and stressful situations, low distress tolerance is often associated with impaired executive functioning and self-regulation issues, and symptoms may include anxiety, tension, decreased attention, and withdrawal (11).

Pilates exercise has garnered interest among sports experts as one of the movement therapy methods that can help alleviate the symptoms of PMS (12-14). Pilates is a set of muscle contractions and a combination of 2 elements, body and mind (15). It is a suitable form of exercise for women worldwide, as it improves physical health (muscle strength, endurance, central muscle stabilization, and respiratory strength), mental health (enhancing mood, motivation, and body awareness), and motor functions (muscle control, dynamic posture control, balance, and coordination) (13). Pilates exercises have been shown to have beneficial effects on a person's physiological and psychological health parameters by aiding in pain reduction (16). Additionally, the biochemical and psychological effects of Pilates can stimulate serotonin secretion and alleviate symptoms of depression (17).

Given that women play crucial roles in family, society, and the workforce, which directly and indirectly impact society, and considering that nearly half of all women experience PMS during their menstrual cycle, it becomes essential to prioritize their mental health. Interventions such as Pilates exercises can assist in alleviating the severity of pain and suffering associated with this syndrome.

Furthermore, since no studies have been found regarding the effectiveness of Pilates exercises on emotion regulation (both suppression and reappraisal) or distress tolerance, the significance of the current study becomes even more apparent. The results of this study can be valuable for clinicians in assisting women with PMS to regulate their emotions and enhance their distress tolerance.

Therefore, this study aims to investigate the impact of Pilates exercises on emotional regulation and psychological distress among women suffering from PMS. The study seeks to answer the question, "Does Pilates exercise enable women with PMS to improve their emotions and enhance their ability to tolerate psychological distress?"

Methods

The present study used a quasi-experimental pretest-posttest design with a nonequivalent control group and a 2-month follow-up. The statistical population consisted of approximately 100 female students, aged 19 to 35, enrolled in various fields (excluding psychology) at the Islamic Azad University of Doroud, Lorestan, during the academic year 2021-2022. The participants were selected based on their scores of 28 and above on the Premenstrual Symptoms Screening Tool (PSST) developed by Steiner et al (18).

Using G*Power software and considering the number of groups (2 groups), a total of 30 students (15 in each group) were included in the study (Figure 1). A convenience sampling method was used for the recruitment of participants. The participants were selected based on the inclusion criteria and randomly assigned to either the experimental or control group. Simple randomization was conducted using random numbers generated in Microsoft Excel. Inclusion, randomization, and allocation of participants is presented in Diagram 1.

Inclusion criteria were providing informed consent to participate in the research (through completion of the written consent form), a diagnosis of the participant's syndrome based on the screening questionnaire (with a cutoff point of 28 and above), no prior use of drug treatment for menstrual problems, and no history of drug or cigarette abuse. Exclusion criteria included the use of any other therapies or medications, non-cooperation during the intervention sessions, and absence from more

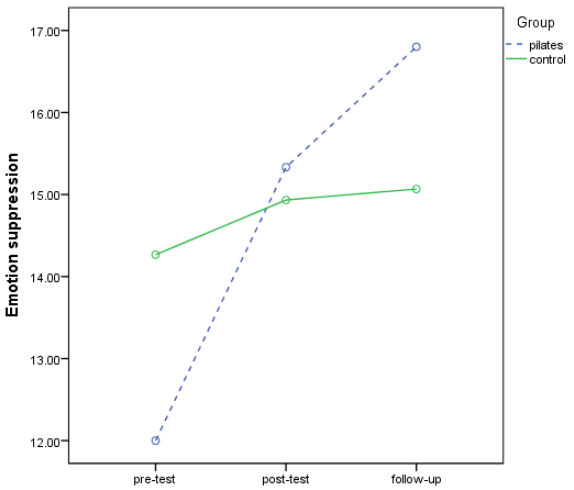

Figure 1. The emotion suppression variable in the pretest, posttest, and follow-up stages

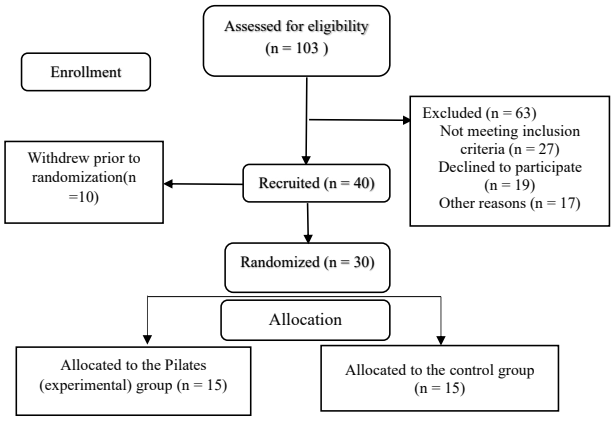

Diagram 1. CONSORT flow diagram for inclusion, randomization, and allocation

than 2 treatment sessions.

After obtaining ethical approval from the university's ethics committee (IR.IAU.B.REC.1401.009) and registering the clinical trial under code IRCT20230123057194N1, the pretest phase was conducted. Both groups were initially asked to complete the Emotion Regulation Questionnaire (ERQ) developed by Gross and John in 2003 and the Distress Tolerance Scale (DTS) developed by Simmons and Gaher in 2005. Subsequently, the Pilates exercise intervention was administered to the experimental group, while the control group did not receive any treatment and remained on the waiting list.

The Pilates exercise protocol, derived from the studies conducted by Taghizadeh et al and Ghorbanian and Mahmoudpoor, was implemented in a group setting for a period of 8 weeks. The participants with PMS attended 3 one-hour sessions per week, resulting in a total of 24 sessions (19,20). An experienced Pilates instructor guided the Pilates group through the exercises at the university gymnasium. The exercise routine included checking the body position, breathing control, proper standing techniques, and stretching movements like rolling like a ball, single-leg stretch, double-leg stretch, spine stretch forward, chest lift with rotation, curl-ups with rings, roll back with the ring, ball bridge, and core crunch.

Following the completion of the treatment sessions, a posttest was conducted for both groups under the same conditions. This entailed administering the same questionnaires to both groups in similar settings. Furthermore, a follow-up phase was conducted after 60 days, during which the participants responded to the same questionnaire items as part of the follow-up assessment.

The study objectives, treatment process, the safety and benefits of the research, as well as the qualifications and expertise of the Pilates instructor and the researchers, were thoroughly explained to the participants. Written consent was obtained from all participants, and they were informed that their participation was voluntary, with the freedom to withdraw from the research at any time.

Measuring tools

Premenstrual Symptoms Screening Tool developed by Steiner et al

This questionnaire consists of 19 questions divided into 2 subscales. The first subscale, comprising questions 1-14, measures mood, physical, and behavioral symptoms. The second subscale assesses interference with the individual's functioning or the impact of symptoms on daily life, encompassing questions 15-19 (18).

In Iran, the internal reliability method was used to assess the questionnaire's reliability, resulting in a Cronbach's alpha of 0.90. The content validity ranged from 0.70 to 0.80 (21). In international research, Cronbach's alpha coefficients have been reported between 0.64 and 0.89 (22).

The questionnaire is scored on a 4-point scale, ranging from "not at all" to "severe." The scoring is as follows: 1 for "not at all," 2 for "mild," 3 for "moderate," and 4 for "severe." Higher scores indicate a higher likelihood of PMS (23). The questionnaire's cutoff point is set at 28 or above (24).

In the present study, the reliability coefficient of the aforementioned questionnaire was calculated as 0.83, as measured by Cronbach's alpha coefficient.

Distress Tolerance Scale developed by Simmons and Gaher

This scale consists of 15 items and serves as a self-measurement index for assessing emotional distress tolerance across various dimensions, including tolerance, absorption, evaluation, and regulation) (25).

In a previous study, Cronbach's alpha coefficients were calculated to assess the reliability of the scale. The coefficients obtained were 0.72 for tolerance, 0.82 for absorption, 0.78 for evaluation, 0.70 for adjustment, and 0.82 for the whole DTS, indicating the validity of the scale (26). Another study conducted by Karami et al reported a Cronbach's alpha of 0.85 for the whole DTS (27). Furthermore, research conducted abroad also investigated the validity and reliability of the DTS. In one study, the internal reliability of the scale, measured by Cronbach's alpha, was reported as 0.93, while in another study, it was reported as 0.92 (28,29).

In the present study, the reliability coefficient for the scale was calculated as 0.81 using Cronbach's alpha coefficient.

The questions in the scale are graded on a 5-point scale, in such a way that it belongs to "completely agree (1 point), slightly agree (2 points), neither agree nor disagree (3 points), slightly disagree (4 points), and completely disagree (5 points)." Question 6 is graded in a reverse way, which includes 5 points for completely agreeing, 4 points for slightly agreeing, 3 points for neither agreeing nor disagreeing, 2 points for slightly disagreeing, and 1 point for completely disagreeing (30). The total score on the scale ranges from 15 to 75, with higher scores indicating higher distress tolerance. A score below 45 suggests low distress tolerance (31). To obtain the overall distress tolerance score, the scores of all the questions are summed. Likewise, the scores of the questions for each dimension are summed to obtain the score for that specific dimension (9).

Emotion Regulation Questionnaire developed by Gross and John

This questionnaire, developed by Gross and John, is designed to assess individuals' strategies for regulating emotions. It consists of 10 items divided into 2 subscales: cognitive reappraisal, which comprises 6 items, and emotion suppression or inhibition, which includes 4 items (32).

The developers of the questionnaire examined its internal correlation, and correlation coefficients between the questionnaire items were found to range from 0.73 to 0.79 (33). In Iran, the reliability of the questionnaire was assessed using Cronbach's alpha, resulting in a coefficient of 0.81 for suppression and 0.79 for cognitive reappraisal (34). In a separate international study, Cronbach's alpha coefficients of 0.73 for suppression and 0.85 for cognitive reappraisal were reported (35).

In the present study, the reliability of the aforementioned questionnaire was assessed by calculating Cronbach's alpha coefficients. The obtained coefficient was 0.79 for cognitive reappraisal and 0.84 for emotion suppression, indicating satisfactory reliability of the tool.

This questionnaire comprises 10 questions that measure the 2 components of cognitive reappraisal with questions 1, 3, 5, 7, 8, and 10 and emotion suppression with questions 2, 4, 6, and 9. The participants answer based on a 7-point scale from "I strongly disagree with score 1, I strongly disagree with score 2, I disagree with score 3, I have no opinion with score 4, I agree with score 5, I strongly agree with score 6, and I strongly agree with score 7." Scores range from 10 to 70. Scoring is done continuously, and the score of each component is checked separately. A lower score in this questionnaire indicates lower emotion regulation, and a higher score indicates higher emotional regulation. For scoring, the average of all scores in each subscale of cognitive reappraisal and expressive suppression is considered. The higher the score, the greater the use of that particular emotion regulation strategy; on the contrary, lower scores indicate less use (33).

After collecting pretest, posttest, and follow-up data, the collected data were analyzed using the repeated measures analysis of variance (ANOVA) statistical test in SPSS version 22. Assumptions for repeated measures ANOVA, including normality, homogeneity of variances, and homogeneity of the data matrix, were checked using Mbox, Shapiro-Wilk, Levene, and sphericity tests. A p value of ≥ 0.05 indicates a normal distribution, while a p value below 0.05 suggests a non-normal distribution. Additionally, the Eta coefficient is calculated to indicate the strength of the intervention's effectiveness.

Results

The baseline characteristics of the participants are displayed in Table 1. The table indicates that 60% of the participants in the Pilates group and 33% of the participants in the control group were between the ages of 19 and 25, while the remaining participants in both groups were between the ages of 26 and 35.

Table 1. Baseline characteristics of participants

Age	Pilates group		Control group	
	No.	%	No.	%
19 to 25	9	60	5	33
26 to 35	6	40	10	67
Total	15	100	15	100

The descriptive data of the mean and SD of the Pilates and control groups in the 3 phases of the study for the variables of emotion suppression, cognitive reappraisal, and distress tolerance are demonstrated in Table 2.

Based on the data presented in Table 2, it is evident that the mean score of the Pilates group in the variable of emotion suppression increased from 12 in the pretest to 15.33 in the posttest and 16.8 in the follow-up (Figure 1). Additionally, in the variable of cognitive reappraisal, the mean score of the Pilates group was 22.40 in the pretest, which increased to 26.26 in the posttest and 26.06 in the follow-up (Figure 2). In the variable of distress tolerance, the pretest of 40.93 in the Pilates group increased to 47.06 in the posttest and 47.06 in the follow-up (Figure 3). In contrast, the control group did not show a significant difference in the variables of emotion suppression, cognitive reappraisal, and distress tolerance across all 3 phases of the study (pretest, posttest, and follow-up).

Considering the assumptions of the repeated measurement test, this test was used for data analysis. The Shapiro-Wilk and Levene tests indicated that the data followed a normal distribution and had homogeneous variances ($P > 0.05$). The Box's M test results demonstrated homogeneity in the covariance matrix of the dependent variables ($P > 0.05$). Furthermore, the condition of sphericity for the variables was also met ($P > 0.05$).

According to the results shown in Table 3, it can be seen that in all 3 variables, emotion suppression (with F = 62.4

Table 2. Descriptive data of emotion suppression, cognitive reappraisal, and distress tolerance

Variable	Group	Phases	Mean	SD
Emotion suppression	Pilates	Pretest	12	2.13
		Posttest	15.33	2.46
		Follow-up	16.8	1.82
	Control	Pretest	14.26	2.54
		Posttest	14.93	2.12
		Follow-up	15.06	2.63
Cognitive reappraisal	Pilates	Pretest	22.40	4.03
		Posttest	26.26	2.91
		Follow-up	26.06	1.70
	Control	Pretest	20.73	2.22
		Posttest	20.53	1.81
		Follow-up	20.04	2.19
Distress tolerance	Pilates	Pretest	40.93	3.73
		Posttest	47.06	3.17
		Follow-up	47	2.26
	Control	Pretest	39.20	4.88
		Posttest	40.40	4.35
		Follow-up	40.46	3.68

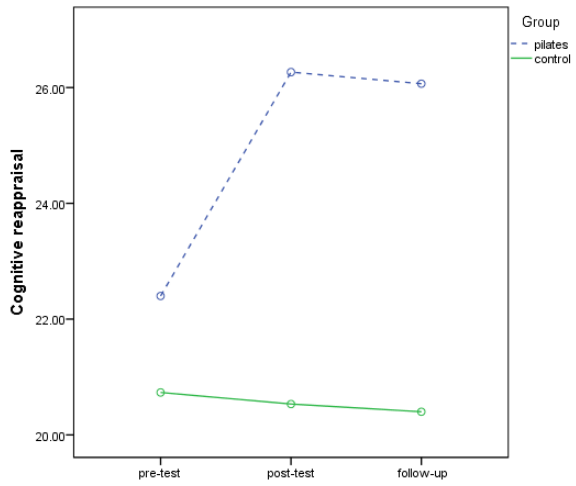

Figure 2. The cognitive reappraisal variable in the pretest, posttest, and follow-up stages

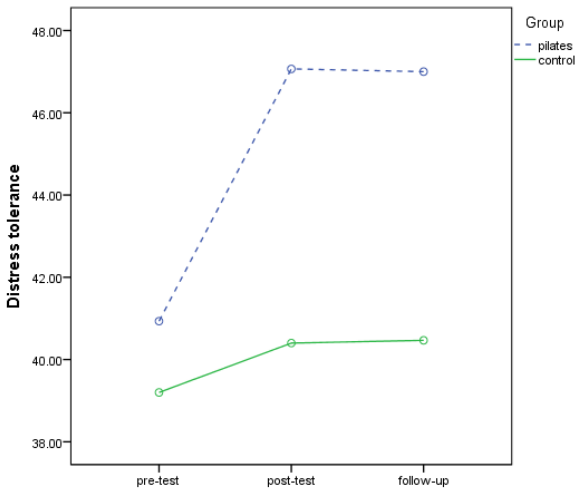

Figure 3. The Distress tolerance variable in the pretest, posttest, and follow-up stages

Table 3. The results of the tests to investigate the intra-group effects and the results of the inter-group effects

Variable	Source	Freedom degrees	Mean square	F	*P* value	Eta
Emotion suppression	Phases	2	62.4	28.88	0.001	0.50
	Phases*group	2	31.11	14.4	0.001	0.34
	Error	55.37	2.18			
	Group	1	0.044	0.004	0.951	0.001
	Error	28	11.62			
Cognitive reappraisal	Phases	2	30.83	8.42	0.001	0.23
	Phases*group	2	40.67	11.11	0.001	0.28
	Error	28	7.32			
	Group	1	426.84	32.76	0.001	0.53
	Error	28	13.02			
Distress tolerance	Phases	2	134.44	23.33	0.001	0.45
	Phases*group	2	59.244	10.28	0.001	0.26
	Error	28	11.52			
	Group	1	557.51	17.84	0.001	0.38
	Error	28	31.24			

*$P \leq 0.05$.

and $P=0.001$) and cognitive reappraisal (with F = 30.83 and $P=0.001$), and the variable distress tolerance (with F = 134.44 and $P=0.001$), the effect of the measurement stages is significant, meaning that there is a difference between the pretest, posttest, and follow-up phases, which can be seen in Table 1.

The effect of stages and groups in all 3 variables of emotion suppression (with F = 31.11 and $P=0.001$), cognitive reappraisal (with F = 40.67 and $P=0.001$), and distress tolerance variable (with F = 59.244 and $P=0.001$) is significant, indicating that the groups did not have similar behaviors in the pretest, posttest, and follow-up stages. This process is noticeable in Table 2, indicating that the Pilates group made changes in the dependent variables in the posttest and follow-up phases, while this process was not noticeable in the control group.

The effect of the groups showed that the intervention through Pilates did not have a significant effect on the emotion suppression variable (with F = 0.004 and $P=0.951$), while in the cognitive reappraisal variable (with F = 32.76 and $P=0.001$) and the distress tolerance variable (with F = 17.84 and $P=0.001$), it had a significant effect. In short, it can be said that Pilates had a significant effect on the variables of cognitive reappraisal and distress tolerance.

Discussion

Based on the study results, it was found that the Pilates group experienced an increase in emotion regulation, specifically in suppression and cognitive reappraisal, during the posttest and follow-up phases. However, this increase was not significant in the suppression aspect when compared to the control group. Furthermore, the results indicated that the Pilates group demonstrated a significant improvement in distress tolerance compared to the control group in both the posttest and follow-up stages.

In terms of the effectiveness of Pilates exercises on emotion regulation and distress tolerance, it is worth noting that no direct studies investigating these specific variables were found. Nonetheless, the findings of the current study align implicitly with the research conducted by Roh (36), Ahmed et al (12), Çitil and Kaya (13), Rezaei Shojaei et al (15), and Yesildere Saglam and Orsal (37) regarding the impact of Pilates exercises on the psychological symptoms of PMS.

In explaining the findings of the current study regarding the impact of Pilates exercises on emotion regulation, it can be suggested that the inclusion of 6 basic principles in Pilates exercises (breath, concentration, control, precision,

center, and flow) provided techniques that were related to breath, precision, concentration, and control in the study. As a result, women with PMS were able to enhance their focus on emotions and engage in better regulation and re-evaluation of their emotions. Research findings support the possibility of several psychological and biological mechanisms, including reduced sympathetic nerve activity in response to Pilates breathing principles, improved regulation of the serotonin system, and social interaction (38).

Furthermore, it can be stated that Pilates exercises have the potential to regulate neurotransmitter levels, stimulate the release of calcium, and increase the release of dopamine and acetylcholine. These factors play a role in maintaining neural functions, promoting positive mood, and improving cognitive performance. Additionally, therapeutic exercises have been found to increase aerobic capacity, enhance the utilization of oxygen and glucose in the brain, and facilitate the transfer of biochemical substances such as endorphin levels while decreasing estradiol and other steroid hormones. These physiological changes contribute to better emotional regulation in women with PMS (39).

Furthermore, these exercises have been found to reduce cortisol levels, thereby aiding in better tolerance of distress (40). Considering that psychological distress can stem from both physical and cognitive processes, Pilates exercises assist in enhancing distress tolerance among women with PMS by addressing their physical processes.

Moreover, molecular mechanism studies on the antidepressant effects of exercise have indicated that exercise increases tryptophan activation and serotonin release in the brain while reducing insulin resistance to prevent depression. Serotonin, known as the "happiness hormone," plays a crucial role in emotional regulation. Therefore, Pilates exercises, which also contribute to strengthening core muscles and correcting postural imbalances, help women with PMS improve their distress tolerance (17,41,42).

Additionally, following the Pilates intervention, the level of prostaglandin, which causes uterine muscle hyperactivity and menstrual pain, decreases, leading to a reduction in menstrual pain and symptoms among these women. Furthermore, Pilates helps improve and alleviate back pain by enhancing core strength, abdominal muscle mass, flexibility, and proper spine alignment (43). This indicates that Pilates can influence the physiology and function of the pelvic and lumbar muscles, resulting in pain reduction and alleviation of menstrual symptoms. Reducing pain in these women contributes to their ability to endure distress (44).

All these mechanisms, facilitated by Pilates exercises, assist women with PMS in regulating their emotions and tolerating psychological distress.

This study has several limitations. First, the limited number of participants may affect the generalizability of the study's findings. Additionally, confounding variables such as social and family issues, which are known to influence PMS, were not controlled for. Furthermore, the lack of student motivation to participate in the research and their cooperation with the Pilates coach can be considered as limitations.

Conclusion

The objective of the present study was to examine the effectiveness of Pilates exercises on emotion regulation, specifically in the subscales of emotion suppression and cognitive reappraisal, as well as distress tolerance in women with PMS. The results indicate that Pilates exercises can significantly enhance cognitive reappraisal and distress tolerance in women with PMS. In other words, engaging in Pilates exercises enables women with PMS to regulate their emotions and tolerate distress more effectively.

For future research, it is recommended to include non-student women with PMS who seek treatment at psychological clinics as participants. Additionally, combining Pilates exercises with other treatments, such as medication, may be beneficial in reducing the symptoms of PMS in affected women. Considering the positive outcomes observed in the present study, where 8 weeks of Pilates exercises led to improvements in emotion regulation and distress tolerance, and these effects remained stable during the 2-month follow-up, future studies could enhance the effectiveness of the intervention by increasing the number of treatment sessions and extending the duration of follow-up periods. This would allow for a comprehensive examination of the treatment's long-term effects.

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Authors' Contribution

Conceptualization: Kourosh Goodarzi, Mehdi Roozbahani, Azadeh Niroomand.
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Competing Interests
The authors declare that they have no competing interests.

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